

Teaching and Learning Together in Higher Education

Volume 1
Issue 9 *Spring 2013*

Article 7

May 2013

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Recommended Citation

Egan Brad, Louisa "Experimental Design as a Threshold Concept in a Developmental Psychology Course," *Teaching and Learning Together in Higher Education*: Iss. 9 (2013), <https://repository.brynmawr.edu/tlthe/vol1/iss9/7>

EXPERIMENTAL DESIGN AS A THRESHOLD CONCEPT IN A DEVELOPMENTAL PSYCHOLOGY COURSE

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As part of the TLI-supported seminar on threshold concepts facilitated by Peter Felten during the Spring-2013 semester, I explored threshold concepts with my student consultant in an intermediate-level lecture course on Developmental Psychology. This semester, 42 students were enrolled in the course. My stated goals for students on the syllabus included gaining an understanding of how children's minds and behaviors develop over the course of childhood, appreciating how a developmental approach can inform psychological theory across areas of psychological inquiry, acquiring foundational knowledge and understanding evidence for key debates in the field, seeing the beauty of the processes that create the mind of the adult human, and understanding the implications of developmental psychology for social policy. To meet these goals, students attended 120 minutes of lecture a week and conducted observations at preschools on a topic of interest at four points throughout the semester. Students were responsible for a midterm and final exam, five quizzes throughout the semester, papers on their observations, and a final paper.

When I first encountered the idea of threshold concepts, these liminal, perspective-changing ideas, I thought that I would be using them in my course in the context of major debates in developmental psychology (nature vs. nurture, etc.). I had thought that the same concepts that spurred major shifts in the history of developmental psychology would be threshold concepts for my students. For example, in 1959, Noam Chomsky published his influential critique of B.F. Skinner's *Verbal Behavior*. Chomsky's work defied the prevailing Skinnerian wisdom that all behavior resulted from environmental reinforcement, and introduced the notion that innate structures might promote language into psychology, linguistics, and philosophy. Chomsky's critique triggered a momentous shift in how psychologists conceptualize mechanisms not only in language acquisition, but also in other domains ranging from object knowledge to morality. I initially thought that for my students, the idea that innate structures support development would be similarly counterintuitive and eye opening. However, my preconception disregarded students' own previous learning in other psychology courses and the fact that by now, Chomsky's ideas of innateness are well within the mainstream of psychological science. I found that the same was true for other big debates in the field—these were taken for granted by my students.

Rather than thresholds related to debates in the field, I was surprised to discover that the major threshold with which my students struggled was acquiring a working understanding and facility with experimental design. The ability to design and analyze experiments is absolutely crucial for consuming and producing research in psychological science—not just developmental psychology—and the universality and general applicability of experimental design may be partially responsible for why experimental design eluded me as a possible threshold concept. When I had begun thinking about how threshold concepts might operate in my course, I was thinking about threshold concepts in developmental psychology, specifically. However, I often asked students to think about experimental design during small group work and on quizzes. My student consultant (SC) was invaluable in helping identify experimental design as an aspect of

the course that was particularly challenging for my students in the context of quizzes, small group work, and the midterm.

My SC sent out a few feedback forms to students over the course of the semester and also engaged students during class meetings when the class broke up into small groups. I think that my students felt more comfortable speaking frankly about what was difficult for them with my SC than with me, and that admitting a lack of facility with experimental design might have been viewed as particularly undesirable for students who had already taken a course in research design. In this way, my SC was helpful not only as a pulse-taker of the class, but as an intermediary between my students and me for them to air concerns that they may have been less comfortable bringing to my attention. I'm grateful to my SC for helping to identify experimental design as a difficulty for students early on enough in the semester for me to begin to address it.

That experimental design was a stumbling block for my students struck me as extremely troubling, not only because of the centrality of experimental design to psychological science, but because experimental design is one of the aspects of my work as a psychological scientist that I most enjoy—I find it to be the domain in my own work with the most potential for creativity and innovation. In my mind, a strong understanding of experimental design is not only a threshold my students must cross in order to become more proficient scientists, but also a threshold necessary for being able to experience psychological science as a creative enterprise.

I decided to alter my syllabus mid-semester to devote about a week and a half to an experimental design workshop. I had already invited two faculty families to bring their combined three children to class one day just after the midpoint of the semester, and I built an experimental design activity around their visit. A week before the children's visit to my class, I told my students that I had a challenge for them: they were going to have three children in class all below six years of age (72 months), and the students' job would be to assess the age of each child. To do so, they were not permitted to ask the child or the parent how old the child was, but could deploy established experiments in developmental psychology or create their own based on their knowledge of developmental psychology. The age assessments would take the place of one quiz (worth ten points) and students would receive one point for figuring out which child was oldest and which the youngest, then earn three points for an assessment of a child's age accurate within three months, two for an assessment accurate within six months, and one point for accuracy within nine months (repeated for each child). Students were to be evaluated on their group presentations by me, and on their contributions to their group work by their group members.

Students identified four domains of development to target (language, cognition/memory, motor, and social/emotional) and broke into eight groups of five students each. I created the groups to include a balance of sophomores, juniors, and seniors. Groups were instructed to prepare for five minutes with each child, but that if they felt it was helpful, they could trade off time with other groups. They were told at the outset that they should coordinate their group work to avoid duplication and that while all groups would be sharing their findings with the other groups, it was up to each student's discretion to decide how to weigh each group's conclusions in their assessments of the children's ages.

The first day of the exercise was devoted to group experimental design, the second to group presentations and feedback, the third to working with the children, and about 15 minutes on the fourth day to students recording their assessments of the children's ages. Between the third and fourth day, groups posted their findings on an online document to share with the class. On the first day, I moved between groups to answer questions. Students tended to use a mix of published experiments and their own experiments. For example, a group looking at social/emotional development employed the method of a published study that probed children's understanding of theory of mind by using the published false belief task and, as a control, a false photograph task. Another group looking at social/emotional development created a task in which they asked children to match facial expressions to pieces of music.

On the second day, students presented 5-to-8-minute Powerpoint presentations of their studies. Presentations covered the basis in the literature of the experiments students were planning to use as well as a detailed description of their methods and what precisely their methods would accomplish. After each presentation, other students asked questions and offered suggestions for improvement. Typically, these were suggestions for better control conditions. As students' age assessments of the children would depend on the quality of their classmates' work, they were motivated to improve the quality of their classmates' projects.

On the third day, three children visited the class. Students worked in their groups with each of the three children. This meant that at any point, three student groups were interacting with the children and five student groups were observing. Students seemed very engaged both while they were interacting with the children and while they observed—they compared notes with others within their group and from other groups. At the end of the third day, the students requested that I set up an online document for each student group to detail each child's performance on their tasks.

On the fourth day, students made their age assessments and reflected on the process. Again, students made their age assessments individually and were able to weigh the findings of the different groups however they saw fit. If they didn't trust the work of a particular group, they were free to disregard that group's findings. As a whole, the class's age assessments were quite accurate. The class average was off by six months for the youngest child, in part because they hadn't prepared for a child with a bilingual background (despite some forewarning on my part), but was within one month for one of the two older children and within two months for the other.

Students' written reflections on the experimental design workshop indicated high levels of engagement and increased awareness of principles important to experimental design. Several students commented on the importance of appropriate controls, the utility of converging lines of evidence, and the need for quantifiable variables. Specific to research with children, students commented on the need for tasks that were short in duration and engaging so as to keep children's attention and the potentially confounding roles of language, the presence of parents, and children's fatigue. Students were surprised at the variation in children's performance across domains (e.g. a child's performance could indicate one age on a motor task, but a younger age on a social/emotional task), and impressed by the accuracy of their assessments. Students also commented in their written reflections and in class discussion that the workshop was enjoyable and that it was fun to feel "like a real experimenter."

All told, I was pleased with how the experimental design workshop turned out. Students' subsequent work in the context of in-class experimental design activities improved markedly, I felt, and I believe they demonstrated improved understanding on questions related to experimental design on quizzes and in the final exam. I perceived improvement in the quality of the questions students asked about experiments I presented in class. They still struggled at times, some more than others, but I believe that they struggled in more sophisticated ways. In the future, I will give my students yet-to-be-determined experimental design assessments at the beginning and end of the semester.

At a meeting with my colleagues in our TLI seminar following my experimental design exercise, I commented that I feel that instead of *Developmental Psychology*, my course should be called *Psychology (Developmental)*. This thought reflects my newfound awareness of the importance in an intermediate level course of learning skills and proficiencies central to the broader discipline. In my mind, these are at least as important at the intermediate level as learning arguments on both sides of the debates within a specific subfield. In my future teaching, I will articulate a working understanding of experimental design as one of my core goals for my intermediate-level courses and work to incorporate more hands-on activities that allow students to wrestle with experimental design in a manner that is immediate and engaging. I will also beware of imposing my own preconceptions of threshold concepts in a course on my understanding of what will be threshold concepts for my students.