AAI Education Committee Highlight: Teaching Tools

In 2016, the AAI Education Committee initiated a new session focused on improving immunology education: the Immunology Teaching Interest Group (ITIG). The ITIG is a group comprised of past speakers and attendees of the ITIG sessions held at the AAI annual meetings, including current immunology educators spanning a range of institutions and levels. It serves as a resource for novel teaching tools and practices that can be implemented in courses to enhance immunology education. The session has grown from an audience of 20 in 2016 to more than 100 participants in 2019 (the last time the session was held due to the cancellation of IMMUNOLOGY2020™). Because of the strong interest in this topic, the AAI Newsletter *features "Teaching Tools" articles highlighting ITIG presentations.*

Reimagining the PowerPoint Slide in Teaching Immunology

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Loyola University offers two immunology courses that use the approach described in this article:

- BIOL 315, *Introduction to Immunology* (a 4-hour lecture/lab undergraduate elective)
- BIOL 413, *Advanced Immunology* (a 3-hour didactic course in Loyola's M.A. in Medical Sciences program).

Both courses use Parham's *The Immune System (Fourth Edition)* as the primary textbook, with the Abbas et al. *Cellular and Molecular Immunology (Ninth Edition)* as a recommended additional text; the readings are supplemented with review articles and primary literature as well.

The methods presented herein should be applicable to immunology students of any level but have been used successfully with undergraduates and M.A. (exclusively pre-med) students. The methods have also been used in teaching other undergraduate science courses. A short video that includes a walk-through of basic principles I use in animating PowerPoint content can be found at *https://bit.ly/3oJm3uT*.

Mayer (2005)[1] proposed principles for multimodal teaching involving animation, among other things, that have great potential to help instructors more effectively communicate complex subjects. Such an approach is applicable to the topics that frustrate undergraduate students in immunology. Having taught immunology at the undergraduate level for more than 10 years, these principles resonate especially from the standpoint that, in my experience, the predominant use of static images and bullet points on slides has not been as successful as desired in terms of student engagement and content retention.

McDaniel and Einstein (1986)[2] described the use of "distinctive" imagery as an effective means of achieving better student recall. The shape-drawing features in PowerPoint and other programs allow the easy development of such imagery that can be custom tailored to one's own preferences in terms of what material to emphasize. By using the easy-to-learn animation features in PowerPoint to develop a more graphics-intensive lecture format, it becomes possible to present complex topics in both lecture and lab much more easily than relying on pregenerated still images and/or text-intensive slides.

Additionally, it becomes possible to control the pace at which the instructor presents animated content because no time has to be spent fumbling with pregenerated, often narrated animations that lend themselves better to individual study than presentation in the classroom. The "click-through" approach I have developed simplifies the process of presenting such material while giving the instructor latitude to customize or update the animations as new research dictates. This can allow the instructor to more quickly and comprehensively describe new developments in the field without having to wait for someone else to release new slides with a revised textbook edition.

This past fall semester, approximately 750 slides were developed and employed between the lecture and lab sections of my undergraduate immunology course. Of those, 50 percent consisted of exclusively self-generated, click-through animations in which the only on-slide text was figure labels. In addition, almost 10 percent of the slides had self-generated still images or animations with bullet points also on-slide. In total, therefore, about 60 percent of all slides featured exclusively self-developed graphic content that allowed for more comprehensive emphasis of prioritized topics and also afforded the students an additional study tool to help them more easily navigate assigned readings.

Custom animations were developed for every topic presented in both lecture and lab. The lab slides were complemented with materials from the virtual labs assigned on the Labster (*www.labster.com*) platform used in the class due to the COVID-19 pandemic, some of which required no additional supplementation on my part. Many of the slides (both lecture and lab) are in the third and fourth generations of development and have become more refined with greater mastery of the animation tools in PowerPoint. They also incorporate self-generated vector graphics that, from both the instructor's and students' standpoints, dramatically improved the quality of this content compared to the earliest iterations. The slides have been widely praised in student course evaluations as being helpful in their learning.

Slides in the lecture section that lacked self-generated visual content either used figures from the textbooks, content from primary literature, or other diagrams with or without bulleted text. In lab, the most common example of such content was sample data sets to show students what to look for in their experiments. While this past semester was taught remotely, lab slides were still used as when classes met face-to-face, with modifications to account for remote learning. The slides were effective in reinforcing methods presented in virtual lab simulations; this was evidenced by class discussions in which students were asked questions about the material and their subsequent ability to engage in informed conversation within the class about the topics.

Finally, it is worth evaluating the efficacy of the approach in terms of student performance, beyond their favorable opinions of it. One strength of this approach could be seen in students' answers to exam questions.

All exams in the undergraduate course have been exclusively free response since I started teaching it in 2009, with a heavy emphasis on drawing pictures to demonstrate their mastery of the content. The questions were such that students could not simply memorize and regurgitate the answers. They had to be able to mentally manipulate the images during exams to apply their understanding and to synthesize multiple complex topics in the context of their answers.

The students' abilities in this regard were remarkable to the extent that even those who did not earn full credit on the content still managed to demonstrate their retention of the visual delivery method through their drawings, despite not recalling all the details. In this regard, the self-generated animation approach to presenting course material shows promise in fostering deeper understanding and retention of the course content.

References

1 Mayer, R. (2005). Cognitive Theory of Multimedia Learning. In R. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning* (Cambridge Handbooks in Psychology, pp. 31-48). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511816819.004

2 McDaniel MA and Einstein GO (1986). Bizarre Imagery as an Effective Memory Aid: The Importance of Distinctiveness. J. Exp. Psych: Learning, Memory, and Cognition, Volume 12, No. 1, pp. 54-65.