What Do Grades Mean? A Scoping Literature Review on Students' Perceptions of Grades and Grading Practices

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Abstract

Do grades matter? What do grades mean or represent? Ways to rank students and describe academic performance have been used in practice since at least the early eighteenth century. Over time, educators have begun to consider whether grades - in their various forms, numeric or otherwise - sufficiently represent how well students learned and explore what grades really mean. The impact of grades on student motivation, self-efficacy, and identity, among other constructs, has also been a subject of interest. In Engineering, these constructs are important to consider as they may impact student persistence, success, and diversity.

This scoping review explores current literature on the use of grades and their impact on students - specifically from students' perspectives. How do students describe grades and their experiences with prevailing grading practices and assessment strategies, as documented in literature? What meaning do students ascribe to grades, and how does this meaning impact their motivation, self-esteem, and identity? Ultimately, the results of this literature review will serve as the basis for developing strategies to ensure that students are able to thrive in a learning environment where the focus is on learning, going beyond numeric or similar representations of academic performance.

To answer the questions posed above, we conducted a scoping review of literature on students' perceptions of grades. We used a broad search parameter that may yield literature from both K-12 and higher education spaces to establish the general conversation on grades from students' perspectives. We followed Arksey & O'Malley's (2005) five-stage framework for conducting scoping literature reviews as a methodology to identify possibly relevant articles and filter through which answer our research question to include in our analysis. Two researchers conducted the analysis, and all decisions and observations were documented in a shared repository to ensure quality, trustworthiness, and replicability. This scoping review provides a deeper insight into students' perceptions of the grading systems they are assessed within and the meanings that they ascribe to grades through the review and summary of literature on the topic of grades through student lenses. The insights from this scoping review will allow faculty to better understand how students may be experiencing learning environments in which grades are assigned, and subsequently intentionally designing curriculum and pedagogy to improve students' learning experiences and environments.

Introduction & Background

Assigning grades as a practice in educational systems has been used commonly since the early

1900's [1]. Grades are globally ubiquitous to students' academic success. Whether represented alphabetically (A, B, C, D, & F) or numerically (through percentages or grade-point averages) grades can be considered a universal language taught to nearly everyone as early as primary and elementary school.

Grades are a practice tool and serve dual function in educational systems. Formative assessments are ideally low stakes assignments that happen multiple times in a way that scaffolds student learning and development and deliver frequent real-time feedback to students [2], [3], so any grades that are a result of a formative assessments (e.g., homework, quizzes, practice problems, etc.) primarily serve as valuable means of communication regarding learning and performance between a student and instructor throughout a course [4]. Summative assessments, alternatively, are final assessments of a student's performance and are used to determine to what level a student has achieved in the learning process [2]. Therefore, grades on a summative assessment primarily serve as means of communication to others within or closely related to the education system regarding a student's learning achievements on a general subject or topic area, and they generally are able to speak to a student's knowledge in a broad topic area (e.g. math, reading, etc.) reliably [5].

Beyond their role in the classroom, grades play a pivotal role in opening doors within and beyond academia. Often seen as a predictor of academic and personal success, a student's grades influence admission to educational programs, scholarship selection, and opportunities such as internships, job placements, and research assistantships. The way in which grades serve as a gatekeeper to many opportunities and sometimes even professions has gained the attention of many in fields that are addressing concerns related to diversity, equity, and inclusion - engineering included.

The relationship that many people draw between grades and success often ignores nuances, complexities, and inequities. Grades are often linked to notions of "ability" or "smartness," acting as a proxy for intelligence. While there has been research that has found correlations between intelligence and grades [6], this relationship should not be over-simplified or used as the standard. Research has also identified that students' getting good grades or scores on tests may actually be more related to study skills [7], their behaviors or effort in the classroom [8], [9], or their personality more so than intelligence or IQ [10]. Similarly, students who receive grades often considered bad are over-representative of students in underserved or minority populations, come from families of lower socioeconomic status, or are non-traditional students who have additional jobs, families, and responsibilities to manage compared to traditional college-aged students coming directly from high school. As engineering programs continue to work to recruit students that have been traditionally underserved and underrepresented we will continue to face considerable challenges, as idea of academic success and smartness has been shown to be complexly intertwined with the field and discipline of engineering [11], [12] and good grades for little effort are a very common indicator to young engineering students as to whether they are considered smart [11].

Additional criticisms of grades include the observation that the behaviors most used by students to achieve high grades often do not align with the habits and behaviors that yield the best results for long-term learning, retention, and deeper understanding of a topic or content [13], [14]. Students often engage in specific practices geared towards obtaining good grades, such as long "cramming" study session hours prior to an exam, short term memorization, or even academic

dishonesty. The common use of these practices to achieve the grades that are so often synonymous with academic success and learning achievement raises questions about the effectiveness of grades being at all indicative of genuine comprehension and intellectual growth. In response to these complexities and concerns related to grades and their impact on students, a growing movement challenges the conventional practice of assigning grades. Education scholars, researchers, practitioners, and administrators across diverse contexts are leading the charge, advocating for alternative ways to assess knowledge. This shift is evident in the discussion and implementation of various 'non-traditional' grading models such as standards-based grading [15], student self-assessment and grading [16], and the adoption of other "ungrading" [17] approaches or recommendations.

Engineering education is an exciting field in which we are often encouraged and rewarded for classroom and assessment innovations that break the mold of traditional engineering education. Early-career engineering faculty members are uniquely positioned such that they are newly responsible for design and delivery of engineering courses while also not being so far removed from our own educational experience that we can remember our personal educational experiences and the impact that various aspects of our education had on our development and learning. Recently our research team of early-career engineering educators responsible for teaching first-year engineering students began to explore the topic of grades and grading practices in educational research, and as we explored a critical question emerged:

> *As educators and researchers continue to engage in critical research and progressive conversations about the purpose and impact of grades and the way that educational structures and systems can innovate to reduce the negative byproducts and stigmas surrounding grades — how often in research and in these conversations are we meaningfully engaging with the most directly impacted stakeholders of grades and grading practices: the students?*

Purpose

The purpose of this paper is to provide the results of a scoping literature review our research team did to better understand to what extent the landscape of research and literature on grades and graded practices has intentionally explored grades through students' lenses, and what the research that has done this has found. All educators have our own anecdotal evidence of students' perspective of grades, but our team was curious as to what research has been formally designed and disseminated to articulate the purpose, utility, and importance of grades through the eyes of their most relevant stakeholder: students.

Methods

This scoping literature review was conducted to identify ways in which late high school and higher education students' perceptions and purposes of grading and grading practices are studied and reported. We followed Arksey & O'Malley's [18] five-stage framework for conducting scoping literature review. According to Arksey and O'Malley, scoping literature reviews are particularly useful to "examine the extent, range, and nature of research activity…identify research gaps in the existing literature…summarize and disseminate findings…and determine the value of undertaking a full systematic review" [18, p. 21].

A scoping literature review differs from a systematic literature review in that a systematic review tends to focus on the evaluation of existing literature when it comes to the quality of the research and findings and involves an exhaustive search of the literature on the particular topic [19]. While a systematic review may follow a scoping review, researchers may also determine that a systematic review is not necessary or feasible after conducting the scoping literature review. Also, scoping literature reviews are useful for understanding a landscape of a particular topic "where it is difficult to visualize the range of material that might be available" [20, p. 21]. After an initial search of literature related to college students' perceptions of grades, our team found that publications focusing on this topic area were not prevalent in peer-reviewed outlets and therefore a scoping literature review was most appropriate for an exploration of literature within this topic area. The remainder of this section will be structured in accordance with Arksey & O'Malley's five-stage scoping review framework [18].

Stage 1: Identifying the research question

The first stage described by Arksey & O'Malley [18] is to identify the guiding research question. The research question used for our scoping review was: *How are the perceptions and purposes of grades in education documented in literature from the perspectives of late high school and higher education students?* This research question is not specific to engineering students, as our research team's initial literature searches did not reveal any engineering-education research relevant to this question, and is inclusive of late high school students as our research team's teaching context is first-year engineering students, whose most recent and relevant education and experience - high school - heavily influences their beliefs about grades and academic success that are directly influential to their conduct in and expectations of courses in their first semester of college.

Stage 2: Identifying relevant studies

Identifying relevant literature is the next of Arksey & O'Malley's [18] stages in the scoping literature review process. Arksey and O'Malley lay out that "the point of scoping the discipline is to be as comprehensive as possible in identifying primary studies and reviews suitable for answering the central research question" [18, p. 23]. To do this we began by consultation with a reference librarian to identify the most relevant databases. After this step, we then conducted a database search across the following relevant databases: Education Research Complete from EBSCOhost, ERIC from EBSCOhost, Educators Reference Complete from Gale, IEEE Xplore, Engineering Village, and ERIC on Worldcat. We used search term combinations "grade* AND goal* AND (student or students)" and "grade* AND perception* AND student*" to identify publications with these search terms in either their keywords list, title, or abstract.

After these searches identifying an initial set of possible articles of interest we then used additional methods to ensure we captured as many relevant publication as possible, including methods such as citation chaining [21] across different manuscripts, and the utilization of literature searching tools (e.g., research rabbit [22]). A total of 49 manuscripts were initially found and retrieved from database searches, citation chaining, and using literature review tools.

Stage 3: Study Selection

In order to further identify only the relevant manuscripts that answer our research question from the list of articles returned from our initial searches, the research team developed and agreed upon the list of inclusion and exclusion criteria using a post hoc approach that is common in

scoping reviews such as this (Arksey & O'Malley, 2005). The inclusion criteria and exclusion criteria for our scoping review are provided in Table 1.

Table 1: Table of Inclusion and Exclusion Criteria

Inclusion Criteria	The study must have students be the subject of the manuscript
	Study participants must be late high school (11th or 12th grade) or college / professional education students.
	The study must report on student's perspectives or opinions about grades
	The study must be published in a peer-reviewed outlet
Exclusion Criteria	Studies are not seeking predictors for students' expectations of grades in a course

The research team manually filtered and discussed manuscripts by reading the abstract and determining if the publication should be included or excluded from the review. If the relevance of the paper was unclear from the title and abstract, it was marked for further review. Two research team members would then examine the full text, make a determination individually, and then discuss with other team members to ensure alignment. Through this iterative process, we finalized a list of 17 peer-reviewed journal articles that meet the inclusion criteria and contained content that answered our research question.

Stage 4: Charting the data

Next, we developed a list of data we hoped to gather from the final 17 manuscripts to both map the various ways in which research was conducted to answer our scoping research question as well as what content within the paper specifically answered our research question of interest. This information includes the publication venue, student population education level and size, research methods, and what findings of their research answered our research question and what those answers were. Each manuscript was read, and the data described above was collected for each of the 17 articles and compiled in a master spreadsheet.

Stage 5: Collating, summarizing, and reporting the results

Upon having reviewed all 17 articles the mapping of the research contexts, populations, and methods was done by compiling a table of the general characteristics categories that each paper fell into. The collation and summarization of the answers to our research questions was done by noting each individually reported finding from all 17 articles (many articles had multiple) that provided an answer to our research question of a perception that students had about grades. All of these individual student perceptions were then reviewed and thematically grouped using a constant comparative analysis technique in which the research team continuously refined the various themes and grouping of the results to best illustrate a full and complete answer to this research question across the 17 articles.

Results & Discussion of Findings

Before elaborating on how the article answered the research question, we first want to lay out the variation of these articles regarding educational context, population, and methods used. Tables 2-5 provide insights into the 17 papers used to answer our research question through this scoping review.

Table 2: All articles that met the inclusion criteria

Publication Year	**Methods**	**Student Population**	**Discipline**	**Bibliographic Reference**
1980	Opinionnaire	345 Junior High School Students	High School Teaching and Learning	R. Hull, "Fairness in Grading: Perceptions of Junior High School Students," *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, vol. 53, no. 7, pp. 340–343, 1980,
1984	Interviews	15 High School Students	Remedial and Special Education	M. L. Calhoun and J. Beattie, "Assigning grades in the high school mainstream: Perceptions of teachers and students," Diagnostique, vol. 9, no. 4, pp. 218–225, 1984.
1995	Survey	106 Undergraduate Students	Role of Communication in Teaching and Learning	N. R. Goulden and C. J. Griffin, "The meaning of grades based on faculty and student metaphors," Communication Education, vol. 44, no. 2, pp. 110–125, 1995.
1999	Survey	7367 Middle and High School Students	High School Teaching and Learning	L. H. Cross and R. B. Frary, "Hodgepodge Grading: Endorsed by Students and Teachers Alike," Applied Measurement in Education, vol. 12, no. 1, pp. 53–72, 1999
1999	Questionnaire	944 Undergraduate Students	College Teaching	H. E. B. Iii and H. L. Bates, "Student and Faculty Perceptions of the Impact of Plus/Minus Grading: A Management Department Perspective," *Journal on Excellence in College Teaching*, vol. 10, no. 1, pp. 23–33, 1999.
1999	Survey and Interview	High School Students 275 surveyed 84 selected for Interviews	Remedial and Special Education	W. D. Bursuck, D. D. Munk, and M. M. Olson, "The Fairness of Report Card Grading Adaptations: What Do Students With and Without Learning Disabilities Think?," *Remedial*

				and Special Education, vol. 20, no. 2, pp. 84–105, 1999
2005	Survey	159 Undergraduate Students	Psychology	J. B. Adams, "What Makes the Grade? Faculty and Student Perceptions," Teaching of Psychology, vol. 32, no. 1, pp. 21–24, 2005, doi: 10.1207/s15328023top3201_5.
2010	Survey	613 Undergraduate Students	Higher Education	M. E. Gordon and C. H. Fay, "The Effects of Grading and Teaching Practices on Students' Perceptions of Grading Fairness," College Teaching, vol. 58, no. 3, pp. 93–98, 2010, doi: 10.1080/87567550903418586.
2010	Focus Groups	45 Undergraduate Students	Higher Education	M. L. Sanders and S. Anderson, "The Dilemma of Grades: Reconciling Disappointing Grades With Feelings of Personal Success," Qualitative Research Reports in Communication, vol. 11, no. 1, pp. 51–56, 2010, doi: 10.1080/17459430903515228.
2011	Semi-Structured Interviews	28 Medical Students	Assessment Methods	H. M. Al Kadri, M. S. Al-Moamary, M. E. Magzoub, C. Roberts, and C. P. M. Van Der Vleuten, "Students' perceptions of the impact of assessment on approaches to learning: a comparison between two medical schools with similar curricula," *Int. J. Medical Education*, vol. 2, pp. 44–52, 2011, doi: 10.5116/ijme.4ddb.fc11.
2012	Questionnaire	120 Undergraduate Students	Higher Education	G. K. Tippin, K. D. Lafreniere, and S. Page, "Student perception of academic grading: Personality, academic orientation, and effort," Active Learning in Higher Education, vol. 13, no. 1, pp. 51–61, 2012,

				doi: 10.1177/1469787411429187.
2013	Questionnaire Interviews	Undergraduate Students 29 Questionnaire 7 Interviews	Cooperative Learning	G. Reddan, "To grade or not to grade: Student perceptions of the effects of grading a course in work-integrated learning," 2013.
2013	Experimental	561 Undergraduate Students	Higher Education	S. L. Boatright-Horowitz and C. Arruda, "College students' categorical perceptions of grades: it's simply 'good' vs. 'bad,'" *Assessment & Evaluation in Higher Education*, vol. 38, no. 3, pp. 253–259, 2013, doi: 10.1080/02602938.2011.618877.
2015	Phenomenological Interviews	3 Undergraduate Students	Higher Education	A. Hasnain and S. Bhamani, "Exploring Perceptions of University Students Pertaining to Grades over Knowledge and Skills," *JoEED*, vol. 1, no. 2, p. 101, 2015, doi: 10.22555/joeed.v1i2.42.
2021	Focus Groups	16 Undergraduate Students	Higher Education	D. J. DeFeo, T. C. Tran, and S. Gerken, "Mediating Students' Fixation with Grades in an Inquiry-Based Undergraduate Biology Course," Sci & Educ, vol. 30, no. 1, pp. 81–102, 2021, doi: 10.1007/s11191-020-00161-3.
2021	Survey	20 Undergraduate Students	Higher Education	D. Guberman, "Student Perceptions of an Online Ungraded Course," *TLI*, vol. 9, no. 1, pp. 86–98, 2021, doi: 10.20343/teachlearninqu.9.1.8.
2022	Semi-structured Focus Groups Online Surveys Audio recordings	Undergraduate Students 493 Online Survey	Physiology	A. Horne, J. J. Yuen, T. S. Beveridge, and S. McLean, "Grade-focused interactions in higher education: has the pursuit

	of student-instructor interactions	9 Focus Groups		for good grades replaced learning?," *Advances in Physiology Education*, vol. 46, no. 4, pp. 752–762, 2022, doi: 10.1152/advan.00021.2022.

Table 3: Articles sorted by Student Population Studied

Student Population Studied	**Number of Articles**
Undergraduate Students	12
High School Students	3
Middle School Students	2
Medical Students	1

Table 4: Articles sorted by Methods of Data Collection

Methods of Data Collection	**Number of Articles**
Questionnaire/Survey	10
Interview	5
Focus Group	2
Experimental	1

Table 5: Articles sorted by general Methodology

Methodology	**Number of Articles**
Quantitative	10
Qualitative	4
Mixed	3

As shown in the tables above most of the articles found are survey/questionnaire-based (ten out of 17), focused mainly on undergraduate students (12 out of 17), while a smaller number of manuscripts use either focus groups or interviews for their main data collection methods. Four manuscripts focused on the perspectives of high school students only while a smaller subset of manuscripts (two) focused on both high school and middle school students' perspectives simultaneously. While one manuscript explored grades from the perspective of medical students. Altogether, of the 17 manuscripts that answered our research question, ten used quantitative methodologies, four used qualitative methodologies, and three used mixed methods.

Next, we will elaborate more on how the 17 articles answered our research question: ***How are the perceptions and purposes of grades in education documented in literature from the perspectives of late high school and higher education students?*** The thematic analysis of the answers to our research question presented in each article revealed five major ways in which students talked about grades and their perspectives on grades: 1) what grades are / are not, 2) the purpose of grades, 3) the outcomes of grades, 4) the influence of grades, and 5) comparing grading systems. The remaining results will be grouped based on these perceptions of grades from students' perspectives.

What Grades Are - According to Students

In a survey study that asked undergraduate students in general education classes their perspective of the meaning of grades in the form of metaphors (i.e., provided the prompt "grades are _____" and asked students to fill in the blank) [23]. This article provided quite a few insights into students' views of grades. This study's analysis revealed that many students view their grades as abstract symbols that aren't reflective of a person's learning or effort [23]. This sentiment was echoed by students in a different study who described grades as generally useless [24]. Despite the shared sentiment across a couple populations of students that grades are only symbolic and not useful or insightful, students from another article share that often they seem to be hyper focused or have a notably high level of awareness of their grades [25].

Another very common sentiment expressed in Goulden & Griffin's study [23] was that grades are like compensation for a job done (e.g., homework, activities, tests, etc.) or "tokens" that are given out to students. When the token metaphor was described, it was noted that these tokens were also not associated with or connected to learning, but instead the grades just served as some sort of incentive or reward system [23]. This metaphor relating grades being given in response to, or as compensation for, work being done aligned with the findings of other articles in which students described grades as being or feeling transactional [26], [27]. From an educators' perspective it is understandable how and why grades are perceived in a transactional way given the traditional structure of a course and its assessments. An assignment is submitted by a student, and more often than not from the instructor a grade is returned to that student as a direct result of that assignment.

Another study reported that when talking to students about grades and points on assignments, students were more often than not framing points or grades as something that they lose (starting off with "all points" and then deductions being made) rather than something that they earn (starting off with "no points" and then additions being made) [25]. This mental model is interesting, as it seems counterintuitive to the compensation or token metaphors given by the students in Goulden & Griffin's [23] article. However, anecdotally, most grading is communicated through or by using point deductions. While course-design fundamentals tell us that our assessments need to be designed such that students earn a passing grade by demonstrating achievement of the learning outcomes [14], our grading practices of point deductions might be unintentionally building this underlying mental model of grades primarily being something you lose rather than earn through demonstration of learning.

The Purpose of Grades - According to Students

Across a few different studies, students' perceptions of the purpose of grades were well aligned with what we as educators know to be the purpose of grades - an indicator of that student's achievement of learning or performance in a specific context. Generally, students do agree with this purpose, because in the metaphor development research study, most of the students (62%) communicated that grades are for feedback on learning [23]. Additional articles that we reviewed report students sharing that grades provide information about students' progress on learning [28], and that lower grades in particular may indicate a lack of learning [24]. While this was exciting to see, as extensive research on formative and summative assessments as well as feedback practices have established in education research that grades are a form of feedback [29], students' perceptions of the purpose of grades and grades' relationship to learning came with caveats.

The first of these caveats being that students in Sanders & Anderson's study also expressed that

while lower grades may indicate a lack of learning, higher grades don't always correlate with learning [24]]. Students have specifically noted that most often the ways in which students go about getting good grades is through superficial learning or short-term memorization [27]. These results are not encouraging, as we know that short-term memorization is not one of the foundational principles of long-term learning and retention of information [13].
Another caveat relates to learning potential. One article's results also shared that students communicated that grades are not reflective of the potential for learning or the performance of the learner [28]. This is absolutely true, as extensive research on student growth, learning, and development has demonstrated that one grade or assessment outcome is not reliably predictive of learning, growth, or ability (e.g., [30]).

Finally, students' last commonly identified purpose of grades was that grades often function as gatekeepers [23]. This phenomenon has been well-documented in literature to the point of this really being common knowledge in education. A student's grades are often used as criteria to determine access to many opportunities such as particular classes, educational programs or degrees, extracurricular opportunities, or internships and jobs. While many in education recognize this problem, the results of this scoping review revealed that students have also called out that grades and the pressures inextricably connected to grades given students' knowledge of their gatekeeping properties are institutional and educational system issues [25].

The Outcomes of Grades - According to Students

Despite many students recognizing grades' purpose as they relate to learning and performance, one commonly discussed outcome of grades (what grades cause or lead to) from student perspectives was students' internal thoughts, feelings, and emotions - both positive and negative.

Students in multiple articles noted the power that grades have as emotional triggers. Students report that grades can trigger good or bad feelings, depending on the performance [23]. One study shared that students were happy with receiving grades rather than simply a pass/fail outcome to a class because receiving the grades lead to feelings of positive recognition, being rewarded, and satisfaction [31]. These good and bad feelings associated with grades are echoed in students' perspectives shared through a different published study reporting that students only saw and described grades in a binary sense - as either having a 'good' or 'bad' grade without any sort of categorization for a neutral area in between [32].

Another article in our scoping review had a 'good' and 'bad' distinction with regards to the outcomes of grades, but this distinction was specific to the types of stress caused by grades. Some students reported feeling "good" stress from grades - this stress motivating them to study / learn / memorize class content [26]. While motivation to study more or work harder sounds initially like a positive outcome of grades, but not all descriptions of the motivation that result from grades were as positive as those reported by [26]. The research that involved students creating metaphors for grades compared the motivation of grades to a "carrot and stick" method of motivation [23] - this colloquial method of motivation is equated to having positive rewards for good behavior or desirable outcomes, and conversely, negative punishments for bad behavior or undesirable outcomes. This tells us that despite some students seeing a bad grade as a reflection of their learning and the need for improvement, others see a bad grade as punishment for the undesirable outcome of not learning or correctly demonstrating learning.

Additional negative outcomes of grades include the 'bad stress' described by students in DeFeo

et. al.'s article - anxiety, worry, concern, or feeling overwhelmed leading up to or completing graded events or tasks [26]. Students in Sanders & Anderson's study research describe the feelings and emotions of frustration, anger, sadness, or discouragement that often follow a grade they have distinguished as 'bad' [24]. While educators don't set out to bring about negative feelings and thoughts within our students, these can be some of the unintended consequences and side effects of grades [33]. An inspiring counter-story shared in Sanders & Anderson's article was students describing that, in the face of bad grades, don't let that bad grade define who they are as a person as they work to separate their value as a person from an academic grade [24]. This perspective is powerful and important, as literature has documented the negative impact of grades on students' whose identities are strongly connected to being considered smart [12].

The Influence of Grades - According to Students

Students across many of the scoped articles described the influence that grades had on their decision making as a student. This included academic planning and big-picture decisions as well as day-to-day decisions in courses and classes.

Big-picture decisions described by students when it comes to choosing courses include what courses to choose and why they choose them. One research article reported students sharing that they rather take a course that was an easy A over a challenging course [25]. A different study described students' displeasure with having to take courses that they deemed irrelevant to their career or "real life", and their desire that these courses not impact their GPA [34]. These findings revealed that academic planning decisions are sometimes influenced by grades, but what faculty are more directly affected by are the day-to-day grade-influenced decisions students make when enrolled in our courses.

One example of students' day-to-day grade-influenced decision making is one that many instructors have inevitably noticed in their own classrooms: Students shared that they are more likely to not pay attention if the instructor reveals that something won't be graded or won't be on the test [26]. Students also described decision making related to engaging with feedback from the instructor [23], as well as planning their study time and study techniques such that they got good grades, which they know are techniques that are not at all beneficial for true learning, but intentionally choose getting a good grade over truly learning the content [26]. Our research team's interpretation of these day-to-day decisions seem to be students' maximizing their academic efficiency - minimizing their mental load and effort while maximizing their grade output (or rather, outcomes). This interpretation is informed by the significant number of articles in our scoping review in which students share their perspectives on grades related to effort. While these findings didn't directly answer our research question, we found them to be salient enough to note here. Students overwhelmingly believe that grades and effort or behavior should be more closely related or influential to one another. While some students report that they believe performance in a class matters significantly more than effort [35], other students expressed wanting effort and behavior to be factored into the final grade or given consideration [36]. One research study went so far as to quantify these proportions, reporting that on average students believe ~60% of their final grade should come from performance and ~40% from effort [34].

Comparing Grading Systems - According to Students

Broadly speaking, students have noted that many times grading practices and systems are inconsistent across educational settings, sometimes from class to class, sometimes from

university to university [28]. This is not surprising given that educators and researchers have been exploring a range of grading practices, policies, and systems in an effort to identify practices that improve students' learning, assessment of outcomes, student motivation, etc. Much of the variation in large-scale grading practices is to what level of granularity grades should exist at. At one extreme of the spectrum students can be graded on a pass/fail basis. While a few of the articles we reviewed indicated some students feel that the scale of grades is arbitrary [37] or that grades are symbolic [23] or useless [24], one study explored students' perceptions of changing from a pass/fail grading system to one with a scale of letter grades. Generally, student's reported that this adjustment improved their motivation to put effort into the course, improved their understanding of the course's focus and the value it held, and that the letter grades has positive impact on their GPA, which had the potential to have further implications as they explore post-graduation opportunities [31]. This appreciation of letter grades was echoed by students in a different research study, who described preferring letter grading scales as opposed to numeric representations of their grades [32]. While the general consensus from Reddan's [31] study was that students generally supported the move from the pass/fail grading system to an alphabetic grading scale, they did identify one disadvantage - the focus on individual assignment marks and grades as opposed to the general evaluation of their performance (good or bad) in that context or environment - which they recognized as being closer to what they will experience in a job setting after leaving school [31]. Another study identified a similar sentiment from students when studying students' perceptions of grading practices. The article reported that students expressed an appreciation for grading systems in which the final course grade was not simply a sum of all of the individual assignment grades, as this model allowed for more flexibility and the integration of student's personal interests into the grade beyond strictly performance on assignments [38]. The alphabetic grading scale adds significantly more granularity to students' grades than the pass/fail grading system. Even more granular, yet, is the integration of letter grades with additional +/- indicators attached to those letters (e.g., B-, B, and B+). One study explored how students felt about a change in the grading system to include the +/- granularity in letter grade. Their results found that students viewed this change negatively, citing that these changes were negatively affecting their GPAs, and disproportionately affecting "good" or "high performing" students in negative ways compared to "lower performing" students [38].

Conclusions, Limitations, & Future Work

As educational research and innovation related to grades and grading practices continue, we used this scoping literature review as a way to summarize scholarship that elevates the voices of students, who are most directly impacted by the positive and negative side effects of our current grading practices. This scoping review revealed a significantly wide range of ways in which students see and describe grades, their purpose, and their impact on the students' educational experiences, with a few instances of contradictions, but none that were inexplicable. From students' perspectives, grades are indeed indications of their learning and performance in a class, but may not necessarily be an accurate representation of their abilities and the time and effort that they put into the learning process, even when they aren't successful. Grades are the source of a wide range of positive and negative emotions, such as motivation to study and work hard; stress and anxiety leading up to high-stakes, graded assignments or tests; as well as feelings of either recognition of satisfaction or of disappointment and frustration after receiving grades, depending on if they view the grade they received as good or bad. Students can be hyper-focused on grades and often use them to make decisions related to their day-to-day course engagement and long-term academic planning, but likely because they also recognize the role that grades play

in gaining access to important opportunities for growth and development, such as eligibility to participate in educational programs, clubs or extracurriculars, internships, research assistantships, etc.

Two limitations should be noted related to the results of this scoping review. Given that this was an exploration of any literature related to this topic, we included dates as far back as 1980 to identify any trends of literature frequency across time. Six of the 17 publications identified in this review were published prior to 2000. The educational experiences of students from the 1980s and 1990s are likely vastly different from those of modern students given the rapid changes to the landscape of education across the last couple of decades. While we make no generalizable claims regarding a common consensus among all students across time, this broad timeline is important to acknowledge. Similarly, the variability in which the articles explored grades made it difficult to assert any common sentiments given what 'grades' were considered. Some research explored 'grade' as the noun – the outcome of an assessment or course, while others studied 'grade' the verb, the action of assessing students and what area they were assessed on. In some articles this distinction was not made clear. Additionally, the scoping review publications varied on what grades students were talking about. Some spoke of course grades, others exam or test grades, and others yet more formative grades such as homework or small activities. The variability in which 'grade' (noun or verb) or 'grades' (formative or summative) were considered across these bodies of work made it difficult for us to make clear comparisons between populations or grade/grading contexts.

The scope of our review revealed that little scholarship has been published from the students' perspective, as only 17 articles met our inclusion criteria and none of those articles were specific to STEM or engineering undergraduate students. The articles were spread across time and educational contexts, and the results reported all came from a variety of research methods. We hope to continue the work of furthering the research and understanding of students' perceptions on the purpose and utility of grades and the impact that grades have on themselves and their peers by conducting more intentional research into students' discussions about the pervasive role of grades in their academic experiences.

This scoping review revealed that students' perceptions of grades and their impact are just as complex as we know them to be according to education literature and anecdotal experiences as both students and educators. The assessment of students' achievement of learning outcomes is critical in education, and especially so in higher education engineering contexts where these learning outcomes and whether students can achieve them are regularly reported for accreditation purposes. While we as educators know grades to be complicated, and a limited sample of research tells us that the perspective of students is also complicated, this should not deter us from continuing to work to develop grading and assessment tools and practices that work to minimize the negative impacts of grades and grading practices on engineering students.

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