The effects of highly rated science curriculum on goal orientation engagement and learning

Purpose

The paper to be presented describes a study of goal orientation (Pintrich, 2000), engagement (Bangert-Drowns & Pyke, 2001) and learning for understanding (Bransford Brown & Cocking, 1999). The context of the study is the implementation of a science curriculum unit with instructional support qualities that assist teachers in facilitating students’ concept development. Specifically, the curriculum unit under consideration structures the activity of the students to focus on: (a) the purpose and the goals for each lesson, (b) a variety if vivid experiences with phenomena, and (c) discussions among students that guide the development of reasoning with the target concepts. Ultimately we hope to learn more about how students’ goals and level of engagement are influenced by the classroom environments created by the implementation of highly rated curriculum.

Our hypothesis for this first of three curriculum studies is that a highly rated curriculum increases adaptive learning goals, produces more sophisticated engagement and increases learning. Our findings show that significant differences in goal orientation and engagement do emerge after using a highly rated curriculum and the relationships among the constructs contribute to explaining the extent of students’ learning. Specifically, the relationships found between engagement and learning bring attention to the context of modest learning outcomes, the relative merit of a basic level of engagement, and the lack of effectiveness of more advanced forms of engagement in the study context.

Background

The conceptual framework of this study draws from a framework of motivation (Pintrich, 2000; Pintrich, Marx & Boyle, 1993) and a taxonomy of engagement (Bangert-Drowns & Pyke, 2001). Our work builds on these prior efforts that merge rational theories of conceptual development with more affect-laden motivational theories. To this end, we study how motivation in the form of goals influences engagement, resulting in conceptual change. Goal theory (Ames & Ames, 1984; Midgely et. al., 2000; Pintrich, 2000) provides a foundational assumption that task-focused mastery goals are most adaptive for learning in schools, even when potentially maladaptive performance goals are present (Pintrich, 2000). In addition, we assert that engagement is guided by goal orientation. We define engagement as the more volitional cousin of goals, embodied by the deployment of strategies (behavioral, cognitive, affective and motivational) for sustaining involvement in activities aimed at learning (Bangert-Drown and Pyke, 2001). Engagement is manifested on two levels when viewed this way. In the first, students’ aim is to be involved, using mostly behavioral strategies to sustain active participation in classroom work (cf. Lee & Anderson, 1993). At this level of Basic Engagement students follow instructional directions, complete assignments and homework, and attend to the explicit behavioral demands of a task or lab activity. As a complement to basic engagement, advanced engagement is identified by the use of strategies for sustained deep involvement in learning tasks (Biggs, 1991), self-regulation of learning (Shunk &
Zimmerman, 1994), and for learning with understanding (Bransford Brown & Cocking, 1999). Such strategies involve creating personal challenges, testing hypotheses about how things work, persisting on difficult tasks, using peers and others as resources, connecting activities to prior experience, and trying different solution paths to problems.

The central claim explored in this study is that goals and engagement are influenced by how a curriculum guides students’ experiences in the classroom. Researchers have known for some time that classroom goal structures influence teachers’ instructional decisions and cause both teachers and students to attend to particular performance information (Ames & Ames, 1984). However, researchers have just begun to identify extant curricula in science that support adaptive learning goals and advanced forms of engagement (Roseman, Kesidou & Stern, 2001). The unit of this study is one of few evaluated by experts to have these qualities. A pilot study for this current work confirmed that the curriculum unit does produce learning gains and it has potential to produce effects on goals and engagement (Pyke, Lynch, & Kuipers, 2003).

Research Questions

We assert that students’ goals influence engagement, which, in turn, affects learning. The scope of our long-term project is to explicitly test this model, however the purpose of the current study is to collect baseline data about the relationships among the variables, build an empirical case, and refine the model. The research questions were modest at this stage in our research:

- Does using a highly rated science curriculum unit result in differences in middle-level students’ goals, engagement, and learning when compared to a conventional curriculum unit?

- Are the relationships among goals, engagement, and learning different for middle-level students after using a highly rated curriculum?

Procedure, Methods and Analyses

The study included grade 8 students from ten middle schools selected from within one large metropolitan school district. The ten schools were matched on demographic variables resulting in five matched-pairs of schools. One school from each pair was randomly selected to implement the highly rated Chemistry That Applies (CTA) curriculum unit. The teachers implementing the CTA curriculum received two days of professional development to orient them to the experiments and kinds of learning experiences the curriculum was designed to promote. The comparison group was experienced with the regular curriculum authorized by the school districts’ curriculum committee.

Goal Orientation was assessed with scales for Mastery Orientation and Performance Orientation (17 items) from the Patterns of Adaptive Learning Scales (Midgley et al., 2000). Engagement in science learning was measured with scales for Basic Learning Engagement and Advanced Learning Engagement adapted from scales developed by Helen Marks (2000). Both instruments were validated in our pilot study and proved reliable with our population of diverse middle school students. Cronbach’s Alpha ratings are: mastery learning orientation = .89, performance approach = .88,
performance avoid = .74, basic learning engagement = .66, and advance learning engagement = .81. A pool of items to assess conceptual understanding of conservation of matter was developed by an expert panel and piloted to assure alignment, difficulty, and discrimination were consistent with the level of understanding targeted by both the curricular goals of CTA and the conventional units.

Differences in mean scores between treatment and control conditions were tested controlling for pretest differences. Also, bivariate correlations among students’ scores on all the variables were calculated.

**Results**

The CTA curriculum condition (n = 1110) significantly increased mastery, performance orientation and advanced learning engagement when compared to the comparison condition (n = 1192). There was no significant difference in basic engagement. Mean scores on a 1-5 Likert scale for each scale were:

- Mastery Orientation (CTA = 3.3; Comparison = 3.1, p<.05, Cohen’s d = .17)
- Performance Approach (CTA = 2.4; Comparison = 2.2, Cohen’s d = .18)
- Performance Avoid (CTA = 2.6; Comparison = 2.5, p<.05, Cohen’s d = .16)
- Advanced Engagement (CTA = 3.1; Comparison = 2.9, p<.05, Cohen’s d = .23)

There was also a significant difference in conservation of matter understanding (using a 100-point scale: CTA = 48.8; Comparison = 42.8, p<.05, Cohen’s d = .23).

In each curriculum condition a stable pattern of correlations between pairs of variables emerged. All correlations were significant except between each of the goal orientation scales and the conservation of matter understanding scores. Of particular interest when considering our conceptual framework were findings of strong relationships between mastery goals and basic engagement (CTA, r = .48; Comparison, r = .46) and mastery goals and advanced engagement (CTA r = .67; Comparison, r = .46). The relationship between basic engagement and conservation understanding (CTA, r = .21; Comparison, r = .30) and between advanced engagement and conservation understanding (CTA r = .07; Comparison, r = .09) posed a challenge to our thinking and caused us to reexamine our simple model.

**Discussion**

Our hypothesis that adaptive goals and productive engagement would increase with students using the highly rated curriculum was supported by the data. However, our more causal claim that relationships among goals, engagement and learning explain the study outcomes could not be directly inferred from the data. Mastery goals translated into more advanced engagement, but an increase in advanced engagement did not correspond sufficiently to increases in learning. In the paper we grapple with the question of why an increase in advanced engagement did not serve as a better predictor of change in understanding.

We conclude that prior knowledge serves to moderate the relationships in our conceptual framework. We know from pretest mean scores that most students began their study of conservation of matter with very little understanding and did not progress very far toward the goal of a flexible and deep understanding of the concepts. Thinking
about students’ engagement through the lens of the Taxonomy of Student Engagement (Bangert-Drowns & Pyke, 2001) suggests that prior to being able to pursue personal, flexible, and deep learning students need to establish a schema for the comprehension of content. Lack of prior knowledge is one indication that students have not yet developed such a schema for complex knowledge building. Under these conditions it is unlikely that even the most ambitious engagement strategies will translate to higher levels of understanding. We believe that most students with ambitious learning goals worked hard to accomplish daily tasks and learn, but they were not yet able to take advantage of the aspects of the curriculum that have potential to support more advanced and self-regulated learning. While this story extends beyond the data of the current study, it demonstrates the utility of using the relationships among goals, engagement, and learning to analyze how and why a curricular intervention produces specific effects in certain contexts. The paper concludes with the presentation of the model we will use in future research. The model suggests that the combined effects of prior knowledge and curriculum structure work to moderate the effects of goals and engagement on learning outcomes. Our future research questions and methods are also discussed.

References


Pintrich, P. R., (2000) Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology* 92, 544-555

