PERSPECTIVES

Understanding by Design: Mentored Implementation of Backward Design Methodology at the University Level

Nancy A. Michael[1]* and Julie C. Libarkin[2]

[1]University of Notre Dame, South Bend, IN
[2]Michigan State University, East Lansing, MI

*Corresponding Author: Nancy.A.Michael.24@nd.edu

Abstract: Unless sought out by the individual, University and College faculty typically receive minimal, if any, pedagogical training as part of their career development. This perspectives essay first introduces pedagogical training for instructors in higher education by comparing it to the training required for primary and secondary school educators. Using this as a backdrop, it then discusses the stated goals of higher education and contrasts these goals with the type of preparation that is traditionally offered to future faculty during graduate and post-doctoral training, with emphasis given to the general lack of teaching mentorship and practical application. It goes on to describe a future faculty member's journey of seeking out higher education pedagogical training, and the process of implementing a student-centered course based on a backward design model, highlighting the importance of experienced mentorship in this process. This essay concludes with a reflection on the backward design process as a whole, the imagined difference in the quality of curriculum and implementation in the absence of mentorship, as well as a discussion about how this experience speaks to pedagogical preparation of higher education teachers in the United States.

Key words: Backward design, pedagogy, teacher preparation

INTRODUCTION

Post-secondary education in the United States serves over 20 million students per year, with students enrolling in over 1,700 two-year and 2,900 four-year colleges and universities (Snyder and Dillow, 2013). Although scope, structure, mode of delivery, and graduation requirements can vary significantly across institutions, the type of training they offer can be divided into two major categories: technical training and liberal education. Technical training prepares students to work as experts in specific careers, focusing on skills and knowledge directly related to the field of study. Liberal education, on the other hand, focuses on a two-pronged approach exposing students to broad knowledge of many disciplines as well as deep knowledge within a particular field of study, with the intention of developing flexible communication, intellectual, and decision-making skills. Where technical training is career-focused, liberal education could be considered to be life-focused (Miller, 2012).

The pathway to college starts with primary and secondary school instruction. The vast majority of primary and secondary school educators in the United States are required to participate in extensive pedagogical training through classroom instruction and mentored teaching before assuming responsibility as lead instructor. In 46 of 50 states, initial or temporary certification to teach requires student teaching experience, with 23 states requiring additional mentoring of new teachers in the classroom for periods of one to three years (compiled from data at www.teach.org/teaching-certification). In contrast, post-secondary educators in the U.S., whether employed at teaching-based or research-focused institutions, receive little pedagogical training and have no required certification standards. Instead, faculty are generally hired based on advanced degree status, often with research acumen

demonstrated by publications and extramural funding leading the hiring decisions.

While content knowledge is essential, and extramural funding might be necessary, these qualifications do little to prepare a faculty member to contribute to the *a priori* goal of all colleges and universities: educating their students. Although many institutions of higher learning require evidence of teaching ability prior to hiring a new faculty member, the fact remains that pedagogical training is hard to come by and even discouraged by some faculty mentors because of the required time away, diverted from the primary research focus. Cumulatively, these observations indicate that unless a graduate student or post-doctoral fellow explicitly seeks a Discipline Based Education Research or Integrative Graduate Education and Research Traineeship Program placement, the training that would prepare these individuals for future faculty positions is lacking. This highlights a disconnect between the stated goals of a higher education institute (student learning) and the metrics for placement into faculty jobs (advanced research-based degree and extramural funding). A few universities and foundations have attempted to bridge this gap through optional certification programs in subjects such as community college teaching (e.g., California State University Dominguez Hills), college teaching (e.g., Michigan State University, University of Minnesota), or specialty teaching, such as online instruction (e.g., The Sloan Consortium). Even where such programs exist, however, and certainly in their absence, graduate students and post-doctoral fellows generally must be explicitly encouraged to participate in pedagogical training during their career preparation.

The following essay discusses the apparent misalignment between higher education learning goals and future faculty training, and continues with a reflection on the shared experience of a postdoctoral fellow who sought out mentoring in pedagogical practice, specifically backward design (Wiggins and McTighe, 2011), from a scholar in discipline-based education research. This shared experience produced tangible benefits for both the fellow and the mentor, and led to collective revisiting and rethinking of the real world complexity of applying backward design theory to produce and demonstrate effective instruction. In addition, this partnership lead to a reflection on what it means to teach at an institute of higher education, as well as a discussion about how this experience speaks to pedagogical preparation of higher education teachers in the United States.

HIGHER EDUCATION LEARNING GOALS

Although education has by definition been a focus of higher education institutions from their inception, the explicit articulation of institutional goals for student learning is a relatively new activity. The goals that cut across the many departments and programs that make up a university generally reflect the overarching institutional purpose. Technical training institutions focus on mastery of skills for career success, while liberal education institutions–whether larger research universities or smaller liberal arts colleges–help students become informed citizens and versatile thinkers (Jaredeleza et al., 2013; http://www.aacu.org/leap/What_is_liberal_education.cfm).

What this means in practice is, unfortunately, difficult to pinpoint. What skills must students obtain during their college tenure for a university to give its 'stamp of approval' upon graduation? Do post-secondary institutions have explicit mechanisms in place for measuring improvement and progress towards meeting goals? Although some organizations are moving towards institutional level assessment metrics, such as the American Association of Colleges and Universities (AAC&U) through its VALUE and other rubrics (Rhodes and Finley, 2013), most

colleges and universities rely on measurement of achievement within the classroom. Therefore, it generally falls on faculty members to design courses with an eye towards learning goals, defined both within the classroom as well as aligned with the broader goals of a liberal arts education. In an effort to achieve this, a faculty member must implement aligned and effective teaching methodologies and develop assessments of student learning that allow accurate tracking of student progress toward mastery of knowledge and skills associated with a liberal arts education.

Given this, the training that most graduate students or post-doctoral fellows receive does not bring about the development of efficacious teaching strategies and accurate measurement of student achievement. New classroom instructors face a wide range of bewildering questions. Where do I begin if I need to design a course? How do I determine the focus of content for a given course? How do I get the training I need to be an effective teacher? How do I know if my students are actually thinking and not just memorizing? What the heck is a learning goal, anyway?

PEDAGOGICAL TRAINING FOR HIGHER EDUCATION

The lack of pedagogical training that faculty members receive becomes apparent when a new instructor has to teach a course for the first time. This lack of training becomes even more apparent when one has to design a course from scratch. Many instructors will solicit colleagues for existing syllabi, lectures, etc., using previously developed material to guide lecture content, while feverishly writing exams in the days preceding the students' summative assessment. Although this approach may save preparation time upfront, it often results in an increased workload during the semester because these "inherited" courses often lack explicit direction. Delivering another's content does little to enhance the quality of instruction over time because there is little to no self-reflection on the part of the new instructor to consider whether they agree with existing course structure, learning goals, course alignment or enrichment of the student experience with modern pedagogical methodology. But when such little training is part of professional development preceding a faculty position, often there is little choice.

Luckily, at many universities, faculty members are offered teaching seminars and workshops to (finally) introduce some pedagogically based practices in their courses. Many of these sessions are open to graduate students and post-doctoral fellows should their mentors allow the time away from research. These training sessions can range from one-hour seminars spattered across a semester to intensive workshops lasting a few days (For an example of such a schedule see: http://create4stem.msu.edu/event/upcoming.) These sessions can be overwhelming with foreign terminology and complex ideas. Terms like "aligned assessments," "Bloom's Revised Taxonomy," "student-centered teaching" and "backward design" are often introduced, described, and reinforced throughout. Depending on the length of a session, time may be allotted to the participants to work through a newly introduced methodology. During her first multi-day pedagogical science seminar as a postdoctoral fellow, the first author was exposed to a number of pedagogical concepts that supported the practice and implementation of a backward design approach to course design. Below, the pedagogical practices are identified and related directly to the theory of backward design.

Identify your learning goals

Prior training for most new faculty has likely been at the level of a teaching assistant, a role in which one rarely instructs beyond a laboratory setting and has little, if any, input into course design or content. Discussion regarding how courses emerge,

dialogue concerning theory, or discourse related to best practice in design are new when it finally comes time to teach. As a result, faculty members (old and new) tend to teach the content that has traditionally fallen within the purview of a given course, without considering the current purpose of teaching specific content, the student demographic (e.g. majors vs. non-majors), or the alignment of the content with the overall course, department or institutional goals.

Identifying learning goals turns the aforementioned "inheritance" practice on its head, and says that, prior to the start of any instruction, broader learning goals or competencies should be identified to give the course direction. Everything else within the course, including formative and summative assessments and specific course content, should be developed after course goals are identified, and align with and reinforce those broad learning goals. This notion of alignment implicitly introduces a theory of curriculum and lesson design that is not always talked about directly: backward design. The idea in itself is simple: identify what you want your students to learn before you fill in the specifics of the course, and then backfill assessments and lessons, ensuring they are aligned with the explicitly stated learning goals. If not aligned, that subject should be removed or goals revised to include the essential topic. When done well, backward design eliminates most of the questions that arise when trying to create fair exams, as well as the difficulty of breaking away from traditional lecture content in the "inherited" course practice. Although backward design sounds elementary and intuitive, applying it is far more difficult in practice, and not commonly implemented at institutes of higher learning.

Aligning your assessments with learning goals.

This pedagogical principle again falls in line with the theory of backward design, and states that formative and summative assessments should be aligned with the broad course learning goals and should evaluate progress toward and mastery of those goals, respectively. If assessments are further aligned with programmatic and even institutional learning goals, universities can then look to student achievement in the classroom as a measure of progress for the overall institutional mission.

Working up to higher levels of Bloom's Revised Taxonomy in curriculum.

Following a backward design model, once the learning goals are set and the assessments are created, the instructor turns attention toward identifying the specific course content and designing individual lessons.

Recognizing the importance of incorporating higher Bloom's levels (Anderson and Krathwohl, 2001) encourages instructors to move away from a traditional lecture model, commonly associated with higher education classrooms. This approach challenges faculty members to design learning activities that allow their students to move beyond recall, providing an opportunity to apply course content to problem solving, evaluating primary literature or problem sets, and potentially creating problems, experiments, or models on their own. As researchers we recognize the value of thinking beyond simple concepts and place high value on new ideas, models, and innovations. As higher educators, we should place the same value on implementing instructional techniques that work up to higher Bloom's levels to develop those critical thinking skills in our students, whether students are budding scientists or aspiring informed citizens.

Implementing active learning in curriculum.

This practice goes hand-in-hand with achieving higher Bloom's levels. Regardless of how an individual might feel about the buzz surrounding "active learning," the principle is well founded and, when applied effectively, has been shown to

increase student achievement (e.g., Haak et al., 2011). The idea is, again, a simple one– move away from lecturing to allow students the opportunity to take an active role in their own learning. This may be achieved by creating student-centered learning activities that reinforce course content, such as open-ended lab experiments, case-studies, analyzing data sets, etc.

When approaching course development using a backward design model, each of these modern pedagogical approaches lends itself to holistic course development. Although presented here simplistically, the actual implementation of backward design, however, can certainly present a variety of challenges.

PRACTICAL APPLICATION

Much like any transition from the classroom to the real world, the practical application of backward design is far more intensive than the backward design models presented in books and workshops. To illustrate this, we present our own personal perspectives of what it was like to collaborate on backward designing a course on Brain and Behavior. In this process, the first author engaged in the detailed development of goals, assessments, and curriculum, while the second author acted as a sounding board during semi-weekly meetings. In all, the backward design process for this course took roughly six months.

A new instructor's perspective–the first author.

I had learned a bit about backward design in seminars during my graduate and postdoctoral training and was very excited about the opportunity to apply this method to my introductory, non-majors 200 level Brain and Behavior course. I had learned that backward design was an efficient strategy for creating a course in which the learning goals, content and assessments were well aligned, and that it allowed for the planned incorporation of active learning strategies. However, when I sat down to actually develop my course, I wasn't sure where to begin. Backward design instructs that course goals should be identified before assessments are created and the syllabus is planned, but without identifying the content of the course, I wasn't sure how to identify course learning goals. It was clear that if I wanted to develop a course using backward design, I was going to need help.

Fortunately, I was lucky enough to know a senior faculty member who had practical experience with backward design and, more importantly, was willing to help me work through this process during my first course development.

I became aware of the work of my co-author via a STEM education email blast soliciting interest in a potential course offering the upcoming semester. As directed by the solicitation, I emailed her directly, expressing my interest in her course with an additional request to discuss discipline-based education research and backward design methodologies. Our first meeting established the dynamic of all our future encounters: casual, yet focused. We would meet, chat about life and move on to discuss teaching and progress toward our goal. I would be given my 'assignment', leave, do my homework and come back for the next step or revision. This process worked because we each did what we said we would do and, as a result of the demonstrated commitment on both of our parts, this partnership and its final product (a backward designed Brain and Behavior course) were a success.

The process of backward designing Brain and Behavior was far more iterative than I ever imagined prior to actually doing it. During the preparatory semester preceding instruction, my first assignment was to put away the text, previous syllabus, and notes, and then outline everything someone who took an introductory Brain and Behavior course should be able to do by the end of the semester. Next, I was to identify the themes that emerged from all of these elements. Through this process, I was actually

identifying the course learning goals. After the coarse goals were defined, I outlined the content and formative assessments and, for each component, identified the targeted cognitive domain(s) of Bloom's Revised Taxonomy (Anderson and Krathwohl, 2001). As I developed the outline, I would revisit my overall course goals, checking for alignment and revising the outline repeatedly. I soon realized that it was very easy to get lost in the detail and incorporate components that were beyond the scope of the overarching course goals. But this 'deviant' behavior turned out to be an essential lesson in the practice of backward design: it is a cyclical, dynamic and adaptive process.

Once the outline of goals and aligned assessments was completed, it was time to shape the syllabus and develop the specific course content. Just as with the outline, it was necessary to continually revisit my course goals and assessments to ensure that the content I was including (lectures and learning activities) could be mapped onto my overarching course goals.

When the semester for instruction arrived, I began instruction by explicitly identifying the course learning goals to my students and over the instructional semester, I also pinpointed how specific course content mapped onto the overall course goals, always bringing the specifics back to the bigger picture. Throughout this process, it was fascinating to see not only the evolution of the course, beginning with basic principles and building to analysis and creation, but more importantly the progression of the students' understanding and ability.

The iterative nature of the design process continued during the semester of instruction in simple ways: revising lessons and class period learning goals, tweaking activities based on what was actually covered and student feedback, refining exams to reflect emphasis, etc. As the course progressed, I realized I had done all of the hard work during the preparative semester. I was not frantically creating exams or scrambling for direction. My goals were outlined, assessments developed and activities designed. I knew where I was headed, where I wanted to bring my students, and most importantly how I planned to get them there.

An experienced instructor's perspective–the second author.

Although I had been teaching at the college level for almost fifteen years when this collaboration began, I had never been presented with a new instructor asking to be mentored through the entire backward design method. This was at first a daunting task, and I wondered if I really had enough understanding of backward design to guide someone through the process. My personal introduction to backward design was informal, and arose from my interest in discipline-based education research. Although without a formal mentor, I learned through seeking out workshops, articles, books, and websites that provided suggestions for best practices in course design. My use of backward design approaches was mostly trial and error; I estimate that it took about a decade of my own practice before I became confident in my knowledge of backward design. More formally, I am in a position where I provide guidance for faculty in development of assessments that are aligned with course objectives. Although backward design figured prominently in my own career, taking responsibility for someone else's professional development is another thing entirely. I ultimately decided that mentoring a new instructor through the curriculum design process is much like mentoring in research, with similar needs for direction, innovation, independence, and review.

The process began with simple discussion of backward design–what is it, how goals are identified and clarified, the role played by assessment, and how curriculum should reflect goals and align with assessments. The limitations of backward design immediately became

obvious in this process. For example, courses sit in larger programmatic and institutional contexts. Although designing courses from learning goals alone would be ideal, course content must often reflect values and culture. That is, some content simply must be included because the community at large expects specific topic coverage. In the case of the Brain and Behavior course, I was intrigued to see which concepts were absolutely necessary from a community norms perspective as well as where student learning goals could drive the content.

The back-and-forth nature of our mentor-mentee interactions provided invaluable opportunity to return repeatedly to discussion of the nature of assessment and instruction. The first assessments designed by my co-author focused more closely on "what should be taught" rather than "what should be learned." Through numerous meetings and discussions, assessments were transformed from a reflection of teaching practice to sources of evidence that could be used to inform instruction and evaluate student learning. Most exciting, these assessments were designed, and re-designed, to provide mechanisms for both reporting outcomes to students (i.e., grades) and conducting research on student learning. This research on student learning provides the instructor with data that can be used in course redesign, as well as data that can be published with appropriate human subjects approval.

Of course, by the time the goals and assessments had been thoroughly developed, the content that needed to be covered was obvious. Although my home discipline sits far afield from the content of the Brain and Behavior course, I could easily see how the goals, assessments, and course lectures and activities fit together to meet both overarching course goals and specific content goals. I thoroughly enjoyed hearing about the progress of the course as my co-author began teaching. In fact, in many ways, watching a new instructor evolve into someone who is truly practiced in backward design turned out to be one of my favorite experiences as an academic. The academy spends precious little time developing faculty as scholarly teachers and this experience has encouraged me to more formally introduce backward design to the scholars engaged in research within my lab. After all, many of my own research students may find themselves in my co-author's shoes, developing their own courses.

REFLECTION

Much as in research, a big difference exists in teaching between learning about something and actually doing it. For first-time instructors, working through the backward design process can be involved and challenging, often frustrating and deflating, and certainly time consuming and overwhelming. Despite all of these aspects, backward design is a superb curriculum model and has the potential to generate courses with direction and purpose that would otherwise be missing. In our experience, backward design produces curriculum that can be easily executed: the entire course is laid out through careful design of goals and assessments, leaving only the relatively simple task of filling in the content that aligns with the learning goals.

Without backward design as a curriculum model, the Brain and Behavior course discussed here would have been dramatically different for both the instructor and, by default, the students. This difference arises simply because the course could easily have been directionless, no more than an amalgamation of concepts garnered from years of prior coursework. Similarly, the process of engaging in backward design would have been different without an experienced faculty mentor assisting in the process. Certainly, having a trained eye scrutinize the course development, especially during its inception, provided needed confidence to the new instructor that the process was being done correctly, as

well as redirection when needed. It is also entirely possible that the backward design process would have been abandoned completely without this mentoring. The first author would likely have fallen back on a syllabus provided by a previous instructor as the guide to building the course, filling in content based on the "subject" of a given day in the existing syllabus or chapter of the course textbook, and then writing an exam that cannibalized lecture content. There may have been little thought put into how cohesively the course concepts fit together, nor to whether the material tested on the exams was actually what was important for students in the course to know and apply.

This experience raises a larger issue of pedagogical training and practical teaching experience. Both authors have been truly lucky to have had mentors—in college, graduate school, as postdoctoral fellows, and as new instructors—that support pedagogical training as a necessary component of professional development for academics. This component of training requires time away from the lab to participate in teaching workshops and seminars, and to practice these pedagogical skills in the classroom. It is the sum of these experiences that provides the knowledge and maturity needed to be successful as a university instructor. As any graduate student or post-doctoral fellow can tell you, training and mentorship in scientific research are the foundations upon which new scientific minds are developed. Future faculty members and new instructors need commensurate training and mentorship in teaching. Sadly, these are rare commodities.

The experience described in this Perspective suggests that a mentored approach to training in teaching could be just as effective as the mentored approach taken in the laboratory. Incentivizing senior faculty to participate in such mentorship, perhaps by offering course load credits in exchange for mentorship, as a component of doctoral and/or post-doctoral training could go a long way towards addressing the discrepancies that exist between how we train future faculty, how future faculty are evaluated, and the value we place on efficacy in undergraduate education. In short, by presenting the tangible benefits of this mentored experience, we would encourage deeper discussion around what it means to teach scientists to become teachers themselves.

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