ARTICLE
Using Action-Mapping to Design a Non-Majors Neuroeconomics Course to Teach First-Year Collegiate Skills

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With its ability to address questions about how decisions are made and why, neuroeconomics is an excellent topic of study for college students at a variety of levels. In this paper we detail a neuroeconomics course specifically modified for undecided First-year students. One particularly daunting challenge was defining clear outcomes and delivering instruction at an appropriate level. We used Action-Mapping to achieve the course objectives of teaching collegiate skills applicable to any path of study or career while also delivering content suitable for credits in both a social science and natural science.

Key words: Action-Mapping; Backward Design; Course Design; First-year Experience; Neuroeconomics

One of the challenges facing institutions of higher learning is the arrival of first-year students who are not fully prepared for the rigors of college education in terms of critical thinking, writing, and basic math skills. This disconnect between high school preparation and collegiate expectation can have consequences for student success in college, dropout rates, and difficulty in obtaining jobs after college (McCarthy and Kuh, 2006; Venenzia and Jaeger, 2013). To facilitate what can be a difficult transition, many schools have implemented first-year experiences to introduce and develop the skills needed throughout their college career and beyond (Tinto, 1999; Permzadian and Crede, 2016).

Our approach to a first-year experience (FYE) was to create a course in neuroeconomics. Though often taught as an upper-level seminar, neuroeconomics provides a unique opportunity to introduce first-year students to interdisciplinary thought, scientific approaches, and key decision-making models and theories, all of which can be applied to a wide range of disciplines later in the students' academic careers.

Types of courses and approaches to FYEs vary by university; the described course was co-taught and created as a two-semester, 6-credit (3 credits per semester) taken during the fall and spring of the students' first year. Our course was charged by the college to foster a close bond between student and advisor, create a support network among peers, and improve academic skill development, including research and communication. The teaching faculty served as academic advisors and students went through orientation activities together prior to the start of the academic year. Our challenges, therefore, were to teach enough content for a full 3-credit course in natural science, a full 3-credit course in social science, to address collegiate skills, and to create a tight-knit learning community.

Learner-centered instruction, utilizing an active learning environment, seemed the best approach to engage non-major students and to address collegiate skill building while also elevating academic learning outcomes (Prince, 2004, Brewer and Smith, 2011; Lo and Prohaska, 2011, Dolan and Collins, 2015). We generated a project-oriented FYE course, "Mythbusters: Why People Make Dumb Decisions," in which students identified myths about decision-making, worked in teams to use the scientific method to bust myths, and created effective presentations at several phases in the project to convey information to each other and to public audiences.

Randolph-Macon College in Ashland, VA, where this course was taught, is a liberal arts institution, home to approximately 1,400 undergraduate students with a student-faculty ratio of 12:1. The 32 (2011-12) and 34 (2012-13) students in our two-section combined FYE course were all entering first-year students undecided on major. Students chose their year-long course largely on the course descriptions available during on-campus registration and orientation. That, combined with the limits on class sizes, forced students to make decisions with relatively little information about the course or the instructors. The result was a set of students with wide and varied interests; none especially directed toward neuroscience or economics.

METHODS

USING ACTION-MAPPING IN COURSE DESIGN
"Mythbusters" was designed with student outcomes in mind using Action-Mapping, as described by Cathy Moore (2008). Action-Mapping is quite similar to the pedagogical process of Backward Design, as described by Wiggins and McTighe (2005). Both require the instructors to reverse engineer the semester, creating focused, achievable student learning outcomes and clear, assessable action items to enable students to demonstrate achievement. Though similar, the two approaches have several significant differences.

In Backward Design, the educator begins the design process by asking what students should learn by the end of the course, then determines evidence for meeting those goals, and finally constructs a plan of learning experiences

and instruction to guide student learning toward those end goals. Backward Design principles have been utilized in designing neuroscience curricula (Muir, 2015; Kerchner et al., 2012), courses in neuroscience (Crisp and Muir, 2012), and courses in economics (Green, 2013) to more purposefully map classroom instruction onto intended outcomes.

Action-Mapping was conceived to improve training techniques in business environments to focus on measurable goals. Moore (2008, 2012) determined that previous models of workplace training simply presented information without considering the points essential to the outcomes, and that this inefficient process wasted valuable resources and failed to deliver all relevant points. For example, a salesperson need not know the entire history of widgets or the details of widget manufacturing in order to increase widget sales. The principles of Action-Mapping include dedicating instructional time and resources to the *minimum* amount of information needed to complete activities on the path to meeting stated outcomes.

A key point of distinction of Action-Mapping versus Backward Design is the emphasis on action-oriented outcomes, rather than knowledge-based outcomes. Moore recently specified that her Action-Mapping isn't intended for use in academia but is meant for the business world "where it is relatively easy to set a measurable goal and analyze what people need to do on the job to achieve that goal. The process focuses on observable, measurable behaviors, not knowledge…" (Moore, 2016). However, we found it to be ideal for tackling the content and skill goals of our course and "to prevent the casual adding of content" that Moore warns against in business training (Moore, 2016). Current SACS accreditation expectations for program assessment seek verification of what students can *do*, rather than what they know (CRAC, 2004), emphasizing measurable outcomes, further indicating that this action-focused pedagogy is appropriate to the current higher education environment.

The process of Action-Mapping is detailed in Figure 1. First, identify a measurable outcome. In order to achieve the outcome, generate a "Do" statement to describe what students should be able to do by the end of the course in order to demonstrate achievement of the outcomes. Third, develop activities for students to improve their skills and practice the "Do" behaviors, and fourth, identify the information students need to complete the activities. Another divergence from Backward Design is the deliberate distinction between the activities and information delivery. Information delivery should be specifically targeted to support activities which are practice for the goals articulated in "Do" statements (Moore, 2016).

Our four main outcomes for the course were scientific literacy, teamwork, presentation skills (mainly oral communication), and interdisciplinary thinking (specifically neuroscience and economics). These outcomes were developed based on college-specific objectives of the FYE program, social sciences, and natural sciences. We also considered the six core competencies proposed by the State Council for Higher Education of Virginia (SCHEV, 2007): Information Literacy, Critical Thinking, Oral
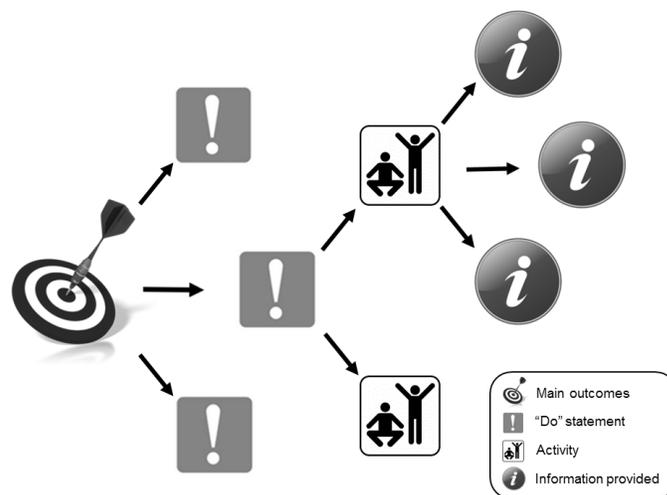

Figure 1. Example of an Action Map. For each outcome (target symbol), there are multiple "Do" statements for students to demonstrate the outcome. For each "Do" statement, there are multiple activities, and for each activity multiple information items provided to students to achieve success in the activity. Often, activities and information provided will overlap and help students with several "Do" statements on the way to demonstrating the end outcome (adapted from Moore, 2008).

Communication, Written Communication, Scientific Reasoning, and Quantitative Reasoning.

Outcome 1: Execute Scientific Inquiry
To satisfy course objectives in order for this course to count as an elective for both Natural and Physical Sciences (Neuroscience) and Social Sciences (Economics), we needed to ensure students were comfortable working with the scientific method at multiple levels. Clear understanding of the scientific method is fundamental to both the natural and social sciences. Figure 2 displays the Action Map for Outcome 1; here we detail the Action Map as we will for the remaining outcomes.

Do Statements
For the first outcome, our "Do" statements included each phase of the scientific method:
1. Make an observation,
2. Identify a question,
3. Create testable hypotheses,
4. Design experiment to test a hypothesis,
5. Conduct an experiment to test a hypothesis,
6. Analyze data and deduce reasonable conclusions,
7. Display and present data accurately, clearly, and effectively

Activities
To develop these skills and practice these behaviors, we created several projects of progressive time investment and intensity:
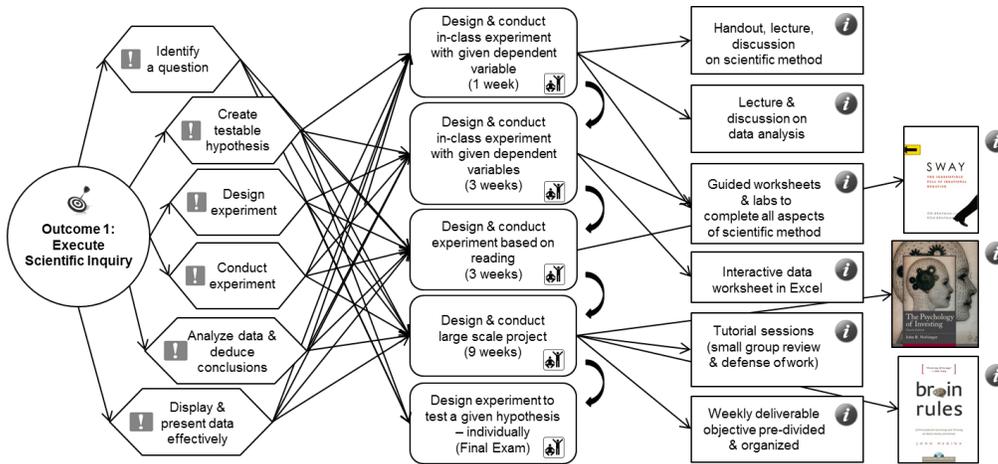- Design and conduct an in-class experiment with given dependent variable (i.e., height), 1 week

Figure 2. Action Map for Outcome 1. During the process of Action-Mapping, the authors found that information provided for one activity would simultaneously support another activity. Likewise, a single activity could help students with many (if not all!) of the "Do" statements. Rather than a weakness of the approach, the multiple-effects were viewed as a strength of the process in terms of helping students reinforce their knowledge and, ultimately, achieve the major outcome (e.g., Executing Scientific Inquiry).

- Design and conduct in-class experiment with given dependent variables (i.e., heart rate and blood pressure), 3 weeks (see Supplementary Materials)
- Design and conduct experiment based on reading (i.e., analyze persuasive environmental factors, or "sways", in place in the dining hall and record behaviors) 3 weeks
- Design and conduct a large scale 9-week project based on multiple neuroeconomics readings
- Final Exam - individually design an experiment to test a given hypothesis

Information provided to students
The goal of the professors – following the tenets of action mapping – was to provide the minimal information needed to assist students in all these activities. As might be expected, for the first few activities, scientific literacy instruction was much more intense than for later activities. Information included teaching on the scientific method (handout, lecture, discussion), lecture and discussion on data analysis, guided worksheets/labs to complete all aspects of the scientific method, interactive data worksheets in Excel, and significant class time dedicated to these objectives. Toward the end of the first semester and into the second semester students worked on large scale projects. We moved to weekly deliverable objectives, which we pre-divided and organized, and held tutorial sessions with project groups (small group review and defense of work) in and out of the larger classroom setting.

Outcome 2: Work Well in Teams
Working in groups is an important skill needed for upper level college classes, and for future workplace environments. Often, collegiate faculty require group work without instructing or facilitating students in the process, expecting them to already know or to figure out how to navigate the many challenges that accompany working in a group. We identified this skill as one that fit well with our other objectives, and also fit well with the content of understanding the brain and behavior.

Do Statements
1. Constructively participate in small group settings (formal and informal)
2. Clearly evaluate contributions of self and others in group settings
3. Hit all deadlines required of the group

Activities
- Assume a specific role as a group member
- Engage in team meetings in class (observed by professors)
- Engage in team meetings out of class
- Achieve task and social outcomes
- Defend ideas in small group team meetings (tutorials)
- Create faux deadlines for each other to send materials to a sole submitting member
- Complete weekly evaluations of self and group members

Information provided to students
To help students succeed in these activities, we discussed the many and varied roles group members can play (Benne and Sheats, 1948). We utilized POGIL (Process Oriented Guided Inquiry Learning) roles (manager, recorder, presenter, and reflector) for some activities, and for others we defined roles such as a recorder, reporter, and 1-2 researchers. We provided guidelines for group member roles specific to particular tasks, explained the importance of task and social leadership/followership, and conducted workshops in class on group work and on listening skills.

From past experience and common college student complaints of uneven work distribution across groups, we recognized that it was necessary to teach accountability and develop peer evaluation skills, providing ongoing feedback to students to maintain each student's active participation within a given group.

Guided book clubs (discussed in Outcome 3; Supplemental Materials) and in-class experiments (Outcome 1) gave students opportunities to participate in

large and small group discussions, finding comfort levels. Small group tutorial sessions (1:4.5 ratio) with the professors, clear deadlines for weekly deliverables, and regular peer-evaluations held students accountable outside the classroom.

Outcome 3: Make Effective Presentations

There are many forms of presentation and we attempted to facilitate growth on several fronts. The first, and seemingly simplest, is the sharing of thoughts and ideas in a classroom environment. Being an active member of a college classroom is a form of near daily presentation that causes anxiety in many students and requires practice and training that most students only attain through self-initiated practice over multiple years. Regarding formal presentations, we focused on PowerPoint-facilitated oral presentations, a skill that students use throughout their collegiate experience and beyond. Additionally, we worked on the students' abilities to streamline their research statements in formal and informal settings, ostensibly to help them clarify their research project, but also to demonstrate the importance of clear, concise messages in all presentation formats.

Do Statements
1. Prepare and participate in class discussions
2. Construct and present research using PowerPoint
3. Communicate research ideas concisely

Activities
- Complete assigned guided discussion sheets related to readings
- Participate in structured critique procedures in-class and in small group tutorial sessions
- Respond to questions and comments
- Construct and present mini-presentations
- Create and deliver a 200-word "proposal"
- Create and deliver a 20-word "elevator pitch"

Information provided to students
The first goal for this outcome was to create an environment where students felt comfortable meeting the expectation of active engagement in the classroom. Experienced faculty know the difficulty of achieving this goal, particularly among First-year students (McCarthy and Kuh, 2006). Our students needed training on becoming active members of a higher education learning environment (and future workplace environments, ideally). We created guided discussion sheets related to assigned readings and students engaged in "Book Club" discussions in small groups. Students were then asked to read prepared responses and comments out to the whole class, either in structured or unstructured formats. Further, we provided examples of how to complete the guided questions and examples of how to respond to direct questions or critiques. Once students had gained confidence in their abilities to identify relevant information from reading and share it with others, they had opportunities to present and discuss partial and whole chapters without providing guided questions. We

facilitated an interactive, engaged learning community, and many of our students reported using these skills throughout their college career and beyond.

The second goal was to give students training on working with PowerPoint, creating presentations, and creating effective presentations. We held seminar-style classes on working with PowerPoint, starting with basic introductory information and practice using available options within the platform, and gradually moving toward generating innovative figures, selective animations, and slide layouts and designs beyond the standard issue. We implemented structured critique procedures for the many small student presentations assigned throughout the course. Students and instructors provided feedback on presentations in class and during small-group tutorial sessions. Content for presentations came from readers used in the class, and from scientific inquiry projects. One reader, You Are Not So Smart (McRaney, 2011), a series of short chapters delivering "mythbusting" on neuroscience topics, was not covered by instructors and was solely covered through student presentations.

Finally, we taught our students to communicate research ideas concisely. The importance of this outcome is for students to demonstrate mastery of material by telling others about their project quickly and precisely. When giving presentations, it is essential to work within a given timeframe while simultaneously conveying important information. First-year students (and indeed more advanced students) often wander through background literature and stumble awkwardly toward the main point when asked about a research project. We wanted students to be able to improve in this area, so we gave examples of good presentations, 200-word proposals, 20-word "elevator pitches," and research abstracts. Students then created their own versions, repeatedly, and evaluated the effectiveness of each other's abilities to convey clear messages. Peer evaluation provided a very useful tool for this outcome, as well as asking students to deliver these short pitches to non-class members, to find out how clearly their message was conveyed with minimal words.

Outcome 4: Synthesize Neuroscience and Economics

This outcome is the content piece of the course, and thus was the most difficult to apply the action mapping technique. Creating action-oriented learning outcomes for knowledge is a challenge (Moore, 2016). Also, limiting our informational content delivery to only what is useful for a particular outcome is counterintuitive to the way many of us think, were taught, and were taught to teach.

Do Statements
1. Explain how the brain can affect decisions
2. Explain cognitive models of decision making
3. Distinguish rationality in decision making

Activities
- Identify brain centers associated with perception
- Identify brain centers associated with decision making
- Apply mathematical models to decision problems
- Study classical and administrative decision models

- Explore investor behavior
- Evaluate financial outcomes

Information provided to students
The neuroscience professor provided some typical introductory content on basic neuroanatomy, neurochemistry, and neurophysiology, utilizing in-class lectures, discussion and interactive labs (e.g., sheep brain dissection), and video tutorials. Accompanying reading material included sections of The Brain: VSI (O'Shea, 2005) and Brain Rules (Medina, 2008). Quiz/test material included primarily memorization and identification challenges, vocabulary (multiple choice, true/false, fill-in-the-blank), and diagram labeling.

The behavioral economist led lectures, discussions, and interactive problem solving on quantitative decision-making, stressing the concept of trade-offs using process mapping, scheduling, expected value, and risk evaluation based on prospect theory. To develop content on decision-making in business environments and discuss theories of rationality, we read The Psychology of Investing (Noftsinger, 2010) and Sway (Brafman and Brafman, 2008). These books built on each other and students noted repetitive concepts with different names. Quiz/test material included multiple choice style vocabulary and identification questions, as well as problem solving and case studies. Students were required to use and explain decision trees and break-even analyses.

Supportive reading for our discussions on integrated decision-making included You are Not So Smart (McRaney, 2011) and The Upside of Irrationality (Ariely, 2010). Further exploration of decision-making scenarios with neuroscience was in reading How We Decide (Lehrer, 2009). Somewhat ironically, after Lehrer's book was removed from publication/circulation in 2012 for plagiarism issues, we were able to discuss the decision-making used by the author that may have led him to make the series of decisions leading to his plagiarism conviction.

Combined Outcomes - Integrated Action-Maps
Action maps are complex by necessity. In many cases, the complexity led to multiple overlaps within the action map, not only within an outcome (see Fig. 2), but also between major outcomes. For example, students practiced teamwork while conducting scientific inquiry, working in groups of varying size to read scientific literature for comprehension, conduct library research, design and conduct experiments, analyze and graph results, and outline and write a scientific paper. Further, as students learned background information and principles of neuroeconomics, they incorporated principles of decision-making and attention into presentation design. Information about the neuroscience underlying multi-sensory information perception altered students' delivery styles. Other neuroscience lessons – understanding learning strategies, memory limitations, and memory triggers – yielded other improvements in presentation design, such as including agenda slides, progress bars, interactive demonstration examples, and story-based anecdotes.

The final project fully integrated all four major outcomes into a culminating experience. Students, in groups, spent nine weeks designing and executing a research project on a topic in neuroeconomics and presented their results at a campus-wide research day event. Projects utilized behavioral economics methods (including observational experiments, analyzing publicly-available datasets, and survey-style experiments) or biological methods (including physiological experiments testing heart rate, blood pressure, or salivary cortisol) to address a question in neuroeconomics. For example, one group of students tested the effect of store design on grocery shoppers' anxiety levels, comparing a Whole Foods Market to a Food Lion, which involved a detailed analysis of store design, shopping trends, shopper profiles, as well as taking behavioral and physiological measures before and after shopping.

RESULTS AND DISCUSSION
The stated student learning objectives in our syllabi were derived directly from collegiate goals and approved through the curriculum approval process prior to teaching the course. While our outcomes served as all-encompassing goals for pedagogical design, the stated SLOs served to define the course in the language of the college and supported immediate assessment needs.

Outcome 1: Execute Scientific Inquiry
Through this process we successfully transitioned students from an elementary review of the scientific method and data analysis (first weeks of the course) to designing and conducting a novel experiment in neuroeconomics on their own (final project 2nd semester).

All students clearly met our course objectives "apply the tools of scientific inquiry to differing decision environments," and "defend a variety of decision challenges by asking questions and seeking answers that are evidence-based" through multiple individual assessments. For example, one examination required students to design an experiment and provide a first draft of introduction and methods sections for a previously unseen hypothesis *(Supplementary Material)*. Another examination provided only a results section and asked students to explain the rest of the experiment. All students achieved at least a C- (class averages = B) for these exams across both years taught. Student final projects, culminations of seeking evidence-based answers through the scientific method, all achieved grades of B or better.

In a future offering of this course, we anticipate utilizing university-wide assessment tools in place for scientific achievement in general education courses in order to more objectively quantify student success.

Outcome 2: Work Well in Teams
Our student learning objective in this outcome was to "Display competence in accepting different roles in group settings." Students were actively assigned to different roles during different assignments and phases of research. We enforced differing roles in weekly sessions by tracking each student's role, as reported on a group handout, and reducing a student's grade if they consistently avoided a

particular role. Active intervention by the professors during group work in class prevented us having to actually enforce the grade-reduction threat. Achieving passing grades on each assignment, regardless of the role the student played, provided evidence that students accepted and succeeded in their different roles.

Assessment of teamwork skills at the collegiate level is both necessary and challenging. To further assess student success in teamwork skills, we implemented weekly student reports, in which students completed a rubric describing each team member's contributions of the week. These rubrics (see *Supplementary Materials)*, and indeed the deliberate teamwork-eliciting design of some of our assignments, were based on several assessment tools, such as the CATME (Comprehensive Assessment of Team Member Effectiveness) and the Association of American Colleges and Universities VALUE (Valid Assessment of Learning in Undergraduate Education) rubrics (reviewed in Hughes and Jones, 2011). From these routinely completed rubrics, we gathered data to support that our students exceeded our initial expectations and developed strong teamwork skills. While grades varied for some students weekly, regular feedback allowed students to recover from failing weeks, and all students achieved a final teamwork grade of C- or better, with class averages much higher. We did not retain all individual data, and are unable to provide detailed analysis here. We anticipate collecting comprehensive data in a future offering of this course.

Outcome 3: Make Effective Presentations
Our student learning objective of "define and present ideas through oral and written communication" was met weekly as we challenged our students to informally speak in small and large groups in every class period, and to make formal presentations multiple times each semester.

Informal speaking was evaluated primarily through noting if and how much a student spoke in class. Formal speaking was evaluated through detailed rubrics completed by one or both professors and often by student audience members as well. Student presentations gradually increased in complexity, as they learned to explain content clearly and concisely, use visual aids effectively, set expectations at the outset, and other measures of an effective presentation. Our grading rubrics gradually increased in complexity (see Supplementary Materials) to reflect the students' learning, and thus did not provide adequate pre- and post- course data for objective assessment.

Written communication also was conducted and evaluated at both formal and informal levels. While many assignments represented group efforts, students were expected to complete at least four individual written assessments during each semester. Rubrics used for these exams allowed the professors to provide interrater reliability measures on student writing achievement (and subject matter comprehension). No formal assessment of writing improvement was conducted during this course, as a supplementary first-year writing course was used for college-wide writing assessment.

Outcome 4: Synthesize Neuroscience and Economics
The student learning objectives for this outcome included "explain how physiology and emotion affect decisions" and "examine the impact of historical developments in science on decision making." These objectives were both met through traditional content testing methods of quizzes and tests with varying question types that built directly on the content learned through books and lectures on these topics. As an example, at a basic level of Blooms taxonomy, students labeled and identified specific brain regions associated with decision-making. At a higher level, students were asked to explain the emotions and physiology underlying the decision to pay $3 for a brand-name juice drink versus $1 for a store brand version.

In some ways, this outcome was the simplest to assess, as it was the primary content piece. However, this nontraditional combination of disciplines has very little pedagogical support, particularly for the novice undergraduate. The authors are currently writing a separate article to describe several strategies for teaching neuroeconomics concepts to undergraduates.

While we set this outcome to be content-specific, the aim here was also partly to introduce students to interdisciplinary thinking beyond the course. By focusing on demonstrable outcomes and concise information delivery, Action-Mapping may be uniquely positioned to facilitate the modern needs of higher education in the 21st century.

Applying Action-Mapping to other Courses
Action-Mapping, like Backward Design, is a time- and labor-intensive process. Recognition of this fact and resources to assist faculty in designing backward can be found in Dolan and Collins (2015). Despite the effort involved, we found the process to be incredibly gratifying, and have since integrated aspects of this pedagogical design into other courses.

As faculty trained to think about how to deliver the content of a textbook, the challenge of Action-Mapping is to revise our own thinking to focus on only the knowledge needed for students to effectively find answers and ask appropriate questions within a discipline. Bridging the gap between what students enter college knowing and the ever-increasing body of disciplinary knowledge is not possible in one class, but instructors can provide the skills for students to bridge that gap on their own. We provide here a few brief examples of how we attempted this bridge.

The first example is from an upper-level neuroscience course. Using Action-Mapping to achieve the "Main Outcome" of understanding material from prerequisite courses, students were given the "Do statement" to demonstrate mastery of material by passing an exam. In lieu of faculty-delivered review lectures, students were given several "Activities" to practice their knowledge. For the "Activity" of completing a multi-page short essay exam, "information provided" to students included their textbook, copies of all relevant lectures from the intro course, and peers as information sources. Time in and out of class was utilized for working in groups to complete the exam. As another "Do," the students were assigned to teach an

interactive mini-lesson on neurophysiology principles (e.g., ion movement during an action potential) in a way that the introductory level students could understand. "Information provided" for this do activity included the textbook, prior lectures, a week preparation out of class, hints of open source lesson plans on the internet, and a list of crafts and materials that would be available.

Action-Mapping can be used not only to review material, but also to present new information to a course. For another course, a "Main Outcome" was for students to explain the regulatory role of hormones on several different kinds of behaviors. A related "Do statement" was to design a study (incorporating knowledge gained throughout the semester). To support that, some "Activities" included quiz/test questions to determine why one would use particular techniques in specified studies. "Information provided" included details on research techniques. To supplement a chapter reading on techniques, we assigned the "Activity" of a discussion board (hosted on the learning management system) for students to crowd-source interactive explanations of research techniques. This assignment served the double duty of providing additional "Information" in the form of alternate resources to the textbook and the "Activity" of practice explaining and determining why a technique was useful for solving a particular question for their study later.

In other courses, and in many small ways, we have approached content-delivery using Action-Mapping. This can range from flipping a single class and focusing on problem-solving to reshaping the entire course into long-term project design. In thinking about the Action-Mapping course design process, one must continually ask what useful thing a student would be able to do after each lesson, not after the course as a whole. Each lesson can and should layer and interweave, but also have individual outcomes.

Evaluating the Action-Mapping Design Process
It was our perception that the design of this FYE course, using Action-Mapping, supplemented institutional initiatives to improve academic performance, satisfaction, and persistence to graduation. Some of the keys to those initiatives, are to create a rich, engaging classroom experience and to design "cooperative learning activities that bring students together to work collaboratively after class on meaningful tasks" (Kuh et al., 2008). In these ways, peer influence on student learning is shaped to be educationally purposeful and reinforce academic expectations. In using Action-Mapping, we were able to create learning communities in which students learned to work together toward academic goals, potentially leading to increased investment. We do not know if the Action-Mapping design itself resulted in measurable changes on retention and success separate from other institutional interventions.

Other questions on the efficacy and effectiveness of Action-Mapping remain. We do not know for certain if the skills acquired in this educational model – which emphasizes "doing" rather than "knowing" – transfer to other kinds of courses that use other models of learning.

To examine this question, one could design a cross-sectional and longitudinal study of two (or more) separate sections of a course of the same content, one employing the Action-Mapping technique and one a more traditional approach. Student success on a variety of measures could be compared across the curriculum and over the subsequent years. We suspect that these skills do indeed transfer, based on anecdotal evidence of two separate professors reporting years later that they "knew which section of FYE" our students had been in, due to skills they exemplified in the classroom.

To conclude, we found that Action-Mapping aided our ability to achieve stated objectives for the course and resulted in an engaged learning environment compared to other courses we have taught. When faculty create an educational environment where students are active participants in their learning, students make the greatest gains during their undergraduate experience (Umbach and Wawrzynski, 2005).

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