Title: Projects with Reflective Writing Component

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Modality: Face-to-Face  Type: Group Project  Scope: Term Long Project

General Objective:
Using project-based learning with reflective writing assignment to improve students’ attitude toward learning calculus.

Description:
Project Based Learning (PBL) is an instructional model that is designed to engage students in investigation of real-life “authentic problems” (Blumenfeld et al., 1991). While there are a number of definitions of project-based learning, the critical components are a driving question that involves students in collaborative problem-solving and the production of a final product as representation of learning (Adderley et al., 1975) Research in the past decade has pointed to a number of benefits for using the PBL approach, including significant positive effects on problem-solving skills, conceptual understanding, and attitudes to learning (Grant, 2011). There are reported challenges in this pedagogy, as well. As Grant (2011) describes, students often resist complex tasks and thoughts, time-consuming assignments and organizational demands. According to Prince and Felder (2006), projects could be defined with varying degrees of autonomy: task projects and discipline projects. In task projects problem and methods are defined by instructor, whereas in discipline project problem and methods are generally described by instructor, students have a significant degree of control of the project. Supplementing lessons with projects is only a small part in improving students’ motivation. Research over the years has confirmed the benefits of using reflective writing as a tool for supporting student learning (Akin, 2011; Hamdan, 2005; Harford, 2008). As students communicate new ideas and concepts in their own words, they are able to establish personal connections with the content (Zull, 2002).

The discipline project was designed and implemented in two sections of MAC 2233. The project consisted of three parts:

Background Research Component:
- Given a partial data set, research the scatterplot and trendline features in Excel
- Obtain data for processor speeds for video games

Direct Application of Methods:
- Select the model that fits the data, make predictions and explain the model limitations
- Find an exponential function that models Moore’s Law
- “How reasonable was Moore’s prediction for video game processor speeds?”

Open-Ended Component:
- Choose a technology and research changes over time
- Formulate a growth model (linear, quadratic, exponential) with Excel
- Use the model to make predictions

The reflective writing assignments to promote math learner identity were created and assigned in one section of MAC 2233.

Reflective Writing Component Sample:
- Reflect on problem-solving skills and mathematical concepts.
- Relate project’s concepts to your other courses or your field of specialization.
- Describe the parts of the project that you had most difficulty with and your strategy for finding your way to a solution.
- Describe the part(s) of the project that were most fun, most effective, and/or had taught you the most, and explain why.
### Resources/Materials:
- (1) Timeline for the project
- (2) Internet resources to help teams to develop a group contract
- (3) Videos on how to perform regression in Excel
- (4) Data on US Student to Teacher Ratio
- (5) Videos on how football video games changed over time
- (6) Grading rubric

### Instructions:
**Week 1-2:**
- discussion of mathematical modeling in class
- assignment of groups, group contract development, and scheduling meeting times

**Week 3-4:**
- each group works on background research component outside of class
- meets with instructor to report preliminary results
- submits final report

**Week 5-6:**
- each group works on direct application component outside of class
- meets with instructor to report preliminary results
- submits final report

**Week 7-8:**
- each group works on open-ended component outside of class
- meets with instructor to report preliminary results
- submits final report to instructor

**Week 9:**
- each group presents week 7-8 final report results to class
- submits student evaluation form
- completes reflective writing assignment

### Evidence of Success: (How do you know it works)
The Whitaker Center pre/post survey was administered in two sections of MAC2233. The results from the fall 2015 semester (N=66) show that discipline projects paired with reflective writing assignments had positive influence on students’ attitude about learning calculus.

### Other Comments:
To implement the project successfully:
- break down the project into its component parts and provide a timeline for each part
- meet with each team regularly
- ask students to complete group-evaluation at the end of the project and base a percentage of their grade on this
- in class or at a conference meeting, ask each group to write up the tasks that they need to complete and who is responsible for each task
• if multiple groups are having the same issue, address the problem to the whole class and work together to explore solutions


