

**Title:** No Reinvention Needed – Enhanced Flipped Class Histology Curriculum Shows Usefulness of Commercial Online Course

**Authors:** Alexis MacDonald<sup>1</sup>, Jennifer M Stratford, Ph.D.<sup>2</sup>, Maxwell E Cooper, M.D.<sup>3</sup>, Charlie Cooper<sup>3</sup>, Ernesto Salcedo, PhD<sup>1,4</sup>, Lisa MJ Lee, Ph.D.<sup>1,4</sup>

**Affiliations:**

<sup>1</sup> Modern Human Anatomy Program, University of Colorado Anschutz Medical Campus, Aurora, CO

<sup>2</sup> University of Colorado Boulder, Department of Psychology and Neuroscience, Boulder, CO

<sup>3</sup> DaVinci Academy, LLC, Cleveland, OH

<sup>4</sup> Cell and Developmental Biology, University of Colorado School of Medicine, Aurora, CO

Histology, a pillar of anatomical sciences for both health professional and graduate students, requires sufficient time and practice to develop the necessary visual literacy and skills in synthesis to achieve competency. However, histology contact hours in medical and graduate education have reduced significantly in the past decades due to disseminated curricular changes emphasizing integration of basic sciences, clinical content and self-directed learning. In turn, adjunct online resources have been in steady incline and in the past year, in response to COVID-19, quickly became an essential component of anatomical sciences education following campus closures. Self-directed learning is challenging in normal circumstances as success is impacted by the level of student preparedness and engagement, which in turn can be dependent on the quality of the asynchronous learning resources. Although many online histology resources are available, few are comprehensive and provide step-by-step instruction in identification of structures in tissue slides. In this pilot project, the efficacy of using a commercial online histology (COH) course (DaVinci Academy, Cleveland, OH) as a primary preparatory resource in a graduate histology curriculum implementing a flipped-classroom pedagogy was assessed. During fall 2020 (F2020), first-year graduate students enrolled in a hybrid histology course were required to review learning objectives, read textbook sections, and complete the COH lessons, consisting of complete lectures, lab videos, and quizzes as a set of pre-work to prepare for on-campus and virtual classes. The synchronous class sessions had minimal didactic lectures, but instead had a series of small group active learning tasks. In a COMIRB exempt retrospective study (#20-2891), the assessment outcomes of the F2020 cohort (n=26) were compared to a fall 2019 (F2019) cohort of students (n=25) who completed the identical histology curriculum delivered in a flipped-class style by the same instructor, but without the commercial online histology course. All course quiz and exam scores were compared across the F2019 and F2020 cohorts using a repeated measures ANOVA. There were no significant differences in assessment outcomes between F2019 and F2020 cohorts ( $p>0.05$ ). Survey of the F2020 cohort throughout the course revealed consistently high rating of the COH with 80% of students believing the resource improved their ability to read and interpret histology slides. Interestingly, students perceived the lecture and lab videos in the COH delivered by the same in-class instructor to be more valuable than those delivered by a third-party instructor, although the assessment performance was independent of the online instructor ( $p>0.05$ ). The results suggest that the online histology course can be an effective asynchronous learning resource for a histology course, allowing for more efficient use of synchronous class time to support a higher taxonomy of learning.

