Abstract
To increase students’ interest and engagement with microscopy and tissue examination, we purchased adapters that simultaneously connect students’ smartphones to the ocular lens of a microscope. Aggregate scores (i.e., percent correct) for tissue questions on lab practicals for BISC 206 students (Fall 2015/2016) and BISC 207 students (Spring 2015/2016) were compared between semesters where students used adapters (2016 semesters) and semesters where students did not use adapters (2015 semesters) to assess effectiveness of the adapters, as were Likert surveys to assess student’s levels of engagement. Lab practical scores were found to have improved but not significantly across all semesters.

Introduction
- Smartphones show potential to serve as convenient technological tools for learning in terms of portability, affordability, accessibility, operability, and applicability (Kafyullo, 2012).
- However, little research has been done to examine how the utilization of smartphones impacts learning outcomes, particularly in a science laboratory.
- Through “Bring Your Own Device” (BYOD) initiatives, educators are starting to incorporate students’ mobile technology including smartphones into the classroom curriculum (Kiger and Herro, 2015).
- Use of microscopes in the study of biological tissues (i.e., histology) is a particularly challenging area of study for students in Human Anatomy and Physiology at the University of Mississippi.
- Microscope adapters that attach simultaneously to students’ smartphones and the ocular lens of a microscope were used by students in the Human Anatomy and Physiology I and II laboratories. These adapters allow students to take high quality pictures through the microscope with their smartphones by aligning the focal points of the smartphone’s camera lens with the microscope’s ocular lens.
- These microscope adapters allowed the students to digitally capture any microscopic images they might need to know and identify on the lab practical. These pictures could then be used by the student as a resource to study for the histological questions on the lab practical.
- The hypothesis of this study was that use of microscope adapters along with the students’ smartphones would improve student engagement in the laboratory and performance on histology-based questions on lab practicals.
- Microscope adapters were used in the Human A&P I and II laboratories during the Fall and Spring 2016 semesters. The students received a verbal description of the project and were given the first Likert-style survey to complete before they used the microscope adapters.
- The students were given instructions on how to use the microscope adapters and refreshers were given throughout the semester as needed.
- The students were given the second Likert-style survey to complete at the end of the lab portion of the course.
- Two, 50 question lab practicals (Steeplechase format) were given during the semester with 1-10 histology based questions on each lab practical.
- Class performance (e.g., % correct responses/total student responses) on the histology questions from each lab practical was compared between semesters where no BYOD adapters were available (Fall and Spring 2015) and semesters where BYOD adapters were available (Fall and Spring 2016) for Human A&P I and II.
- Two-sample t-tests assuming unequal variances were used to compare performance on the histology questions for each lab practical.
- Response data for the two Likert-style survey instruments were analyzed with Chi-square tests along with one-way ANOVAs.
- The level of significance was set at α = 0.05 for all analyses.
- This experiment (Protocol #16x-162), has been approved as Exempt under 45 CFR 46.101(b)(1) & (2) by the University of Mississippi IRB.

Methods
- Microscope adapters were used in the Human A&P I and II laboratories during the Fall and Spring 2016 semesters. The students received a verbal description of the project and were given the first Likert-style survey to complete before they used the microscope adapters.
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Conclusions
- Results from survey responses shows that the use of microscope adapters in the laboratory along with students’ smartphones to take pictures of specimens through a microscope has the potential to improve student engagement in the laboratory.
- Results show that lab practical scores were higher in semesters where microscope adapters and smartphones were used compared to semesters where they were not used, but the increase in scores was not significant.
- This study helps to assure educators that the use of smartphones in the laboratory for learning purposes may enhance student performance and engagement.

References