

Board 78: How Do Grades Matter? A Work in Progress Study on the Influence of Grades on Engineering Students' Motivation & Decision Making

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Introduction

Nearly everyone has likely received grades at some point within their educational trajectory given that grades have been the primary form of communicating learning achievement since the early 1900's [1]. Despite grades having the very practical purpose of communicating our levels of learning or performance achievement to both the learners and the educational system more broadly [2], [3], when reflecting on the moments and instances in which we remember receiving grades we likely don't only remember the learning material or content. Intertwined with these memories of receiving grades are likely emotional reactions - sometimes incredibly strong. The joy and pride of achieving a good grade, the disappointment or frustration with a bad grade, or the anticipatory excitement or fear related to either preparing for a graded event such as an exam or presentation, or even waiting for a grade after submitting an assessment. Everyone likely has their own story they can recall of strong feelings – good or bad – being attached to receiving grades, and it has also been established in literature that grades elicit a wide range of emotions and feelings amongst students (e.g., [4], [5], [6], [7], [8]). While the body of research on grades and grading practices is growing as education researchers continue to explore assessment strategies and outcomes, not much is known about the impact of grades on students beyond their learning outcomes and learning achievements.

Grades & Grading Practices

Grades are well-established as a global tool in the high school and higher education communities to summarize and communicate a student's achievement of learning in a particular course, topic, or context. Final course grades are indicators of a student's ability to demonstrate their achievement of a course's learning outcomes or objectives. In most educational institutions, these course grades are aggregated into a student's grade point average (GPA), which acts as a weighted numeric representation of the achievement of learning across a variety of courses and subjects in a given education context (e.g. High School GPA, In-Major GPA, College GPA, etc.), using final course grades as building blocks in creating this single representative indicator of student achievement. Both final course grades and GPAs should theoretically be the result of students' summative assessments, used to determine if a student can demonstrate achievement of the course's learning outcomes at the end of that course [9]. Course grades and students' GPAs are high-stakes outcomes of educational programs, as these incredibly simplified metrics are used by a variety of stakeholders both within and external to educational communities (such as schools, colleges and universities, businesses, scholarship committees, research programs and assistantships) to make decisions related to whether or not students should be considered for or given opportunities within their organization.

While a student's GPA is something often reviewed and influential to the decision making of others in positions of power or influence over students, there are additional grades that students receive at a smaller scale on a more frequent basis that are far less public. In these cases, these grades are most likely the result of formative assessments (e.g., homework, quizzes, practice problems, etc.) which should be designed to be low stakes assignments that occur multiple times in a course to help scaffold student learning and development with frequent real-time feedback to students [9]. Any grades students receive that result from course content designed as a formative assessment (e.g., homework, quizzes, practice problems, etc.) are pedagogically meant to serve

as a way for the instructor to communicate with the student regarding their learning and performance at that point in the course [2].

Ongoing Grade-Related Research

While students recognize grades for their pedagogical and knowledge building purposes (e.g., [4], [5], [10]), the high-stakes implications of students' grades and the strong emotions and feelings associated with grades (good or bad grades, upcoming or past grades) tend to dominate students' headspace when they think about grades and talk about them with others. A review of literature exploring scholarship reporting students' perspectives on grades revealed that students often feel that grades aren't accurately representative of their performance in a class [5] and can feel more like compensation for work rather than representative of achievement [4] because grades often do not capture time and effort spent working to develop the knowledge and improve learning as much as students would like [11], [12]. Conducting a scoping review of research that focused on exploring the impacts of grades through the experiences and lenses of students revealed that grading practices and their impacts are rarely explored through the lenses of students [13].

To gain further insights into students' perspectives on grades and their impact beyond what was available in literature, our research team has begun conducting research through examining undergraduate engineering students' discourse related to grades. We chose the online discussion forum *Reddit* as the source of publicly available data from which we pulled students' perspectives. *Reddit* is an online forum social network made up of different communities, called *subreddits*, that contain posts related to a specific topic of interest to members of the community. Each *subreddit* is moderated by volunteer users, and users can create posts of various topics related or of interest to members of that community. We are collecting posts related to grades on the *subreddit* "r/EngineeringStudents". We will be examining the perspectives of engineering students by narrowing the discussions examined using search terms and phrases associated with grades and grading practices and analyzing the subset of discourse content in which student bring up or discuss their academic grades. Our data collection indicated that grades are frequently mentioned in this *subreddit*, with hundreds of posts or comments a month mentioning "grade(s)." The findings both from the scoping literature review and our own preliminary explorations of the data collected from *Reddit* prior to formal analysis have left us with questions - specifically, if students aren't primarily using grades to inform and develop their learning, how are they using grades they've received as well as the anticipation of upcoming grades as they navigate their education? In what ways do grades motivate students' decision-making?

Expectancy Value Theory

Expectancy Value Theory (EVT) is a well-known framework that can be used to explain a person's motivation. The theory was an outcome of an exploration made by psychologists on achievement motivation; it emerged as researchers found that various theories of motivation are interconnected, such that a multidimensional theory that considered both a person's beliefs about their success and potential value of the outcome could be created [14]. At a high-level, EVT posits that a person's motivation is a combination of two primary factors: their expectations of success (the expectancy) as well as the worth or importance attached to the outcome (the value) [15]. The expectancy half of a person's motivation is a combination of a person's self-efficacy, expectancies, self-concept, perceived control over a situation, and the attributions associated with an outcome, whereas the value portion considers their psychological needs, the intrinsic vs. extrinsic value of the outcome, the utility of the outcome, as well as its cost [14]. Jacqueline

Eccles-Parsons (and colleagues) are often credited for first introducing expectancy value theory to an educational context to explain students' motivation and choices [16].

EVT is a widely used motivational framework in education and has been used to research students' decisions and student success in multiple contexts and informs a variety of educational programs and interventions designed to increase student motivation [14]. Additionally, multiple engineering education research studies have employed EVT as a theoretical framework [17].

Considering the Integration of Grade Centralization & Expectancy Value Theory

Our research team of engineering educators work primarily with engineering students in their first two years of their college experience, so we frequently see first-hand the ways in which grades are centralized in our students' educational experiences (positive and negative emotions, focus on points/scores over learning and growth, etc.). Recently we have observed how the centralization of grades to students' experiences has negatively impacted their engagement and work in project-based courses. Students have seemed to procrastinate PBL course work to prioritize other courses, disengage with lessons in class to complete homework for other courses, or even not attend class sessions to study for an upcoming quiz or test in a different subject. When addressing these concerns with students, they often offer explanations that relate to their need for a good grade in another course (such as calculus, physics, or chemistry, to give examples). These students appear to be borrowing time and effort from our project-based learning course to put time and effort into calculus, physics, chemistry, power electronics, statics, dynamics, etc. While this is not the case for all students, it raised the question within our team: How do students make day-to-day decisions related to what to do for each course they are in? And what role do their grades play in their decision-making processes?

We began to consider these questions - how grades (either upcoming or already received) influence students' day-to-day decision making when it comes to allocating their academic resources (time, energy, effort, concentration, etc.) - through the lens of EVT, specifically, Barron & Hulleman's 2015 expectancy-value-cost model of motivation [18]. This model argues that cost should no longer be simply a sub-component of the "value" portion of EVT, but it should instead be considered as a major third component given the role it plays in motivation based. Their research into the 'cost' portion of this model recommends four factors of cost: effort related to the task, effort unrelated to the task, loss of valued alternatives, and negative psychological experiences [19]. We believe that the expectancy-value-cost model of motivation has significant potential to shed light on the way in which the centralization of grades in students' educational experiences influence their motivation when it comes to making decisions as they navigate a course or a semester. Considering the concepts of students' expectations relating to grades, the potential value of grades, and cost needed to get them, we map below how each of these concepts relates to the problem we wish to explore in our research.

Could grades relate to engineering students' expectancy of educational success? University engineering programs are often competitive and have high GPA requirements, engineering is often associated with high academic ability or achievement [20], [21], many people who enter engineering were given messaging that there were 'smart' at some point in their K-12 education [22], and intelligence or smartness has been shown to be inextricably connected to the discipline of engineering [23], [24] and often associated with good grades by engineering students [25]. For these reasons, we do assert that most engineering students believe to some degree that good grades relate to their expectancy of success.

Could grades relate to engineering students' value in educational contexts? As already noted in this paper, students' grades and GPAs have gatekeeping properties related to educational access and opportunities within their educational experience and beyond - such as admission to degree-granting engineering programs, scholarships, research assistantships, competitive student design teams / clubs / organizations, graduate school fellowships, internships or co-ops, etc. For these reasons, we assert that most engineering students find some value in receiving good grades.

Could grades relate to engineering students' costs? Whether we recall these from our own experiences or our current students' conversations with us and one another, the list of the cost of good grades is expansive. If we consider the four cost factors [19] there is time and effort related to the task of going to class, studying, completing assignments, etc. There is also effort unrelated to the task such as managing course loads each semester, sometimes on top of extracurricular or jobs. Sleep, meals, socialization with friends and family, and self-care are often the top contenders for the loss of valued alternatives. And finally, the negative psychological experiences described by students - sadness, disappointment, frustration with poor grades (e.g., [26], [27]) or even the fear, stress, or anxiety of upcoming graded events (e.g., [6], [28]). For these reasons, we do assert that most engineering students believe to some degree that there is a cost to good grades.

Next Steps / Future Work

Our research team is in the process of designing a research study that uses the expectancy-value-cost model of motivation to answer our guiding question: *What role do grades play in engineering students' day-to-day decisions related to how and when they engage with course content?* We hope to begin our exploration of by looking into the experiences of students who are in the first two years of their academic careers in engineering, as it is during this stage in the curriculum where students are required to take foundational courses upon which higher discipline-specific courses are built, which also indicates that it is during this period when decisions on how they engage in course content are critical. We understand that grades are in many ways an inevitable aspect of higher education, but this ongoing research and exploration will offer insights into the impact and influence of grades on students as decision makers in their own educational journey. As we begin to understand the role grades play in students' academic experiences beyond the assessment of their learning, educators can better articulate the need for deep and long-term learning of course content to students and design assessment structures and outcomes to emphasize deep learning and ensure that grades are representative of what students' truly learned in a course rather than how they performed on an assessment.

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