Work in Progress: Grading through a Capability Lens

Dr. Stewart Thomas, Bucknell University

Stewart J. Thomas received the B.S. and M.Eng. in Electrical Engineering from the University of Louisville in Louisville, Kentucky in 2006 and 2008, respectively, and the Ph.D. in Electrical and Computer Engineering from Duke University in Durham, North Carolina in 2013. He has served on the organizing committee for the IEEE International Conference on RFID series since 2014, serving as the Executive Chair in 2022, with research interests in areas of low-power backscatter communications systems and IoT devices. He is also interested in capabilities-based frameworks for supporting engineering education. He is currently an Assistant Professor at Bucknell University in the Electrical and Computer Engineering Department, Lewisburg, PA USA.

Sarah Appelhans, Lafayette College

Sarah Appelhans is an Assistant Professor of Engineering Studies at Lafayette College. She earned her PhD in Cultural Anthropology at the University at Albany (SUNY) where she conducted research on the cultural factors that contribute to inequalities in engineering. As a postdoc at Bucknell University, she was the resident ethnographer in the Electrical and Computer Engineering Department, exploring applications of Amartya Sen's capabilities approach in engineering education. Her current book project, On the Bleeding Edge: Gender, Immigration and Precarity in Semiconductor Engineering, investigates the intersections of gender, race/ethnicity, and immigration status among semiconductor engineers.

Dr. Michael S Thompson, Bucknell University

Stu is an associate professor and chair of the department of Electrical and Computer Engineering at Bucknell University, in Lewisburg, PA. While his teaching responsibilities typically include digital design, computer-related electives, and senior design, his focus

Dr. Rebecca Thomas, Bucknell University

Rebecca Thomas is the inaugural director for the Pathways Program at Bucknell University, where she oversees the rollout of Bucknell's ePortfolio initiative. She is also a Teaching Assistant Professor in the Department of Electrical and Computer Engineering where she instructs the first-year design course for ECE majors. She holds a B.S. and M.Eng. in Electrical Engineering from the University of Louisville and a Ph.D. in Electrical Engineering from North Carolina State University.

Philip Asare, University of Toronto
Dr. Alan Cheville, Bucknell University

Alan Cheville studied optoelectronics and ultrafast optics at Rice University, followed by 14 years as a faculty member at Oklahoma State University working on terahertz frequencies and engineering education. While at Oklahoma State, he developed courses

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1. Abstract

The purpose of this WIP research paper is to briefly consider the basis of higher education's current grading system and to discuss an implemented grading structure based on a human development framework which was part of a departmental cultural shift. The letter-grade marking system is relatively new compared to the institution of higher education [1] and brings with it a secondary effect of an "A" ranking conveying significant value and meaning to the interpreter. Students (and faculty) bring their own interpretation of what it means to be an 'A' student and connect this to their personal identity [2]. The shift to letter-based grades coincided with influx of capital into American universities and an industry need for more research. Providing such letter-based sortings is often a required part of the instructional contract with most university structures. Grading systems at their best may provide helpful developmental feedback to learners and reward valued behaviors, but they are also punitive and contribute to shame and feelings of alienation or un-belonging [3]. Grading itself is a strong voice of the faculty. While a curriculum guides the overall experience of students, grades themselves are the "coin of the realm" in terms of directly conveying to students what faculty value [4]. These weightings of various activities and what work is and is not graded tacitly tell students where faculty expect students to spend their time and effort.

Who can be an engineer is then restricted to those who show aptitude in predefined outcomes and can successfully navigate the grading structures given to them. We ask if it is possible to grade across a curriculum in a way that increases opportunities for student agency and can convey to students the multi-faceted nature of being an engineer. While technical skills and knowledge are important, they are only one aspect of being an engineer [5]. We introduce an attempted grading structure that includes six factors of engineering development used across each assignment within a first year engineering course. This change informed ongoing efforts to align grading approaches that place value on student agency in student development and informed an educational model based on the Capability Approach [6].

2. A Brief History of Grading Structures Within Higher Education

The role of grades and grading practices has been in debate for some time. Over a century ago, Mann noted that earning high grades in college does not correspond to a successful engineer [7]. Our current letter grading system itself did not exist until 1897, with prior rankings using descriptors, or percentages [1]. The need for a grade seemed to arise with changing social conditions in the 19th century within the United States [8]. As industry saw potential benefits from higher education institutions, efforts such as Andrew Carnegie's *Advancement of Teaching* injected capital into knowledge production and research. Higher education was increasingly seen as making direct contributions to the growing industrial society. In the midst of this shifting attitude the practice of grading students with letters began to be standardized [1] becoming a

proxy indicator of future success. Noting the incentive structures this system creates, and the distraction from mastery and deep-thinking, grading reforms are in continual discussion [9], [10], [11], [12], [13].

3. Grading and the Capability Approach

While outcomes focused education tends to promote punitive grading systems and a deficit model, an alternative grading may emerge from a development-focused framework. The Capabilities Approach was introduced within development literature by economist Amartya Sen [14], [15]. This framework has been broadly applied to well-being [6] with examples focusing on theories of social justice [16] or higher education [17]. Within this framework both the ends and means of development are rooted in i) the substantial freedoms or *opportunities* that individuals have means to achieve should they desire and the ii) realized achievements that individuals choose to enact [6]. This brings focus to the available (i.e., achievable) opportunities of individuals while also considering resource or structural limitations, thus providing insight into a development process as opposed to something like the GDP which while easily-measurable, only serves as a proxy for deeper understanding. We find this analogy useful for examining the function of grades and grading. While GPA may signal information about a student, it is unable to speak to deeper processes of learning and may create a desired way of being for students that does not align with what the student values as a good life they wish to lead. While Sen's original terms are *capabilities* and *functionings*, for an educational context it is useful to speak of educational opportunities and achievements.

4. An Opportunities Based Framework for Grading

Outcomes based education is rooted in human capital models stemming from industrial practice and places a focus on metrics, such as ABET outcomes. Given the importance faculty place on outcomes, students acclimate to view grades as a recognized achievement even to the point of shaping their identity [2]. This is not without reason as GPA can be an important factor in things like gaining meaningful employment and or even immediate economic benefit such as reduced insurance premiums. Though GPA may provide opportunities for other important achievements, it is otherwise an easily-instrumentable yet poor proxy for measuring development without a shared universal meaning. Within a course, students valuing grades as an achievement can distract from broader goals of learning [13].

From an opportunities focused framework, grading mechanisms should instead support broader student development and agency by providing feedback on the enacting of opportunities into recognized achievements selected by the students. This does not require abolition of grading mechanisms, just as economists would not suggest removing the GDP metric, but points towards a re-evaluation of the utility of grading within a curriculum and their promotion or worsening of equity issues. A traditional grading system, such as one where grades are predominantly determined by few high-stakes exams and series of individual assignments, employs a deficit model where students are *a priori* considered lacking certain knowledge or skills selected by the

professor. Students must prove that they can recall or apply specific knowledge to some expected level. This traditional structure promotes engineering science and fits within a human capital model which dominated the last century, but may not adequately prepare engineers to navigate the complex, interconnected modern problems which require broad disciplinary collaboration.

5. An Opportunities Focused Grading Structure

Knowing that grading mechanisms greatly *support* or *hinder* student development and freedom, a structural change was enacted to the grading system in a first-year required engineering course in a small, private liberal arts undergraduate institution to convey to students the multiple aspects of being an engineer. Prior offerings of the course employed a traditional grading model similar to the one shown in Fig. 4(a) with weightings of typical course components (i.e., exams) summing to a final grade. Such a grading structure clearly conveys to students what the faculty believe matters in the course and more tacitly, what makes a good engineer. Students who value a "good" course grade as a perceived achievement, may therefore internalize these activities as important beings and doings.

To counter such a perception, the grading scheme shown in Fig. 4(b) was implemented. In this model, faculty selected areas relevant to being an engineer and used these to assess across all course activities. Each assignment or exam yielded a set of grades as opposed to a single value, that are weighted and contribute to the final grade. In other words, a single homework assignment may have aspects of Engagement, Knowledge and Concepts, Engineering Skills, Communication, etc., that are evaluated and weighted, as opposed to contributing solely to a "Homework" category. In implementing this model, all assignments and activities of the course did not need significant alteration. Homework assignments, lab assignments, projects and exams remained in the course. However, each activity contributed in its own way to the larger themes comprising the final grade. Faculty selected category weightings of individual assignments based on their content, and final grade weightings as how they perceived the course contributing to student development. The structure more directly conveys the values of faculty beyond pure engineering science and technical recall.

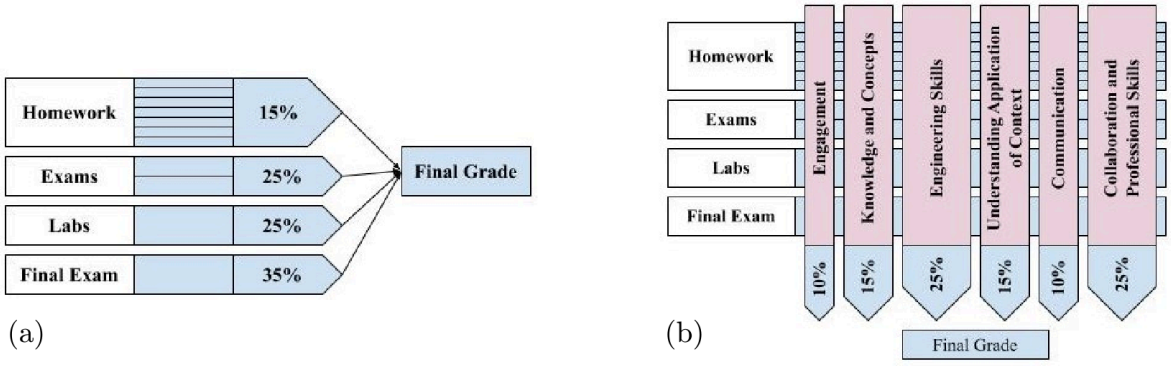

Figure 1. Grading schemes with a traditional model (a) and a re-structured model where assignments include multiple aspects leading to the final grade (b).

The system greatly increased the complexity of managing various grade components. Each assessment item had six different graded components associated with it, requiring complex custom spreadsheets. In looking for tools to support this effort, the deep entrenchment of a traditional grading model within educational ecosystems was apparent. Nearly all educational software and learning management systems are built around an assignment having a single grade [18]. The technological tools are a limiting factor that work to reinforce a traditional grading structure. This complexity both made handing off the course and grading structure to new faculty in subsequent offerings difficult and also left students within the course confused when estimating their current course grade or understanding the weight/impact of assignments to predict future grades. A shift in student attitude may point to an underlying change that pushes students to re-focus their efforts from mere credit-earning to the course learning exercises. However, in the isolation of a single course within a larger department and institution, the modified grading structure led to student frustrations.

The grading structure also provided faculty insight into their own focus of course activities. Faculty members continually evaluated course activities and assignments through the lens of the six chosen categories of being an engineer. Creating assignment weights for each of these categories required a more careful questioning of how much the assignment contributed to each category. As the gradebook grew with multiple components per activity, it became evident—by which categories had more entries and points—that the course focused more activity on Engineering Skills and Knowledge and Concepts than other activities such as Understanding Application of Context. This helped reveal to the faculty what the course actually focused on and how these categories were distributed.

6. Discussion and Limitations

This study has several limitations to note. First, the study is limited to a single offering of a course with 30 students, within an electrical and computer engineering department at a liberal arts university. Prior to this grading change, the department had recently implemented a curriculum overhaul to better align with the liberal arts nature of the institution and provide more electives to students. Since only one course used such a modified grading system, the students were not acclimated to how their grades were being calculated. Also important is the lack of student voice in developing the system. While the Capabilities Approach values agency and input, this input was lacking in the modified grading structure as faculty decided upon the categories and weights for the system. The existing power differential of a traditional grading system was still in place.

However, this grading structure and its ensuing discussions were part of a cultural shift within the department. Despite intentional actions to broaden ideas of engineering, engineering science remained central. Discussion of grading also noted the ever-present focus of grades as being negative. While ideally grades operate as useful feedback mechanisms, in practice grading often turns into an exercise in pointing out what students did wrong. This places grades as punitive or a blaming activity. In restructuring and seeking to evaluate students more broadly, the negative

aspect became evident and challenged the department faculty to seek more positive encouragement for student development.

A further critique from the Capabilities Approach lens, besides the lack of student input, is that this grading scheme still lacks recognized achievements and agency. An activity's set of grades and the ensuing final letter grade of the course remain an educational outcome, and not a recognized achievement. The grading scheme has encouraged ongoing intra-department discussions about providing more flexibility for students to select the opportunities to develop and inclusion of externally recognized achievements within the curriculum. Microcredentials are one example as a recognized achievement that adds to the self-narrative of a student's development [19]. It is important that these operate in concert with other higher education achievements, otherwise, if an educational focus were to shift towards credentials in place of a broad education which the academy provides, microcredentials become a path of furthering the neoliberalization of the university that could ultimately reduce educational opportunities. This tension is important to be aware of.

7. Conclusion and Broader Impacts

While this change was specific to a single course offering, it importantly initiated many conversations within the department surrounding the philosophy of engineering and educational practices. Questioning received practice or norms (i.e., grading) and collectively analyzing the power dynamics and shared values is shifting the department to look beyond purely outcomes based practice. The progress is ongoing. What then are we to make of this exercise in restructuring a course grading system? While the act of grading is tedious for faculty and a sharp focus of the course for students, it is helpful to remember that the grading of students comes from a time when social mobility was on the rise and industry needed ways to rank human capital. That is to say that grading is a socially embedded construct, and we have the freedom to play with its construction. While such grades may have positive impact on one's own social mobility, a traditional grading structure may also reinforce narrow disciplinary norms and be counter to expansive equity and justice efforts seeking broad inclusion. It is important therefore to separate the idea of grading and ranking students—which faculty are often contractually required to do—from the feedback and support in student development. In seeking to combine these ideas, through the exercise described in this work, it became more evident how positive feedback and encouragement are separate from grading. Other structures though, may help unify these two ideas and help students develop on paths which they see as valuable. Our view, rooted in the Capabilities Approach, is that education should equip students to lead a life they value. Providing students opportunities to achieve, and envision new ways of living is central to the institution, and our role as faculty is to help guide them in our chosen discipline.

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