AC 2007-2029: MATCHING TEAM ACTIVITIES TO LEARNING OBJECTIVES: A THEORETICAL DISCUSSION OF THE ROLE OF GOAL ORIENTATION

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Matching Team Activities to Learning Objectives: A Theoretical Discussion of the Role of Goal Orientation

Abstract

Engineering courses can typically be arranged into one of two categories: content area courses and design courses. While the acquisition of conceptual knowledge is an intrinsic objective of a content area course, this objective is sometimes extrinsic to a design course. Conversely, in design, the intrinsic objectives are usually teamwork skills and development of technical proficiencies. Recently there has been a move toward bringing laboratory-based activities into content area classrooms to enrich learning. The purpose of this paper is to investigate course design in view of student goal orientation and the attributional theory of motivation.

In social cognition theory, an individual's goal orientation is seen to greatly influence his willingness to accept a challenge and to persist when faced with difficulties. The types of team activities employed in a classroom foster either a performance-goal oriented or learning-goal oriented learning environment. In a group project, students divide a large task into individually manageable parts, much like practicing engineers do in industry. This type of activity has an inherent performance goal, the creation of a functional end product. On the other hand, cooperative team projects focus on mastery or learning goals. All of the students on a team work together on a single task, and the students help each other so that everyone seeks understanding of each concept.

The conclusion is made that group projects are effective in meeting the learning objectives in design courses due to their inherent performance goal orientation, while cooperative team projects meet the learning objectives in content area courses due to their inclination toward learning goals. Understanding how the design of learning tasks affects students' goal orientation enables an instructor to match team activities to desired learning outcomes and to create an environment which promotes the desired type of goal orientation.

Introduction

When some engineering faculty implement student-centered instructional methods such as cooperative learning and problem-based learning strategies in their classrooms, other faculty sometimes voice concerns that not all of the students learn all of the material to the fullest extent. As a result, some have expressed a desire for engineering education research investigating the effect of group-based instruction on the skills of individual students.[1]

Any classroom atmosphere represents a complex interplay between the instructor's teaching strategies and the student's approaches to learning. How a student is motivated when approaching a task is influenced by many factors, such as their unique prior experiences and self efficacy beliefs, and their parents' beliefs and goals.[2] This paper investigates how a student's motivation is impacted by the learning structures employed by the instructor.

For the sake of clarity, a distinction will be made between a team activity and a group activity. A team activity is any task given in a classroom which requires cooperation and conceptual understanding by all members in order for the group to succeed. Consequently, team members work together, using their strengths and resolving their weaknesses. On the other hand, a group activity is one in which the group achieves success when the task criteria are completed. As a result, students participating in group tasks often utilize "divide-and-conquer" tactics, where the work is divided among the members and then pieced together to form the end product which will be submitted to the instructor.

Why make this distinction? In light of concerns that cooperative learning methods lead to students with knowledge gaps, it is important that faculty members be intentional and thoughtful about the way these activities are designed. Teams and groups both have their benefits and their strengths, but the instructor's decisions about which are used must be based upon the desired learning outcomes. In this paper, teams and groups will be analyzed in terms of the particular goal orientations which they promote, and how this inherent goal orientation interplays with the other goal structures in a classroom.

Theories of Motivation

Motivation, in the context of educational psychology, can be defined as that part of human behavior which impacts the amount of energy or time a person chooses to invest in a task. As a result, motivation has both intrinsic and extrinsic components for each individual. Factors such as a student's needs and beliefs would be classified as intrinsic; whereas, external rewards for good behavior involve extrinsic motivation. In this section, an overview of the primary theories of motivation will be discussed. The intention is not to offer a comprehensive history of the discipline, but to sufficiently outline the current understanding of human motivation so that engineering faculty can better evaluate their instructional choices in terms of their effect on student motivation to learn.

Behaviorism, particularly the idea that human responses to stimuli are the result of operant conditioning, is perhaps the most influential of the extrinsic theories of motivation. While the idea originated much earlier, it was popularized by B. F. Skinner.[3] In this theory, the reinforcement a student receives for their responses determines whether or not they will be likely to produce that same response when presented with the same stimulus in the future. As a result, a student might choose to engage in tasks which they would not consider otherwise, if they received positive reinforcement for that engagement in the past. Often, if positive reinforcement for difficult tasks is neglected by the instructor, this will be received negatively by the student, thus reducing their motivation to pursue similar activities in the future.

Since behaviorism focuses on that which is observable and objective, it ignores internal aspects of motivation. On the other hand, social cognition theory is an umbrella encompassing motivational theories which have both intrinsic and extrinsic components. From a social-cognitive perspective, the way a student thinks about a task is influenced by many external factors such as how difficult the task sounded when the teacher described it, how they view the ability levels of their classmates, and how well the teacher communicated the importance of learning the material.[4] As a result, motivation is investigated as neither completely internal nor completely external to the individual. It is the interplay of a student's internal motivations and goals with the social atmosphere within the classroom. While behaviorism remains influential in all levels of education, the idea that learner motivation results from both internal external influences has recently emerged as the prevailing theory.

There is no single social-cognitive theory of motivation. Some of the prominent theories are Bandura's theory of self-efficacy[5], self-determination theory[6], the attributional theory of motivation[7], and achievement goal theory[8-10]. However, in the midst of these theories, there are some common themes revealing a substantial degree of intersection. For example, all of the theories stress the importance of ensuring that all activities and tasks are appropriately challenging. When students receive a task which is unreasonably difficult, or if the instructions cause them to perceive it as such, they will not be as motivated to complete it because they will doubt their ability to succeed and become focused on the potential for failure rather than the opportunity for learning. Similarly, each theory contains the idea that students must be allowed and encouraged to have a sense of ownership over their work and the learning process. They must have a level of autonomy. Students whose autonomy and individuality are supported in the classroom will increase their feelings of competence or self-efficacy, which makes them more internally motivated. These students are more likely to give themselves internal rewards, such as a sense of satisfaction for a job well done, rather than to seek external rewards from teachers or peers.

Since there is such a high level of common ground among the various social-cognitive theories, this paper will focus on only two of them: achievement goal theory and the attributional theory of motivation. The research on achievement goals has led to the creation of two primary goal classifications. First, mastery goals are indicative of a desire to master a skill or concept and achieve a level of competency. As a result, in some of the literature mastery goals are also referred to as learning goals.[8] On the other hand, performance goals are characteristic of a desire to do better than other classmates or to ensure that everyone views them as both capable and intelligent.

The attributional theory of motivation is based upon the concept that the cause that a student assigns to a success or failure will determine how they approach a similar situation in the future. More specifically, it is how they view the cause that is important. If a student attributes his failure to a factor viewed as unchangeable, he will have little motivation to perform a similar future task and could even avoid the task altogether. However, if the student attributes his failure to a factor seen as changeable, he will be more likely to try harder when confronted with a similar activity in the future. For example, when a student who fails attributes her failure to her low ability, which she views as an unchangeable quantity, she will not try harder the next time because, from her perspective, no amount of effort will ever be able to increase her ability. On the other hand, if she views ability as something that can be developed or increased, she will persist in subsequent challenges and may even seek them out in an effort to develop her ability. Students' motivation is based on whether or not they view control over the attribution to lie within themselves or outside themselves. The two qualities which are salient in academic tasks and are usually viewed as internal are perceptions of ability and perceptions of effort. Factors usually perceived to lie outside of students' control, are task difficulty and mere luck or chance.

To summarize the attributional theory of motivation, when students attribute their failures to factors they perceive as unchanging, they tend to expect to fail on similar tasks in the future, and thus they exhibit little motivation on subsequent tasks. On the other hand, when students attribute failures to factors they perceive as malleable, future failure is perceived as less certain and they exhibit greater motivation on subsequent tasks. Conversely, students who attribute past successes to factors perceived to be stable, expect to succeed in the future, whereas attributing success to factors perceived as changeable engenders less confidence in future success.

The attributional theory of motivation and the theory of achievement goals are quite complementary. Whereas many students perceive ability or intellect to be stable and unchanging, some students perceive it as changeable and capable of development. Students who view intellect or ability as unchangeable will tend toward having a performance goal orientation in activities which rely on that attribute. Conversely, students who view intellect as variable and developmental will be inclined to adopt a mastery goal orientation and see challenges, even failures, as learning opportunities.

Students who embrace mastery goals tend to persevere for longer periods of time when given challenging tasks, seek out a challenge in an effort to increase ability, and utilize more higher-level cognitive processing strategies. These strategies include comparing and contrasting, synthesizing ideas, and monitoring their own thinking. On the other hand, students with a performance goal orientation will shy away from a challenge, not ask for help, and use low-level cognitive strategies such as rote memorization.

Recently, work has been done which further classifies performance goals as either performance-approach or performance-avoidance.[9, 10] The description of performance goals given above is synonymous with performance-avoidance since it causes the student to avoid tasks which they believe will lead to the same outcome (i.e. failure). However, since one of the primary ambitions of the student with a performance orientation is to have others view them as intelligent, it is logical to conceive that a performance-approach orientation also exists. If they have a perceived level of competence, these students will approach a task in an effort to be viewed favorably by the instructor and their peers.

To summarize, student goal orientations fall into three categories: mastery goals, performance-avoidance goals, and performance-approach goals. With a mastery goal, a student is seeking to increase his own perception of his ability. However, with performance goals, a student desires to either attain a positive external evaluation of competence (performance-approach) or avert a negative assessment (performance-avoidance).

All educators want their students to achieve mastery of concepts, so it would be easy to embrace mastery goals at the exclusion of performance goals. But, that stance tends to diminish the importance to students of receiving positive appraisals of their abilities. Since internal motivations do not operate in a vacuum, they are influenced by not only classroom structures but also social interactions. Simply put, performance-approach goals can be a beneficial (and necessary) catalyst for the pursuit of mastery goals. After all, everyone has a story about how she tried harder after some teacher or coach told her that he knew she had the ability to complete the task. On the other hand, it can also be envisioned that in certain types of engineering courses it would be beneficial to create an environment that fosters either a mastery orientation or a performance-approach orientation, or both. This will be the subject of the subsequent discussion.

Discussion

Typically, engineering courses can be divided into two categories: content area courses and design courses. Due to constraining factors such as funding and available laboratory space, most hands-on activities have been consigned to design courses where the knowledge from the content area courses is applied. As a result, much of the practical engineering work has traditionally been left until the last few semesters of an undergraduate degree. However, there is currently a move toward bringing laboratory experiences into traditionally lecture-oriented courses in an effort to enrich learning, enhance understanding of concepts, and increase student retention and transfer of knowledge to new contexts. The result is two different types of courses, which may employ similar procedural skill sets but have dissimilar learning objectives.

In a content area course, the primary learning objective is that students achieve mastery of the concepts. Every instructor will define mastery differently for their particular course, and will decide upon particular measurables which they will use to determine each student's level of achievement. However, the overarching objective is that all students achieve mastery of the concepts. As engineering classrooms are becoming more student-centered and professors are becoming facilitators of learning, cooperative learning strategies are finding their way into content courses. Using the definition outlined in the introduction, cooperative learning utilizes teams and requires cooperation and participation of each member. While much of the work is done as a team, each student completes every task and demonstrates conceptual mastery independent of the team performance. In this situation, even though there is a hands-on/procedural component to the course, learning is focused upon the specific content knowledge. In this context, the purpose of the team projects is to demonstrate understanding of a concept and the ability to apply it to a new situation, not to display technical ability.

Since design courses tend to be the capstone in an undergraduate engineering program, conceptual knowledge is often an extrinsic objective. At the point that these courses are taken, the students have completed most of their content courses, so the learning objectives in a design course include teamwork skills, proficiency with technical equipment, and the ability to complete a design project from initial concept to end product. As a part of this process, prior knowledge will be called upon; however, any acquisition of new content knowledge is apt to be incidental. In this case, it is often beneficial to utilize group projects, as opposed to cooperative learning (team) activities. With a group project, the members must employ divide-and-conquer strategies in order to succeed. Since an objective of a design course is to give students a picture of how engineering is done in industry, it is desirable that students learn to divide the work into manageable pieces and then work as a team to reach the end goal. In contrast to the content area courses, learning in a design course is focused upon the specific technical and teamwork skills; therefore, the purpose of the projects is both to develop and demonstrate these abilities and to display students' capacity for applying specific conceptual knowledge.

In order to visualize the importance of placing team activities in content courses and group projects in design courses, consider the following hypothetical scenario in which students are allowed to utilize divide-and-conquer strategies in a foundational course. The professor has decided that a particular concept is crucial to success both in his course and as an engineer. In order to make the concept relevant to the students, and give students an opportunity to get their feet wet with some of the technical equipment, he designs a project where the students will build an apparatus which demonstrates the simplest case. He thinks it is important for the students' development that they grapple with concepts before they are formally introduced, so he assigns the project about a week before he plans to cover the material in lecture.

For this assignment, he places students into teams of four students. On the project description the students find that in addition to the small apparatus they are also required to write a report and create a poster which exhibits their design and data. One particular team feels pretty lucky. They have one student who loves to work with her hands, and she's good at it, too. Another student made a professional-looking poster for a class last semester for which he received an A. The other two students aren't great with hands-on assignments, but are happy to plot all of the data and compile it into a report. After a successful first meeting where they divide all of the responsibilities, the team adjourns and plans to reconvene the next week and report progress on each part.

The next week the professor covers the material in class and the teams are now prepared to make some headway on their projects. By the time the due date arrives, all of the teams have a working device and are just putting the finishing touches on the other parts of the project. The team that thought they were lucky when the teams were assigned because of the varied skills of their members had a few struggles, such as one of the team members not showing up to meetings and pushing work onto the others, but the team successfully accomplished the task.

When the professor reviews all of the projects and assigns grades, he is impressed that everyone got the product working, and everyone produced high quality reports and posters. So, when he administered an exam over the material the following week, he expected high marks all around. However, that is not what he found. Some members did very well on the exam, but others had difficulties at a very fundamental level. He remembered seeing the students in lecture, so he was unable to explain what he was seeing on their exams.

The problem arose because he assigned a group project rather than creating a cooperative learning environment. Some of the members who had done the posters never saw how the apparatus was built, so they completely missed those concepts. The same was true of the report writers. As a result, those students found themselves unprepared for the next section of the course and got further and further behind.

Delving deeper into the cause of the matter, it is seen that the professor created an environment which fostered performance goals. His students were not focused on mastery of the subject; they were striving for task completion. While the goals that they were espousing were certainly performance-approach goals, they were insufficient to provide long-term success in the course. As a result of their failure on the exam, they will experience lower self-efficacy beliefs and reduced motivation as the semester progresses.

So, what if the professor was teaching a design course instead? Since the goal in a design course is that the students perform a task and demonstrate their competency in utilizing key skills and equipment, it is desirable to create a performance goal oriented learning environment. That is not to say that mastery goals are undesirable in design courses. On the contrary, mastery goals provide a level of motivation which cannot be reached by performance-approach goals alone. In a design course, the two goal orientations will work in concert within a particular student, but students who are primarily mastery-oriented will not be hindered.

Returning to content area courses, it is desirable that the environment in these courses be designed in such a way that makes mastery goals salient. As discussed earlier, performance goals do have their role and can aid a student in transitioning to a mastery goal orientation; however, lingering on performance goals impedes the development of the student as a learner, and, ultimately, as an engineer. In the case of our hypothetical classroom, the professor desired that the students move toward mastery of the concepts as a result of their experience in the project. Unfortunately, he designed the activity in such a way that the students could easily divide the work, so that is what they did. It is that property that shifted the goal orientation of the classroom towards performance, at least for that activity. Unlike the situation in design courses, in this case having a goal orientation which does not match the learning objective in the course (i.e., mastery) has hindered the students and left them lacking necessary conceptual knowledge.

Theory into Practice

From the above discussion it is clear that simply putting students in groups does not constitute cooperative learning, and groups and teams operate very differently. The question then arises, "How can I tell if I have a cooperative learning environment or a group project?" Activities in cooperative classrooms are organized in such a way that divide-and-conquer strategies become cumbersome, or those strategies are utilized under the umbrella of individual accountability. When each team member is required to demonstrate competency for every aspect of the project, much of the tendency toward the goal of simply completing the task is averted. If students are given team activities to work on in class, one way of ensuring that all of the members are contributing and learning is to ask a random member to be the representative for the team. Since students do not know who will be chosen, they must all work together to make certain they are all prepared. This strategy simultaneously invokes both mastery goals and performance goals. The students want to master the material, but their primary motivation is that the group will be seen as knowledgeable by the class.

The main focus when designing both in-class activities and long term projects should be matching the task to the learning objective. As a result, it is important to be deliberate when writing course learning objectives. They need to be specific and measurable. While assessing instruction does not fall within the scope of this paper, it is worth noting since it is integral to the learning experience. The methods of assessment which are employed must both match the instruction and be designed to evaluate whether or not the learning objectives have been met. If a course is taught using an almost entirely hands-on approach with few activities involving recall of information, it is not effective to administer a test which includes writing definitions of vocabulary words. Such a mismatch between the instruction and the test will more than likely not reveal the desired information about the student's level of understanding.

Conclusions

It has been seen that classroom structures make different goal orientations salient. Content area courses tend to foster, and necessitate, mastery goals, while design courses promote performance goals due to their respective learning objectives. Under the social-cognitive perspective, student motivation has both intrinsic and extrinsic components. As a result, a student who tends to be intrinsically mastery oriented can shift toward performance goals if the learning environment allows or encourages it. Sometimes this is desirable, and sometimes it is not. The key is carefully designing both the objectives and the activities, and then observing how they play out in the classroom so that adjustments can be made if necessary.

The work presented in this paper is the result of a synthesis of the prevailing literature on the subject. Clearly, research is needed into how particular goal orientations manifest themselves in an engineering classroom. Additionally, the inherent goal orientation of different types of courses (e.g., content area or design) needs to be fully investigated in a classroom environment. The subject of motivation in undergraduate engineering programs is ripe for investigation, and will be the subject of subsequent research by the authors.

References

[1] K. A. Smith, S. D. Sheppard, D. W. Johnson, and R. T. Johnson, "Pedagogies of Engagement: Classroom-based Practices," *Journal of Engineering Education*, vol. 94, pp. 87-101, 2005.

[2] C. Ames, "Classrooms: Goals, Structures, and Student Motivation," *Journal of Educational Psychology*, vol. 84, pp. 261-271, 1992.

[3] B. F. Skinner, "The Science of Learning and the Art of Teaching," *Harvard Educational Review*, vol. 24, pp. 86-97, 1954.

[4] T. Urdan and E. Schoenfelder, "Classroom Effects on Student Motivation: Goal Structures, Social Relationships, and Competence Beliefs," *Journal of School Psychology*, vol. 44, pp. 331-349, 2006.

[5] A. Bandura, "Self-efficacy: Toward a Unifying Theory of Behavioral Change," *Psychological Review*, vol. 84, pp. 191-215, 1977.

[6] E. L. Deci and R. M. Ryan, *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum, 1985.

[7] B. Weiner, *An Attributional Theory of Motivation and Emotion*. New York: Springer-Verlag, 1986.

[8] C. S. Dweck and E. L. Leggett, "A Social-Cognitive Approach to Motivation and Personality," *Psychological Review*, vol. 95, pp. 256-273, 1988.

[9] A. J. Elliot, "Approach and Avoidance Motivation and Achievement Goals," *Educational Psychologist*, vol. 34, pp. 169-189, 1999.

[10] P. R. Pintrich, "A Motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts," *Journal of Educational Psychology*, vol. 95, pp. 667-686, 2003.