Community College Anatomy and Physiology Education Research: Conducting Research Where It Ought to be Done

Murray Jensen, PhD[1], Kerry Hull, PhD[2], Suzanne Hood, PhD[2], Heather Lawford, PhD[2], Kyla Ross, PhD[3], Ron Gerrits, PhD[4], Betsy Ott, PhD[5]
[1]College of Biological Sciences at the University of Minnesota, Minneapolis, MN 55455
[2]Bishop's University, 2600 College St, Sherbrooke, Quebec J1M 1Z7, Canada
[3]Georgia Institute of Technology, North Ave NW, Atlanta, GA 30332
[4]Milwaukee School of Engineering, 1025 N Broadway, Milwaukee, WI 53202
[5]Betsy Ott, Tyler Junior College, 1327 S Baxter Ave, Tyler, TX 75701
Corresponding author: msjensen@umn.edu

Abstract
Evidence Based Instructional Practices (EBIPs) have been shown to increase student engagement in college classrooms. Education research conducted to date on the effectiveness of these EBIPs and their impact on students' has largely focused on four-year and research-intensive institutions, and community colleges represent a significant gap in the literature. The NSF-funded Community College Anatomy and Physiology Education Research (CAPER) project has attempted to narrow that knowledge gap through instruction, mentoring, and research support teams. To date, two cohorts of community college instructors (six participants each year) have participated in an online course on education research, which culminates in the completion of a research proposal. Participants receive coaching and mentorship through the development and implementation of their research projects at their respective institutions. Data collected to date measures the impact that each EBIP has on student anxiety and academic self-efficacy. The purpose of CAPER is not only to gather data on the EBIP implementation and effectiveness in community college classrooms, but also to gather data on long-lasting change in instructional methods used by community college instructors engaging in this research. Through this research, we are contributing to the body of literature that is currently lacking representation of community college populations. In addition, we are identifying tools and resources that may increase the likelihood that community college faculty will engage in student-centered learning techniques in their classrooms. https://doi.org/10.21692/haps.2019.029

Key words: anatomy and physiology, teaching and learning, community college, education research

Introduction
The student population at two-year schools is quite different from that at four-year research universities. According to the National Center for Education Statistics (Radwin 2017), Community College (CC) students are more likely to be older, to have military experience, to be raising children, and to be working in addition to attending school. Many are members of visible minorities and are the first in their family to pursue post-secondary education. All of these factors are associated with high attrition rates; less than 40% of students complete their program within six years (Bailey et al. 2015), and less than 15% of entering students earn a bachelor's degree within six years (Jenkins and Fink 2016). Yet, as publicly funded institutions, CCs are often limited in the resources they can offer struggling students (Zeidenberg 2008).

CC instructors similarly constitute a distinct population: they are more likely to be part-time, less likely to have a tenure track position, and frequently juggle adjunct positions at multiple schools or have other significant professional or family commitments (Center for Community College Student Engagement 2014), and they typically teach multiple sections of anatomy and physiology each semester. Clearly, help is needed for both the instructors and the students. The Science of Teaching and Learning (SoTL) is an area of research that should motivate and guide CC instructors to increase their teaching effectiveness. However, CC instructors are often less well-equipped than their university counterparts to take advantage of recent developments in SoTL, lacking access to teaching and learning centers, professional development funds, and scientific journals that are not open access (McFarland and Pape-Lindstrom 2016).

One objective of SoTL is to identify teaching practices that help students succeed. Evidence Based Instructional Practices (EBIPs) are pedagogical approaches that have been documented to improve student outcomes (Stains and Vickrey 2017; Center for Research on Lifelong STEM learning, Oregon State University). Broadly speaking, the landmark article "Active learning increases student performance in science, engineering and mathematics" established student-centered pedagogy, or active learning, as an EBIP (Freeman et al. 2014). Active learning techniques may be particularly relevant to CC students, since they have been identified as a means of encouraging inclusivity and reducing the achievement gap faced by underrepresented demographics in STEM (Snyder et al. 2016). However, as Schinske et al. (2017) clearly points

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out, only 3% of biology education research articles address CC-specific issues or are even authored by CC faculty. Thus, with a few notable exceptions such as peer instruction (Fagen et al. 2002), the recommendations for incorporating different pedagogies have primarily been tested in 4-year and research-based institutions, which frequently have a different population of both students and instructors. In order to be fully validated, each EBIP needs to be tested in a variety of real-world institutions including community colleges (Stains and Vickrey 2017).

The NSF-funded Community College Anatomy and Physiology Education Research (CAPER) project (Figure 1) uses a collaborative approach to increase the use of EBIPs in CCs and to gather data as to their impact in CC populations. To work towards this goal, twelve community college instructors, organized into two cohorts, are undertaking small-scale research projects that they design and implement within their own Anatomy and Physiology classrooms. This brief article describes the goals and design of the CAPER project, presents selected preliminary results from Year 1 of the project, and outlines future objectives of our research group.

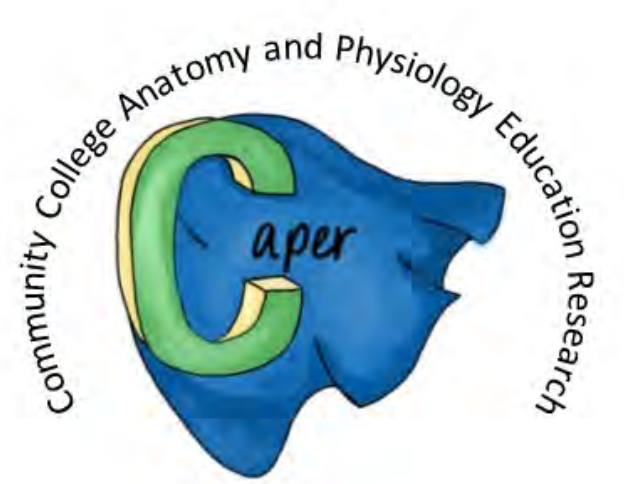

Fig 1. *The CAPER logo. Art credit: Lauren Jones*

Project Design

Each cohort of six instructors spends one year in the CAPER project (Fig. 2). The first phase involves a 1-credit HAPS-I course titled An Introduction to Education Research Methods, in which participants review information about the learning process, study various instructional practices, and look at the basics of experimental design and analysis (Human Anatomy and Physiology Society 2019). This course was developed by Valerie O'Loughlin in 2015 and was offered for the third time in 2019. The final product of the HAPS-I course is a modest, classroom-based research proposal. This proposal includes a research question, implementation strategy, and appropriate data collection instruments and procedures. It also provides the basis for the application to their school's Institutional Review Board (IRB). Phase 2 (Implementation) occurs in the subsequent (spring) semester; instructors implement their research proposal in their own classroom. Finally, in the dissemination phase of the project, instructors present the preliminary findings in a poster at the HAPS annual conference and subsequently write a research paper for the HAPS Educator.

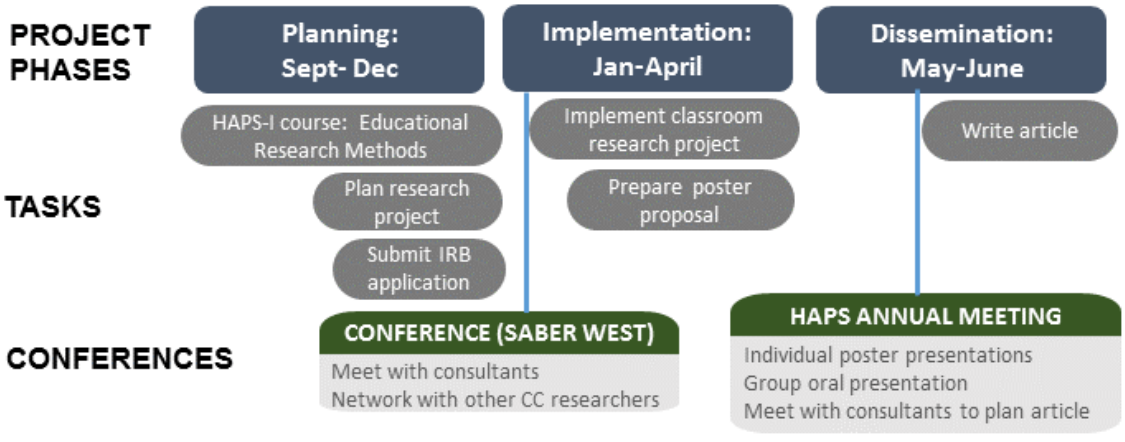

Fig 2. *The CAPER timeline. SABER is the abbreviation for the Society for the Advancement of Biology Education Research.*

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As shown in Figure 3, CC instructors are provided two levels of help throughout the duration of the CAPER project. First, instructors are grouped into pairs based on geographic location or intervention of interest and paired with a mentor with experience with EBIPs and education research. Second, all three mentor-instructor triads are supported by qualitative and quantitative analysis consultants with considerable experience in social science methodology, the course instructor(s), and a writing consultant who is currently the Editor in Chief of the *HAPS Educator*. In this iteration of CAPER, only one mentor is from a community college, and all consultants and course instructors are from universities. However, as discussed later in this article, we hope to increase the number of CC instructors in CAPER leadership positions in the future.

Fig 3. *Each pair of CC instructors worked with a mentor and had access to consultants and the HAPS-I course instructor (Gerrits 2019).*

In concert with their individual projects, all participating CC students will complete a common survey at the beginning and the end of the implementation semester. This survey asks students to rank different classroom teaching techniques in terms of how much anxiety they perceive in response to each and how much they think the technique contributes to their learning (modified from Hull et al. 2018). The survey also evaluates student personality measures such as social anxiety (Connor et al. 2001) and academic self-efficacy (McIlroy 2000). Individual instructors can use aspects of the data from their class in their project, and by pooling the data of all instructors we will be able to generate relatively robust data to address questions such as the impact of social anxiety on perceptions of active learning. This collaborative effort uses a different model of promoting education research in community colleges by incorporating CC instructors into multi-institutional research teams coordinated by researchers at four-year or research-intensive institutions.

Year 1: What Have We Accomplished?

Working collaboratively, twelve of the thirteen individuals, including instructors, mentors, and consultants (Figure 3) involved in Year 1 of the CAPER project have generated data regarding the effectiveness of EBIPs in community college populations. Each participant incorporated a new-to-them EBIP into their classroom such as student response systems, think-pair-share, or formal groups. With the support of quantitative and qualitative analysis consultants, participants measured the impact of the EBIP on one or more variables, such as grades, student anxiety, academic self-efficacy, or willingness to work with others. Involvement in the CAPER project has allowed some of these individuals to collect data that has led to manuscripts published in this issue of the *HAPS Educator*. For example, Nancy Djerdjian and Shawn Magner from Anoka Ramsey Community College examined the effects of student response systems on facilitating group discussions and Melaney Farr from Salt Lake City Community College documented her research on the Think-Pair-Share teaching method.

In addition to the individual research projects led by each CC instructor, the research team used the pooled data from the student surveys to investigate the impact of instructional practices in different student populations. One of the broader questions began as the individual research project of Nancy Barrickman from Salt Lake Community College regarding differences between continuing and first generation students, and resulted in a manuscript to be published in the *Journal of Microbiology and Biology Education* (JMBE).

During the 2019 HAPS Conference in Portland, four of the six CC instructors as well as the mentors engaged in a panel discussion with other members of HAPS entitled The NSF & HAPS CAPER Project: Research in Community College A & P Classrooms. Facilitated by Jenny McFarland of Edmonds Community College, audience questions focused on the feasibility of busy community college instructors trying to engage in one more thing i.e. research. The CC instructors spoke honestly about the difficulties associated with setting aside time for research and securing IRB approval, but also emphasized that research was indeed possible if given enough support. The instructors also appreciated that CAPER provided support for their own experiments rather than simply involving them in large-scale efforts coordinated by researchers at large universities.

Year 1: What Have We Learned?

Our preliminary work highlights the potential of CC research ventures, not only to confirm or nuance work done in four-year schools but also to generate and answer distinct and universally relevant research questions. The most interesting results from our analysis, involving how students' individual differences impact their perceptions and responses to active learning techniques, reflected the greater diversity of the CC student population compared with that at research-intensive and four-year universities (Hood et al. 2019a; Hood

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et al. 2019b). Moreover, involving the end-users in all phases of research, from the formulation of research questions to dissemination efforts (Jacobs 2016), provides distinct perspectives. CC instructors know their student populations and develop unique research questions, as borne out by the investigation of generational status initiated by one of our participants (Hood et al. 2019a).

The barriers facing CC educational researchers are significant. As documented by Schinske et al. (2017), these include the lack of time, infrastructure, administrator/peer support, and incentives. We attempted to address the lack of infrastructure and administrative/peer support by providing CC instructors with mentors and consultants, and the lack of incentives by offering participants a monetary reward of $500 for completion of the project and travel support to attend two conferences. Ideally our participants would have received a teaching relief to address the time constraints imposed by heavy teaching loads; however, arranging course releases requires a level of administrative buy-in that was not feasible.

Despite the mitigating efforts, the research project remained a challenging task for participants for various reasons. Some instructors were overambitious with their original project ideas, assuming that they were required to develop a novel and innovative project using gold-standard experimental designs and quantitative analyses. Others displayed skepticism regarding the utility of qualitative measures and experimental designs not involving control groups, which may partially reflect their previous lab research experiences. Finally, the statistical analysis was often challenging. This latter concern is not surprising because the degree of sophistication of statistical analysis methods used in educational research is increasing substantially, so individuals not trained in education research rarely have the background to perform their own statistics. While we attempted to mitigate this difficulty by providing a quantitative analysis consultant who was very comfortable with advanced statistical analysis, instructors felt less connected with their projects. We are exploring a different approach with the second year cohort, emphasizing simpler statistical techniques and more straightforward research questions. In addition, we are developing decision tree graphics to help select the correct test for common research questions relating to classroom practices (Fig. 4A). Accompanying these decision trees are "plug and play" Excel templates, in which participants can enter their data and the spreadsheet will automatically generate graphs and statistical analyses (Fig. 4B). Participants are empowered to enter and analyze their own data, with the quantitative analysis consultant available for back up.

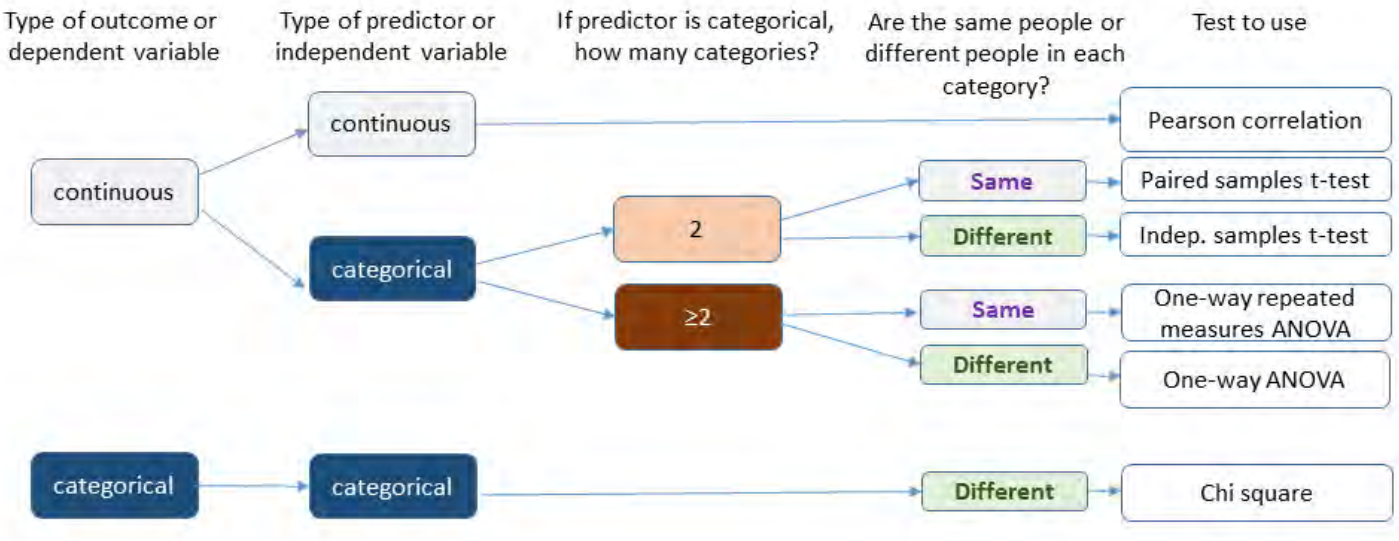

Fig 4a. *A decision tree that can be used by novice researchers to decide on an appropriate statistical test. Modified from Field (2013).*

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continuous variable 1	
participant ID	e.g., academic self-efficacy rating
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
…	
mean score	#DIV/0!
standard dev.	#DIV/0!

continuous variable 2	
participant ID	e.g., reported study habits
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
…	
mean score	#DIV/0!
standard dev.	#DIV/0!

Pearson correlation statistic	#DIV/0!
degrees of freedom (df)	calculated from the number of participants who have data for both of the variables being correlated – 1

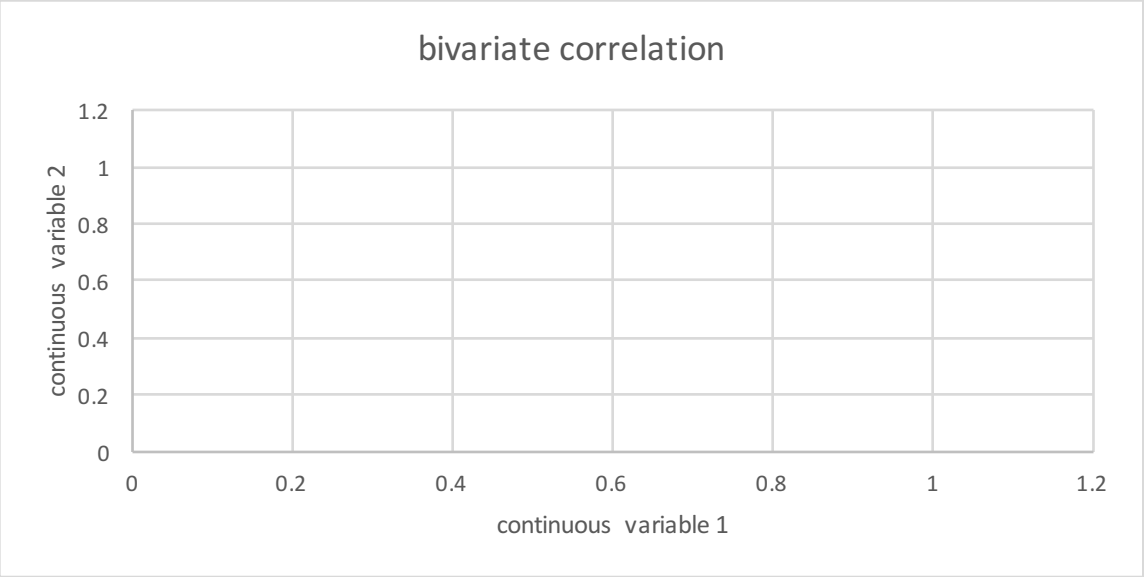

Fig 4b. *A sample Excel template for statistical analysis. Instructors can enter their values, and Excel will perform correlation analysis and generate a simple graph that can be modified by the instructor.*

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Dissemination of research results is also a daunting task, which we attempted to address via writing mentors. We came up against an interesting conundrum; the increasingly rigorous publication standards for statistical analysis increases legitimacy of educational research as a whole, yet potentially dissuades educators hoping to engage in SoTL without social science training. Schinske et al. (2017) notes efforts by some journals to have special CC research sections. Data on smaller populations and/or with less reported statistical significance than what would be acceptable in traditional research domains may still have a place in educational research, by providing an achievable target for potential novice educational researchers.

The lack of consistency in IRB procedures between different community colleges was also a source of confusion and anxiety. It should be noted that, once identified, the CC IRB officials were very helpful; thus, the second year participants were encouraged to identify and speak personally with the relevant individual very early in the project. While we had hoped that IRB approval at a research-intensive institution would be acceptable to the IRBs of the CCs, this did not prove to be the case. Each school required a separate and complete application, even for anonymous data. We facilitated the process by preparing a database of IRB applications prepared for similar projects, but receiving IRB approval remains a daunting task and a potential barrier. In the future, we would like to establish a database of IRB application templates for use by all HAPS members.

Despite the difficulties faced by CC instructors, they found the experience valuable. Furthermore, involving CC instructors in a project that focuses on educational pedagogy may also lead to lasting changes on how they teach. In addition to student data, we are collecting information about instructor perceptions and classroom practices. Though still early in the data analysis, preliminary observations indicate these instructors are motivated to continue with the active learning they implemented as part of the project, with possible expansion of activities in time. To this end, we observed a shift in CC instructor attitudes towards student-centered teaching practices over the course of the year (unpublished observations).

Conclusion

The overarching aim of CAPER is to improve CC student outcomes using EBIPs, both by increasing implementation in CC classrooms and by generating research data to improve the efficacy of implementation. We hypothesize that involving CC instructors in educational research can achieve both of these goals, but this requires significant support. As more individuals complete their projects we hope that a supportive network of CC educational researchers will grow in spite of the challenges, and that they will assume leadership roles in organizations such as the Human Anatomy and Physiology Society. While the original CAPER project will finish in June 2020, we hope to expand the scope of this work by scaling up the project to include more instructors over a longer time period of two years for each cohort. Instructor recruitment will begin in Spring 2020 in preparation for a funding application in December. Interested individuals should contact Murray Jensen at msjensen@umn.edu.

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About the Authors

Murray Jensen teaches at the College of Biological Sciences at the University of Minnesota. Kerry Hull, Suzanne Hood, and Heather Lawford teach at Bishop's University in Sherbrooke, Canada. Kyla Ross teaches at Georgia Tech in Atlanta. Ron Gerrits teaches at the Milwaukee School of Engineering, and Betsy Ott teaches at Tyler Junior College in Texas. Murray, Kerry, Ron, Betsy and Kyla all teach courses related to human anatomy and physiology and are all long-time HAPS members. Suzanne and Heather are both phycologists and have helped the CAPER research team with topics related research design and data analysis.

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