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Purpose

The International Journal of Teaching and Learning in Higher Education (ISSN 1812-9129) provides a forum for the dissemination of knowledge focused on the improvement of higher education across all content areas and delivery domains. The audience of the IJTLHE includes higher education faculty, staff, administrators, researchers, and students who are interested in improving post-secondary

instruction. The IJTLHE is distributed electronically to maximize its availability to diverse academic populations, both nationally and internationally.

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Submissions

The focus of the International Journal of Teaching and Learning in Higher Education is broad and includes all aspects of higher education pedagogy, but it focuses specifically on improving higher education pedagogy across all content areas, educational institutions, and levels of instructional expertise. Manuscripts submitted should be based on a sound theoretical foundation and appeal to a wide higher education audience. Manuscripts of a theoretical, practical, or empirical nature are welcome and manuscripts that address innovative pedagogy are especially encouraged.

All submissions to IJTLHE must be made online through the Online Submission Form. In addition, all manuscripts should be submitted in English and in Microsoft Word format. The following Submission Guidelines pertain to all manuscript types, that is, Research Articles, Instructional Articles, and Review Articles. Ultimately, authors should follow the guidelines set forth in the most recent edition of the Publication Manual of the American Psychological Association (APA).

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Review Process

Following a brief editorial review, each manuscript will be blind reviewed by two members of the Review Board. The review process will take approximately 90 days. At the end of the 90-day review process authors will be notified as to the status of their manuscripts - accept, revise and resubmit, or reject - and will receive substantive feedback from the reviewers. Manuscript authors are responsible for obtaining copyright permissions for any copyrighted materials included within manuscripts.

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Research Articles

Instructional Articles

Review Article

Education and Career Skills Acquired During a Design Internship

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Student internships are valued as solid indicators of future employability, which often result in the acquisition of additional education and career skills. This study describes the perceptions of interior design students after completing a summer internship with a design firm. Utilizing a case study approach, the study data were collected through a survey instrument which gauged students' perceptions of their internship experience, particularly compensation, learning, and satisfaction. They were also asked how beneficial this experiential learning activity was in gaining technical, professional, and communication skills. The results reveal that skills related to employability were perceived as most beneficial and that financial compensation had a weak relationship with overall internship satisfaction. Students believed they learned important hard and soft skills from their internship, regardless of their pay rate. Degree programs with an internship requirement can help their students be better prepared for successful employment upon graduation.

Introduction

Students (and often their parents) are apprehensive about finding employment after four or more years of expensive college tuition. Executives and hiring managers believe students who complete an internship prior to graduation have a distinct hiring advantage (Hart Research Associates, 2018). Employment growth in occupations that typically require an apprenticeship, internship, or residency are projected to increase to 7.4% by 2026 (USBLS, 2019). Specifically, the U.S. Bureau of Labor Statistics (2019) forecasts employment in architecture and interior design to increase four percent by 2026. This may be due to the fact that internships emphasize learning through practice, which is the gaining of "real world" experience that allows graduates to leverage their employability.

This real-world experience and those sought-after job skills are often attained by students through an internship (NACE, 2018; Schoenfelt, Stone & Kottke, 2013). An internship provides avenues to apply skills learned in school and to seek venues for professional experience beyond the classroom walls. An increased awareness of the internship experience has occurred over the last decade, reflecting great interest in these programs by universities and the success of the interns by hiring organizations (Marshall, 2012; Rosario, Flemister, Gampert, & Grindley, 2013; Wanless, 2013). Half of the respondents (50%) in a national survey of employers stated universities should devote resources to developing internship programs (Hart Research Associates, 2008). In a related study, 63% of employers agreed that "too many recent college graduate do not have the skills to be successful in today's global economy" (Hart Research

Associates, 2007, p. 6). Seventy-three percent of these employers say that a student's ability to relate learned skills and information to real-world settings through internships is one of the most important learning outcomes of higher education. In this same study, 510 college graduates ranked applied knowledge in the workplace as the number one priority.

Experiential Learning Theory

Research on internships in the areas of art, architecture, and design is scarce, lacks an overriding theoretical standpoint, and is mainly descriptive. The theoretical base selected for this investigation is experiential learning, which is concerned with the integration of theory with practice. Research in this area began in the early 20th century (Radigan, 2009). It is a broad term that includes various learning opportunities, such as student organization leadership, cooperative education, faculty driven research projects, service learning, volunteering, and, of course, the internship. The internship is an instructional approach founded on the premise that ideal learning occurs by doing and through experience. Kolb (1984), an educational theorist who focuses on experiential learning, and Dewey (1934), a renowned scholar in learning processes, both contend that learning is cyclical.

Kolb and Kolb (2005) call experiential learning "above all a philosophy of education based on what Dewey called a 'theory of experience'" (p. 193). Kolb (1984) defines learning as "the process whereby knowledge is created through the transformation of experience" (p. 38), continuing that knowledge results from the combination of gaining and then transforming

experience into knowledge. Internships stem from the experiential learning social process (Kolb, 1984), which allows students to integrate new experiences into existing concepts. This thought is echoed by philosopher Schön (1983, 1984) in his writings on the "Reflective Practitioner". It is Schön's contention that individuals learn by doing design, as opposed to learning about design. Artists, architects, designers, and performers traditionally learn by doing and making. This is the basis for the predominant pedagogical approach of the studio. Shreeve, Sims, and Trowler (2010) state, "[T]he emphasis on doing is not simply about being able to produce a skilled performance but is about understanding what it means to be a skilled performer, with all the socially situated understanding that comes with that" (p. 128). Unlike a controlled educational environment (such as the design studio), Schön (1987) believes an apprenticeship or internship provides exposure to realistic conditions of practice and work where real-world practice includes "messy, indeterminate situations" (p. 4). A lack of work-related opportunities is a noteworthy problem for art and design students (Blackwell, Bowes, Harvey, Hesketh & Knight, 2001) who need an assortment of experiences that mimic work-related processes (Sterling, 2007). Though not always a requirement for graduation, design programs can include an internship in their curriculum to provide sources for evaluating program accreditation expectations (CIDA, 2020) and to better meet the needs of employers hiring graduates into the interior design industry (Gale, Duffey, Park-Gates & Peek, 2017).

The Internship Experience

There is concern by employers that college graduates have job market readiness and have experienced work-related projects (Fishburne, 2015; Sterling, 2007). In design education, experiential learning is supported through cooperative or internship programs that allow students to earn college credit for supervised professional experience. It is a type of controlled experiential learning in which the workplace becomes a learning laboratory. Academia creates curricula to increase students' employability, seen as the achievement of competence, skill, and knowledge within a disciplinary field. The internship is promoted as a way to assess and develop the raw skills needed for employment (Schoenfelt et al., 2013). Barr and McNeilly (2002) found that recruiters value internships as solid indicators of employability.

Internships provide a point of transition from a first work situation to long-term professional success (Schoenfelt et al., 2013).There is an assumption that students cannot learn all they need to learn in academia to enter the workforce. An internship extends the reach of the classroom, which provides the student the opportunity to smoothly transition into his or her discipline. Di Lorenzo-Aiss and Mathisen (1996) describe four characteristics of an internship as: 1) acquiring a set number of work hours, 2) being paid or unpaid, 3) earning college credit, and 4) having oversight by an organization's mentor plus an academic faculty member.

Three benefactors of an internship are firms, schools, and students. Firms highly value the internship experience (Rigsby, Addy, Herring, & Polledo, 2013) for reasons such as recruitment (Wanless, 2013), job experience (Coco, 2000), and the filling of a skill shortage (Patrick, Peach & Pocknee, 2008). Other reasons include to retain permanent hires, to maintain a good relationship with the school, and to differentiate their firm from the competition (Brooks & Greene, 1998). Internships help universities with student placement in industry (Verney, Holoviak & Winter, 2009) and can attract prospective students to the design program. Faculty may benefit from equipment donations, student scholarships, sabbaticals, advisory board members, consultancy work, and joint research projects (Marshall, 2012; Tufenkjian, 1999).

Students are the greatest benefactors of internships. Gault, Leach and Duey (2010) asked 185 employers of undergraduate interns about the perceived value of the internship in hiring decisions. Firms with high-performing interns perceived the value of the school's internship program higher than firms with average-performance interns. Interns who were considered high performers were more likely to receive higher starting salaries than interns considered as average performers. The variables perceived as most valuable included the intern acquiring better job skills, learning faster, and being more productive. The top three most significant predictors of overall on-the-job performance by employers were the intern's reliability, consistency, and eagerness to learn new skills. These findings support earlier research that undergraduates with internship experience have more full-time employment potential after graduation (Gault, Redington & Schlager, 2000; Reddan & Rauchle, 2012).

Internship Skill Acquisition

Internships expose students to discipline-specific knowledge. An internship can help a student develop professionalism, communication, and interpersonal skills. Additional soft skills, such as attitude and work ethic, along with the technical hard skills necessary for a profession, are in demand today (Gale et al., 2017). An undergraduate education should be balanced between broad knowledge and disciplinary skills (Hart Research Associates, 2007). Fifty-six percent of employers believe higher education should emphasize the following: integrative learning, knowledge of human culture and the world, intellectual and practical skills, and personal and social responsibility. Both employers and graduates in this same study agree that teamwork skills and critical thinking are two important workplace skills (Hart Research Associates, 2007). Beck and Halim (2008) identified the most significant internship learning outcomes as personal and interpersonal skills, with technical skills perceived as less important. Recruiters want evidence of leadership, communication, and interpersonal skills, which are largely unattainable in the classroom (Barr & McNeilly, 2002). For four years in a row, the top selection criterion in the Graduate Careers Australia (2012) survey were interpersonal and communication skills. An intern's communication ability is also a critical skill identified in other studies (Gale et al., 2017; Huber, 2018; Kelley & Bridges, 2005; Ryan & Krapels, 1997).

Financial Compensation of the Internship

A topic under perpetual debate is whether students who participate in an internship should be financially compensated. Students may prefer to be paid for an internship, as 61% of students in a study on student loan usage are working while in school (Javine, 2013). But not every firm wants to pay for interns. Companies can insist on students earning credit so they can legally be considered unpaid trainees (Lipka, 2010), which some view as unethical and exploitive (Gardner, 2010). The United States Department of Labor's Fair Labor Standards Act of 1938 (USDL, 2013) "establishes minimum wage, overtime pay, recordkeeping, and youth employment standards affecting employees in the private sector and in Federal, State, and local governments" (para. one). It further states that an employer must pay an employee for work unless that employee is considered an independent contractor or volunteer. Interns who receive training as part of their education may not be paid if several criteria are met by the company, namely if the internship experience is of a fixed duration and student work efforts are not linked to business dependency (USDL, 2010). If an internship is a legitimate learning experience, the internship could legally be unpaid (NACE, 2011). Most colleges treat the internship as a purely educational experience, yet some students are actually doing real work yet paying for college credit (Wexler, 2016).

Study Context and Internship Structure

The context for this study is an established internship program at a large urban university in the United States. The required internship experience for three college credits occurred during the summer between the third and fourth years of a four-year degree program. The internship was placed here in the curriculum, as upper division students have more substantial disciplinary knowledge to apply to their internship than younger students (Marshall, 2010).

Internship research tends to focus on the employer and what the market desires while fewer studies pay attention to student perceptions (Griffin & Coelhoso, 2019). Based on the results of Gupta, Burns, and Schiferl (2010), the individual benefits of the experience may impact the students' perceived satisfaction with the internship. In an effort to learn more about the skills acquired in an internship and the student's overall satisfaction with the experience, the following questions were generated for this study:

1. Do students experience an internship they perceive as beneficial?
2. What do students perceive as the most beneficial skills learned in an internship?
3. Is there a relationship between financial compensation and student perception of internship value?
4. Is there a relationship between financial compensation and student perception of internship preparedness?

Methodology

A homogeneous sampling strategy was chosen to focus on specific population characteristics and for a richness of information (Patton, 2002). Voluntary and confidential participation was acquired from 24 senior interior design students who had completed an internship

during the previous summer with various local, national, and international design firms. Three participants were male and 21 were female. This single set of student participants were all in their final year of a four-year undergraduate degree program. Data was collected six months after the internship experience, thus allowing time for students to reflect on their experience.

As shown in Table 1, 14 technical, professional, and communication skills were identified from the literature as likely to be gained by students during an internship experience. The skills were randomly distributed in a survey instrument using a five-point Likert scale, with 1 being very unbeneficial to 5 being very beneficial. One question about financial compensation was included on a nominal scale. Two open-ended questions about and internship value and internship preparedness were included to permit a range of data and responses. The instrument was pilot tested by colleagues and graduate students knowledgeable of research methods. Their suggested changes were incorporated into the final version. The hard copy survey was distributed in a class session taught by another instructor. The data was coded by the researcher and entered into a spreadsheet for descriptive data analysis.

Results

All skills obtained in the internship were perceived as helpful, with mean results ranging from 3.38 to 4.29 on a 5.00 scale (see Table 2). Results indicate that students valued the real-world orientation of workplace learning as the most beneficial skill (m=4.29, sd=0.75). Other top skills viewed as beneficial included a broader

Table 1
Survey Instrument Items

How beneficial was your internship to you in the following skill areas?
Broader view of industry
Career focus
Collaboration/Team-building
Confidence/Self-awareness
Exposure to complex design problems
Interpersonal skills
Professional networking
Interpersonal skills
Professional networking
Resume building/Future employability
Self-reliance/Self-motivation
Technical design skills
Time management

Verbal communication
Written communication

Payment for Internship Experience
Was your internship paid? As this anonymous, will you please tell me how much you were paid per hour?

Overall Perception of the Internship Experience
Overall, I believe my internship was a valuable learning activity that augmented my university course work.
Along with my academic coursework, I think my internship has prepared me to enter the profession of interior
design upon graduation.

Table 2
Skills Students Perceived They Obtained in an Internship

Rank	N	Mean	SD	Skill
1	23	4.29	0.75	Real-world orientation
2	24	4.25	0.90	Broader view of industry
3	24	4.21	0.66	Resume building/Future employability
4	24	4.21	0.93	Professional networking
5	24	4.17	0.64	Time management
6	24	4.17	0.76	Career focus
7	24	4.17	0.87	Confidence/Self-awareness
8	24	4.13	0.74	Verbal communication
9	24	4.00	1.05	Self-reliance/Self-motivation
10	24	3.96	0.86	Interpersonal skills
11	24	3.92	1.10	Collaboration/Team-building
12	24	3.79	0.98	Technical design skills
13	24	3.67	0.87	Written communication
14	24	3.38	1.24	Exposure to complex design problems

view of industry (m=4.25, sd=0.90), resume building/future employability (m=4.21, sd=0.66), and professional networking (m=4.21, sd=0.93). *Internship value* was measured with one item, 'Overall, I believe my internship was a valuable learning activity that augmented my university course work'. On a similar five-point scale, most students agreed with this statement (m=4.29, sd=1.13). *Internship preparedness* was measured with one item, 'Along with my academic coursework, I think my internship has prepared me to enter the profession of interior design upon graduation'. They also agreed with this statement (m=4.17, sd=1.29). *Internship compensation* was based on a self-report measure of whether the internship was paid or unpaid. Was there any relationship between internship compensation and perceived internship value? From participant responses, 14 out of 24 students self-reported they were paid with an average hourly salary of $12.00 per hour. Using a Pearson's correlation coefficient, the relationship between financial compensation and internship value was close to zero (r=0.21). According to Cohen (1992), the effect size of this relationship is low or small. The relationship between financial compensation and internship preparedness was closer to one, showing a modest positive correlation (r=0.49). This would be considered a large correlation effect size (Cohen, 1992).

Discussion

This study addressed four research questions about the benefits students perceived from a recent internship experience, as shown in Table 3. In response to the first question, "*Do interior design students experience an internship they perceive as beneficial?*", the findings showed that students responded positively to both survey questions about overall internship satisfaction (m=4.29; m= 4.17).

Similar findings about workplace skills were found in a study of 36 undergraduate business students who also completed an eight week internship experience (Griffin & Coelhoso, 2019). Almost all (95%) received credit toward their degree for their internship and viewed it as a success. Similar to work by Gupta and colleagues (2010), the individual benefits of the internship experience impacted the level of perceived satisfaction. The findings from the current study are consistent with other research that showed an internship can maximize students' potential for employment (Reddan & Rauchle, 2012), give them a more confident view of the learning experience (Blackwell et al., 2001), allow them to acquire the industry's work culture (Renganathan, Karim & Li, 2012), and offer future employees the occasion to build mentoring relationships with supervisors (O'Neill, 2010).

In response to the second question, "What do students perceive as the most beneficial skills learned in an internship?," data show the top four skills all revolved around employability. The "real world" orientation of workplace learning, a broader view of industry, resume building/future employability, and professional networking were all skills students perceive as helping them be future full-time employees. Better employability has equated to better pay and quicker full-time employment in past research (Gault et al., 2000), where findings show that participation in an external work experience provided solid exposure to career skills.

In response to the third research question of the relationship between financial compensation and perceived internship value, the study finds a positive correlation (r=0.21). However, being closer to zero and being a smaller effect size, this denotes a less important linear relationship between the two study variables. This means that if interns from this sample reported a higher pay rate, their perception of their own career preparation did not necessarily get any better. Interns paid less still viewed their internship as positive career preparation. Finally, the final research question addressed the relationship between financial

Table 3
Summary of Research Findings

Research Question	Summary of Findings
Research Question 1: Do students experience an internship they perceive as beneficial?	Students believe the internship was a valuable learning activity and that it has prepared them to enter the professional world.
Research Question 2: What do students perceive as the most beneficial skills learned in an internship?	All skills obtained in the internship were perceived as helpful, with real world orientation of workplace learning rated highest.
Research Question 3: Is there a relationship between financial compensation and student perception of internship value?	A weak relationship was found between pay and satisfaction.
Research Question 4: Is there a relationship between financial compensation and student perception of the internship preparedness?	A modest relationship was found between pay and preparedness.

compensation and the perception of student preparedness to enter the workforce. This resulted in a modest correlation (*r*=0.49) with a large effect size (around .50). This denotes a relatively strong relationship between variables. Interns reporting they were paid were more likely to feel prepared to enter the profession of interior design than students who were not compensated. Other research has shown that students who are financially compensated in their internships have a higher level of what McHugh (2017) calls

"developmental value". This variable is similar to this study's definition of preparedness, in which students use an internship to acquire more skills and develop clarity about future career goals. Yet, the same study (McHugh, 2017) reported no significant difference when correlating those with a paid internship and their personal satisfaction with that internship.

Though the national average wage for an intern is $19.05 per hour (NACE, 2019), it is understood this amount is for all professions and not just interior design. As the average hourly wage for a professional interior designer is $25.66 (USBLS, 2019), a less-knowledgeable intern's rate of $12.85 is comparable. Gupta et al. (2010) also found no significant relationship between intern compensation and interns' satisfaction. Instead, their satisfaction was more strongly related to the skills they gained. However, students in other studies have expressed negative concerns about internship compensation, time commitment, and paying for credit while "working" (Roznowski & Wrigley, 2006; Wexler, 2016). The debate over financial compensation for interns remains an active one and warrants further investigation.

Conclusion

The benefits of an internship are many and impact academia as well as industry. An important area of design research acknowledges the perceptions of interns toward their workplace experience (Gugerty, 2011). This study reported interior design interns at one school who believed their internship was valuable in preparing them to enter the workforce. As shown in Table 2, these students perceived that they received the benefits of an internship, including a real-world orientation, a broader view of industry, the ability to build their resume and increase future employability, and more professional networking. They also perceived satisfaction with the internship experience regardless of pay rate, seeing this as the opportunity to gain job-related skills. Industry executives believe colleges should better prepare graduates for success by helping them develop both broad and specific skills (Hart Research Associates, 2010). Soft and hard skills are necessary to form a well-developed designer (Gale et al., 2017; Huber, 2018).

It is recognized that significant learning can take place in industry, as learning is a continual and on-going process (Kolb, 1984). However, there is more to an internship than gaining work experience. As stated by Guile (2006), "No matter how well trained newly

qualified professionals and/or recent entrants have been in educational institutions, this does not automatically equip them to work in the creative and cultural sector" (p. 439). Beckman (2007) notes that design students learn skill sets specific to their careers, but rarely do they learn how to leverage these skills to produce a sustainable career.

As in any educational study, this study is bound by limitations. A small homogenous sample drawn from one discipline at one school limits the study's theoretical and logical generalization. Though the 14 benefits listed in the survey instrument were determined from available research, the list may exclude other skills gained by an intern. This instrument has a modest level of face validity, yet its content validity and internal reliability is low, as the survey was constructed with only one measurement for each internship skill (i.e., construct). Also, if the survey were administered to more than one group of interns, the internal validity of the instrument would be higher. Finally, some study participants had varied opinions, as evident in any standard deviation over one (see Table 2). This may also be due to the small sample size.

Future research may benefit from student responses that are confidential (rather than anonymous) in order to determine if any relationship exists between the type of firm and geographic location of the internship, along with compensation and internship satisfaction. To further broaden the scope of internship research, a survey of past interns and their supervisors may shed light on the perceptions of the internship's impact on long-term career success and satisfaction. Finally, gathering student perceptions two to three years after graduation may give a more accurate assessment of career development, as graduates would likely be beyond entry-level positions at that time.

In conclusion, both the literature and the current study support the inclusion of an internship in design curricula as a form of experiential learning. The data reported in this study can help educators determine how best to assist students in maximizing learning outcomes from this form of experiential learning. Providing exceptional internship opportunities that contribute to learning will require the ongoing attention of educators and researchers for years to come.

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The Effect of Practical Activities on Scientific Initiation Students' Understanding of the Structure of Scientific Articles: An Experience Report

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During the university term, in addition to graduation, some Brazilian science undergraduate students have the opportunity to join Scientific Initiation Programs (SI). Students are expected to be able to develop scientific writing skills. Based on these goals, this descriptive study aimed to investigate the efficacy of practical activities for SI students on the topic of the structure of scientific articles, using a qualitative approach via a case study. Five female students, who were aged between 20 and 30 years and enrolled in a Food Engineering undergraduate course, participated in the study. The students attended two meetings. In the first, texts that dealt with the structure of scientific articles were distributed, followed by a scientific bingo game. The second meeting focused on the creation of concept maps. The activity methodologies used allowed the SI students to remember their previous knowledge about the subject and generate new knowledge. The association between the two activities provided a better understanding of the subject. It was concluded that educators should seek new ways to introduce the understanding of topics that are part of the student's daily life and that practical activities usually generate a positive result because they are dynamic, interactive, and undertaken in groups.

Introduction

Schooling plays a central role in human development, with the educator as an intermediary in this process (Berbel, 2011). Demo (2011) describes the educator as an individual who has scientific knowledge yet can still perform those activities specific to teaching. The educator, therefore, should be a research education professional, as this is the basis of the emancipatory proposal, that is, to seek to build self-sufficient, critical, self-critical and participatory individuals through research. Furthermore, according to Berbel (2011), scientific research activities in Brazilian universities, such as the Scientific Initiation (SI) and Course Completion Works (CCW), are types of active methodologies, which comprise ways to develop the learning process in order to solve problems or challenges in scientific learning. These types of experiences are very important to enable students to grow beyond "common sense" and develop intellectual skills, from the simplest to the most complex. As stated by Seung, Choi, and Pestel (2016), scientific research activities, such as chemistry investigations, are often performed in laboratories. When introduced to this space for the first time, students can begin to understand what professionals do in this environment and what skills they will need to develop. When undertaking research, students under supervision have to acquire new knowledge and come to be able to conduct original investigations (Seung et al., 2016).

The purpose of scientific research programs is to solve the everyday problems of students or the community to which they belong. These processes aim to enable students to be active, learn new techniques and methods, and acquire permanent knowledge (Bolat, Türk, Turna, & Altinbas, 2014), as well as to be able to

observe, investigate, formulate hypotheses, and collect and interpret data (Seetee, Coll, Boonprakob, & Dahsah, 2016). Franco and Pimenta (2016), based on studies by Freire (1996) and Charlot (2000), confirm that teaching activities generate better results when based on research processes. This process consists of problematizing the proposed topic, while taking into account the reality of the student, in order to provoke reflection and critical thinking. The educator, as a mediator of the learning process, should consider the student's curiosity, since this attitude can trigger questions, knowledge, and reflection.

For Capalonga and Wildner (2018), education plays the role of preparing students for the world of work. Given this fact, there is a need to consider the reality of students and the education-work relationship to create individuals who are well adapted for both their personal and professional lives. Vocational education is attuned to this perspective, offering training in both theoretical and practical skills.

However, the experience of carrying out scientific work usually happens after a student graduates. In this phase of the student's school life, there is often a lack of preparation for reading and writing scientific texts (Yamaguchi & Furtado, 2018), and Oliveira, Batista and Queiroz (2010) state that these difficulties are usually recurrent, pointing out that, frequently, not even educators have been instructed in this practice during their own academic training. Even in graduate school there are gaps in scientific writing, research, and the publishing process (O'Hara, Lower-Hoppe, & Mulvihill, 2019).

In light of this issue, the objective of this study is to examine how students may identify and learn the appropriate structure of scientific articles, based on a theoretical foundation and obtained through practical activities. Volpato (2015) brings that the publication of

scientific articles in reputable journals is a way for the researcher to divulge their ideas around the world. Matte and Araújo (2012) also consider the valuable weight of article production to the resumé in standing out from other productions such as projects, summaries, and reports. However, the ability to write is still a scientific barrier in all levels of educaion. Considering this issue, can educational games and concept and mind maps contribute to teaching and learning? This type of resource in the classroom favors knowledge-building by the students themselves, in which previous knowledge is related to new knowledge (Grübel & Bez, 2006). To this end, students participating in SI were studied in the laboratory of a Brazilian public institution while reading scientific articles and creating a bingo game and concept maps.

Method

This descriptive research study utilized a qualitative approach via a case study. According to Godoy (1995), qualitative research places value on the contact of the researcher with the environment and the situation investigated, thereby taking interest in the process and not only in the results or product. Case studies can be defined as the study of particular individuals, professions, conditions, institutions, groups, or communities with the aim of establishing generalizations (Lakatos, 2017). Observation was used as the data collection technique in accordance with the author, who stated that the purpose of this technique is the acquisition of information in order to have a vision of the aspects of reality.

Five students who were linked to the Scientific Initiation Programs of a Brazilian public institution and who had developed projects in the Biocomposite and Bioprocess laboratory were invited to participate in the present study activities. In this institution, research focusing on the field of food is carried out by students at the Scientific Initiation, Master, and Doctorate levels. The profile of the participant group was composed only of females aged between 20 to 30 years. One student was undergoing her first experience with SI, while the others had previously been involved. All participants were studying Food Engineering.

Two meetings took place at the research lab itself, on May 30 and June 6, 2019, and lasting one and a half hours each. The subject matter and location of the research were chosen through an informal conversation with the campus SI coordinator and the lab supervisor, who provided the space for the activities to take place. When the supervisor was asked about the main difficulties experienced by the students in the research environment, scientific writing was mentioned, which confirmed the findings of previous research by Yamaguchi & Furtado (2018) and Oliveira and colleagues (2010).

First, an electronic questionnaire was sent to confirm the difficulty that had been expressed by the supervisor. The questionnaire comprised the following question: "What are your biggest difficulties in relation to scientific writing?" and answer options: a) "structure of the scientific article;" b) "structure of abstracts;" c) "tables;" d) "graphics;" e) "other, please describe." In this questionnaire, most respondents indicated that they found that the structure of the scientific article was their main obstacle.

Consequently, it was established with the participating students that the structure of scientific articles would be considered during the two meetings, based on the book *Scientific Articles: How to write, publish and evaluate* by Maurício Gomes Pereira (2011), and with the aim of contributing to the writing up of research carried out through SI projects. When asked about undergraduate subjects that address this type of topic, it was found that the students were offered only one module that focused on writing, and scientific methodology, which is taught in the first period of the course. Based on the initial contact made with the students, three activities were proposed: 1) a brainstorming session; 2) the creation of a scientific bingo game, and; 3) the construction of concept maps. The proposed activities sought to verify student learning through games and concept maps. Zabala (1998) emphasized that learning activities should provide different ways to relate and interact and, as an example, cites the discussion and communication parts of such activities.

First Meeting: Presentations, Brainstorming and the Creation of a Scientific Bingo Game

The first part of the data collection involved a presentation by the researcher to the students, the examination of the structure of a scientific article, and the creation of the bingo game. On this occasion, the importance of undertaking the SI experience during the undergraduate course, the benefits and knowledge it provided for comprehensive student education in the sciences, and possible future referrals, either in the job market or in graduate education, were discussed. Participation in other colleagues' research was also discussed, where new concepts, changes, and perceptions could often only be generated through the knowledge of that group of individuals.

Each student was initially asked to introduce herself by stating her name, identifying her course, and stating whether or not this was her first time attending the SI. It was found that although the undergraduate students were more involved in the practical part (experiments) than in the writing of scientific texts, they were interested in learning more about the basic concepts of the structure of scientific articles and contributing more effectively to its writing.

The researcher then informed the students about the purpose of the study and that participation was voluntary, and the five students present provided informed consent to take part in the activities. The students also signed an image use authorization form, to give consent to the images featured in this experience report.

Five articles by Maurício Gomes Pereira, published in the *Epidemiology and Health Services Journal*, were distributed. The areas of focus in each article were the summary (Pereira, 2013a), introduction (Pereira, 2012), method (Pereira, 2013b), results (Pereira, 2013c), and discussion (Pereira, 2013d) sections of scientific articles, which were chosen and divided among the participants for reading.

After reading their individual texts, the brainstorming session began, which consisted of each one of the five students exposing and explaining to the others present what they had read. This allowed each student both to express what most caught their attention and their doubts and to interact with their colleagues about their thoughts. This activity sought to investigate the reading, comprehension, and interpretation of the text in question, as well as to allow each individual to express themselves.

Following the group presentations, each student wrote five questions and answers on the topic she had presented on an A4 sheet. The researcher's guidance at this stage was for participants to ask questions that had objective answers (one word) about the section of the scientific text that had been given to them. Collective work was observed during the execution of the tasks, where those who finished first volunteered to help those who were having difficulties in carrying out the activity. All the materials needed, such as paper, rulers and pens, were made available. Subsequently, cardboard sheets were provided to make the scientific bingo game. Participants were asked to divide the space into six squares and write in each a response that was included in the list of questions and answers.

Once finished, the questions and answers were placed in a box, and the researcher began the draw of the questions. As each question was drawn and read, the students were required to mark the answer on their card in order to check if they had understood what was said in the brainstorming session sufficiently to choose the correct answer. At the end of the activity, there was one winner who had completed the entire card correctly.

Second Meeting: Construction of Concept Maps

Between meetings, the students were tasked with undertaking some research on what a concept map is and with creating their own map according to the topics of the article section they had discussed in the first meeting. The students were informed that they could research and construct the map as they preferred. One week later, a second meeting was held with three of the students in order to discuss what a concept map is, the kind of tools they had used to create their maps, whether there was a need for extra information after the presentations, and if they understood the objectives of map-making.

During this meeting, the concept maps on the structure of the scientific article were presented and discussed and a questionnaire with three open questions was distributed to identify how students evaluate the educational practices they had performed during the meetings. Open-ended questions provide freedom for research subjects to respond with their own language and voice their opinions as individuals. This questionnaire was designed to extract from the participants what they thought of the activities performed, how they conducted the steps of the activities, what were the main difficulties they encountered, and if the activities had contributed to the understanding of the structure of scientific articles. The students were asked not to identify themselves in the questionnaire to ensure confidentiality and privacy.

Results and Discussion

This experience report aimed to provide an understanding of the development of knowledge about the structure of scientific articles by using a target sample of undergraduate students of SI who have undertaken research in a Biocomposite and Bioprocesses laboratory. As mentioned in the method, two meetings were proposed for the appropriate development of the activities. Of the six students who were linked to the SI in the lab setting of our research, five participated in the first meeting and three in the second.

In the first activity, the brainstorm, it was observed that the session's objectives were achieved: the students showed a good understanding of the subject matter, were able to express themselves in public, and were able to relate what they read to past experiences (Figure 1). During the initial presentation, recaps of everyday situations emerged, and the students' previous ideas on the subject of scientific writing were confronted with new knowledge. This is in accordance with Zabala (1998), who recognized that it is essential for students to express their ideas, and from that standpoint, review their previous ideas, and allow themselves to expand their knowledge while recognizing their limitations, and if necessary, modifying it.

In the second activity (Figure 2), the preparation of the questions and answers for a scientific bingo game and the creation of the bingo cards took place. The biggest difficulty reported during the production of Q&A was consolidating each answer into a single keyword in order to be transcribed to the bingo card. During the game, moments of concentration were observed as the students attempted to understand what was being asked

Figure 1
Reading of texts on the appropriate structure of scientific articles.

Figure 2
Preparation of questions for the scientific bingo game and the creation of the bingo cards.
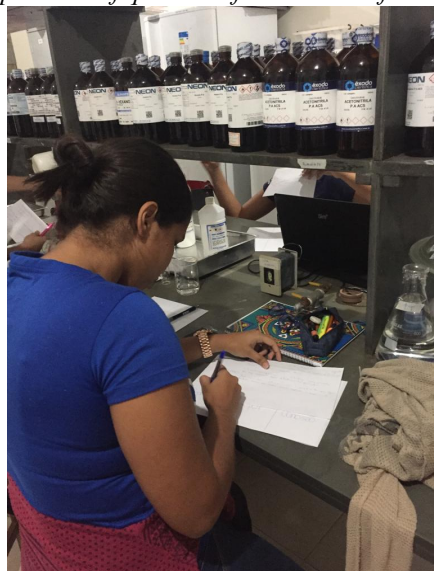
and to interpret the correct answer to mark on the card. Moments of relaxation and competition to complete the bingo card first were also noted.

In the second meeting, the presentation and discussion of the conceptual map of the structure of each section of a scientific article took place. Each student presented her constructed map and explained how she had made it. The following characteristics were observed in this activity: construction of both a conceptual (Figure 3) and a mental map (Figure 4 and 5), manual creation of maps, and student collaboration, even though the activity was performed outside the lab. The students explained that they had searched the Internet to obtain information on what a concept map is, but that they had also made mind maps simultaneously. Regarding the use of maps, the students mentioned that they rarely or never used conceptual or mental maps in the subjects they were studying but could understand the purpose and importance of such learning instruments.

Figure 3
Concept map on the introduction of a scientific article
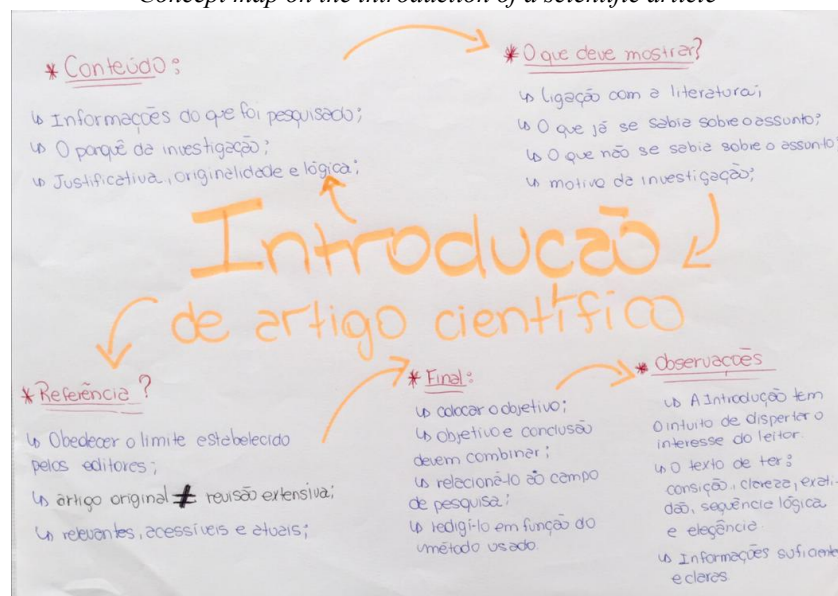
Figure 4
Mind map on the results section of a scientific article
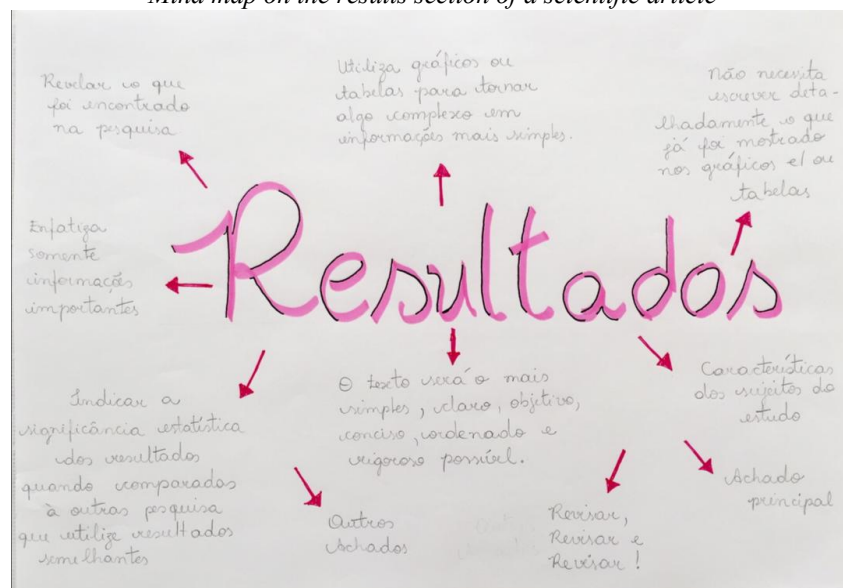
Recognizing the differences between a concept map and a mind map is important for students since different goals can be achieved through each tool. Mind maps are graphical representations intended to express how a given subject is thought of in a quick manner and with a well-defined central topic. The central idea should be placed in the middle, and the others should be linked to the initial word only by a keyword, forming a kind of "web". This type of map is more closely related to the memorization of a topic than to the effective understanding of the subject (Silva, 2015).

Concept maps, on the other hand, are graphic constructions that aim to show the relationship that unites two concepts. To construct the concept map, students must have knowledge about a certain topic (Ministério da Educação Brasil, 2014). Silva (2015)

lists some ways in which concept maps can be useful for students and educators alike. For example, for students, they can assist in the process of studying for an assessment through the process in which the student organizes and hierarchizes the subject. For educators, concept maps can be helpful when teaching something new about a subject where it is necessary that students start from a position of previously understood knowledge, seek to make connections, and establish hierarchies of concepts.

The concepts represented in the concept maps come from scientific definitions; however, Silva concluded that there is no right or wrong map, but that more elaborate maps demonstrate more detailed knowledge about the relationships between the concepts presented. Good concept maps are those that establish a relationship of concepts from the main topic while also presenting a large number of connections (Tavares, 2007).

Also, according to Tavares (2007), the act of constructing a concept map can reveal more clearly a student's difficulties with a subject, and the student will, as a result, seek other ways to answer their queries so that they can create their map. This favors the creation of meanings, and constant practice in developing concept maps will provide students with autonomous learning. To support the construction of maps, theorist David

Ausubel, a North American psychologist, presented his contributions to education with the Meaningful Learning Theory (MLT), which can be taken into account in the creation of the concept map.

Ausubel emphasized learning from the cognitive perspective, which comprises the organized absorption of information in the mind of the individual that is learning. Based on this, he dedicated his attention to learning in the school environment, reinforcing the idea that student learning starts from already established knowledge, and that the understanding or proposition of a concept cannot be merely obtained through the verbalization of concepts or their fundamental elements (Moreira, 1999). An example of Ausubel's theory through the creation of concept maps in the room was the study of Aquino and Chiaro (2013), who used the construction of maps with high school students on the subject of radioactivity. After the creation of the maps by the students and discussions on the subject, it was observed that the preparation of the maps helped the students in teaching and learning concepts, in addition to directing the pedagogical practice of the teacher. This study confirms what Ausubel's theory says through other classroom studies, establishing that concept maps are an effective means of developing understanding about new topics, with specific reference to science education.

Figure 5
Mind map about the discussion section of a scientific article
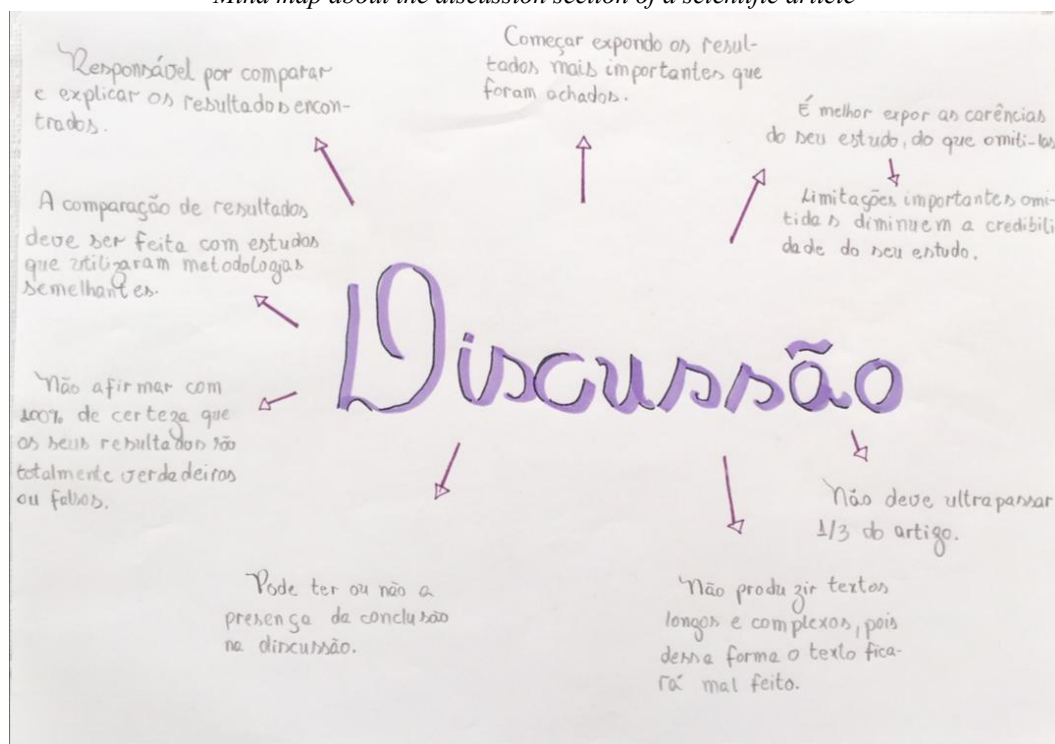
Table 1
Did the Activities Performed (Educational Practice) Help You Learn About the Structure of a Scientific Article?

Student	Comment
Student 1	"Yes, because when we discuss something in a group, we can better solidify the information exchanged, and it will be difficult to forget it so easily. In addition, I got a simpler and clearer view on how to "assemble" an article."
Student 2	"Yes, because through group discussion it is possible to better assimilate the subject. The article was easy to read and understand. [The activities] also made it possible to create a didactic concept map."
Student 3	"Yes, these activities have helped me to clarify doubts I previously had about writing and also helped me to pin down information [I had already learned]."

Table 2
What is Your Opinion on the Way (Methodology) in Which the Activities Were Conducted?

Student	Comment
Student 1	"Intelligent. When you put a group together to discuss a particular subject and to examine and memorize topics that add to our academic life, for example, we become more efficient. Congratulations!"
Student 2	"The activities were conducted in a dynamic and integrated manner. Everyone in the group participated and reviewed what was learned."
Student 3	"The methodology used in these activities was simple to carry out. It was not boring or tiring and without realizing it, we had learned new things."

Table 3
What Were the Methods for and the Difficulties of Carrying out the Proposed Activities?

Student	Comment
Student 1	"Methods: talking and discussing issues. Difficulties: the concept map, given the fact that it is not something I often use."
Student 2	"In the first activity, when asked to formulate questions about the text which needed to be answered with just one word, there was great difficulty. Understanding the subject and creating the concept map were the easiest parts."
Student 3	"The reading and the bingo dynamics were easy. The biggest difficulty was in making the map since I had never done one before, but even this was not difficult to do."

Throughout the observation of the activities in this study, a good relationship between the students was seen, and when the tasks were proposed, they demonstrated not only an understanding of what was requested, but also initiative and a spirit of cooperation. To finalize the research, a questionnaire was distributed to examine the students' perceptions of the activities carried out. Three students answered the questionnaire, and the answers obtained are in agreement with the observations made. Tables 1, 2 and 3 show the questions formulated and a transcript of the answers.

It was also observed that the students were able to work in groups and that they considered the exchange of information important. As for the way the activities were performed, the students used words such as "intelligent", "dynamic", and "simple". Regarding the methods and difficulties, it was observed that some had the faculties to expose and discuss the proposed subjects, while some found difficulty in the synthesis of a single word to make the bingo card and in the construction of the concept map.

It is observed that for the practical activities to happen the researcher teacher of the group must look for ways to interact with the students and also search for alternatives to solve basic barriers, such as scientific writing. Rushton and Reiss (2019) evaluated the changes from teacher to researcher teacher in the UK, in total 17 participants. The changes were positive because they demonstrated that teachers involved in research can be beyond the classroom professional to being a scientist, mentor and coach. They emphasize the relationship between teachers and students involved in scientific research projects, where the research teacher sees the research experience as a valuable opportunity to develop skills and knowledge with students, as well as the possibility of developing an authentic project. Therefore, the teacher has a crucial role for the engagement of students in the scientific

research and the students in the teacher's life, contributing to the search for real problem solutions.

Final Considerations

The activities carried out in this study allowed SI students to understand the theory-based structure of scientific articles and to subsequently apply it in practice. Given the observations made during the study's activities and the answers obtained through the questionnaires, it can be inferred that the objective of learning the stages of scientific article construction through the bingo game and the concept or mental map was achieved successfully, in addition to being well accepted by the students.

This study might be useful for teachers who are looking for new ways of teaching content to students. The exploration of knowledge through practical activities on topics considered by some as being difficult, such as the writing of scientific articles, can be accomplished through mental and conceptual maps, as well as brainstorming in the Scientific Methodology classes.

During such activities, students feel at the center of knowledge production while actively talking and exchanging information, therefore building an environment of learning and cooperation. The activity methodologies are well accepted because they take the educator/advisor from the main role and place the student as the protagonist of their teaching and learning process.

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Examining the Digital Professor's Use of Technology and the Required Support

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This study explored faculty perceptions on the challenges and opportunities to engage and support digital natives, the new wave of students to include individuals who are now pursuing post-secondary education at colleges and universities across the country. The study also examined faculty perspectives on the kinds of support systems that they believe are most important to facilitate meaningful learning experiences in the classroom at a Southeastern University in the United States. Results indicate that institutions must have an enabling environment to help with greater integration and use of digital technology on campus. The data also showed there is need for strong operational support and tailored coaching to help faculty achieve desired learning outcomes in their assigned courses. Finally, the study found that a focus should be placed on creating a sense of a learning community among faculty and their peers to achieve the goal of sustained adoption and use of digital technology within a university.

Introduction

At present, faculty members at colleges and universities across the country face the major challenge of finding ways in which to engage, motivate, and coach today's learners inside and outside the classroom (Knepp, 2012; Rutledge, Crawford, Ford & Rausch, 2018). These students, often referred to as digital natives are said to be technologically social and always connected (Coleman, 2011; Howe & Strauss, 2000; Negron, 2017; Seemiller & Grace, 2016). This is because these digital natives grew up using a wide array of information and computing technology (ICT) systems and tools in all aspects of their lives (Toothaker & Taliaferro, 2017). Digital natives are known to be comfortable with smart phones, social media, tablet PCs, game boxes, and digital readers. As a result, academic institutions across the country now seek to offer a variety of training and support services to strengthen faculty's skills and capability for using or integrating digital technologies in teaching and learning to better support the generations of students on campus who are known as digital natives.

According to Bowen and Watson (2017), prior to the broad acceptance and use of the Internet, faculty members were provided very little training and support in the effective use of tools and technology in the classroom. At present, however, faculty members, and most specifically those who teach online, are offered the training and support required to create active and hands-on learning experiences with the use of modern technology (Kopcha, 2010). Yet, research shows that the successful integration of technology in instruction depends on many factors. At the top of the list of those factors is instructors' perceptions of the benefits of technology to help engage learners in classroom activities (Dougherty, 2015; Johnson, 2019). Therefore, as the use of technology in education has become more widespread, training and professional development of faculty must take center stage (Lawless & Pellegrino, 2007).

Scholars and researchers, such as Allen and Seaman (2013) and Rebora (2016), have noted that many faculty members are not yet embracing the idea of increasing the use of modern digital tools and technologies in teaching and instruction. According to Purcell (2014), many instructors currently use computers and mobile devices mainly to conduct online searches related to fact-checking. Rebora (2016) and Bowen and Watson (2019) specifically argue that ICT tools are often used on basic activities such as drill and review and therefore can actually hinder meaningful learning in the classroom.

Some faculty at higher education institutions are often resistant to change. Even so, as Bowen and Watson (2017) have argued, there should be clear and valid reasons for integrating new technologies or instructional practices in the classroom. In addition, research shows that sound pedagogy and clear instructional approaches are essential and necessary conditions to soliciting students' engagement and participation in the learning process (Chickering & Gamson, 1991; Gagné, 1985; Grasha, 1996). Therefore, faculty culture, as well as the level of support offered at their institutions, must be taken into consideration to create an effective, enabling, and nurturing learning environment for digital natives who are now studying at colleges and universities across the country.

In the next sections of the paper, we highlight the background and the level of technology use by digital natives. We will also discuss the needs and objectives for the revitalization of the professional development and training of faculty in higher education while exploring the impact of academic culture on adoption of innovations and use of appropriate pedagogy to fully engage digital natives in the learning process and the higher education classroom. We then present findings from the study and, most specifically, highlight faculty's

perceptions on the kinds and types of support that are most beneficial to them with regards to integrating and using digital technologies in the classroom.

Literature Review

Digital Natives and Academia

The overwhelming majority of students on today's campus, known as Gen Y'ers and Z'ers, have great facility with many digital tools and applications (Negron, 2017; Seemiller & Grace, 2017). Collectively known as digital natives, these students grew up having unlimited access to the Internet and computing and information applications (Allen, Allen, Karl & White, 2015; Cilliers, 2017; Rothman, 2016; Seemiller & Grace, 2016). Digital natives use a wide variety of information and computing technologies, such as smart phones, Social Media, tablet PCs, connected video game boxes etc. in practically all aspects of their lives at an early age (Burgess-Wilkerson, Hamilton, Garrison & Robbins, 2018). Digital natives are thus very accustomed to interacting with technology and doing multiple things such as communicating with peers, searching for information, and using multimedia simultaneously (Seemiller & Grace, 2017). Gen Y'ers and Z'ers who are termed digital natives began using iPhones at an early age and are known to prefer texting instead of using email (Venter, Carin & Myburgh, 2018). Therefore, the pedagogical implication for that generation of students involves ways in which to help them stay engaged and connected with instructional activities and learning experiences that occur inside or outside the classroom whether face-to-face or online (Tanaid & Wright, 2019).

Digital Natives and Competency with Academic Technology

In the last few years there has been a strong and vigorous debate concerning whether the constant use of and dependence on social media, messaging, Internet, and similar communications devices by digital natives can translate to proper and effective use of technology in academia (Margaryan, Littlejohn & Vojt, 2011; Prensky, 2001; Rothman, 2016). While some researchers accept that digital natives have great facility with technology in general, others argue that they exhibit some challenges with key academic tools and applications that are widely used in the academic setting. For instance, Anderson (2018) and Twenge (2017) offer that, despite greater use and familiarity with technology, digital natives often lack strong learning technology and information management skills. Doucette (2018) notes, "[Gen Y'ers and Z'ers] may be tech wizards in some areas, [yet] many [of

them] lack the digital literacy skills to be conscientious, responsible media consumers and members of the professional arenas they'll soon be joining." Indeed, while digital may be fluent with technologies and at ease with social media, according to the literature, this does not mean that they have the knowledge and the skills to be self-directed learners. Moreover, recent research argues that there is a need to avoid "myths that perpetuate unfounded generalizations about cohorts... and [that] minimize the unique needs of individuals" (Jauregui,Watsjold,Welsh, Ilgen & Robins, 2020).

New Approaches to Engage Today's Learners Still Needed

Given some of the unique profiles and characteristics of Gen Y'ers and Z'ers or the digital natives, there is a need for higher education institutions to adjust instructional support and delivery practices to meet the needs and requirements of these students (Pološki Vokić & Aleksić, 2020). As important, faculty need to be adequately trained and supported so that they can be prepared to help all of their students to fully engage in learning activities inside and outside the classroom (Davis, 2011). According to Keengwe, Kidd, and Kyei-Blankson (2009), digital natives are thought to view, consume, and process information differently than the preceding generations to include Millennials and Baby Boomers. As offered by Moran (2016), students on campus today exercise greater independence and autonomy in their learning preferences. However, other researchers do not support the view that the new generation on campus represents a different type of learner despite their constant, and almost ubiquitous, use of technology tools and other gizmos (Bowen & Watson, 2017; Fink, 2013).

While there are different ideas and perspectives on how the digital natives actually learn, it is nonetheless important for higher education to continue to integrate and use modern ICT tools and applications in the classroom (Hannay & Fretwell, 2011; Toothaker & Taliaferro, 2017). This is because there is a need to engage and motivate the new wave of students in higher education who bring a very different approach to information consumption and use to academia. In addition, given the acknowledged importance of fluency with technology for the 21st century workforce, faculty must have the required skills and capacity to create learning experiences that will help prepare the Digital Natives for their post-collegiate lives (Malat, 2016).

Faculty Preparation and Readiness for Digital Natives

Faculty members face many challenges in trying to promote student involvement and active engagement in

the learning process, particularly in online courses (Granberg, 2010). In a recent survey conducted by the Educause Center for Analysis and Research (ECAR), students found faculty technology skills to be adequate (Dalstrom, 2015; Pomerantz & Brooks, 2017). Yet, the survey also offers that students' activities frequently excluded problem-solving and critical thinking tasks (Raths, 2017). Moreover, Levin and Wadmany (2008) found that faculty uses of technologies mainly involved managing and organizing class instruction as opposed to placing emphasis on learning and outcomes. Other researchers have found that many faculty members use technologies for online document sharing tools that foster student collaboration (Ajjan & Hartshorne, 2008). Ajjan and Hartshorne (2008) also found that faculty believe that technology use in their instruction not only improved student learning, but that the quality of their teaching also improved. The good news is that as learning technology continues to take center-stage in all areas in the higher education environment, past resistance to technology among faculty is giving way to growing acceptance of integrating technology (Dysart & Weckerle, 2015). In addition, many faculty members are becoming more aware of the opportunities technologies can afford in eliciting student behaviors that foster deeper learning (Adams Becker et al., 2017; Granberg, 2010). Nonetheless, faculty need to have the appropriate training to use these technologies. Research shows that although faculty are committed to using technology in their instruction, the learning curve can be high. Moreover, most modern learning technologies require time to master. Thus, many faculty members find it beneficial to rely on their peers from their discipline to learn new technologies (Griffin-Sobel et al., 2010; Schlager & Fusco, 2003).

Faculty Adoption and Use of Technology

In his seminal work on adoption and use of technology, Rogers (1983) offers that adoption and use of new technology tend to follow a standard approach beginning with innovators, followed immediately by early adopters, then early majority and late majority, and finally laggards. Rogers' model has generated considerable debates over the years. Critics of the model have argued that it presents an overly simplified representation of a complex reality and carries universalistic assumptions about human behavior (Liao, Palvia & Chen, 2009). Further, Rogers' use of labels such as "innovators" for groups who readily adopt new technologies indicate that some groups have a preference for novelty items and new trends (Lundblad, 2003). Despite the criticisms, the model provides a useful means to gauge potential reasons for the lack of adoption of new technology amongst specific groups of people (Sahin, 2006). Moreover, faculty appear to especially appreciate opportunities to observe the work of peers and to obtain feedback on their technology integration efforts (Koehler & Mishra, 2005; Schlager & Fusco, 2003). Thus, peer coaching is instrumental for offering sustained, ongoing assistance to faculty throughout their development from novice to experts (Mulholland & Wallace, 2005; White, Howell, Kunz & Nugent, 2015). Sufficient evidence exists to support that it can be very productive for the novice instructor to observe the practices of a more accomplished colleague (Gibbons & Cobb, 2016). Research by Hansman and McAtee (2014) shows that faculty who have worked with coaches demonstrate improved teaching as they employ more active engagement strategies, higher order questions, and differentiation in selection of instructional material and skills for their students. Nevertheless, in spite of that, faculty face challenges in trying to foster active engagement and promote greater student involvement in the learning process (Granberg, 2010).

The Modern Classroom and Faculty Training and Development

The integration and use of advanced learning and instructional technologies are key aspects of the modern classroom teaching and learning environment. For example, most schools nowadays have tools and applications that can be used by faculty to help students connect, communicate, share learning contents, and collaborate with each other in a much multifaceted fashion than they were able to do in the past (Davis, 2011; Dede, 2005). McKenna, Avery and Schuchardt (2000) highlight many advantages for integrating technology into instruction such as providing a new way of thinking and communicating for both students and professors, expanding the emphasis on problem-solving, and enabling the learning of higher-level skills. These include embedding learning in relevant contexts, critical thinking, goal-setting, planning and self-monitoring.

However, the traditional approach to training faculty often falls short with regard to helping them apply the available tools and applications in teaching and learning correctly (Koehler & Mishra, 2005). On an optimistic note, with the increasing number of college faculty teaching online, the acceptance of integrating technology use in instruction is growing (Dysart & Weckerle, 2015; Lederman, 2018). Even so, a strong need for appropriate training regarding the use of new and modern advanced learning technologies still exists.

Technology Adoption In the Context of Faculty Culture

Although faculty are committed to using technology in their courses, the perceived learning curve can be high as most modern learning technologies require time to

master the nuances and uniqueness of their graphical user interfaces, software interfaces, data exchanges, and network communication processes. As Rogers (1983) presented, there is a life cycle for the adoption of technology. Moreover, faculty often value learning and sharing with peers with whom they can interact and discuss relevant issues in Communities of Practice (Terosky & Heasley, 2014). These communities are comprised of learners with different levels of knowledge and expertise where novice learners can engage at the periphery and move toward the center as their knowledge matures (Lave & Wenger, 1991). Thus, an understanding of faculty culture is extremely important to gauge their disposition and orientation to adopting and using new learning technologies in the classroom. Furthermore, it can be concluded that faculty are poised to using technologies based upon the perceived support from their social environment and their involvement in the decision-making process of selecting and deploying new tools and applications in teaching and learning (Samarawickrema & Stacey, 2007; Schlager & Fusco, 2003).

Method

Research Questions

Given the increasing number of native digital learners on today's campuses, knowledge and use of digital tools and applications have now become very important aspects of the teaching and learning experience at practically all higher educational institutions. However, despite increased levels of investments in technology, engaged teaching and learning continue to lag in the classroom and online (Koehler & Mishra, 2009). As a result, there is a need to understand how academic culture, level of technology adoption, and professional development of faculty stand to influence sustained integration and use of technology in the classroom (Keengwe et al., 2009). While there are many factors affecting faculty's adoption and use of modern learning technologies in the classroom, this study was guided by the following two questions:

1. What are the reasons faculty choose to use digital technologies in instruction?
2. What are the types of support needed by faculty to facilitate their integration and use of digital technologies in teaching and learning?

Research Design

A basic qualitative research design was selected for the study. Merriam and Tisdell (2014) assert that such a design is derived philosophically from constructionism, phenomenology, and symbolic interaction and that it is used by researchers who are interested in "(1) how people

interpret their experiences, (2) how they construct their worlds, and (3) what meaning they attribute to their experiences." This research design can also help uncover in depth meanings that faculty apply to the context of using digital technology use in teaching and learning. Merriam (2009) offers: "The overall purpose is to understand how people make sense of their lives and their experiences" (p. 23). Data for such a design approach are collected through focus group interviews and analyzed inductively to address the research questions, therefore a basic qualitative research design provides a means for participants to express their experiences in their own voice (Merriam & Tisdell, 2014).

Site of Research

The study was conducted at a Southeastern University in the United States in the spring of 2018. The institution is classified as a higher research activity by the Carnegie Classification of Institutions of Higher Education. As a result, participants in the study represented a diversity of viewpoints, backgrounds, training, and teaching orientation with regards to the adoption and use of technology in teaching and learning.

Participant Selection

Purposive sampling was used to select participants for the study. Through the help of the Director at the Center for Teaching and Learning at the University, a list of faculty members who had who were known users of technology in their classes were obtained. Emails were sent to those faculty members inviting them to participate in a focus group for the study. Dates and times were coordinated to include as many of the faculty as possible who agreed to participate. Some faculty that agreed to participate could not attend due to extenuating circumstances. All faculty members who participated in the study were employed at the same university. Table 1 below presents demographics information and other characteristics of the participants in the study.

Data Collection Methods

Two separate 45-minute focus group interview sessions were conducted, and both were audio recorded. The same interview protocol was administered with semi-structured and open-ended questions. One group was comprised of five faculty members, and the other group consisted of three faculty members. The focus group interviews were moderated by a doctoral graduate assistant, who facilitated and jotted notes, and an assistant moderator, an Associate Professor of the Instructional Systems Technology program at the university who also took notes. Both interviews were conducted in the same conference room at the

Table 1
Focus Group Participants

Participant	AD ***	PMT	PLT	YT	YTB/H	YTFO	A/U T	FG
Senior Lecturer	Biology	Face-to-Face	Under-graduate	9	NA	NA	Early Majority	A
Professor	Marketing	Face-to-Face	Under-graduate	29	NA	NA	Early Majority	A
Teaching Professor	Chemistry	Face-to-Face	Under-graduate	18	NA	NA	Early Majority	A
Assistant Professor	Education	Online	Masters/Doctoral	10	4	6	Innovator	A
Associate Professor	Psychology	Online/Hybrid	Under-graduate	31	5	8	Innovator	A
Assistant Professor	Educational Research	Hybrid/Blended	Masters/Doctoral	NA	1	3	Early Majority	B
Teaching Assoc. Prof.	Computer Science	Face-to-Face	All	NA	10	NA	Early Adopter	B
Clinical Asst. Prof.	Education	Online	Masters/Doctoral	22	5	12	Innovator	B

*** *AD: Academic Discipline;* **PMT:** *Primary Method of Teaching;* **PLT**: *Primary Level of Teaching;* **YT**: *Years Teaching;* **YTB/H:** *Years Teaching Blended/Hybrid;* **YTFO:** *Years Teaching Fully Online;* **A/UT**: *Adoption and use of technology (Self-identification based on Roger's Diffusion of Innovation);* **FG:** *Focus Group A or B*

university. The conference room had adequate seating where the participants could spread out and face each other as a means to encourage them to engage each other in discussion.

Data Analysis

Data analysis was primarily inductive and guided by the literature review conducted for the study. Audio recordings were transcribed verbatim and reviewed. The qualitative data analysis approach we adhered to was Smith, Flowers, and Larkin's (2009) Interpretive Phenomenological Analysis (IPA) of placing focus on the group interviews to generate initial themes and codes in search of patterns across data sets. Data analysis involved a close reading of both faculty focus group interview transcripts. We began analysis of the transcript data by manually selecting raw words, phrases, and statements that were repeated, simultaneously grouping them to form codes related research questions of the study. The next phase of analysis involved examining codes to develop categories by grouping words and statements with similar meanings. During the process of categorizing codes, relationships between categories were examined. From this point, themes and sub-themes were formed based on common phrases and statements from the transcripts. The process of constant comparison was utilized to identify how other pieces of data could be grouped and categorized, as described by Ezzy (2002).

Results

Q1 asked: What are the reasons faculty choose to use digital technologies in instruction?

To answer that question, we reviewed the data and looked for emergent themes and sub-themes from the answers provided by the participants that touched on the reasons that they choose to use digital technologies in instruction. As shown in Table 2, three major themes and six sub-themes came out of the answers provided. Below are sample of comments provided by the participants with regards to the reasons that they choose to use technology in their courses. The comments are broken down by the themes and sub-themes that emerged from the data analysis of the study.

Engaged Instruction

Interaction:

- "I use technology to allow [students] to take a poll and then project the results back to them. This allows me to engage the entire class in the lecture and presentation." Participant 2
- "I teach a large lecture of about 200 [students]. I use technology to keep students engaged and involved." Participant 3
- "I do create my own videos. And also use it, um, to keep students engaged, online discussions and so forth." Participant 4

Table 2
Reasons for Faculty of Use of Technology in Instruction

Reason for Use		
Theme	Sub-theme	Examples of Technology Used
Engaged Instruction	Interaction Collaboration	Polling tools, Interactive Posters Google Drive, Google Sheets
Student Learning	Ownership Motivation	Video Creation, YouTube Flipbook, Online Quizzes
Content Presentation	Organization Delivery	PowerPoint Canvas (Learning Management System)

Table 3
Faculty Support Needs for Greater Use of Technology in Instruction

Theme	Challenges	Opportunities
Flexible Training	• Scheduling • Set training times • Age of Current Set of Tools Available	• Flexible Delivery • Targeted Instruction • Multimodal Instruction e.g., use of webinars and videos
Peer Connections	• Awkward Training Locations • Isolation from Peers and Colleagues	• Community Sharing • Creation of Linkages • Availability of Clear Support System
Institutional Backing	• Unrealistic Expectations • Challenging Workload	• Recognition • Reward for Efforts

Collaboration:

- "[I use] case-based learning strategies where [I give students] the opportunity to discuss relevant issues online, sometimes." Participant 2
- "I make use a lot of collaborative tools, online Web 2.0 tools, where student can collaborate. [These include] Flipbooks, interactive posters, and video creation." "Participant 6
- "[I] encourage students to work together on [class assignments]. So, they are using Google Docs and stuff." Participant 8

Student Learning

Ownership:

- "I do a lot of pre-quizzing using online technology, so [students] have to master a quiz before class." Participant 3
- "[I have found that technology can] get my students to take ownership of their own learning." Participant 2

- "I like using the technologies to make things easier for my students and not necessarily for myself." Participant 8

Motivation:

- "Students like using technology such as YouTube, because it provides a certain motivating factor to them." Participant 4
- "[I use] Instructional Games and simulations and podcast, I use those [tools] sometimes as supplements to my lecture." Participant 6
- "It would be easier for me to say open my PowerPoint and just record narration and [make] a digital, which I know some faculty do ... But I tend to take on a little more work [on my use of technology] to make it easier for the students." Participant 5

Content Presentation

Organization:

- "It keeps the expectations clear when technology

is used for organization ... and [to] structure for the class." Participant 3

- "PowerPoint and other modern educational really help keep everything organized." Participant 8

Delivery:

- "On the more efficiency side, when incorporating an online quiz it's going to be easier to grade. [Therefore] that technology helps with content delivery. " Participant 1
- "LMS is beneficial from a course delivery standpoint. I use it both for my online and face to face courses." Participant 6
- "Power Point slides [are excellent] for teaching the same class and share demonstrations." Participant 7

As presented in Table 2, participants reported using technologies for a variety of reasons. Some of them perceived that technologies helped keep the students engaged during class and orient their learning behaviors. Participants shared some technology tools that they were comfortable using to connect with students with classes with them either online or face to face. Faculty also noted that student-centered learning approaches encourage students to be more responsible for their own learning.

Q2 asked: What are the types of support faculty need to facilitate their use of digital technologies?

Regarding supports to facilitate greater use of digital technologies, three themes with potential challenges and opportunities emerged from the analysis of the data. These are Flexible Training, Peer Connections, and Institutional Backing.

The data reviewed to answer question 2 reveal the approach of using set training times for faculty at their institution are insufficient and do not fully consider teaching schedules or the ebb and flow of school-related activities during the academic semester. Participants also shared that they and their colleagues desire to have training on technology that are offered in less traditional training spaces. The participants also noted that they desire technology training that is accessible and use a variety of delivery formats to accommodate the available times their schedules. In the area of peer support, participants shared that they wish to hear how other faculty members use technology in the courses. Thus, they believe that faculty should be encouraged to present their work in training sessions and discuss practices among peers within and outside their disciplines. Regarding the Institutional Backing theme that emerged from the data analysis, participants shared that they desired recognition and appreciation for the time commitment they devoted to developing technology-enabled instruction for student

learning. Below are samples of comments provided by the participants with regards to support needed to facilitate their use of digital technologies in the classroom. These are broken down by the themes, challenges, and opportunities noted by the participants in the study.

Flexible Training

Challenges

- "Expectations are high for faculty [so] support needs to be more strategic. How can we use technology to simplify things for students and for me in an efficient way?"
- "I go to a lot of the CTL events, but, you know, it's going to be, like, well at this time, in this month and I may be teaching a class, so I'm not going to be able to learn about Camtasia." Participant 1
- "I'm teaching a class or I'm doing something else that I can't be there and you know, I'd love to just have it at my disposal if I [want to] go home in the evening and do it or something like that." Participant 2

Opportunities

- "Personally, I would actually like to have, uh, online videos that I can watch whenever I [want to] watch for the digital technology that I could be using in class." Participants 5
- "Webinars are good ... They are available to watch at any time." Participant 1

Peer Connections

Challenges

- "[There is a need to] have more opportunities to view each other's online classes and sharing best practices. [But] people get compartmentalized. [We] need to break down barriers." Participant 8
- "One place we get to share many of these things is in the active learning academy we do get to discuss how things are going, and talk about your courses, what difficulties you're facing." Participant 3

Opportunities

- "Maybe they could come out to departments or have, you know, like we had biology and chemistry and psychology could have, you know, an event where we're [together] in one of the buildings." Participant 1

- "They also have something similar with the faculty fellows, where they have faculty that are doing these things well. Sharing their ideas. That is a wonderful thing to do for faculty that are doing these things well and sharing ideas with each other. That could be increased." Participant 2

Backing from Institution

Challenges

- "A lot of time is put into developing instruction with technology." Participant 5
- "Faculty are juggling class prep, advising, service in the department etc., there is very time left to attend training and workshops during the semester." Participant 7

Opportunities

- "Some schools offer course release or some form of compensation for time spent in training." Participant 4
- "Institutional support that would help encourage faculty use of technologies would come in the form of grants or awards for experimenting and support" Participant 7
- "It might be helpful to have a faculty award for how the technologies are used in teaching and courses." Participant 2

Discussion

Participants in the study stated that they used the technologies to keep students engaged in the learning process. They also offered that the use of technologies enabled them to focus more on student-centered learning practices and activities during instruction. They also offered that the technology allowed them to create learning experiences that required students to interact with content and their peers. Moreover, the participants noted that the technology allowed students to develop a sense of ownership of their learning experiences and to be more engaged in collaboration activities in and outside the classroom. Some participants were very intentional in engaging the Digital Natives generation in digitally-oriented learning activities. Those participants, who for the most part were early adopters of technology based upon Rogers' model, created collaborative group interactions using Google applications that are specifically designed for collaboration. A few other participants use various technologies like games, simulations and resources from online sites as these would be very familiar with the Digital Natives generation of learners in their courses.

Hansman and McAtee (2014), in referencing King and Lawler (2003), offer, "The constantly evolving technological developments and innovation challenge all educators to learn and adapt new applications to design academically sound courses" (p. 12). Further, Austin and McDaniels (2006) notes that faculty simultaneously belong to, and work within, various cultural groups: their discipline, department, institutional type, and the profession and therefore must assume the appropriate roles, values, and norms for each context. All of these aspects of a faculty member's professional life and work setting directly influence their pedagogical beliefs, which in turn shape their perceptions of how technologies may be used for teaching and learning (Hansman & McAtee, 2014; Yee, 2015). Therefore, based upon the findings of the study, we believe that a model such as Covington Petherbridge and Warren (2005), with three systems of support services, can help faculty integrate more and/or better technology into their teaching practices, curricula, and research. These will lead to improved technology-enabled learning performance for students and further enhance the quality of decisions by IT and administrators to plan strategically to integrate technologies into the higher education mission of teaching and learning.

Implications

Given these findings, three key recommendations can be made on how to best facilitate greater integration and use of technology by faculty to engage and support today's learners. First, professional development programs should be offered in a manner that fully accommodate faculty's teaching schedules and the academic work cycles. In conjunction with the development programs, other forms of delivery should be considered, such as online video repositories for faculty to learn particular technologies at their own pace and at more convenient times. Second, coaching and mentoring should be integrated into professional development programs as faculty find it beneficial to have other faculty members, who are trained to use the technology in a particular content area, act as champions (Hill, Bahniuk, & Dobos,1989). Such an approach serves also to scaffold pedagogical approaches used by faculty in support of student learning (Coburn & Russell, 2008; Griffin-Sobel et al., 2010). Third, there should be some recognition of innovative teaching approaches to incentivize faculty and promote experimentation.

Limitations and Suggestions for Future Research

Our study explored the technology integration experiences of eight instructors. Therefore, the findings

should be carefully interpreted as the focus of the study was on one university in the southeast U.S. Given the relatively small sample, broad generalization is limited. Nevertheless, the study can be viewed as contributing to the growing body of literature on faculty technology integration in pedagogical practice. Finally, a larger sample of one-on-one interviewees may have provided different perspectives regarding experiences. An area for further research is exploring the impacts of academic backgrounds on faculty readiness to use technologies in the classroom. By determining whether disciplines such as Arts and Sciences, Business, Engineering, Health etc., react differently to the use of technology in the classroom, policies can be developed to address the unique needs of each college and department of a university regarding faculty training. Context of the use of technology is another area for further exploration. Since this study was conducted at one specific institution, it could not be readily determined whether the existing leadership structure, administrative policies, or academic culture of various types of institutions have an impact on the faculty attitudes toward use of technology in the classroom. In this study we found scheduling to be a reason why faculty don't attend training. However, we hope future studies can examine this in depth on how faculty can prepare for this generation for students. Finally, an examination of how faculty development programs influence learning outcomes is needed. Such efforts will help in determining which items need to be incorporated in faculty training programs.

Conclusion

While digital tools and technologies are widely used in the modern world, their integration in teaching and learning to engage learners continue to lag. As a result, there is a need to understand the challenges involved in facilitating faculty use of technology in their courses. Moreover, given the current number of Digital Native learners on today's campuses, faculty members must employ new pedagogy, including more integration of technology in the classroom to engage, motivate, and support these new learners. As presented in this paper, a holistic faculty training and support approach is needed to help faculty obtain the technology skills and competencies they need to support and engage the Digital Natives Generation of learners.

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Exploring Meaningful Experiences Promoting the Development of Graduate Students' Professionalism

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Graduate education advances students' competencies and skills to prepare them as professionals and should provide various learning experiences to support their development as socially responsible professionals who meet role expectations. Learning experiences that support the development of students' professionalism are discussed in the research, but limitations lie in understanding the constructs of professionalism. In response, this study examined formal and informal learning experiences that influence graduate students' understanding of professionalism and relevant learning experiences that support the development of professionalism. The study concludes with the implications of possible instructional strategies that can be used to promote professionalism in higher education.

The three-part mission of higher education adheres to the goals of research, teaching, and service (Binder, Chermak, Krause, & Thacher, 2012). Reflecting on ways higher education is being constituted, universities have been creating knowledge, applying it to serve the society, and equipping students with disciplinary knowledge and leadership skills, thus allowing them to serve various communities in and outside universities. Higher education has historically shifted from reaching out to communities to deliver expert knowledge towards engaging with communities to co-create solutions on local, national, and global levels, which are acts of scholarship that can advance knowledge and make societal contributions (Fitzgerald, Bruns, Sonka, Furco, & Swanson, 2012). Ideas around the scholarship of engagement and the philosophies of working with and serving the public continues to be encouraged, which is represented by the growing number of centers in universities that focus on civic engagement (Barker, 2004), and through recognizing that learning opportunities in developing scholarship of students also reside in non-academic settings as well as academic settings (Fitzgerald et al. 2012).

Along those lines, professionals have been described as individuals who instill their expert knowledge to the needs and values of the social systems and go beyond to provide service to the public (Kunitz, 1974; Larson, 1977). The similarities found between the mission of higher education and professionals providing service to society call for the importance of the ideas to be intertwined by higher education, supporting students' development as responsible professionals who respond to public needs and positively contribute to the society as leaders upon graduation. All students preparing for the workforce should develop professional skills to apply to society and reflect a sense of civic responsibility. Providing these learning experiences may also be effective in promoting students' long-term engagement in their field of work as well.

It may, therefore, be of value for graduate education to focus on offering learning experiences that foster student development, including research experiences, to support their research productivity (Paglis, Green, & Bauer, 2006), provide enriched learning experiences and curricula focused on their development as scholars to promote changes in the awareness of their professional skills (Fitzgerald et al. 2012; Franz, 2009), and to expand on the innovative ideas through research and apply ideas in a real-world context (Fitzgerald et al. 2012). Students'understanding of the purpose of higher education, as well as exploring the roles to take as professionals, may help gain insight into their future careers, which may help sustain their roles as professionals upon graduation.

There are various descriptions of professionals discussed in the literature, but the distinctive expectations of professionals lie on their abilities to apply their knowledge in social settings and on the level of contributions they make in societies (Flexner, 1915; Schön, 1983). The act of meeting those social expectations as socially responsible professionals are oftentimes referred to as one withholding and reflecting professionalism (Flexner, 1915; Sullivan, 2004). Based on that description, professionalism is then an intellectual activity that is connected to a specific responsibility (Flexner, 1915) and describes an act of all professionals to engage with societal values (van Mook et al., 2009). As graduate students enter their fields to take roles that directly influence communities, it should become essential for them to develop an awareness of the significance of their positions and the level of social responsibility they should adhere to. To lay out the foundations for graduate students to develop as professionals in higher education, this study attempts to understand experiences that influence their development as professionals, as well as learning environments that can be designed in graduate education to support their development of professionalism.

Professionalism in Graduate Education

Graduate education has been the learning platform that provides various opportunities for students to engage in meaningful learning experiences for them to develop as socially responsible professionals. However, the process of graduate students' development as professionals has been rarely discussed (Hurst, Cleveland-Innes, & Hawranik, 2013). As professional identities progress as individuals gain insight into the development and actual practices of their professions (Schein & Schein, 1978), graduate students provided with the opportunities to learn about professional identities including the attitudes, values, knowledge, beliefs, skills (Adams, Hean, Sturgis, & Clark, 2006), and ways to provide service to the public as professionals (Larson, 1977) may be meaningful.

Graduate education has highlighted the importance of professionalism in the past, but there have been variations in the knowledge and skills describing students' training as professionals. For example, professionalism has been described as the professional having acquisition of knowledge that focuses on the development of both knowledge and practice for real-world applications (Bastian & Yakel, 2005), or as the degree to which professionals exhibit unique attributes of that profession (Johanson, 2005). The literature also indicates different academic fields having varied definitions of professionalism, with the instruction of the development being context-specific and based on the need for the field. For example, medical education, which is a field that has initially engaged in research and development of professionalism in learning (Flexner, 1915), has historically changed perceptions of professionalism over time. Seeing the importance of ethical virtues as professionalism in the beginning has shifted toward physicians portraying behaviors and competencies of professionalism and currently discusses physicians forming their identities around a community of practice as a construct of professionalism (Irby, 2017). On the other hand, the field of engineering focuses on the students' professional development of technical, societal, and cultural skills needed to become globally competent engineers (Barakat, 2015).

Learning Environments in Graduate Education

Graduate students sense more value of their attained skills and research activities when the topic of learning becomes not only personally valuable, but socially recognized as well (Pabst, 2011). This aligns with the previous recommendation that graduate education should be designed for students to progress as professionals who can engage with the social contexts to serve the communities. As research productivity implies one's commitment to investigate a problem in question (Pabst, 2011), an imperative step to enhance graduate students' professionalism is to design learning environments that expose them to socially relevant activities and develop a commitment to solving real-world problems.

Current instructional strategies cover a spectrum of learning experiences for students that instill values of engaging with communities. Ever since the imperative mission of higher education in promoting service learning and community engagement was proposed in the mid-1990s (Saltmarsh, Janke, & Clayton, 2015), universities have focused on students' development by designing community-engaged experiential learning environments, such as internship-based learning, service learning, and curriculums emphasizing work and service (Kovarik, 2010; Perrin, 2014). The different learning pedagogies focused on increasing students' engagement in communities through extending professional knowledge to be used in real-world situations for problem-solving (Perrin, 2014), emphasizing relationship building with communities (Perrin, 2014), and improving academic experiences so that they become relevant and meaningful (Kovarik, 2010). These learning activities enabled students to engage in autonomy and accountability for real-world implications, to develop a sense of peer support, to value academic learning, and to recognize the potential benefits of service-learning.

Moreover, additional efforts are currently being made to design learning strategies that enable students' active engagement in community-related activities. The strategies include experiential learning (Burrell, Finch, Fisher, Rahim, & Dawson, 2011; Karri & Kode, 2011; Lucas, Sherman, & Fischer, 2013) and service-learning (Bright, 2016; Levkoe, Brail, & Daniere, 2014; Richards, 2013), both of which integrate theoretical and practical experiences for learners, and provide opportunities for them to find the value of their knowledge and skills in the real-world and develop as reflective innovators of knowledge (Harkins, Kozak, & Ray, 2018; Kuk & Holst, 2018). Despite the effort to set the groundwork for designing learning environments, more research is needed in thoroughly investigating specific experiences that can enhance students' socially responsible mindsets, as well as the role graduate education might have in instilling these learning experiences. Adding value towards research that examines learning experiences that can be used in instruction to enhance the development of graduate students' professionalism will be meaningful.

Cross-disciplinary Professional Skills Training Program

In response to the emerging trends to promote community-engaged learning experiences and to integrate

the real-world application into instruction, a training program in a land and sea-grant University in the United States developed a professional skills training program for incoming doctoral students (Coffield et al., in press). A two-semester professional skills training program that provides early exposure to support students' development of professional skills that enable them to go beyond academic knowledge and work across disciplines, engage with communities, and develop problem-solving skills to provide sustainable solutions in the real-world was designed and implemented as a pilot study for three years. Each cohort group of the three-year implemented training program consisted of 13-15 incoming doctoral students who were contacted and recruited through recommendations from the departments across the University. The participating students enrolled in a six-week summer leadership academy course during the summer followed by a semester-long challenge course in the fall as they officially entered their graduate programs. Each week of the summer leadership academy consisted of activities including workshops and guest lectures, panel discussions, and field trips to local communities, and they focused on developing students' problem-solving, leadership, effective communication, teamwork, and community engagement skills. The workshops were organized and facilitated by the course facilitators, and content experts and community leaders were invited as guest lecturers and to participate in panel discussions. All topics were pertinent to enhancing students' professional skills. During the fall challenge course, students applied their knowledge and skills in collaboration with community experts to design community-related projects that addressed local issues so that they could provide feasible plans and develop sustainable solutions in underserved communities. Students worked in collaboration to engage across disciplines to develop leadership skills and work together to solve community issues.

Research Statement

Based on the overarching goal of graduate education to promote students' professionalism and the learning environments that can support the development, this study recruited participants in the cross-disciplinary professional skills training program to understand how participating in the program may have influenced their understanding of professionalism and experiences in the program that may have supported their development.

This study will contribute to graduate education as the findings will provide insights into both formal and informal experiences that influenced students' development of professionalism, which can be used to propose design guidelines of different instructional strategies that can support professionalism. The study will set the groundwork for how professional development can be generalized and implemented across graduate education by examining the following: a) ways first-year graduate students in different fields perceive professionalism before and after participating in a cross-disciplinary professional skills training program, b) learning experiences that promoted their understanding of professionalism, and c) personal experiences that were significant and influenced their professionalism over time.

Through analyzing the qualitative data, the study aims to answer the following research questions:

1) What are the changes in the students' professionalism before and after the cross-disciplinary professional skills training program?
   a) In what ways did their perspectives of professionalism change?
2) What are learning experiences in the program that can be suggested to promote the development of professionalism of graduate students?
3) What personal experiences and/or moments do students believe promoted their professionalism?
   a) In what ways did the students perceive those specific experiences?

Methods

Research Design

A qualitative study was selected to understand the participants' perception of professionalism across the cross-disciplinary professional skills training program, as well as other personal and professional experiences. Qualitative research, which is an open-ended form of research, supports the meaning of data that is "socially constructed by individuals in interaction with their world" (Merriam, 2002, p. 3). Under the constructivist paradigm, open-ended questions were used so participants could openly discuss, share, and construct the meaning of their perspectives and experiences, in which patterns of meaning associated with the study were developed (Creswell, 2014). In collecting and analyzing data, a multiple-case design was employed. Case studies are an "intensive description and analysis of a phenomenon or social unit such as an individual, group, institution, or community" (Merriam, 2002, p. 8), and they investigate a contemporary phenomenon (the "case") in depth and within its real-world context (Yin, 2014). As the objectives of the studies were to understand participants' experiences across different disciplines, a multiple-case design was used to examine each research participant's personal and professional experiences, as well as their program participation experiences (Baxter & Jack, 2008).

Research Context and Participants

This study was designed and carried out by recruiting participants in the cross-disciplinary professional skills

training program, as the nature of the program in developing graduate students' professional skills through engaging with communities and solving real-world problems was aligned with the objectives of the study. On the first day of the training program, participants were asked to participate in this study to share their formal and informal learning opportunities related to professionalism. In the cohort that had 13 students, four students volunteered to participate in the study. The participants were from diverse disciplines, including anthropology, history, toxicology, and geography, and they were enrolled in the University's doctoral program. Out of the four participants, two participants joined the doctoral program after receiving their bachelor's degrees, and two participants had attended graduate school before joining the doctoral program to obtain their master's degrees. Prior professional experiences of the participants included research experiences and internships in their field. The four participants were equal in gender distribution with two females and two males, which was not intended in the recruitment process. In reporting the findings, pseudonyms have been used across the findings and discussion with Mia, Lauren, Will, and David as the participants.

Data Collection

Following the constructivist approach, open-ended semi-structured face-to-face interviews (Roulston, 2010) were conducted to gain compelling details and insights on how participants perceive professionalism, and the experiences as well as instructional strategies in the training program and in their personal and professional lives that promoted the development of professionalism.

An interview is a powerful way to gain insight into educational contexts through understanding the experience of the individuals (Seidman, 2013) and is considered among the most important sources of data and a technique most case studies employ (Yin, 2014). To gain insight into participants' experiences before and after the training program, pre- and post- interviews that lasted about one hour were conducted. The questions for both pre- and post-interviews were sent to the participants directly after each interview was scheduled. All interviews were audio-recorded and then transcribed for analysis (check Appendix for the interview protocols). The researcher met with each participant for the pre-interview at the beginning of the program and asked some of the following questions:

- What is your current understanding of professionalism?
- What is a personal experience that has led to changes in how you perceive professionalism?
- How do you hope to develop your professionalism through the training program?

The post-interviews were conducted at the end of the training program, which occurred about six months after the pre-interview. Some examples of the interview questions included:

- What is your current understanding of professionalism?
- Through the training program, were there changes in your understanding of professionalism?
- What are some learning experiences in the training program that promoted this change?
- What is a personal experience that has led to changes in how you perceive professionalism?

Data Analysis

Analysis. The research questions guided the analysis of the interviews by coding the data based on each participant's understanding and experiences of professionalism, as well as instructional strategies that promoted the development of professionalism. For research question #1 that examined the participants' changes of professionalism through the training program, pre- and post-interviews were coded to compare and track the changes of their perspectives. As research question #2 identified learning experiences that promoted the development of professionalism, examples in post-interviews were analyzed. Finally, as research question #3 aimed to understand personal experiences that promoted changes in the participants' professionalism, both pre- and post-interviews were analyzed to extract personal occurrences.

For all research questions, concept coding was initially used to generate codes based on participants' experiences to extract the represented meaning and provide a bigger picture of the data (Saldaña, 2016). Generated codes were then themed to further probe the meaning of the coded data, and as a result, overarching themes were found to represent a coherent narrative of the findings (Saldaña, 2016). The themes were then grouped into categories or experiences. A cross-case analysis is used to discuss the overarching findings of the research questions discussion (Yin, 2014).

Trustworthiness. To respond to the uncertainty of data quality and lack of reliability of case studies (Yin, 2014), the following procedures were taken to ensure the credibility of data. First, following the constructivist paradigm (Creswell & Miller, 2000), the interviewer developed a rapport with the research participants by spending time in the training program. The interviewer took notes during data collection as well as after data analysis in order to develop ideas and to note any issues as well as personal reactions (Maxwell, 2012; Saldaña, 2016). A peer debriefing process was used to receive feedback on the analysis and interpretation of the generated codes as well as themes. The first author

(also the interviewer) generated the initial codes and themes, and the second author provided feedback to reach an agreement of the analysis. The second author continued to check the plausibility of the emerging codes as well as themes (Merriam, 1995) and reviewed the transcription and its initial assertions made all throughout the ongoing analysis (Roulston, 2010).

Findings

Based on a cross-case analysis, the four participants' experiences related to their changes of professionalism over time through the challenge-based professional skills training program are discussed. Categories and related themes for each research question are discussed through interview excerpts from the beginning of the summer (pre-interview) and at the end of the fall (post-interview).

What are the changes in the students' professionalism before and after the professional skills training program?

The components of professionalism that emerged as a result of the training program included students' competence, the building of relationships, and perception of community-engaged activities. Participants' perceived changes of professionalism that occurred through participating in the cross-disciplinary professional skills training program identified competence as a component of professionalism. Before the program, competence was initially understood as an interest for a topic, which shifted towards being a strategic form that includes the knowledge and skills to efficiently and successfully perform the work at hand. At the beginning of the program, Will expressed his competence in his professional field that had developed through a passion for learning:

> I was thinking about my future career and figuring out if I was only doing the classwork I chose to take. I mean those classes aren't quite enough for either becoming a professional or going to the industry. Nowadays, I read all about what is going on in my current field which is my passion, but I don't know where it actually came from.

After the program, he began to see the alignment between his professional knowledge being applied in the real-world context, by describing the importance of applying his professional knowledge base in solving real-world problems: "We have limited time, limited resources, we need to decide what we want to accomplish; which would be carried on in the future – being able to deliver to probably other organizations too, which would also be carried out for this

organization for probably years, not just for a semester or two." As competence from a higher education perspective is defined as a "functionally linked complex of knowledge, skills, and attitudes that enable successful task performance and problem solving" (Wiek et al., 2016), the training program was successful in influencing students' competence in higher education.

Building authentic relationships was another component of professionalism that was identified as the participants saw value in developing long-term relationships, in effectively working in collaboration, and in embracing the value of collaboration and communication skills. After the training program there were changes in terms of how participants viewed research and relationships, and the changes reflected a sense of empathy. Empathy describes the capacity of an individual to experience another person's feelings and ideas (Eisenberg & Strayer, 1990) and to be objective in the situation (Crandall & Marion, 2009). At the end of the program the participants expressed that their roles as professionals had a type of impact toward the real world and shared the importance of authentic relationships that are built on honesty and respect, as well as ongoing interactions that provide benefits to others and the values around collaboration in effectively and efficiently solving problems. As the participants understood their professional values of research and in interacting and building meaningful relationships with others, they became capable of reflecting not only on just themselves, but also on the larger contexts that could influence how they build relationships. Table 1 presents the overarching changes that were found before and after the training program.

Ways participants perceived community-engaged activities also shifted before and after the training program. The participants frequently expressed the experiences with community-engaged activities which helped enhance their professionalism after completion of the program. Community-engaged activities are oftentimes referred to as scholarly activities related to publicly engaged academic work, public engagement, community partnerships, etc. (Doberneck, Glass, & Schweitzer, 2010). The experiences participants had in working directly with community partners to solve problems through the training program enabled them to become more motivated towards making meaning of their work and to develop a sense of identity that is related to their professional roles. For example, in Mia's reflection on her perception of doing research, she expressed it as an ability she had as it enabled her to "jump from the idea stage and actually get to the 'doing something about it' stage" at the beginning of the program. After the program, Mia expressed her understanding of finding the meaning of doing research by describing the following:

I want to find these things out and be able to argue the relevance of what we're doing… if somebody tells me, hey, I want you to do this project, I'm not just going to say okay I'll do it; I'll do it but I'm also going to investigate why am I doing this, why does it matter, that type of thing.

Moreover, through the experiences of directly working with community partners to solve a community issue, students were able to develop a sense of identity by positioning themselves as professionals that can provide [an] actual impact to societies:

I just really want to believe in my work, and I feel like I don't believe in it right now, but anyway, that's – I'm trying to prove that what I'm doing, prove to myself that what I'm doing is important.

Overall, the learning experiences of the training program shifted participants' perceptions of professionalism. They went from having a generalized understanding of the roles towards having a more tangible understanding of their professions through enriched outlooks of their research and potential level of impact, as well as in specifying their roles as professionals in the communities. These findings lie in consensus with the responsibilities of universities to transfer and apply knowledge to improve the public (Fitzgerald et al., 2012).

What are the learning experiences that can be suggested to promote the development of professionalism of graduate students?

The nature of the professional skills training is to support incoming doctoral students' development of professional skills to go beyond academic knowledge and work across disciplines, engage with communities, and develop problem-solving skills to provide sustainable solutions in the real-. After the program, the participants were asked to share the learning experiences of the training program that promoted their understanding of professionalism.

As a result, there were four learning experiences the participants identified, including community engagement projects, real-world applications, interdisciplinary panel discussions, and reflective opportunities. The community engagement projects enabled the participants to broaden their scope of research as they were able to discover firsthand and experience other possibilities of research. The nature of real-world applications in working alongside communities also helped participants to see broader perspectives and to understand the actual influence their work can have in societies, as well as in solving real-world problems. Opportunities to listen to and communicate with various guest speakers who were invited to panel discussions to share their experiences in doing community-engaged work were also beneficial for the participants to obtain different perspectives and increase awareness for community engagement. Through reflective opportunities that were embedded throughout the training program, the participants were able to reflect on themselves as well as through communicating and interacting with instructors of the program, which enabled them to be attentive to their development of professionalism as researchers. Refer to Table 2 for a list of these learning experiences and interview excerpts describing how the training program influenced their professionalism.

Table 1
Shift in Students' Perception of Professionalism Before and After the Training Program

Components of professionalism emerged	Students' perception at the beginning of the program	Students' perception after the program
Competence	Interpreted as an interest in a topic	Competence is interpreted as an efficient and successful performance for real-world problem-solving
Building relationships	Building relationships through communication and collaboration	Building relationships through real-world communication, developing empathy
Perceptions of community-engaged activities	A response in conducting research	Opportunities to develop a sense of identity as researchers, finding the purpose of research through creating real-world impact

Table 2
Learning Experiences of Professionalism in the Cross-disciplinary Training Program

Learning activity	Learning experiences	Interview quotes explaining how the experiences promoted understanding of professionalism
Community engagement projects	• Discovering new issues other than what one knows • Connecting one's interest in real-world contexts • Real-world application of one's knowledge	• Just in doing our projects, I mean that's really helped me empathize mostly because I'm doing a project that concerns an issue that I didn't even ever think about before. • I think the training program is great because .. I guess they want to try to inspire us to be people who can take our research and actually learn how to make the connections we need to make so that it can be pulled into the actual community. • This semester, the (real-world) experience has really helped (..) just working with the project and learning one example of something that I'm not familiar with that's a problem, it kind of opened my eyes to the fact that there must be so many problems that I don't even think about that these people are experiencing.
Interactions	• Gaining multiple perspectives • Understanding various dimensions	• We also interacted with a lot of panelists and community members and so just – I mean, simply through that and like – those people have so many different experiences than what I have or the faculty in my department have that really just – it kind of increased my awareness of opportunities for community engagement, service-learning, and then how to do those. Like lessons that they learned in their process of pursuing those goals.
Reflective activities	• Reflecting on self	• The kind of constant level of interaction that we had with the instructors helped us develop trust so that we could talk about things that were a bit more difficult or awkward and kind of actually try to make progress in those areas, and I think a lot of reflection kind of helped in that process.

The learning experiences that were designed as part of the training program allowed participants to become more mindful of themselves, as well as the society, as they began seeing the larger scope of what can be done through real-world application. Moreover, by listening to experiences of community representatives, as well as faculty who worked firsthand with communities increased their awareness of roles to take as professionals. Reflective opportunities that were provided throughout the program also enabled students to conceptualize their thoughts and ideas and to develop their self-identities as professionals (Neve, Lloyd, & Collett, 2017). The participants' acquired ability to look into, and engage directly with communities aligns with the conception that professionals should be able to reflect on themselves to develop abilities to apply knowledge into practice to support the needs of social contexts (Chickering, 2010).

What experiences and/or moments do students believe promoted their professionalism?

To better examine overall experiences that may promote graduate students' professionalism, the participants' personal experiences were also explored. Through both pre- and post-interviews, the participants shared experiences and opportunities that they believed developed their professionalism.

Personal experiences that influenced the participants' professionalism were through the level of interaction with others. Lauren shared her past experience in working as an intern in another country where the culture in that workplace and her values collided. Lauren had made a mistake and was told of this mistake through a co-worker, who had been notified by two of her managers. Lauren explained how

she was highly offended by this situation as additional people had found out about the mistake she had made. Although this situation was difficult for her to understand, she later learned that the two managers were using the most appropriate way to tell her about the mistake by having her co-worker deliver the message. Through this experience, she explained she was able to develop mindfulness of the differences and values that can derive from working with different cultures. Will also shared his interactions with various people, which helped him form personal ideas of professionalism. When thinking about his future career, he had an opportunity to interact with some senior peers who were very passionate and were actively seeking out opportunities to expand their research interests. By interacting with student colleagues, Will was able to expand his horizons and see the possibilities of how he can continue developing as a professional.

Interacting with mentor figures (McLaughlin, 2010) and with people who shared prior experiences with the participants (e.g., community-engaged project experiences, interdisciplinary collaboration and engagement) helped them form distinct ideas about what professionalism is. Mia asserted that the mentoring experiences she had will influence her role as a professional in her field in the future, as those experiences helped her identify the gaps between the current professionals (e.g., professors) in her field and the type of mentor she hopes to become. Aligned with the discussion that mentorship plays role in shaping doctoral students' identities as future faculty (Anderson & Anderson, 2012), she was able to understand the different types of professionals/mentors and the personal traits she would want to have as a mentor in being passionate about sharing knowledge and being empathetic with her students.

Additional experiences that supported the participants' understanding of professionalism were through interdisciplinary engagement and collaboration, as interacting with others across different fields helped them to be more reflective of themselves. David had drastically changed majors prior to enrolling in the graduate program, which naturally enabled him to gain prior experiences of engaging with people from different disciplines. Through these past engagements, David acknowledged interdisciplinary collaboration as an experience that shaped his understanding of professionalism and further noted that it can also support the development of becoming an effective leader with broader perspectives. Moreover, through interdisciplinary engagement opportunities, Mia was able to learn the value of collaboration, where she also recognized empathy as a vital factor in a construct of professionalism. The experiences that come from naturally occurring situations and environments may positively influence the development of professionalism,

as its nature may enable individuals to become more ethical and reflective of their positions and practice to apply the appropriate knowledge and skills (Trede, Macklin, & Bridges, 2012). Refer to Table 3 for a description of the personal events and its related learning mechanisms, and relevant quotes from the interviews.

Discussion and Conclusion

Perceptions and experiences of incoming graduate students' professionalism were examined through this study. The purpose of this study was to understand the incoming graduate students' perceived understanding of professionalism before and after the cross-disciplinary professional skills program, as well as learning experiences related to professionalism through the training program. Further, personal experiences that influenced their understanding of professionalism were also discussed

The changes in students' professionalism before and after the training program were influenced by the nature of the training program promoting socially responsible and scholarly activities through real-world, authentic learning experiences. Allowing students to identify authentic problems and provide sustainable solutions through utilizing their professional knowledge enabled them to see the possibilities of the broader impact they may provide and the importance of the application of knowledge and skills in the communities. The aims of the training program, to allow students with learning opportunities to engage in community issues, were effective as it supported their understanding of their roles in society. This is consistent with the purpose of community-engaged learning activities, as these enable students to experience empowerment of knowledge and skills and to find the meaning and value of learning (Kalas & Raisinghani, 2019), and they promote students' active involvement in working with the public (Bringle & Steinberg, 2010). As individuals valuing communities as a form of professionalism may empower them to continue producing significant research that benefits the society, as professionals, they will be able to maintain scholarly agendas throughout their careers by responding to the goals of higher education (Fitzgerald et al., 2012).

Learning experiences that promote students' understanding of professionalism aligns with the learning pedagogy that focuses on service learning. Service learning connects the curriculum to community needs so that students engage in direct problem-solving of social issues (Altman, 1996). Service learning enables students to participate in activities that meet community needs, as well as reflect on those activities to gain further understanding of the course content and an enhanced sense of personal values and civic

Table 3
Personal Experiences that Promote Students' Professionalism

Personal Events	Learning Mechanisms	Quotes
Interaction with others	• Reflection	• It did help me learn to understand that there are different dynamics and that I was assuming that they were being rude or mean..but in actuality, their intention was to be as thoughtful as they could be. So I guess it helped me develop mindfulness of different values and approaches. • The seniors at the time (during my second year of college), graduate students, they were really creative, eager to learn, and very passionate in their areas. Yeah, in being a professional you need to have passion. I learned a lot from them, not only academics but also the way, or how you need to or could absorb more knowledge."
Mentor figures	• Modeling	• I want to be an empathetic mentor… I'm really excited that I kind of was able to figure out because I really think it's important to carry that forward because I think there's such a shortage of people, I look around me and I don't see a lot of people in academia or necessarily passionate about their students, passionate about sharing knowledge and empathetic and that type of thing.
Collaboration	• Multiple perspectives • Communication	• I feel that the more kind of entrenched you become in your specific field, the more likely it is that your ideas are just going to be kind of echoing back on to you rather than being challenged and questioned and everything. And I feel like an effective leader needs to have a lot of people from a lot of different backgrounds with a lot of different life experiences to kind of not necessarily actively challenge his or her worldview, but to just see – experience those worldviews. • I think that there is this important element of being concerned about other people and like facilitating sort of a collaborative workplace. And empathy is really important to achieving that goal of achieving a collaborative workplace and I think that that's a huge part, like empathy and caring about other people, that's like a huge part of professionalism that I used to think was – I used to not associate that with professionalism.

responsibility (Bringle & Hatcher, 1995). Furthermore, it provides learning experiences that contribute to the students' acquisition and development of socially responsive knowledge; they can see firsthand and experience social problems and are able to gain an understanding of community issues (Altman, 1996). These described experiences learners can have through service-learning activities align well with the experiences of the training program that students shared which promoted their understanding of professionalism. Since service learning implies the teaching and learning of cognitive processes, student-centered instruction, and collaborative learning (Bringle & Steinberg, 2010), the use of these learning pedagogies may be beneficial in designing instruction to develop graduate students' professionalism.

Personal experiences that promoted the understanding of professionalism were related to their interaction with others (e.g., professional relationships, mentors, and interdisciplinary collaborative opportunities). These interactions influenced their personal perceptions of professionalism and experiences that broadened their understanding, such as developing an awareness of others' thoughts and insights, and other professional experiences that promote personal awareness as professional beings. As professionalism is not just simple acquisition of knowledge and skills but is considered a transformational process (Wilson et al., 2013), having opportunities for individuals to interact with others, all while reflecting on themselves may support their development of professionalism as they gain a better understanding of what professionalism could entail.

Overall, unpacking graduate students' experiences that promote the development of professionalism contributes to understanding the complexity in setting the foundation to implement professionalism development in graduate education. In the past, various disciplines have highlighted the importance of engaging with societies as a form of professionalism (Flexner, 1915; Hancock & Walsh, 2016; Kunitz, 1974; Larson, 1977), and disciplines have individually examined professionalism particularly by the demands of the field, with learning objectives focused on the professional's personal development (Dalli, 2007; Harwood & Tukonic, 2016; Mohan, Merle, Jackson, Lannin, & Nair, 2010; Stern, 2006). Through this study, the underlying meaning of professionalism and learning experiences perceived by graduate students were examined to offer insights in generalizing professionalism and in designing learning that promotes the development of professionalism.

Implications for Research and Practice

The findings of this study can be used as groundwork in designing instructional guidelines to develop applicable strategies that can be widely adapted

to use in graduate education. The program supported students' development of professionalism through interdisciplinary collaboration and communication, various opportunities to engage with different professionals that utilize their professional roles to work directly with communities, understand the interconnectedness between their competence and to solve social problems, and opportunities for reflection. Students being exposed to these interventions enabled them to reflect on ways to utilize their professional roles in society and see the effectiveness their roles can have as well. For graduate education to promote professionalism in instruction, the context of the cross-disciplinary professional skills training program that offers early interventions for students to enhance their problem-solving, leadership, effective communication, teamwork, and community engagement skills may be a possible direction to promote students' development as professionals that withhold the competence (e.g., professional knowledge and skills) and abilities to communicate their understanding with the larger context, all while reflecting on themselves as well as the needs of the larger communities.

Graduate education should focus on students' knowledge development as well as their real-world application skills, which will support new scholarship that allows students to make the most of developing their own values and goals in education (Strouse, 2015). Professionals develop abilities to solve problems in practice (e.g., real-world problems), and they become capable of transferring their content knowledge. Transfer of content knowledge enables them to reflect on themselves and eventually towards thinking about the meaning and practice of their knowledge in real-world contexts (Schön, 1983). As there have been needs for the field of instructional technology to work towards designing instruction that meets the public expectations (Yusop & Correia, 2012), making further attempts to design instruction grounded in pedagogies including community engagement, interdisciplinary collaboration and engagement, service, mentorship, etc., will enable learning experiences that help students' reflective practice (Culhane, Niewolny, Clark, & Misyak, 2018) and to make meaning of their professions.

Limitations and Suggestions for Future Research

Some limitations of this study are as follows. A total of four graduate students out of twelve students took part in this study. Although the research participants in the study had different majors, three of the four participants were in departments within the same college. Since the findings result from the participants' experiences (e.g., prior experiences, their field of studies), the lack of variation may have affected the findings. Moreover, the

participants' shared perceptions of professionalism could have been influenced by their personal experiences, including background knowledge, prior experiences, the purpose of enrolling in the training program, and the nature of their research programs. Volunteer bias (Salkind, 2010) may have occurred as participants who had positive experiences with their professional lives in the past may have volunteered to take part in the study, which would influence the professional experiences they shared. Due to these variations, conducting interviews with a wider selection of participants may be needed to inform a more generalized finding in understanding the development of professionalism of graduate students and in setting the groundwork for designing learning environments.

The duration of the pre- and post-interviews were within a period of six months. Though the changes of professionalism, as well as learning experiences of the training program, were part of the investigations of this study, the time period may not have been long enough to investigate and document the changes of students' perceptions of professionalism. Moreover, the nature of the program focused on developing students' professional skillsets may have limited the findings of instructional strategies that can be used to promote professionalism.

Further investigations to examine the types of instructional strategies that are currently being used across different fields may add value to identify cross-cutting strategies that are mutually beneficial across all fields and applicable in generalizing professionalism development in graduate education. Addressing the limitations of this study may also set the direction in continuing to follow the current trends of higher education by ensuring its sustainable commitment towards community engagement.

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Appendix

Pre-interview Protocol for a Study in Understanding Ways Professionalism is Promoted in Higher Education
- Interviewee's background
  - What is your:
    - Academic background, major, work experiences
  - Purpose of pursuing a higher degree
    - What is your purpose for enrolling in graduate school?
- Interviewee's current perceptions of the training program
  - What experiences do you hope to gain?
  - What are your expectations in terms of personal growth?
- What is your current understanding of professionalism in terms of the following?
  - Definition of professionalism
  - What personal indicators of yourself currently reflect professionalism?
  - What professional skills do you have?
- Personal experiences
  - Please share any personal experiences that have led to changes in how you perceive professionalism.
  - What professional skills did you develop?
- How do you hope to develop as a professional through the training program?
- In relation to the development of your professionalism, what experiences do you hope to have in the training program?

Post-interview Protocol for a Study in Understanding Ways Professionalism is Promoted in Higher Education
- What is your purpose for enrolling in graduate school?
- What is your current understanding of professionalism in terms of the following?
  - Definition of professionalism
  - What personal indicators of yourself reflect professionalism?
  - What professional skills do you have?
- Share professional experiences of the training program
  - As a result of the program, how have you developed as a professional to date?
  - As a result of the program, how have your perceptions of professionalism changed, if at all?
    - If there were changes to the development of your professionalism, what experiences did you have in the training program that promoted this change?
    - What professional skills did you develop?
- Personal experiences
  - Please share any personal experiences that have led to changes in how you perceive professionalism.
  - What professional skills did you develop?
- In what ways do you see the development of professionalism in the training program influencing your:
  - Purpose of pursuing a higher degree
  - Research

Citizenship Behavior and Learner Engagement in Collaborative Learning: Exploring Dual Mediation with Emergent Leadership and Group Cohesion

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How can we increase the level of students' engagement in collaborative learning in higher education? To answer this question, we investigated the potential factors that were known to affect teamwork engagement in workplace settings because of the compatibility between collaborative learning and teamwork in the workplace. Specifically, we examined how Emergent Leadership and Group Cohesion mediate the relationship between Organizational Citizenship Behavior (OCB) and engagement. Two hundred and thirty-four college students participated in the study. The hypothesized dual mediation model was tested using the SPSS PROCESS macro (Hayes, 2013). Overall, the proposed model was significant, and the relationship between OCB and engagement was fully mediated by Emergent Leadership and Group Cohesion. The results present the mechanism of how OCB can positively contribute to student engagement in a collaborative learning environment. By enhancing OCB in collaborative groups, therefore, it is expected that students can experience good shared leadership and cohesive groups, and eventually such students' experiences will positively affect learners' engagement levels in collaborative work. Our results provide evidence that instructors should consider how OCB can be encouraged in collaborative settings when they design, plan, and facilitate collaborative learning projects. Theoretical and practical implications of the research are also discussed.

Introduction

Working effectively with others as a group is one of the necessary skills that our college students should possess to succeed in their professional world where they will work after graduating. This is because many tasks they will perform in their careers will frequently require them to work as a group. As educators in higher educational institutions, we are responsible for teaching them not only content knowledge related to their majors, but also the skills for working collaboratively. Students have often gained such skills via collaborative learning experiences while they are in college.

Many educators and researchers in the field of higher education, therefore, have given their attention to collaborative learning (hereafter CL), meaning "an instruction method in which students at various performance levels work together in small groups toward a common goal" (Gokhale, 1995, p. 22). Learners can learn better through CL compared to individual learning (Johnson & Johnson, 1989; Lou, Abrami, & d'Apollonia, 2001), develop social interaction skills and critical thinking skills, build learning communities, and get help to understand diversity (Laal & Ghodsi, 2012; Micari & Pazos, 2019; Tlhoaele, Hofman, Winnips, & Beetsma, 2014).

Despite some empirical evidence of the effects of CL, some researchers also argued that collaborative learning design and research may often neglect some critical elements which relates to socio-emotional aspects of group forming and group dynamics in CL.

For example, Kreijns, Kirschner, and Jochems (2003) pointed out that CL researchers and educators often limited the understanding of social interaction to cognitive processes like deep learning or information retention, although social interaction like member support or group well-being functions are important for successful group work. Therefore, it is important to incorporate social dimensions to gain a better understanding of CL. In light of research findings in the fields of management and human resource development (HRD) (Morse, 2010; Organ, Podsakoff, & MacKenzie, 2006; Strijbos, Martens, Jochems, & Broers, 2004), we propose that group-related constructs such as organizational citizenship behaviors, group cohesion and leadership, which are relatively neglected topics in CL, can be considered. Outside of the educational context, groups of researchers have examined the group-related factors for promoting group members' engagement in group work (e.g., Bakker & Demerouti, 2016; Bakker, Demerouti, & Euwema, 2005; Goering, Shimazu, Zhou, Wada, & Sakai, 2017; Joubert, 2014; Macgowan, 1997). Considering a CL environment as a group work setting in educational contexts, it is reasonable to regard the factors related to group processes as the ones working for engaging learners in CL. In the current research, we aim to explore the effects of organizational citizenship behaviors (OCB), group cohesion, and emergent leadership on student engagement in CL in higher education and how these constructs influence student engagement in the collaborative learning environment of higher education.

Key Constructs of the Study

Engagement

Engagement is one of the critical conditions for students to achieve learning goals successfully (Kuh, 2007). Highly engaged learners are likely to learn more, get better grades, and eventually pursue higher education (Wang & Holcombe, 2010). In spite of the importance of engagement and significant efforts to reach a consensus on its definition, there has not yet been a single and firm definition of student engagement (Groccia, 2018; O'Brien & Toms, 2008). Depending on the context of the studies, engagement has been defined in various ways. For example, Kuh (2003) defines engagement as "the time and energy students devote to educationally sound activities inside and outside of the classroom, and the policies and practices that institutions use to induce students to take part in these activities" (p. 25). Axelson and Flick (2011) refer to engagement as the concept of "how involved or interested students appear to be in their learning and how connected they are to their classes, their institutions, and each other" (p. 38), and Fletcher (2016) defines engagement as a continuous connection of a learner toward any learning activities.

In addition, some argue that engagement is a complex concept that cannot be explained with a single dimension. According to Hu and Li's (2017) categorizations, student engagement has been identified as a construct that has two, three, or even four dimensions. For example, some researchers (e.g., Finn,1989; Marks, 2000; Newmann, Wehlage, & Lamborn, 1992) have explained engagement with two dimensions, which are behavioral and emotional engagement. Others (e.g., Appleton, Christenson, & Furlong, 2008; Appleton, Christenson, Kim, & Reschly, 2006; Reschly & Christenson, 2006) have asserted four dimensions by adding cognitive and affective engagement to behavioral and emotional engagement. Similarly, some studies divide the concept of engagement into three dimensions, such as behavioral, emotional, and cognitive engagement (e.g., Fredricks, Blumenfeld, & Paris, 2004; Jimerson, Campos, & Greif, 2003; Klem & Connell, 2004).

As shown above, researchers have identified engagement in various ways and with multiple dimensions. However, the core of learner engagement, which is interpreted through those definitions and multiple dimensions, is the very term describing a *state* that a learner subjectively experiences in a specific environment or an activity. In this regard, Doherty and Doherty (2018) explain that "engagement is most frequently characterized as a variable *state*" (p. 8). Also, Schaufeli, Salanova, González-Romá, & Bakker, (2002) define engagement as "a positive, fulfilling, work-related *state* of mind" and "a more persistent and pervasive affective-cognitive *state*" (p.74).

Viewing engagement as a *state* of mind has led researchers to consider flow theory, coined by Csikszentmihalyi (1990). It is because the concept of flow refers to "a subjective state that people report when they are completely involved in something to the point of forgetting time, fatigue, and everything else but the activity itself" (Csikszentmihalyi, 2014, p.230). In the same vein, Nakamura & Csikszentmihalyi (2009) describe the concept of flow as "a state of deep absorption in an activity that is intrinsically enjoyable" (p. 195). Hence, due to the conceptual similarity, the concept of flow has often been interchangeably used with a concept of engagement (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2014). Also, Guo, Klein, Ro, and Rossin, (2007) found that students' flow experience also affects learning outcomes, specifically, the students' perceived learning of the subject matter, perceived skill development, and student satisfaction.

Based on this comprehensive interpretation discussed above, we define engagement using one of the dimensions classified by Schaufeli et al. (2002): absorption, referring to "being fully concentrated and deeply engrossed in one's work, whereby time passes quickly, and one has difficulties with detaching oneself from work" (Schaufeli et al., 2002, p. 75). As described in the definition of absorption, it represents the core concept of engagement. Furthermore, it could be considered as the deepest level of engagement (Brockmyer et al., 2009), and so it can directly affect the learner's work performance, as does flow. Therefore, we operationally define learner engagement as a learner's absorbed *state* of mind that firmly attaches the learner to work due to the learner's full concentration and deep engrossment in the task at hand.

Organizational Citizenship Behavior

It is frequently observed that people in an organization and team help other members in various organizational settings such as the military (Gurbuz, 2009), government (Shim & Faerman, 2017), workplace (Astakhova, 2015), and education (Chen & Carey, 2009), although these helping behaviors are not part of their required tasks or roles. The voluntary helping behaviors in an organization are positively correlated with people's job satisfaction (Bateman & Organ, 1983). Organ (1988) devised the concept of this behavior and called it organizational citizenship behavior (OCB). OCB is defined as the following:

> Individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promotes the effective functioning of the organization. By discretionary, we mean that the behavior is not an enforceable requirement of the role or the job description, that is, the clearly specifiable

terms of the person's employment contract with the organization; the behavior is rather a matter of personal choice, such that its omission is not generally understood as punishable. (Organ, 1988, p. 4).

In group collaboration in the workplace, team members' OCB plays a significant role in team performance, individual performance, work engagement, and work satisfaction (Bruque, Moyano, & Piccolo, 2016; Walz & Niehoff, 2000). Also, OCB in the team is correlated with various constructs in collaboration such as transformational leadership, team climate, and group cohesion (Podsakoff et al., 2017). However, some researchers (e.g., Al Ahad & Khan, 2020; Ariani, 2013) have found that demographic attributes like gender and age are not playing a significant role on OCB. In light of these findings in the workplace, it is reasonable to examine the effects of OCB in higher education.

Emergent Leadership

Leadership is important in learning as a group. A strong leader can inspire and stimulate group members, provide directions for the group, and facilitate group participation (Denison, Hooijberg, & Quinn, 1995). Researchers have explored how traditional leadership constructs such as transformational leadership and transactional leadership influence learning outcomes (e.g., Chang & Lee, 2013; Raes et al. 2013) and learning satisfactions (e.g., Huang, Kahai, & Jestice, 2010). In the last two decades, researchers have been exploring a new leadership phenomenon: emergent leadership. Instead of seeing how appointed leaders lead an organization or a group, which transformational leadership and transactional leadership address, emergent leadership describes how individuals emerge as leaders in group work environments, which often appear in the context of collaborative learning. Studies in the management area found that people in groups emerge as leaders in various ways. For instance, Yoo and Alavi (2004) found virtual group members initiated conversation and activities, scheduled meetings, and integrated group members' work. Recently some educational researchers sought to explore how emergent leadership works in educational environments. For example, Li et al. (2007) examined discussion groups in elementary classrooms, and they found that children shared leadership functions including turn management, argument development, planning and organization, topic control, and acknowledgment. Carte, Chidambaram, and Becker (2006) found that higher-performance virtual teams in college classes exhibited more emergent leadership behaviors. In conclusion, some empirical pieces of evidence indicated that members in learning groups emerged as leaders in

different ways and emergent leadership could lead to better learning outcomes.

Group Cohesion

Group cohesion is defined as "an individual's sense of belonging to a particular group and his or her feelings of morale associated with membership in the group," (Bollen & Hoyle, 1990, p. 482). A sense of belonging and morale is directly related to an individual's motivation to achieve group goals because people are willing to connect with each other, remain united to pursue group success, and harmonize with other team members in a highly cohesive group (Carron, Brawley, & Widmeyer, 1998; Philippe, Lafreniere, Paquet, & Hauw, 2014). Group cohesion improves the group decision-making process and the productivity of the group as well (Harris & Sherblom, 2018).

In CL, group cohesion is positively associated with the quality of collaboration in groups and student satisfaction because collaborative learning can foster trust and better communication among team members (Dewiyanti, Brand-Gruwel, Jochems, & Broers, 2007; Williams, Duray, & Reddy, 2006). Bravo, Catalán, and Pina (2019) examined the consequences of group cohesion in college student collaborative learning groups and reported that group cohesion in collaborative learning enhances student satisfaction with teamwork, the quality of teamwork results, and learning. Wang and Hong (2018) similarly reported that group cohesion in the computer-supported collaborative learning environment could improve team performance.

Relationship among Key Constructs

OCB and Engagement (Absorption)

Since Organ (1988) proposed OCB, OCB studies have proliferated in the field of management (Alkahtani, 2015). The previous OCB research in management and the workplace consistently supported that OCB is positively related to various workplace outcomes. OCB is, for example, positively correlated to job satisfaction (Lu, Zhao, & While, 2019) and work performance (Podsakoff, Whiting, Posdakoff, & Blume, 2009) in the workplace. Previous studies also reported the positive relationship between work engagement and OCB (Ariani, 2013; Babcock-Roberson & Strickland, 2010). Babcock-Roberson and Strickland (2010) collected data from college students regarding their work experiences and found a significant positive correlation between OCB and work engagement. Although there are no direct research results of OCB and student engagement in learning, based on the research in the workplace, we hypothesize as follows: H1. OCB affects engagement in CL.

OCB and Emergent Leadership

Another question is: What may lead to emergent leadership in CL situations? Although little research has focused on the relationship between OCB and emergent leadership, the literature suggests that various citizenship behaviors lead to emergent leadership. For instance, some studies found that internal team environments that supported citizenship behaviors, including shared purpose, social support, and voice, were positively related to emergent leadership (Carson, Tesluk, & Marrone, 2007; Serban & Roberts, 2016). In addition, the studies found that emergent leadership and OCB were both related to personality traits such as extraversion (Kickul & Neuman, 2000; Walter, Cole, der Vegt, Rubin, & Bommer, 2012). Another antecedent of emergent leadership is group conflict. Li, Hui, Ashkanasy, and Ahlstrom (2012) found that task and relational conflict had a negative relationship with emergent leadership. Choi and Sy (2010) also found that task and relational conflict had a negative relationship with OCB. Marinova, Moon, and Kamdar (2013) examined the relationship between aspects of OCB, including conscientiousness and altruism, and emergent leadership. They found that the relationship between conscientiousness and emergent leadership was mediated by altruism. Hence, we hypothesize as follows: H2. OCB affects emergent leadership in CL.

OCB and Group Cohesion

In terms of the relationship between OCB and group cohesion, we hypothesize that OCB can be an antecedent of group cohesion. Bravo et al. (2019) examined the antecedents of group cohesion in CL: individual factors (cooperativeness and collaborative behavior) and task factors (task complexity and workload). Collaborative behaviors and cooperativeness, the individual factor antecedents of group cohesion, are similar to OCB. Collaborative behaviors and cooperativeness in their research include prosocial behavior, and OCB is a type of prosocial behavior in an organization, including commitments to other members and the organization (Borman & Motowidlo, 1997). This argument is reasonable because OCB components such as high altruistic behaviors towards other team members can promote group cohesion (Prapavessis & Carron, 1997). Therefore, we hypothesize that: H3. OCB affects group cohesion in CL.

Emergent Leadership and Group Cohesion

Group cohesion is another important factor that can lead to positive team performance. Indeed, group cohesion has been found to be positively related to emergent leadership in various contexts (Xie, Hensley, Law, & Sun, 2019; Yamaguchi & Maehr, 2004). For example, Neubert

(1999) found that emergent leadership had a positive relationship in a manufacturing team context. In another study, Xie et al. (2019) investigated college student teamwork in an online class. They also found a strong correlation between emergent leadership and group cohesion. Yamaguchi and Maehr (2004) found that emergent leadership led to stronger group cohesion in elementary classrooms where students collaborated in math activities. In the teamwork literature, Yoo and Alavi (2004) found that emergent leaders often coordinate the logistics among the team members, as well as integrate team members into work teams, which, in turn, can improve group cohesion. Therefore, we hypothesize that emergent leadership is an antecedent of group cohesion in the context of higher education: H4. Emergent leadership affects group cohesion in CL situations.

Emergent Leadership and Engagement

In a learning environment, students have to engage in learning activities in order to learn. The relationship between emergent leadership and engagement has only been explored in limited amounts of research. A few studies have focused on how emergent leadership influences communication patterns, which can be an aspect of engagement. Carte et al. (2006) investigated 22 virtual teams from three different universities located in three different states. They found that the teams with higher emergent leadership communicated more than those teams with lower emergent leadership. Xie et al. (2019) examined how emergent leadership influenced posting and reading online discussions in an online class. They found that task emergent leadership had a positive relationship with both posting and reading behaviors in an online discussion, but relational emergent leadership and posting in/reading the online discussion did not have a significant relationship. In another study, Waldman et al. (2013) examined emergent leadership and team-level engagement in MBA classes. They found that individual engagement in problem-solving tasks was related to the individuals' emergent leadership. As a result, we hypothesize that students' emergent leadership is an antecedent of engagement: H5. Emergent leadership affects engagement in CL.

Group Cohesion and Engagement

A few studies have shown that group cohesion is a construct showing a positive relationship to engagement. Costa, Passos, and Bakker (2014) argued that group cohesion is positively related to teamwork engagement. In addition, Gaspar (2016) stated that a group high in cohesion tends to be engaged and absorbed more at work because they are motivated to work together to achieve the group's desired goal. Thus, he asserts that group cohesion is positively

Figure 1
Hypothesized serial dual mediation model
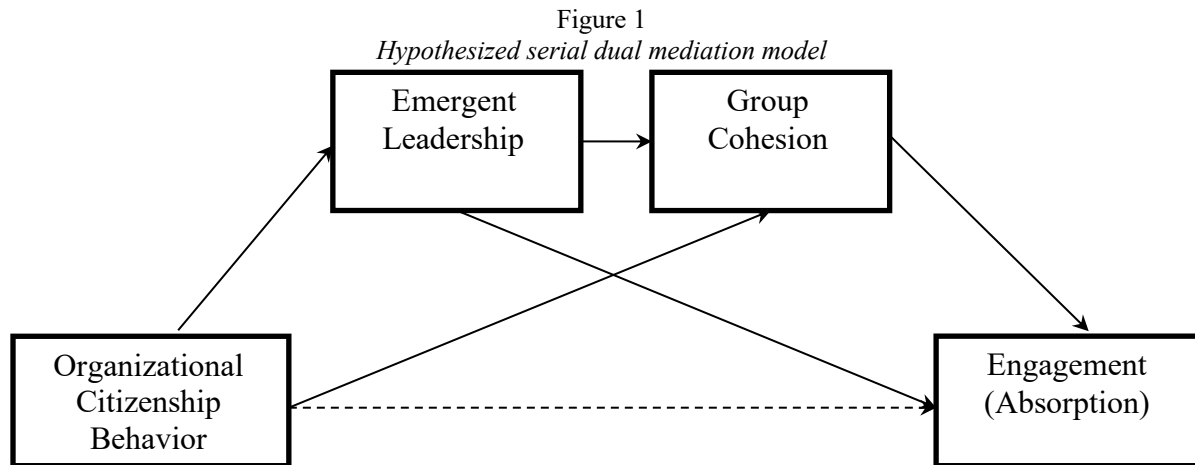
related to teamwork engagement. Some researchers like Rodríguez-Sánchez, Devloo, Rico, Salanova, and Anseel (2017) also support the positive relationship between group cohesion and engagement. According to the previous research studies in the context of the corporate working environment, the teams with high group cohesion tend to perform well on tasks through increased engagement with the task at hand. Hence, we hypothesize that a similar situation can happen in higher educational settings: H6: Group cohesion affects engagement in CL environments in higher education.

Study Hypotheses and Proposed Model

Based on the hypotheses listed above (H1-H6), we propose the following model for engagement (absorption) in CL environments (Figure 1). To test the proposed serial dual mediation model shown in Figure 1, we established three specific hypotheses additionally as follows: the relationship of OCB to engagement in CL would be mediated by (a) emergent leadership, (b) group cohesion, and (c) both emergent leadership and group cohesion. Hence, the three additional hypotheses are:

H7: Emergent leadership mediates the relationship between OCB and engagement in CL.
H8: Group cohesion mediates the relationship between OCB and engagement in CL.
H9: Both emergent leadership and group cohesion mediate the relationship between OCB and engagement in CL environments.

Methods

In order to examine the hypotheses, we collected data from college students using a survey and employed the SPSS PROCESS macro (Hayes, 2013) to analyze the dual

mediation model. In this section, detailed descriptions of research participants and measurement are provided.

Participants

Two hundred and thirty-four Korean college students participated in the study. The data was collected in a general mandatory course for all junior and senior students in the college. The goal of the course is that students, as good citizens of society, identify critical social issues (e.g., climate changes and economic inequality) and design solutions through collaborative group work. One hundred and eighty-four juniors (78.6%) and 50 seniors (21.4%) participated in this study. Students taking the course were from various disciplines in the university such as humanities (53 students, 22.6%), social sciences (75 students, 32.1%), science (55 students, 23.5%), information technology (32 students, 13.7%), and arts (17 students, 7.3%). Two students (0.9%) did not reveal their discipline.

In the 16-week course, students conducted a group project from week four to week 12. Before forming teams for a group project, for five weeks the students had a chance to learn the necessary collaborative learning skills including team-building skills, team communication skills, and problem-solving skills, as well as primary research skills such as topic investigation skills and literature search skills. The students formed groups of four or five people, and they worked on a group project for nine weeks. The rule of thumb to form groups was that the instructors of the classes assign students to groups by their interests in topics. Hence, most groups were formed under this principle. After completing the research, each group presented their findings and solutions to the class. The survey was distributed in class and collected on weeks eight and nine of the group project.

Table 1
Sample Items by the Key Constructs

Key Constructs	Sample Items
OCB	I help other group members who have a heavy workload.
	I am one of the most conscientious students in the group.
	I consume a lot of time complaining about trivial matters in group work.
	I do not abuse the rights of other group members.
Emergent Leadership	Task leadership: I took charge of what the group should do on the group project activity.
	Relational leadership: I made sure that everyone in my group was listening to one another.
Group Cohesion	Belonging: I feel that I belong to this group.
	Morale: I am happy to be part of this group.
Engagement	When I am working in the group, I forget everything else around me

Table 2
Descriptive Statistics and Values of Coefficient Alpha for Key Constructs (N=234)

Key construct	Number of Items	M	SD	Min.	Max.	Skewness	Kurtosis	Chronbach's α
OEB	18	3.997	.404	2.51	4.95	-.130	.448	.89
Emergent Leadership	9	3.867	.611	1.73	5.00	-.186	.180	.93
Group Cohesion	6	3.827	.834	1.00	5.00	-.799	.939	.95
Engagement	7	2.823	788	1.00	5.00	-.005		.88

Measurement

We measured demographic data and four constructs using the validated measurements. The original survey items for all four constructs were written in English, and we employed a rigorous survey item translation and adaptation process such as expert panel review for contextual and cultural adaptation, face validity examination, and forward and backward translation to assure semantic equivalence and comparability (Brislin, 1970; Keszei, Novak, & streiner, 2010; Lim, Morris, & McMillan, 2011; Sanson-Fisher, & Perkins, 1998). The face validity for the survey item adequacy in a higher education setting was examined by three university professors in the education and human resource development fields. The forward translation was conducted by two professors who are Korean native speakers teaching in universities in the US, and the backward translation was accomplished by two English native social scientists who are fluent in Korean.

Organizational Citizenship Behavior (OCB)

As a pilot study, Kang, Byun, Law, Seo, and Ferris (2019) adapted and validated the OCB measurement

developed by Podsakoff, MacKenzie, Moorman, and Fetter (1990) for college students in the collaborative learning environment, and in this research the measurement was used. The measurement consists of 18 items.

Emergent Leadership

We measured emergent leadership by adapting the scale developed by Yamaguchi (2001). Following Stogdill's (1969) Leadership Behavior Description Questionnaire, Yamaguchi (2001) suggested two dimensions of emergent leadership: task leadership (four items) and relational leadership (five items) [see Table 1 for sample items]. Task leadership asked the participants about their leadership used in the execution of the group task. Relational leadership focused on the behaviors that build group relationships.

Group Cohesion

We measured group cohesion by adopting the scale developed by Chin, Salisbury, Pearson, and Stollak (1999). They created and validated six items to measure two dimensions of group cohesion: belonging (three items) and morale (three items) [see Table 1 for sample items].

Engagement (Absorption)

Engagement for this research was measured using the seven items for absorption developed by Schaufeli et al. (2002).

We used a 5-point Likert-type scale that ranges from 1 (strongly disagree) to 5 (strongly agree) for the measurement of all the items. Sample items are shown in Table 1. Descriptive statistics and the values for Cronbach's alphas for all the key constructs used in the final analysis are presented in Table 2.

Data Analysis

Using SPSS Statistics 25, we first conducted descriptive analyses for the four key constructs (OCB, emergent leadership, group cohesion, and engagement) in the hypothesized model. Then, we performed a series of t-tests and one-way analyses of variance (ANOVAs) as preliminary analyses to examine if there are any differences in the mediators (emergent leadership and group cohesion) and the outcome variable (engagement) in terms of year of study and discipline the participants were studying, respectively. Subsequently, we conducted bivariate correlation analyses to examine any significant associations among the four variables in the model. Finally, we tested the hypothesized dual mediation model of students' engagement in CL by using the SPSS PROCESS macro (Hayes, 2013) with 5,000 bootstrap samples to estimate the indirect effects of the students' OCB on engagement in CL (Preacher & Hayes, 2004).

Results

Preliminary Analysis

We conducted preliminary analyses to examine any significant differences in the key variables in terms of year of study and discipline the participants were studying. One-way analyses of variance (ANOVAs) were performed to examine the mean differences across disciplines. The analyses revealed that there were no significant differences across five different disciplines on any mediators or outcome variable (Fs ranged from .170 to 1.855, $df = 4/227$, ns).

However, as presented in Table 3, significant differences emerged between junior and senior students on the mediators and the outcome variable. Specifically, the seniors were more likely to report higher levels of emergent leadership, $t(232) = -2.628$, $p < .01$, group cohesion, $t(232) = -2.248$, $p < .05$, and engagement, $t(67.305) = -2.359$, $p < .05$, compared to juniors. Even though the mean differences were statistically significant, the effect sizes were small ($\eta^2 s$ range from 0.021 to 0.030). To provide a conservative test of the hypotheses, however, we conducted a mediation analysis with the year of students as a covariate to examine the effects of independent and mediation variables on the dependent measure of engagement after controlling for the year of students.

Table 3
Means and Standard Deviations of Major Dependent Measures for Juniors (n = 184) and seniors (n = 50) Student Samples

Variables	Junior (n=184)		Senior (n=50)		
	M	*SD*	*M*	*SD*	*t (df)*
OCB	3.976	.383	4.074	.471	-1.528 (232)
Emergent leadership	3.813	.606	4.066	.594	-2.628 (232)**
Group cohesion	3.764	.839	4.060	.780	-2.248 (232)*
Engagement (absorption)	2.753	.737	3.083	.914	-2.359 (67.305)*

Note. The t-value and df obtained from the unequal variance t-test were reported for the engagement variable, as it did not meet the assumption of homogeneity of variance. * $p < .05$, ** $p < .01$.

Table 4
Correlation Matrix for Study Variables (N = 234)

Variable	1	2	3	4
1. OCB	–			
2. Emergent leadership	.657*	–		
3. Group cohesion	.457*	.500*	–	
4. Engagement (absorption)	.370*	.525*	.553*	–

*$p < .001$

Table 5
Parameter estimates of total, direct, and indirect effects

	B	SE	t	p	LLCI	ULCI
Total effect						
OCB→ Engagement	.695	.119	5.859	.000	.461	.928
Direct effects						
OCB→ EL	.978	.075	13.108	.000	.831	1.125
OCB→ GC	.470	.153	3.070	.002	.168	.771
EL→ GC	.463	.102	4.528	.000	.261	.664
EL → Engagement	.449	.093	4.835	.000	.266	.632
GC → Engagement	.368	.057	6.412	.000	.255	.482
OCB→ Engagement	-.084	.136	-.620	.536	-.352	.184

	Effect	Boot SE	BootLLCI	BootULCI
Indirect effects				
Total	.779	.117	.564	11.019
Indirect 1	.439	.128	.215	.715
Indirect 2	.173	.091	.027	.381
Indirect 3	.167	.057	.062	.283

Indirect 1 OCB → Emergent Leadership (EL) → Engagement
Indirect 2 OCB → Group Cohesion (GC) → Engagement
Indirect 3 OCB → Emergent Leadership (EL) → Group Cohesion (GC) → Engagement
Note. B = path coefficient; SE= standard error; LLCI = lower limit confidence interval; ULCI = upper limit confidence interval; Boot SE= Bootstrapped standard error; BootLLCI = 95% bias-corrected bootstrapped low limit confidence interval; Boot ULCI = 95% bias-corrected bootstrapped upper limit confidence interval.

Bivariate Correlations

The bivariate correlations among the four study variables appear in Table 4. As anticipated, students' OCB in group activities was positively correlated with engagement ($r = .370$, $p < .001$), emergent leadership ($r = .657$, $p < .001$), and group cohesion ($r = .457$, $p < .001$) respectively. Emergent leadership was significantly and positively associated with group cohesion ($r = .500$, $p < .001$) and engagement ($r = .525$, $p < .001$). Lastly, group cohesion was also positively related to engagement ($r = .553$, $p < .001$) in CL.

Serial Dual Mediation Model

We tested the hypothesized dual mediation model of students' engagement in CL. As there was a significant difference in the engagement variable in terms of students' year of study, year of study was entered into the model as a covariate.

Overall, the hypothesized mediation model was statistically significant and explained the 39% of variance in students' engagement in CL, $R^2 = .393$, $F(4, 229) = 37.024$, $p < .001$. Through the serial dual mediation analysis using bootstrap estimation with 5,000 samples, we tested three mediations of OCB on teamwork engagement by (1) Emergent Leadership (OCB → Emergent Leadership→ Engagement), (2) Group Cohesion (OCB→ Group Cohesion → Engagement), and (3) both Emergent Leadership and Group Cohesion (OCB→ Emergent Leadership → Group Cohesion → Engagement).

As shown in Table 5, the results supported all three mediations, and all of the paths in the three mediational pathways were significant. First, the indirect effect of OCB on engagement through emergent leadership was statistically significant, $b = .439$, $SE = .128$, 95% CI [.215, .715], indicating that students with higher levels of OCB were more likely to show greater emergent leadership, which in turn related to higher levels of engagement in CL activities. Second, the indirect effect of OCB on engagement through group cohesion was significant, $b = .173$, $SE = .091$, 95% CI [.027, .381]. That is, students who showed more OCB in the CL setting tended to feel a greater sense of group cohesion, which in turn contributed positively to engagement. Lastly, the indirect effect of OCB on engagement through both mediators of emergent leadership and group cohesion was also significant, $b = .167$, $SE = .057$, 95% CI [.062, .283].

As shown in Figure 2, students with higher levels of OCB were more likely to demonstrate emergent leadership during the CL activities, $b = .978$, $p < .001$, which then was linked to their greater sense of group cohesion, $b = .463$, $p < .001$. In turn, students with a greater sense of group cohesion tended to be more engaged in CL

Figure 2
Serial dual mediation of OCB on engagement
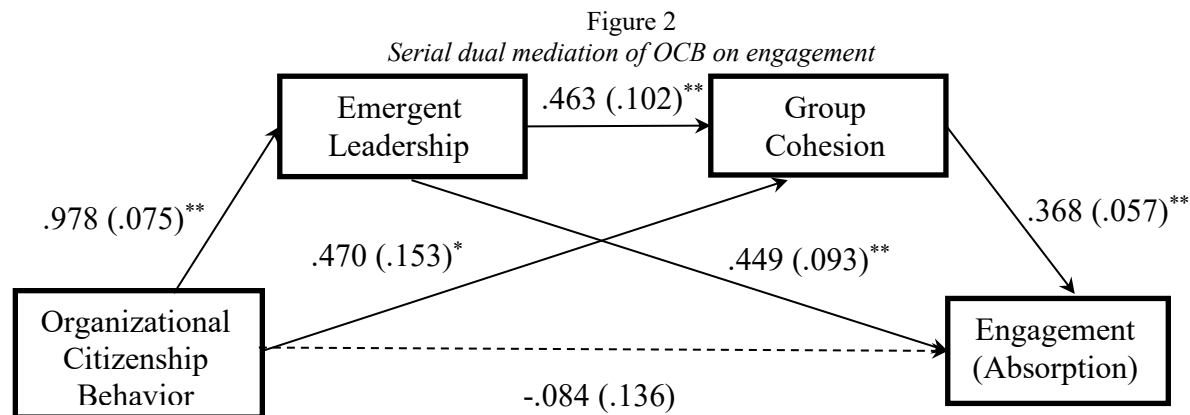
$^* p < .01, ^{**} p < .001$
Note. Year of study was entered into this mediation model as a covariate. All presented path coefficients are unstandardized and standard errors are presented in parentheses.

activities, $b = .368$, $p < .001$. The correlation between OCB and engagement in CL was statistically significant, $r = .370$, $p < .001$, but the direct effect of OCB on engagement in the serial dual mediation model was not significant, $b = -.084$, *ns*. That is, the relationship between OCB and engagement was fully mediated by emergent leadership and group cohesion.

Discussion

The purpose of this study was to explore the relationship between OCB and student engagement in CL in higher education settings with a dual mediation model with emergent leadership and group cohesion. The research result shows that students with high OCB are engaged in learning in a collaborative learning context (H1). In other words, when students show OCB in group work, they thoroughly concentrate and are engrossed in their group work (Schaufeli et al., 2002), which can lead to successful project accomplishment and positive learning experiences for students (Nkhoma, Sriratanaviriyakul, Cong, & Lam, 2014; Van Wingerden, Derks, & Bakker, 2018).

This finding is compatible with OCB research findings in the workplace such as the positive relationships between employees' OCB in the workplace and work engagement (Ariani, 2013; Babcock-Roberson & Strickland, 2010). OCB is a recently introduced construct in the collaborative learning field, although the construct has been broadly studied in corporation settings. This transferability of previous OCB research to the field of collaborative learning provides possibilities of OCB research applicability and expansion in the field of education such as OCB with student social loafing, learning performance, and student satisfaction.

Because of its positive relationship with human performance, engagement has been studied in various contexts. In the corporation setting, for example, researchers have noticed the strong relationship between work engagement and employee performance, and so they have been looking for the factors that likely affect employees' engagement level (e.g., Bakker & Demerouti, 2016; Schaufeli, & Salanova, 2007). For the same reason, researchers in the field of education have also been finding ways or factors to increase students' engagement. Nonetheless, researchers have indeed defined the term engagement in various ways, even in the same contexts, and there has not been a strong consensus on its definition yet. In this study, we defined and measured engagement as a state of mind to be wholly concentrated on, and acutely absorbed in the group work (Schaufeli et al., 2002), which has been discussed relatively little in the context of CL despite its potentials for students' learning achievement. The previous studies typically presented engagement as behavioral participation in group work in the collaborative learning context (Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013; Zhao, & Kuh, 2004). Considering that the dimension requires a deeper level of engagement than simple participation in group work, it is significant to approach engagement with the dimension of absorption. As the results of the current study indicated, OCB, emergent leadership, and group cohesion are all related to students' fully absorbed state of mind when they work as a group. Hence, the instructors who design CL environments should consider those factors as critical elements for helping students to be engaged in CL activities.

The dual mediational relations in this research show the mechanism of the relationship between OCB and engagement. First, the hypothesized dual

mediation model was significant overall, and each mediational path within the model was also supported. Second, students' emergent leadership and group cohesion respectively mediated the relationship between their organizational citizenship behavior (OCB) and teamwork engagement (H7 and H8). That is, students high in OCB tended to demonstrate greater emergent leadership, which then was associated with higher levels of engagement in their group project, and students with higher levels of OCB were more likely to have a greater sense of belongingness and morale in their group project, which, in turn, related to more engagement. The significant mediation results are consistent with the prior literature regarding OCB, emergent leadership, and engagement that showed positive relationships between OCB and emergent leadership (e.g., Carson et al., 2007; Serban & Roberts, 2016) and emergent leadership and engagement (e.g., Carte et al., 2006; Xie et al., 2019).

Additionally, students' perceived group cohesion also mediated the relationship between OCB and engagement. Students with higher levels of OCB were more likely to have a greater sense of belongingness and morale in their group project, which in turn related to more engagement. This research result supports previous studies such as Bravo et al.'s (2019) research showing that prosocial behaviors are antecedents of group cohesion in CL and Costa et al. (2014) and Gasper (2016) reporting a positive relationship between group cohesion and engagement. While the previous studies see a direct relationship among OCB, group cohesion, and engagement, we examined the mediational relationship among them.

Lastly, the relationship between OCB and teamwork engagement was fully mediated by emergent leadership and group cohesion (H9). Specifically, students who engaged more in OCB during the group project tended to display more emergent leadership behaviors, which were in turn linked to higher perceptions of group cohesion. Subsequently, students who felt a greater sense of group cohesion were more likely to engage in their group projects. While previous studies partially support the relationship among constructs respectively in the workplace and in cooperative learning settings (Babcock-Roberson & Strickland, 2010; Carte et al., 2006; Gaspar, 2016; Shaw, 2011; Slavin, 2015; Slavin, Hurley, & Chamberlain, 2003; Watkins et al., 2018), the current research results show the mechanism of how OCB can positively contribute to student engagement in a group project. By enhancing OCB in group work, students can experience and practice good leadership, group cohesion, and learning engagement in group work. As a result, instructors of cross disciplinary courses in higher education should consider how OCB can be encouraged in the collaborative setting when they design, plan, and facilitate collaborative learning projects. In addition, it would be worth trying to apply various instructional strategies and activities that can promote students' leadership and group cohesion. The example strategies could be to use "Energizers" which are small games designed to stimulate thinking and group interaction before starting group projects (Foster, 1989), or to use an inquiry-based learning method that is associated with authentic problems (Melgosa, 2018).

Limitations

Despite the contributions of this research, the research contains limitations. First, we collected data from a women's university, and so all participants are female students. However, the previous research reports that there are no gender differences in the relationship between OCB and work engagement (Al Ahad & Khan, 2020; Ariani, 2013). In light of the findings of the previous studies, we do not foresee that sampling from a women's university could be a significant drawback of the research. Second, there is a lack of consensus regarding the causal directions between group cohesion and OCB. Previous studies hypothesized the various relationships as well, such as GC as an antecedent of OCB (Kidwell, Mossholder, & Bennett, 1997) and GC as a moderator between OCB and group performance in the workplace (Cohen, Ben-Tura, & Vashdi, 2012). Based on research by Bravo et al. (2019) examining OCB as antecedent of group cohesion in the higher education context, we examined the relationship, and it would be our recommendation to investigate the possibility of the other direction between OCB and GC in future research.

Implications for Future Scholarship

As a future research agenda, a good contribution would be to examine antecedents of OCB in collaborative learning because OCB is an influential construct that can improve emergent leadership, group cohesion, and student engagement. In addition, it would be valuable to research other consequential constructs of OCB in collaborative learning, such as student satisfaction and student learning achievement. Considering the importance of student engagement in the cooperative learning environment, key constructs of this research would be applicable to cooperative learning. Therefore, it would be beneficial to examine OCB, GC, and EL in cooperative learning contexts in future research. We conducted this research in a general education course, and contextual expansions such as OCB's effects on engineering lab classes or online courses would be also worthy contributions.

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Examining the Benefits Associated with Implementing an Active Learning Classroom among Undergraduate Students

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The last 35 years have shown a greater interest among higher education professionals to adapt the principles of active learning within the classroom. Active learning, an instructional approach that allows students the opportunity to participate in the process of learning, requires them to do something more than just passively receive instruction. Increased student engagement, participation, and learning have long been linked with active learning, but little is known about any additional benefits. The focus of this study was to identify and examine any additional benefits associated with active learning above and beyond those of increased engagement, participation, and learning. A sample of 45 undergraduate students were randomly assigned to one of two treatment groups: active learning or traditional lecture. Results indicate that in addition to engagement, participation, and learning, active learning also promotes increases in communication and interactivity, community and connectedness, satisfaction, and flexibility.

Within the last 35 years there has been a greater interest among higher education professionals to adapt the principles of active learning in their classrooms (Baepler & Walker, 2014; Barnes, 1989; Cooperstein & Kocevar-Weidinger, 2004; Freeman et al., 2014; Huda, Ali, Nanji, & Cassum, 2016; Kyriacou, 1992; Stoltzfus & Libarkin, 2016). Active learning, an instructional approach that allows students the opportunity to participate in the process of learning, requires them to do something more than just passively receive instruction (Bonwell & Eison, 1991). When educators implement active learning in the classrooms, students are required to go beyond solely listening to course content to being fully engaged with reading, writing, discussing and solving problems (Bean, 2011). To be successful in an active learning course students must assess and examine the course material beyond the traditional lecture format. Students must not only do things, but actively and intentionally think about the things they are doing, both in and out of the classroom (Bonwell & Eison, 1991). Ultimately, active learning is a student-centered approach to teaching and learning.

Closely associated with the principles connected with the educational theory of constructivism, active learning operationalizes the principles of constructivism and, as such, one cannot truly exist without the other (Anthony, 1996; Cooperstein & Kocevar-Weidinger, 2004). This theory is based on the belief that learning occurs when students are actively engaged in their own educational process and are able to connect meaning with knowledge through experiences (Anthony, 1996; Gray, 1995; Merrill, 1991). This requires students to take ownership and responsibility over their own learning experiences (Tam, 2000).

Previous research demonstrated the rich benefits associated with implementing active learning. For example, Michael (2006) stated, "[T]here is an enormous wealth of research supporting the benefits of active learning in helping students master difficult subjects" (pp. 164-165).Furthermore, Bonwell and Eison (1991) concluded there is a clear link between increased student learning and active learning. Prince (2004) identified "support for all forms of active learning" (p. 229) and demonstrated a strong connection between increases in student engagement, participation, and learning with the implementation of active learning teaching strategies. Additionally, a meta-analysis of 225 peer reviewed research articles compared collegiate traditional lecture courses with collegiate active learning courses and found that active learning significantly reduced failure rates. In fact, on average, students in the traditional lecture classroom were 1.5 times more likely to fail when compared to those students in an active learning classroom (Freeman et al, 2014).

Additional research has shown an increase of over 37% in grades of college students enrolled in an active learning classroom over a traditional lecture classroom (Hoellwarth & Moelter, 2011). Active learning has also been shown to significantly increase knowledge retention, student engagement, and overall student success (Baepler & Walker, 2014; Costello, 2017; Huda et al., 2016; Olson & Riordan, 2012; Petersen & Gorman, 2014; Prince, 2004; Stoltzfus & Libarkin, 2016). However, these studies all focused primarily on three main benefits of active learning: increased student engagement, increased student participation, and increased learning. Increases in student engagement, participation, and learning have been demonstrated in a variety of educational disciplines through active learning integrating a wide range of active learning teaching techniques. Yet, it is still unclear how active learning provides additional benefits within the context of constructivism.

Student Engagement, Participation and Learning through the Theory of Constructivism

Active learning techniques lead to increased engagement, participation, and learning due to their foundation on constructivism. It is the student's role and responsibility to be actively engaged with the learning process (Von Glasersfeld, 1989). The student needs to construct their own knowledge by looking for meaning of the new material and relating that meaning back into their own personal belief system (Von Glasersfeld, 1989). Unlike a traditional lecture classroom delivery, the responsibility for learning does not rest upon the teacher to teach and the student to sit passively absorbing the course material. Therefore, the teacher must become comfortable serving as a facilitator, helping the student obtain his or her own understanding of the course material (Cooperstein & Kocevar-Weidinger, 2004). In support of the notion of facilitation, Rhodes and Bellamy (1999) stated:

> A teacher tells, a facilitator asks; a teacher lectures from the front, a facilitator supports from the back; a teacher gives answers according to a set curriculum, a facilitator provides guidelines and creates the environment for the learner to arrive at his or her own conclusions; a teacher mostly gives a monologue, a facilitator is in continuous dialogue with the learners (p. 23).

Another characteristic of constructivism is that the instructor and the student are equally involved in the learning process; both learning from one another (Ertmer & Newby, 1993; Fosnot & Perry, 1996; Von Glasersfeld, 1989). This requires constant engagement and the building of a relationship between the student and the educator, more so than traditional teaching theories require. This relationship requires that the educator serve as a guide to facilitate and coordinate learning, rather than merely dispensing course materials (Gagnon & Collay, 2005; Tam, 2000).

The benefits of increased engagement, participation, and learning from active learning and constructivism have been well documented across disciplines. However, additional benefits are less established. Chen (2015) has called for further studies on the impact active learning has on student group dynamics and on a student's sense of community within the classroom. Freeman et al. (2014) indicated further research is warranted to explore the relationship of active learning and instructor/student communication. Henshaw, Edwards, and Bagley (2011) further support this engagement of additional research on the role interactions, both between students and with the instructor, and how it plays in active learning. Jensen, Kummer and Godoy (2015)

called for increased examination on student flexibility in active learning classrooms.

Therefore, the focus of this study was to identify and examine additional benefits associated with active learning providing greater insight into student engagement, participation, and learning.

Methods

Study Population and Design

A convenience sample of 45 junior and senior undergraduate students (6 men, 39 women) participated in this study. Their inclusion in the study was based upon their enrollment in a recreational therapy undergraduate 300-level course at a traditional 4-year public university in the midwestern portion of the United States. All students were declared majors in recreational therapy. After enrollment, students were randomly assigned to one of two course sections. The first section, the control group, received a traditional lecture approach. The second section, the experimental group, received an active learning instructional approach. Both course sections received the exact same curriculum, assignments, and exams delivered in the same classroom and by the same instructor. Both sections met at the same time of day, although they did meet on different days of the week. Students were blind to the random assignment and were not aware of the differential instructional delivery. Every measure was taken to ensure that the only difference between the two sections was the method of instructional delivery (traditional lecture or active learning). A similar model has been used successfully with psychology students (Benjamin, 1991) and among biology students (Brooks, 2011; Jensen et al., 2015) to effectively impose a quasi-experimental design.

Questionnaire (Pre-test and Post-test)

Students were given a pretest and posttest survey on the benefits of active learning using the Active Learning Classroom Student Survey (ALCSS) (Joosten, 2014). The ALCSS was created by Joosten at the University of Wisconsin-Milwaukee and designed to capture the benefits and perceptions of students in active learning classrooms (2014). We made two minor changes to the ALCSS to adapt them to our study, including removing the phrase 'active learning course' and replacing them with 'this course' for all survey items to maintain integrity of the blinding between course sections. The second minor change was converting the survey into present tense to allow for pre-test and post-test survey administration. In total, we included 44 survey items examining student participation, engagement, learning, communication/interactivity, community/connectedness,

flexibility and satisfaction in the course questionnaire. Student responses to the survey items were measured using Likert scales that ranged from 1 to 5 (1-strongly disagree, 2-disagree, 3-neither agree or disagree, 4-agree, 5-strongly agree). The questionnaire was administered to the students during class time using an online survey platform, Qualtrics®. The pretest was administered during the first week of the course, and the posttest was administered on the last day of the course.

Measures

All study measures came from the aforementioned ALCSS questionnaire and were grouped into seven domains. These domains are described in detail below.

Participation in this study was defined as a student's contribution in class (Fritschner, 2000). This was measured by asking them questions such as, "The way this course is designed has increased my participation in the learning experience," and, "The way this course is designed has made me want to attend & contribute more in class."

Communication and interactivity were defined as the process of speaking, working, and influencing one another (Wei, Peng, & Chou, 2015). This was measured through the ALCSS by asking questions such as, "The way this course is designed has promoted better communication with my instructors," and, "The way this course is designed has allowed me to interact more with my instructor."

For the purpose of this study community and connectedness were defined as the process of being actively involved with another person or group in a manner prompting comfort, well-being, and a sense of belonging (Hagerty, Lynch-Sauer, Patusky, & Bouwsema, 1993; Laux, Luse, & Mennecke, 2016). This was measured by asking them questions such as "The way this course is designed has made collaboration with my classmates easier," and, "The way this course is designed has promoted my connection with the instructor through discussions."

Student engagement was defined as the degree of attention, interest, willingness, curiosity, and effort a student showed towards what they were learning (Fredricks, Filsecker, & Lawson, 2016). Engagement was measured by students' positive or negative responses to these two statements: "The way this course is designed has increased my willingness to put forth effort to complete the learning activities," and, "The way this course is designed has not increased my curiosity about the course subject." Engagement was measured by students' positive or negative responses to these two statements.

Student learning is the gaining of knowledge or skills through study, experience, and instruction (Entwistle & Ramsden, 2015; Savery, 2015). Student

learning was measured by students' positive or negative responses to these two statements: "The way this course is designed was beneficial to my learning," and, "The way this course is designed has did not help my learning in the class."

For the purpose of this study student flexibility was defined as a student's ability to change, compromise, or modify their learning for their benefit. This was measured through the ALCSS by asking questions such as, "The way this course is designed has made it easier to share information," and, "The way this course is designed has allowed us to adapt the room for different activities."

Student satisfaction was defined as the "results when actual performance meets or exceeds the student's expectations" (Elliott & Healy, 2001, p. 3) resulting in fulfillment and/or pleasure. This was measured by asking the students questions such as "The way this course is designed has led to a way of interacting that was exciting" and "The way this course is designed has enhanced the in-class exercises."

Statistical Analysis

In order to avoid potential grading biases, the analysis of the survey results took place following the completion of the semester. Assumptions of normality were checked through descriptive statistics and histograms. Before analysis, the data was reviewed and checked for errors, missing data, or outliers. Due to the small sample size, to prevent issues with collinearity, and in keeping with past literature, independent mean's t-test comparing the two sections were used for analysis instead of regression techniques (Jensen et al., 2015; Mason, Shuman, & Cook, 2013). Levene's test for equality of variances was utilized to compare across course sections. An a priori p-value of $p < 0.05$ was used to determine statistical significance. We analyzed differences for all of the 44 survey items across the 7 domains. Results were analyzed using SPSS 24.0.

Results

The pre-test results indicate that there were not any statistically significant differences in the survey items between the courses, suggesting that the two course sections were interchangeable at the start of the semester regarding participation, engagement, and learning. An analysis of the post-test means indicated students in the active learning section exhibited significantly higher scores on 16 of the 44 ALCSS survey items than did students in the traditional lecture section. A review of these 16 items revealed that students in the active learning section exhibited an increase in all seven domains of the ALCSS: participation, communication/interactivity, community/connectedness, engagement, learning, flexibility, and satisfaction.

Table 1
Group Statistics – ALCSS

Questions - The way this course was designed…	Group	N	Mean	Std. Deviation	Std. Error Mean
COMMUNICATION/INTERACTIVITY: - … promoted better communication with my instructors.	Control	23	3.696	.974	.203
	Test	21	4.381	.805	.176
COMMUNICATION/INTERACTIVITY: - … allowed me to interact more with my instructor.	Control	23	3.174	.984	.205
	Test	21	3.762	.539	.118
COMMUNICATION/INTERACTIVITY: - … limited my opportunities to interact more with the class.	Control	23	2.609	1.033	.215
	Test	21	1.714	.902	.197
COMMUNITY/CONNECTEDNESS: - … made collaboration with my classmates easier.	Control	23	3.435	.992	.207
	Test	21	4.429	.676	.148
COMMUNITY/CONNECTEDNESS: - … promoted my connection with the instructor through discussions.	Control	23	2.696	1.295	.270
	Test	21	4.286	.644	.140
COMMUNITY/CONNECTEDNESS: - … lead to increased cooperation in completing assignments.	Control	23	3.087	.996	.208
	Test	21	4.333	.796	.174
SATISFACTION: - … was fun.	Control	23	3.826	.887	.185
	Test	21	4.333	.658	.144
SATISFACTION: - … led to a way of interacting that was exciting.	Control	23	3.609	1.033	.215
	Test	21	4.238	.768	.168
SATISFACTION: – T… enhanced the in-class exercises.	Control	23	3.739	.864	.180
	Test	21	4.429	.598	.130

Participation

Students in the active learning section indicated that "the way their [class] section was designed made them want to contribute more in class" ($M = 4.429$, $SE = .111$) than the students in the traditional lecture section ($M = 3.956$, $SE = .204$). Levene's test for equality of variances was significant so equal variance between the two sections was not assumed. This resulted in a significant difference $t (33.692) = -2.038$, $p < .05$.

Communication and Interactivity

Three items under communication and interactivity indicated a difference between the two groups. Students in the active learning section had higher mean scores on "better communication with their instructor" and "more interactions with their instructor" than their peers (see Table 1). Both of these items were significant at $p < .05$ (see Table 2). Students in the active learning section also had lower mean scores on "decreased opportunities to interact with the class" than their peers in the traditional lecture section (see Table 1). This item was significant at $p < .005$ (see Table 2).

Community and Connectedness

Three items related to community and connectedness revealed statistical significance. These items involved course design which "made collaboration with my classmates easier," "promoted my connection with the instructor through discussions," and "led to increased cooperation in completing assignments." Students in the active learning section had higher mean scores for all three items than the students in the traditional lecture section (Table 1). Additionally, all three items were significant at $p < .001$ (Table 2).

Engagement

Two items related to student engagement were significant. Students in the active learning section indicated that the course design "increased my willingness to put forth effort to complete the learning activities" ($M = 4.429$, $SE = .148$), more so than students in the traditional lecture section ($M = 3.870$, $SE = .181$). Students in the active learning section also had lower mean scores on "did not increase my curiosity about the course subject" ($M = 1.667$, $SE = .144$) than the students in the traditional lecture ($M = 2.783$, $SE = .188$). "Increased willingness to put forth effort in completing learning activities" was significant $t (42) = -2.365$, $p < .05$. Lower mean scores of "did not increase my curiosity about the course subject" were also significant $t (42) = 4.648$, $p < .001$.

Learning

Results from this study identified two significant items related to learning. Students in the active learning section had higher mean scores on "the way this course was designed was beneficial to my learning" ($M = 4.333$, $SE = .159$) than students in the traditional lecture

Table 2
Independent Samples Test – ALCSS

The way this course was designed…		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
COMMUNICATION/ INTERACTIVITY: – … promoted better communication with my instructors.	Equal variances assumed	1.125	0.295	-2.530	42	0.015	-0.685	0.271	-1.232	-0.139
	Equal variances not assumed			-2.552	41.610	0.014	-0.685	0.268	-1.227	-0.143
COMMUNICATION INTERACTIVITY: - … allowed me to interact more with my instructor.	Equal variances assumed	5.114	0.029	-2.425	42	0.020	-0.588	0.243	-1.077	-0.099
	Equal variances not assumed			-2.486	34.709	0.018	-0.588	0.237	-1.068	-0.108
COMMUNICATION/ INTERACTIVITY: - … limited my opportunities to interact more with the class.	Equal variances assumed	0.892	0.350	3.046	42	0.004	0.894	0.294	0.302	1.487
	Equal variances not assumed			3.065	41.926	0.004	0.894	0.292	0.305	1.483
COMMUNITY/ CONNECTEDNESS: - … made collaboration with my classmates easier.	Equal variances assumed	3.779	0.059	-3.845	42	0.000	-0.994	0.258	-1.515	-0.472
	Equal variances not assumed			-3.911	38.980	0.000	-0.994	0.254	-1.508	-0.480
COMMUNITY/ CONNECTEDNESS: - … promoted my connection with the instructor through discussions.	Equal variances assumed	12.843	0.001	-5.081	42	0.000	-1.590	0.313	-2.222	-0.958
	Equal variances not assumed			-5.225	32.875	0.000	-1.590	0.304	-2.209	-0.971
COMMUNITY/ CONNECTEDNESS: - … lead to increased cooperation in completing assignments.	Equal variances assumed	0.300	0.587	-4.557	42	0.000	-1.246	0.274	-1.798	-0.694
	Equal variances not assumed			-4.604	41.307	0.000	-1.246	0.271	-1.793	-0.700
SATISFACTION: - … was fun.	Equal variances assumed	0.596	0.444	-2.137	42	0.038	-0.507	0.237	-0.986	-0.028
	Equal variances not assumed			-2.166	40.385	0.036	-0.507	0.234	-0.980	-0.034
SATISFACTION: - … led to a way of interacting that was exciting.	Equal variances assumed	2.175	0.148	-2.275	42	0.028	-0.629	0.277	-1.188	-0.071
	Equal variances not assumed			-2.306	40.416	0.026	-0.629	0.273	-1.181	-0.078
SATISFACTION: - … enhanced the in-class exercises.	Equal variances assumed	1.475	0.231	-3.049	42	0.004	-0.689	0.226	-1.146	-0.233

section (M = 3.565, SE = .197). Students in the active learning section also had lower mean scores on "the way this course was designed did not help my learning in the class" (M = 1.714, SE = .122) than the students in the traditional lecture section (M = 2.522, SE = .165). Student responses to "the way this course was designed was beneficial to my learning" were significant t (42) = -2.995, p < .01 while student responses to "the way this course was designed did not help my learning in the class" were also significant t (42) = 3.874, p < .001.

Flexibility

Student flexibility was defined as a student's ability to change, compromise or modify their learning for their benefit. Two items relating directly to flexibility were significant. Students in the active learning section had higher mean scores on "the way this course was designed made it easier to share information" (M = 4.333, SE = .144) than students in the traditional lecture section (M = 3.261, SE = .129). The active learning students also had higher mean scores on "the way this course was designed allowed us to adapt the room for different activities" (M = 4.667, SE = .105) than the students in the traditional lecture section (M = 3.826, SE = .162). Student responses to "the way this course was designed made it easier to share information" was significant t (42) = -5.568, p < .001 and responses to "the way this course was designed allowed us to adapt the room for different activities" were significant t (42) = -4.258, p < .001.

Satisfaction

Three questions linked to satisfaction resulted in statistical significance. The questions were, the way this course was designed: "was fun," "led to a way of interacting that was exciting," and "enhanced the in-class exercises." These mean scores were all greater in the active learning section than in traditional lecture section (see Table 1). Increases in the items "the way this course was designed was fun" and "the way this course was designed led to a way of interacting that was exciting" were significant at p < .05 (see Table 2). The item "the way this course was designed enhanced in-class exercises" was also significant, but at p < .005 (see Table 2).

Discussion

The focus of this study was to identify and examine additional benefits associated with active learning providing greater insight into student engagement, participation, and learning. The results of this study support previous research demonstrating that increases in student engagement, participation and learning are firmly established benefits of active learning. The findings also identified four additional active learning classroom benefits: communication and interactivity, community and connectedness, satisfaction, and flexibility.

The results were consistent with existing literature on active learning. For example, Bonwell and Eison (1991), as well as Costello (2017), found that active learning plays an important role in increasing student learning. Additionally, Prince (2004) and Freeman et al. (2014) both found that active learning helps increase student engagement and participation. These results also supported Chen's (2015) call to further examine the role active learning plays in establishing a sense of belonging and community in the classroom. By creating a sense of belonging and community in a classroom an instructor can continue to help and support the education of their students. Henshaw, Edwards and Bagley (2011) discussed the need to further explore the student and instructor interactions resulting from active learning. These findings support that need by establishing communication and interactivity as a firm benefit of active learning, something that is frequenting missing in traditional classroom settings (Stoltzfus & Libarkin, 2016). To date, the research supporting interactivity as a benefit of active learning is limited, and additional study is warranted. These findings also support Jensen, Kummer, and Godoy's (2015) request that student flexibility in an active learning classroom be more closely examined. These findings indicate that student flexibility does indeed increase in an active learning classroom when compared with a traditional lecture classroom.

Recommendations

The findings in this study support the existing literature on the benefits of active learning as well as begin to address some of the gaps in that literature. This study also identifies four additional lesser known benefits of actively learning: increases in communication and interactivity, community and connectedness, satisfaction, and flexibility. Therefore, the following recommendations are made in respect to teaching and learning. First, it is recommended that active learning be implemented in all forms of higher education. The rich benefits associated with active learning are so much greater than traditional lectures that instructors who do not utilize active learning are, quite possibly, failing their students. Second, whereas the benefits of increased participation, engagement, and learning are well established in the active learning literature, the additional benefits of increases in communication and interactivity, community and connectedness, satisfaction, and flexibility are significantly less established. Additional research needs to be undertaken to firmly establish these additional benefits.

Limitations of this study included a small sample size and a non-random sample. As such, the generalizability of the results is limited to the test sample. Another limitation is the lack of reliability and validity with the ALCSS. Additionally, the students in this study may have discussed the differences between the two sections with students from other sections. This may have resulted in skewed results.

Future studies should examine the role active learning plays in developing a sense of community, connectedness, and belonging in the classroom. An exploration on the types of active learning tasks and techniques that help foster this greater sense of community would be appropriate in a variety of higher education classrooms. Future studies can explore the impact communication and interactivity, created through active learning, have on student learning. Additionally, the benefits of increased student satisfaction and flexibility as products of active learning need to be further examined. It might also be interesting to link studies specifically with course outcomes and observe if they are met, and to what extent, through active learning.

Active learning has the potential to greatly increase the quality of higher education teaching and learning across disciplines and majors. It has the power to engage and motivate students above and beyond what traditional lecturing has historically accomplished. Active learning has the ability to not only increase student participation, engagement, and learning, but also to foster a greater sense of community and increase students' communication, flexibility, and student satisfaction.

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Re-Operationalizing and Measuring "Impact" of a Leader Development Course

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This article re-operationalizes the term "impact" to evaluate success in the USAF Leader Development Course for Squadron Command (LDC). Literature is used to define impact in a three-part way: area of impact (what topics were most effective in instruction), level of impact (how topics will be applied in the future), and depth of impact (why the course was effective). Based on qualitative analysis of 379 surveys completed by students and their supervisors, findings revealed 10 top areas of impact. Seven topics were common between what students indicated had impacted them with what graduates reported actually applying post-graduation. Regarding level of impact, self, others, and unit were the top-rated categories of applying course content. The depth of impact was seen as being in an ecosystem of interconnectedness between the human microsystem (interactions with instructors, peers, and self) and six overlapping elements – the exosystem – that brought the student experience to life. The system of relationships is depicted in a new model called the "Student Experience Ecosystem" that may serve as a blueprint for designing similar courses. The study aids LDC revisions, informs development of similar programs in the academic community, and offers a holistic way to improve pedagogy in higher education.

Re-Operationalizing and Measuring "Impact" of a Leader Development Course

In 2018 the U.S. Air Force's (USAF) Air University initiated the Leader Development Course for Squadron Command (LDC) based on guidance from the Chief of Staff of the USAF and the results of an Air Force-wide study on morale and leadership culture, "Improving the Effectiveness of Air Force Squadron Commanders" (Ausink, Matthews, & Conley, 2018). The overall objective of the LDC is to develop future officers and civilians approaching positions of command/leadership with an emphasis on "human domain leadership skills" (USAF LDC Smart Card, 2019). The LDC is an eight-day intensive course consisting of lectures, seminars, and experiential events that builds human domain and leadership skills for students in Week One and then offers multiple methods to apply that knowledge in simulations, scenarios, and discussions during Week Two. The course culminates in an end-of-course immersive experience involving augmented reality scenarios, also called the Capstone Experience, and follow-on discussions on how to apply the knowledge and experiences to leading oneself and others in preparing for Squadron Command. There are no in-course assessments or grading/ranking structure. The incentive for student engagement with the content is strictly for students' own personal and professional growth.

All courses taught at Air University employ some kind of end-of-course assessment that is used to measure key areas for improvement, normally including learning objectives, student experience, content, delivery, and instructor effectiveness. The instructors of the LDC sought to go beyond the traditional assessments and develop a way to measure the impact of the course and to strengthen the student experience, which was seen as a key factor for course success. Hence, the real inquiry to be answered is, "What is the impact of the LDC?" How impact is measured is central to the primary research question. A follow-on inquiry is, "What needs to change, if anything, to strengthen the impact?" This study answers the two inquiries, or research questions, about impact and change.

Literature Review

Defining and measuring impact has become a mantra for evaluating contemporary leadership development programs (Ebrahim, 2013; Gugerty & Karlan, 2018; Keyte & Ridout, 2016; Martineau & Patterson, 2010). The challenge with measuring impact is two-fold. Foremost, defining what "impact" means is a somewhat controversial topic, as agreement must be made on what to measure and how to measure it (Diem & Nikola, 2005; Ebrahim, 2013; Gugerty & Karlan, 2018; Keyte & Ridout, 2016) and whether impact is even the right thing to measure (Ebrahim, 2013; Gugerty & Karlan, 2018). The second challenge involves designing the data collection process to answer the research questions with the right data collected (Collins & Holton, 2004; Keyte & Ridout, 2016) and deciding on which indicators to use from that data (Gugerty & Karlan, 2018; Robinson, Lloyd & Rowe, 2008).

Defining "Impact"

Impact is different from measuring output or outcome (Mills-Scofield, 2012; Stannard-Stockton, 2010; Walker, 2015). Whereas output is a count of what is done (often called activities), and outcomes are the measured effects or results of the outputs (the observed effects), impact is the link between the output and outcome, or "the degree to which outcomes are attributable to the activities" (Stannard-Stockton, 2010, p. 2). The linking of outcomes to activities must be identified and clearly explained (Mills-Scofield, 2012) or measuring impact is not feasible or not worth the effort expended (Gugerty & Karlan, 2018). The primary mission of the LDC is to teach students to thrive in command based on learning and applying specific leadership and human domain skills (LDC Smart Card, 2019). The eight course objectives are:

- Prepare for an inspired squadron command
- Build self-awareness and understand tendencies
- Develop a personal philosophy of command
- Understand the value of a peer network
- Align resources with strategy, mission, vision, and values
- Assess and improve command climate and organizational culture
- Value taking calculated risks and learning from mistakes
- Value critical thinking and values in decision making

So, the impact of the LDC could be best conceptualized as understanding the degree to which the course content resonated with students' most desired leadership and human domain skills and their intent on applying those skills in the future as related to command in a military unit. Additionally, ensuring an overall positive student experience is critical to all courses taught at Air University. Thus, in relation to the LDC, measuring impact would include three categories: the area of impact (what topics were most effective in instruction), the level of impact (how topics will be applied in the future), and the depth of impact (why the program was effective in terms of the student experience). These categories of impact are measured to uncover the link between the course output – students complete course content – and the outcomes, which are a 92.3% and 90.33% course approval rating by graduates and their supervisors, respectively, based off either a four or five star response to the question of how well the course met its stated mission "to equip and inspire Airmen to thrive in command". In order to understand these approval ratings – uniquely high for Air University courses – the intent of this study is to understand the initial links between course output *in toto* and the outcome of these approval ratings. This study does not attempt to link specific course activities to course learning objectives. The task of understanding why specific course content and activities impacted students will be a topic of future study.

Measuring "Impact"

Deciding how to measure impact is a fundamental step in any leadership development program (Martineau & Patterson, 2010) and, according to recent literature, is generally done in five to seven stages (Center for Creative Leadership, 2018; Gugerty & Karlan, 2018; Keyte & Ridout, 2016). The overlapping or agreed upon stages include narrowing the scope of what to measure and deciding the appropriate collection methods (Center for Creative Leadership, 2018; Gugerty & Karlan, 2018; Keyte & Ridout, 2016; Martineau & Patterson, 2010). The scope of what to measure includes how impact was defined earlier using three components: the area of impact (what topics were most effective in instruction), the level of impact (how topics will be applied in the future), and the depth of impact (why the program was effective in terms of the student experience).

Currently, the LDC course outcomes are assessed indirectly using participants' responses to end-of-course surveys coupled with additional data compiled from post-course follow-up surveys completed by course graduates and their supervisors. While Air University students generally expect to complete an end-of-course survey, they did not know ahead of receiving the post-course survey email that a second survey would be requested. A limitation to this study is that only the existing survey data could be used, and no additional data collection was allowed in order to prevent survey fatigue of students. While the data from the eleven 5-point Likert scaled questions provide various information and feedback on the course (e.g. course purpose, content, instruction, and most / least effective topics), three questions are most applicable in measuring impact. The answers to Question 7 ("What are the five most effective areas on instruction?") can be used to measure the area of impact, or what topics were most effective in instruction; the answers to Question 11 ("How do you plan on applying what you

learned in the course so far?") are best to measure the level of impact, or how topics will be applied in the future; and the answers to Question 9 ("What are the three things you liked most about the course and why?") can be used to measure the depth of impact, or why the program was effective in terms of the student experience. The new method of understanding impact as a measure of area, level, and depth is defined specific to the issue at hand: understanding impact in a leadership development course in the Air Force.

Methods

This study used a three-stage qualitative approach. The first stage of the methodology measured impact by coding responses to three questions in end-of-course critiques of five cohorts of students (N=288; Q7, n=279; Q9, n=278; Q11 n=269). Impact was measured using three components: the area of impact, the level of impact, and the depth of impact. The second stage of the methodology examined data collected from the post-course surveys sent to graduates (n=79) and their supervisors (n=31) of two courses after a three-month period. The third stage of the methodology compared the results in stage one and stage two to measure to what extent the learning outcomes were achieved.

Data Collection

Students electronically completed surveys via a link provided in a general email. The responses were aggregated for each question, allowing individual survey participants to be anonymous. Copies of the electronically-collected survey responses were provided to the researchers via email from the course director of the LDC. The researchers used only the responses to three questions from end-of-course surveys, specifically answers to question 7 (n=279 or 90.5% response rate), question 9 (n=278 or 90.2% response rate), and question 11 (n=269 or 87.3% response rate). Regarding the online post-course surveys, the researchers collected 79 responses (32.4% response rate) from three questions on the graduate survey and 31 responses (12.7% response rate) from two questions on the supervisor survey for analysis. The researchers speculate that the low post-course survey response rates are attributable to the course being new and relatively unknown, as well as to general organizational survey fatigue and a data collection cutoff decision that was made in order to proceed with the data analysis.

Data Analysis

For the first phase, analysis of the data collected was done using multiple coding cycles. The coding process was cumulative in nature, progressing from pre-coding to multiple coding cycles of exploring the data with codes and sub-codes and building categories and themes, followed by theoretical coding to help answer the research questions. For Question 7 ("What are the five most effective areas on instruction?"), 28 pre-codes were developed based on course subjects and learning themes. However, after the first coding cycle, 12 learning themes were dropped due to low significance (<5 occurrences in the data), and 10 additional codes were added due to separating course content into more specific topics, leaving 26 codes that were used for analysis. For Question 9 ("What are the three things you liked most about the course and why?"), eight pre-codes were increased to 14 because of six emergent codes. The final coding cycle combined several codes and reduced the number of codes to 11, which ultimately became themes to frame the concept of student experience. For Question 11 ("How do you plan on applying what you learned in the course so far?"), seven pre-codes were established which grew to 10 during the initial coding cycle; these were then re-organized into five primary codes with 11 sub-codes for the final coding cycle.

To address impartiality and positionality concerns, two qualified researchers collaboratively conducted the assessments using a simple coding structure based on course concepts and in-vivo coding that honored participants' own words and language choices (Merriam, 2009; Saldana, 2013) with emphasis placed on intercoder agreement and interpretive convergence (Bernard, Wutich, & Ryan, 2016; Saldana, 2013) in interpreting the data. Specific techniques for intercoder agreement and convergence were followed (Lombard, Snyder-Duch & Bracken, 2002) to ensure reliability in the coding process (Kolbe & Burnett, 1991; Lacy & Riffe, 1996; Neuendorf, 2002; Tinsley & Weiss, 1975). The intercoder agreement was 95% average for the three questions analyzed in the first methodological stage. Each of the two researchers separately coded all questions in one entire cohort (n=44) or 14% of all respondents, followed by shared coding of a second cohort (n=62) or 22% of all respondents. A second cohort of students was selected because of subsequent changes made in the course following the first cohort, making the second and subsequent cohorts more divergent with the first cohort than with each other. Each of the reliability coders – experienced researchers –

coded all three questions, which included multiple coding cycles. Two minor coding differences were found in applying sub-codes during the first coding cycle and one minor difference in interpretation of combining codes in the second coding cycle (pattern coding). The approximate amount of coding to reach a 95% agreement rate took roughly five hours. Disagreements were resolved through discussing and agreeing on the meaning of codes and re-checked during the second round of coding together. When turning categories into themes in the third coding cycle, the minor discrepancies were not a factor in the overall coding process.

For the second stage, the data from the online post course surveys were aggregated to protect respondent confidentiality. Responses and percentages were pulled directly from the aggregated answers. For graduates, responses to three of the nine questions on the survey were used. Question #4 was a scaling question asking graduates to provide their level of confidence in applying each learning outcome. Question #5 asked graduates to select the subject areas they had practiced/applied the most since returning home. Question #8 asked graduates to rate the LDC from one to five stars on how well the course met the mission to "equip and inspire Airmen to thrive in command". For supervisors, responses to two of the eight questions on the survey were used. Question #4 was a scaling question asking each supervisor to assess their graduate's abilities and attitudes relating to each of the eight learning outcomes. Question #7 asked supervisors to rate the LDC from one to five stars on how well the course met the mission to "equip and inspire Airmen to thrive in command."

Table 1

Area of Impact: Students Responses on Course Topics that were Most Effective

Course Concept/Topic	Frequency	Ranking
Know Yourself and Best Fit (personality types)	115	1
Clarity of Purpose	114	2
Know Your Team (personality & communication)	110	3
Capstone Experience	84	4
Cognitive Diversity	82	5
Creating a Culture of Trust & Empowerment	70	6
Air Force Culture and Climate	58	7
Leading a Squadron in Crisis	48	8
Values-Personal, Organizational and USAF	47	9
Coaching	43	10
Ethics, Legal, Justice, and Discipline	41	11
Commander Communication	34	12
Deliberate Development	33	13
Enlisted Force Distribution Panel	29	14

Negotiations for the Engaged Leader	28	15
Leadership Application	26	16
Energy Management and Human Performance	24	17
Leadership Staff Ride (Tuskegee or Rosa Parks)	18	18
Leading Through Failure	16	19
Squadron Commander's Perspective	15	20
Senior Officer/Wing Command Team Lesson	14	21
Squadron Leadership Case Study/Practicum	13	22
Decision Making	11	23
Human Performance and the Commander	9	24
Budget/Fiscal Readiness	7	25
Valor Workout/Road March	5	26

For the third stage involving comparing data, the analysis was framed by looking for overall trends, convergence, and divergence between what was collected at the end of the course with what was collected three months after the course. Results in stage one and stage two were examined in order to measure which course topics were actually utilized based on what topics students thought were most effective, the extent to which the course learning outcomes were achieved, and the number of stars assigned to how well the course met the mission to "equip and inspire Airmen to thrive in command."

Findings

The results or findings from the analysis are presented based on measuring impact using three questions from the end-of-course surveys, understanding impact using three questions from the graduate post-course surveys and two questions from the supervisor post-course surveys, and then comparing the data. The findings are then directly applied to the two research questions in the following discussion section.

Measuring Impact from the End-of-Course Surveys

In the end-of-course survey students were asked which topics they believed were the most effective in instruction, which the researchers understood as area of impact (see Table 1). Of the 279 of 308 respondents (90.5% response rate), the top ten areas of impact were: Know Yourself and Best Fit, Clarity of Purpose, Know Your Team, Capstone Experience, Cognitive Diversity, Creating a Culture of Trust & Empowerment, Air Force Culture and Climate, Leading a Squadron in Crisis, Values-Personal, Organizational and USAF, and

Coaching. The least reported areas of impact included Human Performance and the Commander, Budget/Fiscal Readiness, and Valor Workout/Road March.

Table 2 aggregates student responses to how they planned on applying what they learned in the course, which was understood as the level of impact. Of the 269 of 308 respondents (87.3% response rate), students reported that they planned on applying what was learned in the course in five categorical ways. The highest reported application was for self, specifically to better know oneself, for their own leadership, for future command, for self-reflection, and for developing a command philosophy

Table 2
Level of Impact: Students Responses on How Students Plan on Applying What They Learned

Category and Sub-Categories	Frequency	Ranking	Internal Ranking
For Self	151	1	
Knowing self	50		1
Own leadership	49		2
For future command	32		3
Self-reflection	24		4
Develop command philosophy	16		5
For/With Others	114	2	
Professional development of others	50		1
Generally, for others	36		2
Knowing others better	15		3
Peers	13		4
For Military Unit	72	3	
Squadron type organization	62		1
Unit other than squadron	10		2
Multiple Use	39	4	
At Home or Life in General	14	5	

Table 3
Depth of Impact: Students Responses on What They Liked Most About the Course

Reasons Why Students Liked the Course	Frequency	Ranking
Learning Environment/Atmosphere	118	1
Relevant Content/Subject Matter	97	2
Quality Faculty/Instructors	70	3
Learning from Peers	69	4
Delivery of Content/Quality of Instruction	43	5
Learning from Graduated Squadron Commanders	31	6
Allowed Time/Space for Self, Reflection, Introspection	30	7
Practicing/Applying what was Learned	25	8
Senior Leader/Wing Command Team Lesson	19	9
Networking	15	10
Teambuilding with Others in the Course	7	11

specifically. The second highest reported application of course content was for others, specifically to professionally develop others, for others in general, for understanding others better, and for peers. Application of course content for a military unit was the third reported category, with the squadron type unit as the primary focus as an organizational unit. Across the five categories and 11 sub-categories, the highest three areas of applying course content included a squadron type organization (62),

knowing self (50), to professionally develop others (50), and for personal leadership.

Students were also asked in general terms what they liked most about the course, which was understood as depth of impact in terms of the student experience (see Table 3). Of the 278 of 308 respondents (90.2% response rate), the most liked aspects of the course were the learning environment/atmosphere, relevant content, quality instructors, learning from peers, and delivery of

content. During the final coding process of coding for themes and relationship of data, what emerged was a system of relationships between the 11 areas or reasons why students liked the course. The dynamics of the interconnectedness of the areas are explained in greater detail in the discussion section on answering research question one.

Understanding Impact from the Post-Course Surveys

In a follow-on survey 2–3 months after the course students were asked to rate their level of confidence in

Table 4

Level of Confidence in Ability to Do Each of the Eight Course Learning Objectives

	Completely Confident	Very Confident	Confident	Not Very Confident	Not at All Confident	Total
Thrive in Command	23.08%	57.69%	19.23%	0.00%	0.00%	78
	18	45	15	0	0	
Build Self-Awareness and	34.62%	56.41%	8.97%	0.00%	0.00%	78
Understand Tendencies	27	44	7	0	0	
Develop a Personal Philosophy of	42.31%	47.44%	8.97%	1.28%	0.00%	78
Command	33	37	7	1	0	
Utilize Your Peer Network	47.44%	43.59%	7.69%	1.28%	0.00%	78
	37	34	6	1	0	
Align Resources with Strategy,	32.47%	48.05%	19.48%	2.60%	0.00%	77
Mission, Vision, and Values	25	37	15	2	0	
Assess and Improve Command	29.87%	48.05%	19.48%	2.60%	0.00%	77
Climate and Organizational Culture	23	37	15	2	0	
Take Calculated Risks and Learn	37.66%	54.55%	7.79%	0.00%	0.00%	77
From Mistakes	29	42	6	0	0	
Think Critically and Consider Values	48.72%	47.44%	2.56%	1.28%	0.00%	78
in Your Decision Making	38	37	2	1	0	

their ability to do each of the eight course learning objectives (see Table 4). Across all eight learning objectives, graduates reported extremely high confidence levels – ranging between 97.40% to 98.72% – that combined very confident and completely confident. The objectives with the highest combined percentages of completely confident and very confident were thinking critically (96.06%), taking calculated risks and learning from mistakes (92.61%), building self-awareness (91.03%), utilizing peer network (91.03%), and developing a personal philosophy of command (89.75%). The lowest levels of confidence were reported for the objective of assessing and improving command climate and organizational culture. This data set serves as one of the course outcomes,

specifically that students generally have strong confidence in their abilities to execute the course learning objectives. Seven students rated themselves as "Not Very Confident," however it is unclear whether this is attributable to the course making those students aware of new blind spots, to the course neglecting to elevate students' confidence where they previously felt unconfident, or to some other reason. It is unclear to what degree students' self-assessments of their confidence in these eight areas is attributable to course content; for this reason, the researchers have modified this question set for future surveys.

The survey asked graduates to indicate which course topics and/or skills they had actually practiced since graduating from the course as a data set to drive deeper

analysis of area of impact (see Table 5). Of the 79 of 244 respondents (32.4% response rate), the top ten course subjects that graduates practiced since graduating from the course were: Know Yourself and Best Fit, Clarity of Purpose, Decision Making, Culture and Climate, Know Your Team, Deliberate Development, Creating a Culture of Trust & Empowerment, Accountability, Cognitive Diversity, and Values-Personal, Organizational and USAF. Graduates were then asked to rate the level to which they felt the course met the mission "to equip and inspire Airmen to thrive in command" on a scale of 1–5 stars. Of the 78 graduates that responded to the question, 72 (92.30%) rated the course with four stars or more with 41 (52.56%) rating the course as five stars. This data set also serves as one of our course outcomes, specifically that students have very high confidence that the course met its overall mission. This question is asked after all Air University professional development courses and does not typically return such high remarks, suggesting that the high approval is authentic and is not based on any desire to please the authority figures (instructors). Yet, we cannot totally discount the potential for highly positive response rates due to the positive relationships between instructors and students.

Follow-on surveys were also sent to graduates' supervisors 2–3 months after course completion which asked them to rate changes in their confidence in their graduates' ability to do each of the eight course learning objectives (see Table 7). Across all eight learning objectives, supervisors reported being more positive to much more positive (ranging from 64.51% to 90.32%) of the graduates' abilities relating to the eight learning objectives than they were before they took the course. The objectives with the highest level of positivity were inspired to thrive in greater leadership role or command (90.32%), ability to think critically (87.10%), ability to develop their own personal philosophy of command (80.65%), and being self-aware and *understanding interpersonal communication tendencies (80.64%).*

The survey then asked supervisors to rate how they felt the course met the mission "to equip and inspire Airmen to thrive in command" on a scale of 1–5 stars. Of the 31 supervisors that responded to the question, 28 (90.33%) rated the course with four stars or more with 13 (41.94%) rating the course as five stars. This data set serves as another one of the course outcomes, specifically that students' supervisors have very high confidence that the course met its overall mission.

Table 5
Course Concepts/Skills Practiced by Graduates

Course Concept/Skill	Frequency	Ranking
Know Yourself and Best Fit	48	1
Clarity of Purpose	46	2
Decision Making	45	3
Culture and Climate	42	4
Know Your Team	42	5
Deliberate Development	39	6
Creating a Culture of Trust & Empowerment	37	7
Accountability	35	8
Cognitive Diversity	34	9
Values-Personal, Organizational and USAF	33	10
Negotiations for the Engaged Leader	30	11
Commander Communication	28	12
Leading Through Failure	25	13
Energy Management and Human Performance	25	13
Ethics, Legal, Justice, and Discipline	23	14
Fitness Activities	23	14
Innovation	23	14
Coaching	17	15
Human Performance and the Commander	17	15
Senior Leader Perspective	16	16

Budget/Fiscal Readiness	13	17
Capstone Experience	10	18
Senior Noncommissioned Officer Perspective	10	18
Leading a Squadron in Crisis	4	19
Leadership Staff Ride (Tuskegee or Rosa Parks)	1	20

Table 6
Graduates' Star Rating of How Well the Course Met the Stated Mission

Star Rating	Respondents	Percentage
5 Stars	41	52.56%
4 Stars	31	39.74%
3 Stars	3	3.85%
2 Stars	0	0
1 Star	3	3.85%

Table 7
Supervisors' Rating of Graduates Abilities/Attitudes to Do Course Learning Objectives

	Much More Positive	More Positive	Neither More Nor Less Positive	Less Positive	Much Less Positive	N/A; Not Observed	Total
Inspired to Thrive in Greater Leadership Role or Command	16.13% 5	74.19% 23	9.69% 3	0.00% 0	0.00% 0	0.00% 0	31
Self-awareness and Understanding interpersonal Communication Tendencies	19.35% 6	61.29% 19	19.35% 6	0.00% 0	0.00% 0	0.00% 0	31
Ability to Develop their Own Personal Philosophy of Command	25.81% 8	54.84% 17	16.13% 5	0.00% 0	0.00% 0	3.23% 1	31
Value their Peer Network	19.35% 6	45.16% 14	29.03% 9	3.23% 1	0.00% 0	3.23% 1	31
Ability to Align Resources with Strategy, Mission, Vision, and Values	16.13% 5	54.84% 17	25.81% 8	0.00% 0	0.00% 0	3.23% 1	31
Ability to Assess and Improve Team/Command Climate and Organizational Culture	32.26% 10	41.94% 13	25.81% 8	0.00% 0	0.00% 0	0.00% 0	31

Attitude Toward Taking Calculated Risks and Learning from Mistakes	16.13% 5	54.84% 17	29.03% 9	0.00% 0	0.00% 0	0.00% 0	31
Ability to Think Critically and Consider Values in their Decision Making	25.81% 8	61.29% 19	12.90% 4	0.00% 0	0.00% 0	0.00% 0	31

Comparing Data

Data was compared in three different ways. The first comparison used student responses in the end-of-course survey and graduate responses in the post-course surveys. The second and third comparisons viewed how graduates and supervisors assessed outcomes and how they rated the course using stars in the end-of-course survey. Table 9 compares the topics students found most effective in the end-of-course surveys with the topics they actually reported practicing in the post-course surveys. This comparison is made to draw data to help determine whether the topics that students report being impacted by immediately after the course are, in fact, being utilized once they return to their organization, thus meeting the LDC mission "to equip and inspire Airmen to thrive in command" as well as the eight course learning objectives.

Seven topics were common between what students indicated had impacted them with what graduates reported actually applying once they returned: Know Yourself, Clarity of Purpose, Know Your Team, Cognitive Diversity, Creating a Culture of Trust & Empowerment, Culture and Climate, and Values. The common categories between the two groups are highlighted in the table below. Three topics that joined the list of course topics actually practiced included Decision Making, Deliberate Development, and Accountability. Decision Making rose from a ranking of #24 on the most effective list to #3 on the actually practiced list. The topic that fell the farthest in the rankings from most effective to actually practiced, from #4 to #18, was the Capstone Experience, which was more of an experiential activity that allowed students to utilize numerous course concepts and was less of a topic and more of an event. The topic that fell the second most in ranking, from #8 to #18, was Leading a Squadron in a Crisis, perhaps because the respondents had not actually experienced a crisis. Coaching fell from #10 to #15, most likely because students may not have yet had an opportunity to practice the coaching concepts learned in the course.

Table 10 shows to what extent the course learning objectives were achieved or assessed by graduates and supervisors in the post-course survey. Graduates reported a higher confidence of their ability to achieve the eight course learning objectives than the supervisors reported. For graduates, the objectives with the higher percentages were thinking critically (1st), taking calculated risks and learning from mistakes (2nd), and tied for 3rd were building self-awareness and utilizing the peer network. For supervisors, the objectives with the higher percentages were inspired to thrive in greater leadership role or command (1st), thinking critically (2nd), and developing a personal philosophy of command (3rd).

Table 11 compares the number of stars assigned by graduates and supervisors for how well the course met the mission to "equip and inspire Airmen to thrive in command". A higher percentage of graduates gave five stars to the course, where a greater percentage of supervisors gave four stars. Collectively, 91.31% of graduates and supervisors gave four or five stars.

Discussion

The discussion of the results is presented in two parts. Part one answers the first research question, "What is the impact of the LDC?," using the responses to three questions on end-of-course surveys and the answers to post-course surveys by graduates and their supervisors. Part two addresses the second research question, "What needs to change, if anything, to strengthen the impact?" based on analysis of the responses in relation to course content and course objectives.

Answering Research Question #1: What is the impact of the LDC?

The top ten areas of impact from the end-of-course surveys were: Know Yourself and Best Fit, Clarity of Purpose, Know Your Team, Capstone Experience, Cognitive Diversity, Creating a Culture of Trust & Empowerment, Air Force Culture and Climate, Leading a Squadron in Crisis, Values-Personal, Organizational and USAF, and Coaching. Seven of these topics were consistent with results from the post-course surveys.

The seven topics that were common between what students felt was most effective and what graduates reported that they actually applied: Know Yourself, Clarity of Purpose, Know Your Team, Cognitive Diversity, Creating a Culture of Trust & Empowerment, Culture and Climate, and Values.

Table 8
Supervisors' Star Rating of How Well the Course Met the Stated Mission

Star Rating	Respondents	Percentage
5 Stars	13	41.94%
4 Stars	15	48.39%
3 Stars	3	9.68%
2 Stars	0	0
1 Star	0	0

Table 9
Comparing the Topics Students Found Most Effective and What They Actually Practiced

End-of-Course Topics	Ranking	Post-Course Topics	Ranking
Know Yourself and Best Fit	1	Know Yourself and Best Fit	1
Clarity of Purpose	2	Clarity of Purpose	2
Know Your Team	3	Decision Making	3
Capstone Experience	4	Culture and Climate	4
Cognitive Diversity	5	Know Your Team	5
Creating a Culture of Trust & Empowerment	6	Deliberate Development	6
Air Force Culture and Climate	7	Creating a Culture of Trust & Empowerment	7
Leading a Squadron in Crisis	8	Accountability	8
Values-Personal, Org and USAF	9	Cognitive Diversity	9
Individual Coaching one-on-one	10	Values-Personal, Org and USAF	10
Deliberate Development	13	Individual Coaching	15
Accountability	18	Capstone Experience	18
Decision Making	24	Leading a Squadron in Crisis	19

Table 10
Comparison of Objective Assessments by Graduates and Supervisors

Course Learning Objective	Graduates		Supervisors	
	Completely Confident and Very Confident		Much More Positive and More Positive	
Inspired to thrive in greater leadership role or command	80.77%	5th	90.32%	1st
Build self-awareness and understanding of personal tendencies	91.03%	3rd	80.64%	4th
Develop a personal/individual philosophy of command	89.75%	4th	80.65%	3rd
Utilize own peer network or value peer network	91.03%	3rd	64.51%	8th
Align resources with strategy, mission, vision, and values	80.52%	6th	70.97%	7th

Assess and improve organizational climate and culture	77.92%	7th	74.20%	5th
Take calculated risks and learn from mistakes	92.61%	2nd	70.97%	6th
Think critically and consider values in decision making	96.06%	1st	87.10%	2nd

Table 11
Comparison of Star Ratings of the Course by Graduates and Supervisors

	Graduates		Supervisors	
Star Rating	Respondents	Percentages	Respondents	Percentage
5 Stars	41	52.56%	13	41.94%
4 Stars	31	39.74%	15	48.39%
3 Stars	3	3.85%	3	9.68%
2 Stars	0	0	0	0
1 Star	3	3.85%	0	0

Regarding level of impact, self, others, and unit were the top-rated categories of applying course content. Of the 11 sub-categories of applying course content, the levels with the highest ranking included applying what was learned to a squadron-type organization (62), knowing self (50), to professionally develop others (50), and for personal leadership (49). These levels of impact are consistent with the learning objectives and the mission of the LDC, although students taking course content back to their organizations and using it to deliberately develop others was not a stated course objective but not an undesired development either. To the contrary, their interest in teaching course content to others is yet another indication that students find the course content relevant and important.

Depth of impact was the most intriguing and interesting area in the study. The five most liked aspects of the course were the learning environment/atmosphere, relevant content, quality instructors, learning from peers, and delivery of content. In reading the qualitative remarks from students in the end-of-course surveys, a positive "student experience" was a concept that was continuously used to describe students' strong liking, support, and praise for the course. Moreover, the responses indicated that the student experience was a large reason why they opened themselves up and invested personally into the course and therefore got more out of it. While the student was at the center of the "student experience', it seemed that the learning environment contained all of the other layers that added depth to the students' experience of the course.

Students positively experienced aspects of the course through others (humans) that contained the greater human domain of elements. Students positively experienced the delivery of relevant course content, immediate application of course content, and networking through the instructors and senior leaders. Especially prominent in students' qualitative comments on surveys was the teaming of military instructors who were successful squadron commanders with civilian instructors who were experts due to senior leadership experiences, some including graduated commanders and leaders from the corporate arena, or because their educational background included doctoral work in leadership, education, mental health, and history. The collaborative approach to teaching proved significant in student assessments and is supported in key literature that discusses frameworks for collaborative teaching (Friend, 2017; Friend & Cook, 2007; Mason & James-Burga, 2019). Students positively experienced learning from others, teambuilding, and networking through their peers in the course, especially in their small groups or seminars. Students positively experienced personal growth, self- reflection and introspection, learning from others, and learning content through a self or personal lens.

In aggregating the reported elements of positive experience that provided depth of impact for students, the data points to a complex web of interconnected elements consisting of interactions with both humans and the learning environment more broadly. Urie Bronfenbrenner's Bioecological Model of Human Development provides a useful theoretical framework

for organizing the various elements that comprised what students reported as the "student experience" (Bronfenbrenner, 1979; 2005). Bronfenbrenner's model links the various levels and layers of interactions and influences that comprise the environment of human development, beginning with the microsystem (immediate interactions with the individual) and progressing outward through the mesosystem (interactions between elements of microsystem), exosystem (elements that affect structures within the microsystem), macrosystem (dominant beliefs and ideologies affecting the environment), and chronosystem (how the individual and environment change over time). Bronfenbrenner's model therefore provides a model to aid in understanding and visualizing the student experience.

See Figure 1 for the diagram depicting the Student Experience Ecosystem, or how the depth of impact relates to the greater system of interconnectedness between the human micro interactions (instructors, peers, and self) and the exosystem of six overlapping elements that brought the student experience to life (delivery of relevant course content, immediate application of course content, networking, teambuilding, learning from others, and self-reflection/introspection). Learning and delivery of relevant course content along with the benefits of the course were experienced through the interactions with quality instructors/senior leaders, peers, and self. By aggregating the students' own words and feedback we can construct the ecosystem that defined their collective interaction with the course content and learning experience. This ecosystem comprises the link between course outputs (content) and outcomes (positive student growth and development), enabling the greater study of measuring impact.

Figure 1
The Student Experience Ecosystem
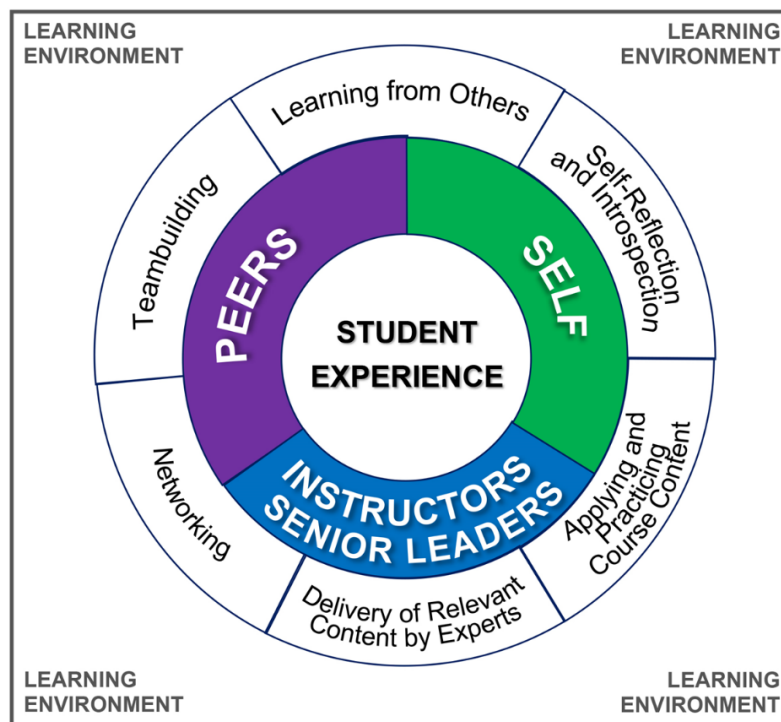
Answering RQ #2: What needs to change, if anything, to strengthen the impact?

Based on analysis of the findings, ten recommendations are presented to strengthen the overall impact of the course. Recommendations 1–5 focus on strengthening the *area of impact*; 6–8 focus on strengthening the level of impact; and recommendations 9–11 are aimed at strengthening the depth of impact.

1) Increase emphasis on topics that the graduates are using more after the course like decision making and deliberate development.

2) Revise coaching to having students practice coaching techniques more than just receiving coaching from an instructor.

3) Conduct additional analysis comparing content delivery methods and instructional activities for the areas of higher impact (i.e., find what is working well) and revamp areas of lower impact to incorporate those best practices.

4) If revamping produces no significant increase in impact, consider replacing lower-rated topics with more time to practice and apply new information.

5) Consider discussing course objectives with students in ways that are more meaningful – partially because the findings showed differences of assessments between graduates and supervisors, utilizing peer network and taking risks.

6) Consider ways to deepen the level of self-learning, especially regarding leadership and personality.

7) Consider increasing additional time and activities for self-reflection.

8) Consider increasing emphasis on professional development of others.

9) Continue with the current program format and make minor course corrections based on end-of-course surveys and instructor feedback that strengthen the student experience.

10) Consider emphasizing to students what supervisors believe to be positive about graduates and the course.

11) Ensure the same high caliber of instructors for the long-term future, especially the graduated Squadron Commanders and civilian faculty.

Limitations and Concerns

The limitations to the study are few, and steps to mitigate them must be addressed. The first limitation involves only using the data provided by the course critiques with no follow-up interviews conducted to further understand the data. No personal identifying information of participants was provided to the researchers, so only the data collected via surveys was available. The second limitation is the use of two coders and the inter-rater reliability in the coding process, but training and inter-rater agreement were conducted before and during the data interpretation stage. The positionality of the researchers is present as both are civilian faculty hired by the U.S. Air Force and instructors of the course under study, but in recognizing the potential influence of positionality, the concern and potential limitation were addressed in a deliberate way. The final concern involves the process of redefining the concept of impact, largely due to entering into new conceptual ground, but this limitation was accepted as there was no current definition in relation to the program being evaluated. The very nature of the inductive, qualitative approach required re-operationalizing impact as a key stage in the three-part methodology.

Implications and Further Research

The impact of this study provides a framework for re-operationalizing the concept of "impact" in leadership development programs, as well as informing future changes to the overall course design, data collection process, faculty development program, and specific change recommendations to course content and structure. Future study can implement this framework for measuring impact in other professional development courses inside and outside the armed forces to help streamline course content with achieving course objectives. Moreover, the Student Experience Ecosystem provides a way to organize and understand the positive student experience that can be used to inform and consult other professional development courses to enhance the student experience and impact of their content on students. Future study will expand the ecosystem model with analysis of additional course aspects that contribute to the overall student experience (logistics, food/snacks, support staff, travel days, etc.). Continued study is warranted as the USAF continues to invest in, and improve, leadership development of its future leaders and commanders.

Conclusion

Using students' end-of-course surveys and post-course surveys completed by graduates and their

supervisors, this study re-operationalized the concept of "impact" as having three main components. Measuring the area of impact (what topics were most effective in instruction) resulted in six highest rated areas that included Know Yourself, Clarity of Purpose, Know Your Team, Capstone Experience, Cognitive Diversity, and Creating a Culture of Trust and Empowerment. Measuring the level of impact (how topics will be applied in the future) resulted in three primary levels of impact that included application of course content for self, for others, and for the respondents' military unit. Measuring the depth of impact (why the program was effective in terms of the student experience) resulted in identifying a new conceptual model, the *Student Experience Ecosystem*, that depicted the student experience as the interconnected relationships of delivery of relevant content, application of course content, networking, teambuilding, learning from others, self-reflection, and introspection as seen thru the lenses of learning from quality faculty, learning from peers, and self-learning. This unique multi-layered depth of the student experience remained strong after course completion as both graduates and their supervisors reported high levels of effectiveness of course content along with high positive growth in the leadership of graduates. Overall, the results from the study contributed to recommendations for program improvements, for greater impact on strengthening the student experience, and for aiding the USAF in the future Quality Enhancement Plan (QEP) for the LDC.

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Using an Applied Geophysical Imaging Course to Enhance Quantitative Reasoning and Problem-Solving Skills for Environmental Geography Students

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Quantitative reasoning and interdisciplinary skills are central to real-world environmental problem solving. Enhancing those skills for students in environmental programs will help them succeed as future environmental professionals. This paper describes an approach that uses an applied geophysical imaging course to enhance quantitative reasoning and interdisciplinary learning in an environmental geography program. To adapt the course to geography students, applied learning is emphasized through the high-impact educational practices (HEPs) of undergraduate research and service learning. Throughout the course, students learn the theories of, and utilize electrical resistivity (ER), ground penetrating radar (GPR), and electromagnetic (EM) induction methods to answer real-life environmental questions in the local community. Course evaluations indicate that the course produced positive learning outcomes consistent with the course objectives. Similarly, students appreciate the unique opportunity to learn and utilize these technologies that are not commonly found within geography programs. The teaching strategies described in this paper can benefit other faculty contemplating curricular integration for interdisciplinary learning and quantitative reasoning outcomes.

Introduction

Environmental challenges are increasing in complexity (Rodela & Alašević, 2017; Vogel, Scott, Culwick, & Sutherland, 2016), driven by both anthropogenic and natural stressors (Abernethy, Maisels, & White, 2016; Princiotta & Loughlin, 2014). Addressing these challenges often requires professionals to invoke interdisciplinary perspectives (Cantor, DeLauer, Martin, & Rogan, 2015; Ewel, 2001; Simon et al., 2013). Similarly, environmental problem solving requires the ability to manipulate and interpret large sets of data, some of which cut across disciplinary boundaries. These tasks demand a great deal of quantitative reasoning skills. Thus, helping environmental science students to build interdisciplinary and quantitative reasoning skills will prepare them for success as future environmental professionals (Cantor et al., 2015; Fortuin, Van Koppen, & Leemans, 2011; Lopatto, 2003). This paper discusses a rare curriculum integration approach that leverages the concepts and techniques of environmental geophysics to enhance both interdisciplinary and quantitative reasoning skills for environmental geography students. This is rare in the sense that geophysics is not commonly found in the corridors of geography. In fact, ordinarily, not many geography students will be excited by the term geophysics owing to their limited exposure to physics and mathematics coursework. However, as demonstrated by this course offering, geophysical concepts and methods can offer unique learning opportunities to environmental geography students. First, geophysics is interdisciplinary in nature, combining the principles of physics, geology, mathematics, and computer simulation. When put to use, it gives students the

opportunity to embrace interdisciplinary perspectives to real-world problem solving. Second, the mathematical principles behind geophysical methods can help students sharpen their quantitative reasoning skills as they apply concepts to real-life problems. Lastly, geophysics provides subsurface imaging tools for engaging students in experiential learning that leads to characterizing several real-world environmental problems. For example, geophysical methods such as electrical resistivity (ER), ground penetrating radar (GPR), and microgravity, can be deployed to detect areas of groundwater pollution, unexploded ordnance (UXO), sinkholes and caves on construction sites, as well as soil and water contamination from landfill leakages (Reynolds, 2011; Van Dam, 2012).

To deliver this course successfully, two High-Impact Educational Practices (HEPs), i.e., field-based and service learning, are emphasized. In the following section, a brief literature on the merits of HEPS is presented. The remainder of the paper presents the specific geophysical methods taught, example field investigations and targeted skills, as well as the student learning outcomes, and the conclusions reached.

High Impact Educational Practices (HEPS) and Student Learning

HEPs are a collection of teaching and learning strategies including undergraduate research, collaborative learning, internships, and service learning, among others that have been found to enhance student learning, persistence, and engagement (Kuh, 2008). It has been suggested that students who participate in at least two HEPs tend to earn higher grades and retain, integrate, and transfer information at higher rates (Kuh, 2008). In a related study, Kilgo, Ezell Sheets, and

Pascarella (2015) found the particular HEPs of active and collaborative learning, as well as undergraduate research, to have broad-reaching positive effects across multiple learning outcomes including critical thinking and metacognitive abilities. Further, there is evidence that students who are introduced to HEPs are better able to integrate ideas and apply same outside the classroom setting (Brownwell & Swaner, 2009). More specific to environmental problem solving, some researchers have observed that HEPs help students to develop the critical reasoning skills that enable them to understand better the complexities of real-world environmental problems (Whiley, Witt, Colvin, Arrue, & Kotir, 2017; Cantor, et al., 2015; Simon et al., 2013). In the geosciences particularly, a high premium is placed on field-based learning because it allows students to acquire multiple skills through data collection, processing, and interpretation (Mogk & Goodwin, 2012; Skop, 2008). From my personal experience, students show extra motivation and derive a sense of satisfaction when engaged in field learning that also helps them to solve a practical problem in their local community. Likewise, MacFall (2013) indicated that students engaged in environmental science service learning pedagogy reported long-term outcomes in commitment to civic engagement and environmental stewardship, as well as the ability to relate classroom principles to real-world issues. Field learning, integrated with service learning, can also help learners build interdisciplinary knowledge. For environmental studies, field learning often embeds a systems approach whereby learners must integrate information across different subsystems. Thus, Simon et al. (2013) advocate for environmental science education that integrates systems theory and service learning to better offer learners the breadth of knowledge that is required to synthesize ideas across disciplinary boundaries.

The range of useful skills that HEPs offer students can only be limited by the approach and depth of pedagogical implementation by individual faculty. For the course described here, another key target is to help students develop quantitative reasoning (QR) skills. QR, also referred to variably as quantitative literacy, fluency, or numeracy, has been identified as one of the must-have skills or competencies for all undergraduate students (AAC&U, 2010; Dingman & Madison, 2010; Jungck, 2012). It is at the heart of practical problem solving, especially in today's world where every sector, e.g., education, health, business, and government settings, is increasingly basing decision making on large quantitative datasets (Elrod, 2014). Several avenues exist for teaching QR to students, but one highly touted approach is the exposure of students to active learning situations with opportunities to integrate theory and practice.

According to the Numeracy Infusion Course in Higher Education (NICHE), students often come to understand the relevance of quantitative reasoning skills when theory and data analysis are combined in an active learning setting (https://serc.carleton.edu/NICHE/best_practices.html). Pozo and Stull (2006) further note that contextualized use of data is central to teaching QR. The above ideas are leveraged to help students develop interdisciplinary and quantitative reasoning skills in the course described further.

Context to Course Offering

The course described is GEO 463 (Applied Geophysical Imaging), which is taught as part of the Geoenvironmental Studies curriculum at Shippensburg University (SU) of Pennsylvania. SU services a student population of over 6000, drawn primarily from rural Pennsylvania and neighboring states. The university strongly encourages its faculty to utilize high-impact instructional strategies that maximize students' life-long learning skills. For the Geoenvironmental Studies program in particular, a natural, outdoor laboratory exists in the local karst geology that surrounds the university campus. Within a 5 km radius of campus, karst features especially sinkholes, and caves are commonplace. Very often, students witness the hazards posed by sinkholes, as manifested in the delay of construction projects on or near campus. In this context, it was considered ideal to integrate techniques of environmental geophysics into the existing Geoenvironmental Studies curriculum for enhancing students' research-based, as well as service-based, learning opportunities. Thus, a National Science Foundation grant (the NSF-CCLI) was sought and used to purchase a range of geophysical equipment that are used to educate students in an applied geophysics course. It is noteworthy that this course adaption is greatly facilitated by the core requirements of our Geo-Environmental Studies students to take at least two introductory physics, chemistry, and computer science classes, as well as three introductory mathematics courses including algebra and statistics. These offer them the basic computational skills to build upon.

Course Structure and Implementation

The structure and delivery of this course leverages the identified five principles of learning (Merrill, 2002), i.e., 1) learners are engaged in solving real-world problems, 2) existing knowledge is activated as a foundation for new knowledge, 3) new knowledge is demonstrated to the learner, 4) new knowledge is applied by the learner, and 5) new knowledge is integrated into the learner's world. All five principles

are woven into the various parts of the course and implemented. Overwhelmingly, the course seeks to engage students in practical problem solving, be it in the classroom or in the field. Practically, the course is taught in two parts: classroom and outdoor field learning environments. To better provide for the field learning emphasis, the course is offered in the spring semester so that students spend the cold winter months of January – mid-March learning in the classroom and embark on outdoor learning during the warmer spring months. The course is capped at 15 students to maximize participatory learning experiences.

To be successful, students enrolling in the course are expected to have foundational knowledge of physics and algebra. Our students acquire these basic skills through core course requirements. Although foundational knowledge of calculus would be beneficial, it is not required as calculus is not a required course in our curriculum. The goal of this course is to help students build higher order quantitative reasoning skills through a combination of classroom and field-based learning modules.

The Classroom Learning Part

This primarily involves providing the theoretical concepts behind several geophysical methods. Further, students get an overview of the disciplinary connections of geophysics and learn important foundational mathematical principles while building critical quantitative reasoning skills. The overriding goal is to provide students with the foundational knowledge that is necessary to apply geophysical techniques to practical environmental problem solving.

Overall, the classroom learning part kicks off with a discussion of case studies. Because geophysics is not typical for the students in this course, and many may have physics and math phobia, it is considered better to provide some foundation knowledge, consistent with Merrill's learning theory 2, before exposure to the theoretical geophysics principles. Thus, we begin by examining case studies and videos that highlight the environmental problem-solving capabilities of geophysics. Particular attention is given to cases similar to local issues that the students are familiar with. In this way, not only is the intimidation of perceived course content lessened, but students gain a level of familiarity with geophysical methods prior to the introduction of the theoretical concepts. Moreover, I found that this approach generates students' interest and enthusiasm in the subject, possibly instilling the confidence that is needed for successful learning. From the learner's perspective, this approach is also consistent with the assertion by Khalil, Nelson, & Kibble (2010) that students who lack foundational knowledge should be given some relevant experience as a foundation for the

new knowledge to come. Indeed, student feedback via course evaluations justify the approach as exemplified by these sample comments: (1) "I never imagined myself liking geophysics but now, I think I am in love with it but having those case studies/videos at the beginning really helped my focus"; and (2) "Geophysics proved to be manageable-thanks to the many case studies and videos. The lawn mower in the videos became GPR and I could relate and even felt more accomplished as I was personally using it to collect data."

Emphasizing the Interdisciplinary Nature of Geophysics. The complexity of environmental issues often challenges professionals to integrate knowledge across disciplinary boundaries. Thus, it is critical that students understand clearly the importance of interdisciplinary perspectives in resolving environmental problems. To help students appreciate this, class time is dedicated to highlighting the interdisciplinary nature of geophysics. It begins with a reflective assignment on the meaning of geophysics. Students are given Figure 1 to examine at home and reflect on the many disciplinary connections to geophysics. The figure is further discussed in class with reflections on some practical problems. For example, students are guided to reflect on how a practical environmental problem involving soil and water contamination may require the investigating scientist to acquire, analyze, and integrate soils, water, biological, and human health data in order to draw a remediation plan. Lastly, students are urged to keep this interdisciplinary image in focus throughout the course, especially as it evolves into practical field investigations.

Focusing on Quantitative Reasoning. Quantitative reasoning (QR) is critical to coping with geophysics and to solving most environmental problems. It entails the ability to reason critically and apply basic mathematics/statistics skills to evaluate and interpret data and solve problems within a disciplinary or interdisciplinary context (Elrold, 2014). To be successful as environmental scientists, students need to attain quantitative fluency. To foster this skill, students are aided to solve basic mathematical problems repeatedly, first in groups, and then individually. QR learning begins with identification of equation types and variables in an equation. Students are handed Figure 2 showing equations and guided to learn the nature of formulas and how to use them. By the end of this exercise, most students verbally confess to how easily their fear of formulas have evaporated. Throughout the classroom problem solving part of the course, student use data in Excel to solve basic practical math problems, as well as method-specific quantitative geophysics problems. Following these, students become more easily adapted to the theories of the individual geophysical methods.

Geophysics Theory. Students are introduced to the theoretical frameworks behind individual geophysical methods. To begin, a broad introduction to the

Figure 1
Disciplinary connections of geophysics
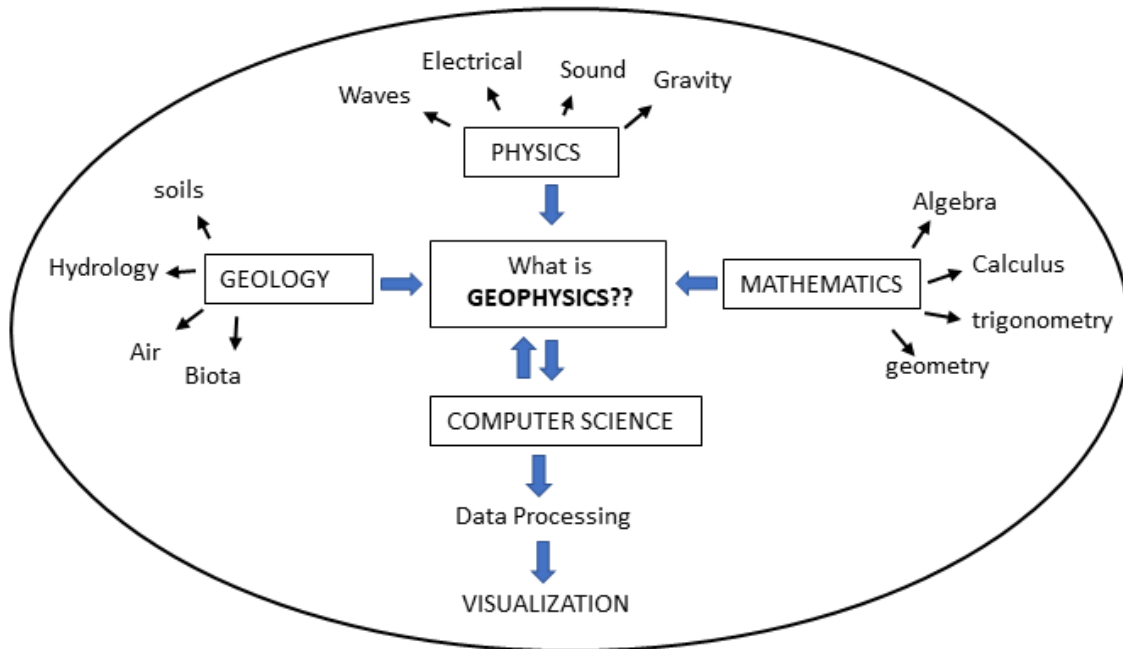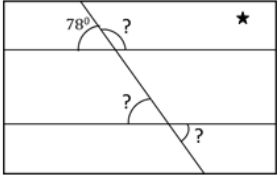
Figure 2
Introductory equation box for QR exercises

The equations shown in Figure 2 include:

$$\rho = \frac{2\pi\delta}{V_{MN}I}\left\{\left[\frac{1}{AM} - \frac{1}{MB}\right] - \left[\frac{1}{AN} - \frac{1}{NB}\right]\right\}^{-1}$$

$$\rho = a\varphi^{-b}f^{-c}\rho_w$$

$$\cos\alpha + \cos\beta = 2\cos\frac{1}{2}(\alpha+\beta)\cos\frac{1}{2}(\alpha-\beta)$$

$$g(\lambda) = gc(1 + \alpha\sin2\,\lambda + \beta\sin4\,\lambda$$

$$Cos^2\theta + Sin^2\theta =? \quad \star$$

$$F = G\frac{m_1 m_2}{r^2} \longrightarrow g = \frac{4\pi G\rho R}{3}$$

$$a^2 + b^2 = c^2 \quad \star$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \star$$

$$t = \left(t_0^2 + \frac{4x^2}{v^2}\right)^{1/2} \qquad Z_c = \frac{X_c}{2}\sqrt{\frac{V_{p2}-V_{p1}}{V_{p2}+V_{p1}}}$$

$$f(x) = a_0 + \sum_{k=1}^{\infty}\left(a_k\cos\frac{n\pi x}{L} + b_k\sin\frac{n\pi x}{L}\right)$$

$$gt = gobs - gn + 0.3086\,h - 0.04193\,r\,h + TC\,(mgal)$$

$$\left(\frac{H_s}{H_p}\right)_v = \frac{2}{(\beta S)^2} * \{9 - [9\beta S + 4(\beta S)^2 + (\beta S)^{3]*e^{-\beta S}}\}$$

$$B = \mu_0 H + \mu_0 kH = (1+k)\mu_0 H = \mu_R\mu_0 H$$

★ :Students expected to identify with ease

commonly used geophysical methods for environmental investigations, e.g., gravity, electrical resistivity (ER), seismic refraction (SR), electromagnetic induction (EM), and ground penetrating radar (GPR) are discussed. In furtherance of QR skill development, class time is further dedicated to hands-on solutions to basic problems specific to individual geophysical methods. These also enable students to conceptualize some theoretical parameters as they apply in the context of field investigations. For example, students process seismic refraction data in Excel to determine subsurface layers and depths. Similarly, for ER, they hand-solve

numerical problems involving the geometric factor and electrode separations. For ground penetrating radar (GPR), students solve simple problems involving common GPR parameter settings such as determining optimum time windows for desired depths of investigations with given antenna frequencies. They practice velocity-distance-time calculations, frequency-wavelength relations, dielectric permittivity, sampling frequency, etc. Additionally, students practice converting the unit of wave velocity from m/s to m/µs to m/ns. All calculations involve important parameters that students must understand clearly when deploying equipment in the field. Course evaluation comments indicate positive learning outcomes with respect to strengthening quantitative reasoning skills.

The Outdoor Component of the Course

Introduction to the Geophysical Methods Implemented. Although a suite of geophysical methods (e.g. gravity, seismic, magnetics, etc.) exist for a range of applications, several factors including costs, availability, suitability, specific site conditions, among others, often compel investigators to use only a few for a given project. However, it is a common best practice to use at least two geophysical methods at a site so that results obtained with one could be corroborated with the other. In this course, field investigations are limited to the methods for for which we have equipment, e.g., electrical resistivity (ER), ground penetrating radar (GPR), and electromagnetic (EM) induction. As of the time of this writing, a magnetics system has just been acquired. For now, students are exposed to Electrical Resistivity (ER), Ground Penetrating Radar (GPR), and Electromagnetic (EM) Induction methods. For environmental monitoring and characterization, these methods are complementary, but each also has its specific advantages in different environments and study targets. The ER method works by sending electrical currents underground and recording the resistances offered to the current flow by different subsurface materials. In simple terms, those resistances help to determine which features are good and bad conductors of electricity. GPR, on the other hand, works by sending radar pulses underground via a transmitter and receiving the reflected (signals bouncing off of subsurface features) waves via a receiver unit. It produces a real-time image of the subsurface along the path traversed, allowing subsurface features to be identified. Lastly, the EM method works by transmitting a primary electromagnetic field into the subsurface via a transmitter dipole, which induces an electrical current in subsurface features. The induced currents, in turn, induce a secondary electromagnetic field in the features which is received at the receiver dipole on the surface. Thus, practically, the EM method

measures the conductivity of earth materials. Note that the working principles described for all three methods have been oversimplified for a general audience.

For all methods, acquired field data are processed using specialized software to obtain 2- or 3-dimensional models of the subsurface. All methods can be used to detect and map several man-made and natural features underground. It should be noted that although geophysical methods are not typical for geography students, the applied methods are adaptable owing to advancements in equipment and processing software. These have made it relatively easy for those with less rigorous physics and mathematics preparation to be successful at learning and applying geophysical technology. For this course in particular, the emphasis is on active learning via field application rather than the theoretical rigor. The integration of theory and practice via field engagement of students has been a cherished HEP in the geo and environmental sciences (Anđelković, Dedjanski, & Pejic, 2017; Garner & Gallo, 2005; Scott et al., 2012). Appendix D shows students with equipment at field sites.

Example Outdoor Learning Projects and Outcomes

This course has been offered five times since its inception, and students have investigated various local sites with practical environmental issues. A selected site offers students the opportunity to solve a real-world problem while also rendering a service to the local community. This section describes two such sites as examples and summarizes the outcomes of student investigations. For each field project, students are divided into three groups, with each group starting off using one geophysical method to collect data. Afterwards, the methods are swapped until each group has had experience with each method. One site is visited repeatedly throughout the outdoor portion of the course for thorough investigations, as well as to maximize student's practice with equipment and methods. For each project, the students are tasked with the following: (1) collect data using appropriate methods; (2) process and produce 2-D models from the raw data collected; (3) identify anomalies on the model visualizations; (4) interpret anomalies in terms of physical subsurface features, providing justifications for the interpretations; and (5) produce reports and make classroom presentations. To further reinforce the interdisciplinary nature of environmental issues and geophysics, the students are guided to explore exhaustively the geology, soils, and hydrology, as well as land use/cover for each site to be surveyed. Students access online databases such as those of the U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), and U.S. Department of Agriculture (USDA), to locate relevant resources, and they are also

tasked with producing geologic sketches including strikes/dips/outcrops on sites. They must integrate information from these resources to reflect on their field survey design requirements and any potential impacts on their geophysical results. For presenting their results, report writing is individualized while class presentation is still done in pairs. Specific instructions that form the basis for evaluation, including formatting the final reports, are given to the students to follow. Appendix A and B show example results produced by students at the two sites. The figures are picked from student submissions and intentionally left in their original formats. Similarly, detailed written interpretations by individual students are omitted for brevity.

Site 1: The Old Shippensburg Travel Plaza. This site is roughly a 5- to 7-minute drive from the Shippensburg University campus. The Pennsylvania Department of Environmental Protection (PADEP) had concerns about possible gas leakage from a buried tank at an abandoned travel plaza that posed the risk of soil and groundwater contamination. I was contacted for help and decided to use it as a service-learning opportunity for students. Consequently, students used geophysical methods to image the tank and evaluate the risk of soil contamination. First, the class conducted a preliminary study of the site geology, soils, hydrology, and site-specific conditions before deciding on the suitability of ER and GPR for detailed investigation. Appendix A (Figures i and ii) show the results of the ER and GPR interpretations respectively. On A (i), the buried gas tank is clearly visible as the zone of very low resistivity with pronounced boundaries (indicated on the figure). There was evidence of gas leakage as well. Similarly, the buried gas tank is clearly indicated by the hyperbola on the GPR radargram in A (ii).

Site 2: An Abandoned Landfill Site Associated with the Property Disposal Office at the Letterkenny Army Depot, near Chambersburg, PA. This site is one of the EPA's superfund sites, added to the National Priorities List on March 22, 1989. Areas on the site are associated with the storage and disposal of industrial chemicals and petroleum. Soils, groundwater, sediments, and surface water around the sites are known to be contaminated with hazardous chemicals. Students investigated this site with the goal to detect and map zones of subsurface soils and groundwater contamination from the migrating landfill leachate. Shown in Appendix B (Figure i) is the final ER model produced on one of the transects at the site. The circled areas of very low resistivities are the suspected groundwater contamination zones. Students learned that the composition of leachate material makes it highly conductive; thus, they are captured as very low resistivity anomalies on the 2-D ER model. Figure ii of Appendix B shows the corresponding GPR anomalies on the same transect. Because conductive zones absorb

GPR signals, the lack of strong reflections near the end of the transect were interpreted to be due to groundwater contamination, and they compare well with the ER anomalies in Figure i.

Throughout the outdoor field component of the course, students work both collaboratively and independently to achieve their final outcomes. In the process of executing their research tasks, students come face to face with the interdisciplinary nature of environmental issues. First, the nature of geophysics requires that they review information on the soils, geology and, in some cases, the hydrology of the study site. Next, they must draw upon theoretical concepts learned in class to decide on both the suitability of a particular geophysical method and the data collection strategy to use. For example, students must know that GPR surveys won't be successful at sites with clay overburden because clay soils are highly conductive and easily attenuate GPR signals rather than allowing them to penetrate deeper into the ground. This understanding draws upon physics, geology, and soil science, reinforcing interdisciplinary perspectives. Additionally, students learn the empirical mathematical relationships between soil conductivity and the electrical and magnetic properties of the propagating radar waves. All the learning is done hands-on and collaboratively with group peers and the instructor. The experiential component lies in the entire learning process where the students learn by direct experience and having to reflect repeatedly upon their research methodology and findings. Many times, students also experience the frustrations of equipment temporally malfunctioning in the field due to practical field conditions and learn coping/backup strategies. These all add to the overall learning experience and students' problem-solving capabilities.

Assessment and Student Feedback

Students' learning achievements in the course are gauged on the basis of performance on different testing areas. Specifically, besides exams and homework assignments, a concept quiz (CQ), interactive questioning sessions in the field, written project reports, classroom presentations, and an end of semester course evaluations are used. To assess students' mastery of basic quantitative reasoning skills, a CQ consisting of 20 MCQs, all basic math problems, is given at the end of the classroom learning portion of the course. Performance on the CQ is rated on the scale of "Very High ($\geq$ 90%); High ($\geq$ 80 < 90%); Average ($\geq$ 70 <80%); low ($\geq$ 60 < 70%); and poor (<60%). For the most recent class (spring 2019) with 13 students enrolled, 4 students (31%) performed at the "Very High" level, 5 students (38%) at the "High", and 2 students (15%) at the "Average" and "Low" levels

Table 1
Scores on Questions 1-7 of the End of Semester Course Evaluation

Question	Rating		
	Min	Max	Average
Rate how this course has advanced your understanding of the scientific method (i.e. observation, data collection, analyses, and interpretation).	8	10	9.0
To what extent has this course helped your ability to recognize and correctly interpret variables in a mathematical formula?	4	10	7.0
To what extent has this course helped your quantitative reasoning abilities?	5	10	7.5
To what extent has this course helped you to link classroom concepts to real world environmental issues?	8	10	9
How responsive was the professor to your questions and concerns?	9	10	9.5
How effective was the professor in teaching this course?	7	10	8.5
Overall, how satisfied were you with this course?	6	10	8

respectively. No student scored below 60% (i.e., < 12/20) on the quiz. The distribution is similar to the two prior semesters. This result suggests an overall high level of QR skills for students in a geography program.

An additional form of assessment takes the form of interactive questioning sessions in the field to gauge the ability of students to relate concepts learned in the classroom to field procedures. This is a formative assessment to identify gaps in student understanding and address them while they perform fieldwork. Example questions for ER are: (1) Why use a non-conductive rope to separate the receiver and the transmitter dipoles? (2) What advantage do you get by connecting more than one receiver in series? (3) What limitation(s) of this entire setup can you think of, on this specific site? To answer these questions, a student would need to draw upon basic theoretical background offered in the classroom. The students are similarly assessed on the GPR and EM methods.

The more standard form of assessment is an end of semester course evaluation adapted from the university's evaluation instrument. This instrument further adds student voices and or perceptions regarding their own learning, which is consistent with Mogk and Goodwin (2012) and Waldron, Locock, and Pujadas-Bootey (2016), who have emphasized the need for metacognitive-based assessment of student learning. Appendix C shows the survey questions administered and Table 1 summarizes the student responses to the scoring part of the survey (questions 1-7). The results shown are aggregated over the Spring 2018 and Spring 2019 semesters. Overall, the scores offer evidence to positive learning outcomes for students in the course. For example, when asked the extent to which the course has helped students to link classroom concepts to real world environmental issues, the minimum aggregate score is 8/10. This is significant because the ability to conceptualize and solve real world problems depends

on a student's understanding of relevant theoretical frameworks. The results also show that the course has had a positive learning outcome with respect to students' quantitative reasoning abilities although, as expected, the overall average rating is lower in the quantitative categories. Altogether, students also expressed overall satisfaction with the course. Responses to the open-ended questions are consistent with ratings on the scoring part. On question 1, the most positive aspect(s) of the course, a majority of the students favor the field work component (>90%). Only a handful of students had the video/case study discussions aspect as their favorite. For question 2, most students don't see an aspect of the course they would change except a few that felt the CQ was too difficult. In all, written comments indicated students took ownership of their accomplishments and relished the opportunity to address real-life environmental issues of practical significance. Sample students' comments are presented below:

It was a great feeling to be out there doing geophysics and solving the problems that professional people solve for big money. This class has given me possibilities after I graduate. I learned a lot in the class-resistivity, gravity, seismic, mathematics, simulation, etc and will definitely consider geophysical imaging as a career in the future.

The time to set up equipments and run the surveys was a lot of hard work but I enjoyed it and gained a lot of new knowledge. Now I see that geophysics answers many important problems in the environment like identifying graves, sinkholes, pollution and more. These are important problems, and I am happy to have the chance to become an expert.

This was a fantastic course for me. Though I must admit that I am not a math person, this course has cleared most of my fears for numbers. I now can see equations as "coded words" and just a different way of communicating once you understand the variables.

I feel fortunate to have geophysics knowledge! Without the early videos though I would of still been scared of what was to come in the class despite the professor's assurances that the class would be fine. The videos helped me to see firsthand how geophysics works and that made me more interested.

The coolest thing for me was that we solved real problems close to home. Using resistivity and gpr to identify groundwater and soil polluted areas was a new discovery. I never would of thought that the trash we send to the landfill is actually polluting groundwater. Geophysics helped me to make this connection and it was obvious.

Many other written comments echoed similar voices of satisfaction with the course. These, together with my assessment of final project reports and classroom presentations, led me to the conclusion that the course as delivered produces positive learning outcomes for students.

Potential for Broader Cross-Disciplinary Application

The curriculum adaptation presented here, though of geophysics content and localized, provides a model for cross-disciplinary application. For environmental scientists in general, the range of environmental problems that can be addressed by geophysics, geochemistry, or tools of environmental engineering are global in scope. For example, issues of groundwater and soil contamination, sinkholes/caves, dam leakages, unexploded ordnances (UXO), unmarked tombs at historical cemeteries, etc., are common global problems that can be addressed with environmental geophysical methods. Beyond environmental sciences, other global issues exist that require interdisciplinary solutions. In the health sciences, for example, several factors including social, environmental, biological, and climatic among others, influence disease prevalence and propagation. Currently, mathematical models that integrate social, environmental, biological, and economic variables to model and predict impacts of infectious diseases on human systems, are used to reduce human fatalities and other losses at the local, regional, or even the global scale. In this mix of problems and existing technologies lie ample opportunities for cross-disciplinary curriculum

innovations to engage undergraduate students in interdisciplinary learning. Hence, similar to the approach described in this paper, a broadly trained sociology faculty member, for example, could adapt a course where sociology undergraduate students learn the application of mathematical models (or some other tool) to patterns of human response to crises over different spatial scales. The success of the approach presented in this paper is proof that students are highly adaptable to different learning modules if given the right tools. Thus, this curriculum adaptation model could similarly be implemented by other educators irrespective of discipline.

Conclusion

This paper describes a curriculum integration approach whereby the concepts and techniques of environmental geophysics are taught in an environmental geography program to enhance both interdisciplinary learning and quantitative reasoning skills for students. To adapt geophysics content to geography students, three major strategies are used: (1) the course begins with a review of case studies before introducing geophysics theory, to lessen intimidation and student phobias regarding the term "physics"; (2) applied learning is emphasized over theoretical rigor; and (3) the high-impact educational practices (HEPs) of field research and service learning are integrated to maximize experiential learning opportunities for students. For environmental sciences, courses employing HEPs have been reported to improve learning outcomes including critical thinking, interdisciplinary knowledge, and environmental problem-solving skills (Brownell & Swaner, 2009; Wawrzynski & Baldwin, 2014). Likewise, both formative and summative assessments in this course indicate that students learned environmental geophysics concepts and gained useful interdisciplinary, as well quantitative, reasoning skills. Additionally, students' written comments indicated that they took ownership of their accomplishments and relished the opportunity to address real-life environmental issues of practical significance in the local community. Although this curriculum adaptation is localized, the range of environmental problems addressed by the students is global. The issues of groundwater and soil contamination, sinkholes and solution cavities, and unmarked tombs at historical cemeteries are common problems addressed with environmental geophysics and are common at many locations. Thus, in a similar tune as Cantor, DeLauer, Martin, and Rogan (2015), I note that human–environment geographic issues are widespread, as are other global issues beyond the environment. These hold excellent potential for student learning via interdisciplinary, inquiry-driven, learner-centered research projects, and provide a platform for students to

learn and acquire essential skills for solving real-world problems. Hence, the curriculum adaptation presented here could be implemented by other educators. Broadly, the student testimonies above and the overall success of this implementation should be encouraging to other faculty contemplating similar curriculum integrations. The success of this course suggests that, with the right approach and tools, students are capable of adapting to any curricular adaptions that provide them with practical learning opportunities.

Despite the successes achieved, educators looking to adapt geophysics in a similar manner should be aware of the following challenges: (1) Motivating geography students, who often have limited exposure to physics and mathematics coursework, requires a higher level of effort; (2) Geophysics equipment are expensive to acquire and maintain. Long-term maintenance can be expensive as well, depending on the level of usage. This means that careful planning, including internal arrangements for sustained support in equipment, must be in place; (3) Scheduling field times for adequate student exposure to the applied aspects can be a challenge. This challenge led to the first offering of this course to be in a summer session. However, students' ability to enroll in summer classes is limited by several factors; therefore, the course had to go on a regular semester schedule. Despite the above challenges, the overall value added to the educational experiences of students makes these sorts of curricular integrations worthwhile.

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Acknowledgements
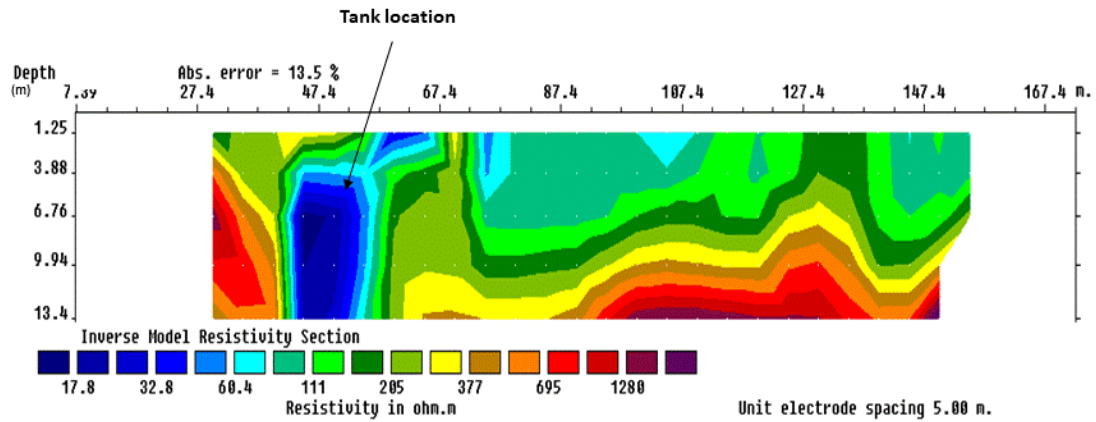
Appendix A

i.   Final ER model showing anomalies for the buried gas tank at the old Shippensburg travel plaza

ii.
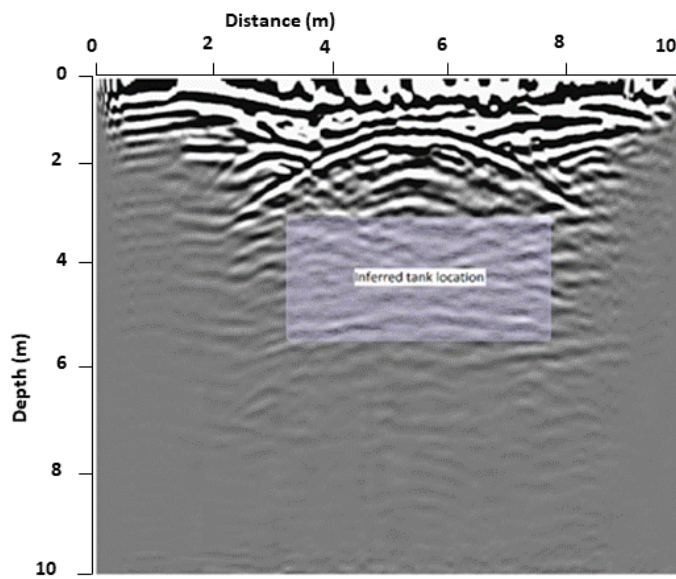
ii.   GPR radargram showing anomalies for the buried gas tank.

Appendix B
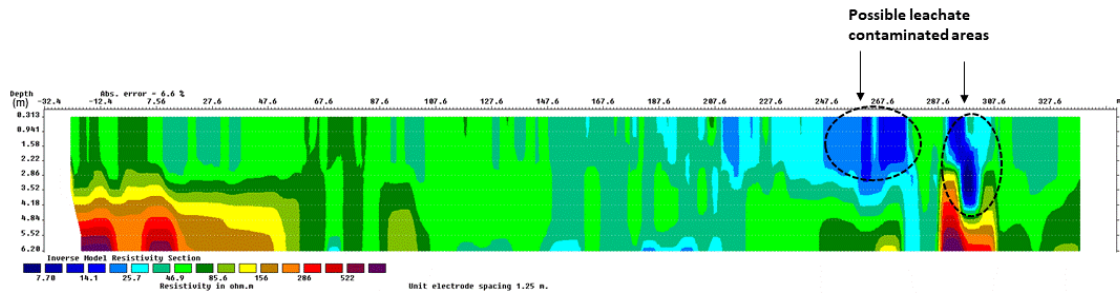
i.

Final ER model produced on transect 1 at the Letterkenny closed landfill site.
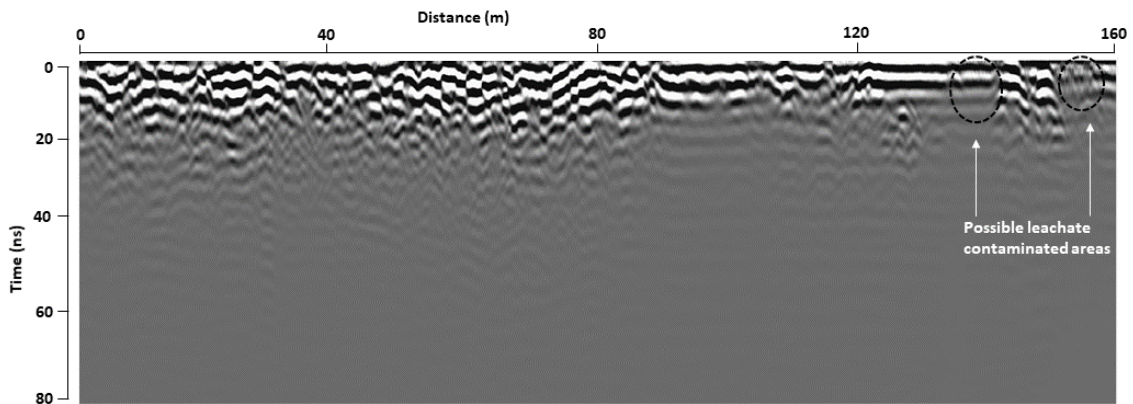
ii. **GPR radargram, produced on the last 160 m of transect 1 at the Letterkenny closed landfill site.**

Appendix C

End of course survey (adapted from university course evaluation)

A: For this section (questions 1-7), rate each question on a scale of 1 – 10 (1 being minimum impact and 10 being highest impact).

1. To what extent has this course helped your understanding of the scientific method (i.e. observation, data collection, analyses, and interpretation).
2. To what extent has this course helped your ability to recognize and correctly interpret variables in a mathematical formula?
3. To what extent has this course helped your quantitative reasoning abilities?
4. To what extent has this course helped you to link classroom concepts to real world environmental issues?
5. How responsive was the professor to your questions and concerns throughout the semester?
6. How effective was the professor in teaching this course?
7. Overall, how satisfied were you with this course?

B: Open-ended questions:
1. Please describe the most positive aspect(s) of this course.
2. Please describe the aspects of this course you would change.
3. Please provide any other comments that you may have.

Appendix D

Field scenes of students at work with ER, GPR, and EM equipment.

A Framework for Student-Instructor Partnerships

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In recent years significant emphasis has been placed on staff and students as partners in higher education in order to address issues of engagement and transferable skills. However, the concept covers a wide range of meanings. On the one hand it can refer to module feedback questionnaires. At the other extreme it can include student input in curricular design, particularly constructing course materials. These very different experiences require different levels of academic preparation and student engagement. For the purpose of clarity in discussion it would seem useful to have a framework for the different levels of student-instructor partnerships, which emphasizes this range of experience rather than the activity content. This paper presents a framework based on the levels of student initiation of the partnership and of student involvement in the outcomes (referred to as ownership and autonomy respectively). The scheme was arrived at following study of the collaborative activities in two cognate programmes, the Natural Sciences degree programme at the University of Leicester and the Honours Integrated Science program at McMaster University. These programmes adopt pedagogical models which encourage the formation of strong, cohesive learning communities, thereby providing a rich variety of examples and an international perspective.

Introduction

The traditional form of education, especially in the sciences, has long been the transmissive mode, as if education is something done to the pupil, not with the pupil, even where students complete closed exercises or follow laboratory scripts. Much has been done to change this through active engagement in problem solving including guided instruction (for example, McDermott, 1996; Moog and Spencer, 2008), various forms of problem-based learning (Raine, 2019), peer learning (Boud et al. 2001), or peer instruction (Crouch & Mazur, 2001), among many others. Student-instructor partnerships provide Higher Education Institutions with a means to develop curricular, co-curricular, and extracurricular experiences in a way which fully integrates student representation in course and program design and review processes, discipline and pedagogical research projects, and the development of outreach and in-reach strategies (Healey, Flint & Harrington, 2014; Williamson, 2013). Such partnerships are well placed to encapsulate the difference between school and university and to re-focus the emphasis in science from content (knowing science) to process (becoming a scientist). Student-instructor partnerships span multiple roles for both students and instructors, from student representation on instructor-led curriculum committees to student-conducted research and outreach projects. In implementing student-instructor partnerships as a developmental process within the curriculum, there is a need to articulate the level and type of interaction involved. The aim of our research is to construct a framework for partnerships that can guide the development of process (how to cooperate) rather than content (what to cooperate on). We arrive at this framework by observation of partnerships in two science programmes.

We describe a new two-dimensional scale based on axes of increasing student ownership and increasing student autonomy to allow the classification of various activities or projects according to the degree of student and instructor involvement. We have developed this framework principally through analysis of two programmes (one in the United Kingdom and one in Canada) showing how students at two universities have contributed to student-instructor partnerships as joint owners and decision makers (Healey et al., 2014). The analysis was conducted over a two-day roundtable meeting of the authors. The two institutions feature interdisciplinary science programs and include instructors in a unique role: teaching fellows and teaching-dominant lecturers (University of Leicester, UK) and teaching professors (McMaster University, Canada).

A note on terminology: the expression "instructor-student" is the usual way of referring to these partnerships

in North America. On the other side of the Atlantic, they would be more naturally termed "staff-student" partnerships. We have used the terms interchangeably and, similarly, with the spelling of "program" or "programme," in reference to the two institutions.

Classification of Student-Instructor Partnerships

Healey et al. (2014) have proposed a conceptual model of the staff-student partnership based around broad areas of interest: learning, teaching, and assessment; subject-based research and inquiry; the

Table 1

The Classification Framework for Partnerships According to the levels of Student Initiation and Student Involvement with the Examples Presented in the Text

| Student autonomy | Student ownership → | |
	A. Instructor-initiated	B. Student-initiated
1. Instructor-led	Module Evaluation	Lecture capture Research seminars
2. Co-conducted	Laboratory working group Enhancing PBL PBL resources Chemistry clips	Well-being initiative
3. Student-led	Research (capstone) project Student conferences Large scale outreach	High school workshop Research talks Careers Symposium

scholarship of teaching and learning; and curriculum design and pedagogic consultancy. The emphasis is therefore on the content of the activity – essentially what can be collaborated on. While usefully laying out the field of possibilities for partnership, such typologies are of less help in designing a progressively structured curriculum. We propose a complementary approach in which we consider where the focus of ownership lies and the depth of the collaboration: essentially the nature of the collaboration. The two-dimensional framework we propose for the classification of student-instructor partnerships centers around two factors: the level of student initiation in the creation of a partnership and the level of student involvement in carrying out a partnership activity (see Table 1).

We have observed that student-instructor partnerships take a variety of different forms. They may involve a wide range of different levels of student input at the initiation stage, for example from an instructor-initiated partnership to carry out pedagogical research to a student-initiated project to develop a careers seminar. The level of student involvement in conducting the activity defined by the partnership also varies widely, ranging from students acting as advisors to academics to students taking co-ownership of a project and conducting much of the work themselves. The framework has been constructed to reflect the fact that these two descriptors are independent: for example, an instructor-initiated pedagogical research partnership may be largely conducted by a student partner. The nature of the partnership may also change over time.

In Table 1 the level of student initiation is divided into two columns that describe whether the partnership activity is primarily initiated by either the instructor or the student. The level of student involvement in the partnership activity is classified by the different rows of the framework. The framework was developed inductively by fitting examples of student-instructor collaborations into a matrix. A 3 × 3 matrix with a column for shared initiation has some merit (a project

may be molded by instructor input into a student idea) but limited applicability. On the other hand, a 2×2 matrix, omitting the central row, proves too crude to distinguish the examples. We believe this is the first time a framework to describe student-instructor partnerships has been developed which describes both level of student initiation and level of student involvement in partnership activities.

The Natural Sciences Programme (Leicester) and the Honours Integrated Science Program (McMaster)

In order to set our examples in context, we start with a brief description of the degree programs from which the examples are mainly drawn.

The Natural Sciences Programme at the University of Leicester is a three-year (BSc) or four- year (MSci) degree course which is built around interdisciplinary (as opposed to multidisciplinary) modules (University of Leicester, 2019). The programme adopts a pedagogical model which incorporates elements of Problem-Based Learning (PBL) and Context-Based Learning (CBL) to create a series of group-based learning experiences. Students research novel problems based on research themes at the frontiers of biological science, chemistry and physics. Instruction is led by a teaching team assigned to the programme, together with specialist lectures from about forty academic researchers, and has an intake of 20 to 30 students a year.

The Honours Integrated Science (iSci) Program at McMaster University (McMaster University, 2019) is a four-year limited enrollment H.B.Sc. program which involves students in research from the earliest stages. A cohort of 60 high-achieving students is accepted annually. In the first year of study the program interweaves the disciplines of chemistry, earth science, life science, mathematics and physics along with science literacy. The learning of discipline content in all four years is driven through a series of interdisciplinary research projects. Students may choose to complete a "concentration" in a particular science discipline, which allows them to focus their non-iSci courses in that area. Students largely work in groups to complete the projects. However, in order to develop independent research skills, Level 2 students undertake an enrichment project, Level 3 students engage in a supervised independent (research) project of their choosing, and at Level 4 the capstone project is an independent thesis. The programme instruction is carried out by a group of instructors, which includes two full-time teaching professors (McMaster University, 2019) and other teaching-focused or traditional instructors from specific science departments.

Teaching in both programmes is delivered largely by instructors who are actively engaged in the scholarship of teaching and learning (Gretton et al., in-press), and there is a high level of inter-programme interaction (Hurkett et al., 2018). The examples of partnership will be supplemented by case studies from the Chemistry programmes at Leicester and McMaster, which are taught by more traditional pedagogical approaches.

Examples of the Framework

A1: Instructor-Initiated, Instructor-Led

The ubiquitous module evaluations fall into the simplest category of staff-student partnership. We include these for completeness, but also because our examples here have a small twist. At Leicester an annual planning meeting reviews student inputs to module evaluations and to the student-staff committee. The important twist is the closing of the loop – that is, feedback to students on the outcomes of their input. We publish to students' actions taken as a result of consultation and run through these changes at the induction sessions at the start of each year. This is also useful in damping the "yo-yo" effect since students get the picture of how previous student inputs have impacted on the programme.

Since the introduction in 2008 of a revamped Honours Chemistry program and a new Honours Chemical Biology program in the McMaster University Department of Chemistry and Chemical Biology, students have been invited to participate in annual program refinement sessions. These are conducted on behalf of the Department by staff from the McMaster Institute for Innovation and Excellence in Teaching and Learning (MIIETL). The value of third-party facilitation is that students' participation and responses are anonymous and less likely to be influenced by instructor-led sessions. The third-party facilitator consolidates the results and notes any recommendations.

A2: Instructor-Initiated, Co-Conducted

The original idea and basic structures for the following projects were defined by the staff partners, but the research work was planned, carried out, and the resulting data

analyzed by the student partners. The first example here exemplifies the transition between A1 and A2. The final cases are more illustrative of student contributions.

Natural Sciences Laboratory Working Group

In 2015 a group of students on the University of Leicester's Natural Sciences programme wrote a letter to staff raising issues about the laboratory modules related mainly to scheduling, the format and marking of assessments, and the workload. In order to address student concerns, a laboratory working group was assembled. The aim of this working group was to evaluate the laboratory programme and to check the alignment between student and instructor expectations.

The working group took the form of a series of regular meetings between instructors of the course and two student representatives from each of the year groups. The outcome was a series of changes to the laboratory programme that were completely acceptable to staff and manifestly addressed the students' concerns. The group also helped to ensure alignment between student expectations across cohorts: year three and four representatives were very effective at emphasizing the rationale for the structure of the laboratory programme to year one and year two students.

A similar structure is used in the iSci Curriculum Committee at McMaster University. The members (student, staff, and faculty representatives) work together to create informal surveys gathering in-progress feedback to improve the program.

Enhancement of Problem-Based Learning Sessions

The University of Leicester has used Problem-Based Learning (PBL) in its chemistry degree programme since 2007 (Williams, Woodward, Symons, & Davies, 2010). Evaluation has shown that PBL does improve social cohesion (shown by enhanced student retention figures) and that students do appreciate the opportunity to learn how abstract chemical contexts are applied to real situations.

The integration of highly varied assessments in the PBL module has provided the opportunity for first-year students to be trained in a range of workplace and transferable skills. Students tend to appreciate these skills toward the end of their degrees when they may be thinking about applying for jobs or postgraduate study opportunities. But they tend not to appreciate the significance of these skills in earlier years of study and consequently sometimes struggle to relate what they do in years one and two to their professional skills development.

In order to address this issue, in 2014 we set up a student-staff partnership project to help year one students recognize the personal skills they develop during PBL modules. Student partners took responsibility for developing and deploying resources, including reflective questionnaires and video resources, which highlighted how the primary transferable skills developed would become useful towards the end of the degree programme.

In a second project in 2015 a team of student partners contributed to the development of a new PBL module based on the role of chemistry in food security. Student partners were briefed by members of the staff on the scope of the project and the expectations of the external funding body (the Royal Society of Chemistry) supporting the project. The students undertook an open-ended laboratory research project as the basis for the development of a learning activity. This gave these students the opportunity to appreciate the considerations necessary in the development of engaging learning resources. From the staff perspective, involving students provided an opportunity to integrate their suggestions as stakeholders in the new resource.

These two projects were supported by a teaching fellow as a staff partner. It is likely that the success of such projects is enhanced by a staff partner with a deep understanding of the theories of teaching and learning as well as the relevant subject material.

Chemistry Clips - Creation of a Blended Learning Environment

The Department of Chemistry and The Centre for Interdisciplinary Science at the University of Leicester started producing multimedia resources (video and audio clips) for use as part of a blended approach to teaching chemistry in 2011 (Williams, Bird & Davies, 2013). The project was conducted as a student-staff partnership as it was felt that students could identify topics where these resources would be of most benefit and would also be able to help design, produce, and evaluate resources which met student expectations.

Since it was essential that the student partners had a good overview of the content taught in years one and two modules, final year BSc students were recruited as partners. At the start of the academic year these students were briefed on the goals of the project by the blended learning coordinator. They were reminded that

student and staff partners would make equal contributions and that they would be expected to contribute to the decision making and evaluation stages of the project, as well as to resource planning and development. Regular meetings of the student and staff partners were held throughout the term.

Students created drafts of the multimedia resources which they shared with staff partners for feedback. Staff partners provided guidance on relevant points of educational theory. Following some modification, the drafts were recorded as screen-capture presentations and distributed to year one and two students via the Virtual Learning Environment (VLE). The resources were evaluated by monitoring student usage (using "Statistics Tracking") and by questionnaires and focus groups managed by students. Responses indicate that year one and two students value these resources.

From the perspective of the student partners, creating the resources is a useful experience in allowing them to consider familiar course material in a different way. Student partners gain a useful insight in how to present their understanding of scientific concepts in a way that results in productive learning experiences for a diverse cohort of undergraduate students. From the perspective of staff partners, this resulted in a useful set of learning resources and the publication of valuable research outputs (Williams et al., 2013; Williams, Balonwu, Banwaitt & Davies, 2013).

A3: Instructor-initiated, Student-led

The first example is probably the most familiar illustration of student autonomy: the capstone research project. The audience for these is usually internal, although the group research projects in many UK Physics Departments involve interactions with industry (King, 2013), and external partners are common in more applied sciences such as engineering.

As research partners, students can make important contributions to pedagogical research projects. Student partners can provide a user's insight that instructors may lack. Student partner contributions range from the development of research questions to managing and evaluating a project.

Independent Projects in iSci and Other McMaster Programs

While traditionally structured programmes have long offered capstone thesis projects in the fourth year of undergraduate study, newer examples offer a shorter-term introduction to independent project work at earlier levels of study (Levels 2, 3). Three of the authors have experience with these projects, as well as thesis projects, both within the iSci program and beyond. Projects for credit have ranged from the equivalent of a single course (module) to 4 course equivalents. Since many of these projects involve pedagogical research into the curriculum of a course or program (see for example, Cunningham, Lock, Knorr & Vajoczki 2012; DiPucchio & Lock 2014; Pantaleo & Lock, 2012), they may also appear in the framework as curriculum enhancement activities.

Student Conferences

Synthesis, which began in 2012 and has continued annually at McMaster, is an end-of-year research conference across all years organized by students. It has three purposes. First, it is a model academic science conference. Students plan the sessions, invite speakers, and submit papers which they peer review. Second, it offers students the opportunity to communicate their research in a variety of formats. This includes original research from projects, as well as work outside the curriculum, for example as summer research assistants. Third, the event serves to promote coherence across the cohorts, providing continuity between years such that methods, expectations, and culture are passed down. As a staff-student partnership, students act as junior colleagues in taking responsibilities and receive mentorship in aspects of professionalism that may not be part of the curriculum. The one-day event provides staff with an archive of student data to showcase the program both internally and externally.

A Large-Scale Outreach Event

Each year since 2012, a group of around 25 final-year chemistry BSc students at Leicester conduct some laboratory-based research from which they develop an outreach activity that allows them to disseminate the highlights of their research in a week-long exhibition. The staff partners in these projects provide students with an initial outline of research themes. Weekly progress meetings allow cross-fertilization of ideas between students working in different themes. The outreach exhibition takes place in a local museum at the end of the project. Staff partners take responsibility for booking the venue and notifying local schools, but all other organizational matters are dealt with by the

students, including the greeting of visitors and the planning of evaluation questionnaires. The project gives students an opportunity to develop laboratory research skills as well as professional skills, including communicating scientific research to a range of audiences, running a large-scale event, and collecting and analysing evaluation data.

B1: Student-Initiated, Instructor-Led

The collaborations in this category are responses to "Why don't staff do something?" beyond changes to curricula and syllabi. Examples include the provision of lecture recordings. The case below resulted from a wish from undergraduate students to get some insight into current interdisciplinary research in a way that, authentically as possible, mirrors the post-graduate experience.

Undergraduate Research Seminar

Most of our instructors have a research background in a single discipline, and while we may collaborate across disciplines and can talk about interdisciplinary research, our students at Leicester suggested it would be confidence-building to hear from some interdisciplinary researchers from outside the institution. The idea is quite straightforward: several times a year we invite speakers to give a seminar on their research in a form that is accessible to an undergraduate audience. Students from all years attend and meet the speaker afterwards. There is a small associated assignment of a short article or blog post which serves to provide practice in science communication. More recently, we have handed over the organization of some of the talks to year four students, a task which they accepted enthusiastically and from which they have learned a great deal about the practicalities of event management!

B2: Student-Initiated, Co-Conducted

Well-being Initiative

In 2014 a student-initiated mental health in-reach event took place for the first time at McMaster. Students were motivated from their own experiences with stress and mental health issues to create a forum where they could share their experiences with younger cohorts in the same programs. A collaborative team of students and faculty members worked together to create a vision for

the event, which centered around three goals: (1) [I]t's okay to talk about mental health; (2) [I]f you are experiencing stress or mental health issues you are not alone; and (3), [L]et's get students connected to resources. Because of the sensitivity of mental health issues and the perception by students of the attached stigma, clear communication among the team members was critical, as was careful facilitation of the group dynamics. Staff from Student Wellness gave critical support to the planning and delivery of the event. The event was hosted by students and with small discussion groups led by senior students. Faculty members were invited to be present at the event to sit apart during the small group discussions and then to join in a large group discussion. Students identified that the presence of faculty at the event was very meaningful to them and was seen as supportive. Students were surprised to learn that faculty had lived with some of the same concerns in their time as students (and in their current jobs). Students and faculty learned to listen to each other's concerns and viewpoints. Faculty members were able to hear about specific concerns related to academics and curricula that were stressful, and they took this information away to consider how to make changes. Student partners also created an evaluation form for event participants and event organizers to collect feedback on the event and the planning process. In 2015 the event was put together largely by students, based on the experience in 2014.

B3: Student-Initiated, Student-Led

The activities in this group are classified as student-initiated and student conducted partnerships as they are largely student conceived and student-led throughout. They demonstrate what a highly motivated and organized student cohort is capable of with a minimum level of support from instructors.

High School Workshop

Originally part of *Synthesis* (see A3 above), the workshop was conceived by students as a way of introducing the iSci program to prospective students based on their own difficulty in understanding the nature of the program. Initially they proposed taking some of the degree coursework and adapting it to a workshop. The staff pointed out the issues with this, and instead students created specific materials for the workshop designed specifically for high school pupils. Instructors play a minor role with regard to laboratory safety and communication.

The project involves around fifteen students a year. Optionally, they can write a reflective essay for credit. The students see this as largely altruistic; the benefit to staff with respect to recruitment is perhaps obvious.

Research Talks

In 2012 the Natural Sciences student society at Leicester decided to respond to a perceived lack of support provided for students wishing to pursue careers in academia. One of the primary aims of this intervention was to create a series of experiences which would demystify the nature of academic roles from the student perspective. The intervention took the form of a regular programme of research seminars delivered by postgraduate and postdoctoral researchers. Researchers at this career stage are only one or two steps ahead of the undergraduate students themselves. The project involved a minimal level of guidance and support from staff. The seminars also benefitted the postgraduate and postdoctoral speakers as it allowed them to gain valuable experience of presenting to a supportive audience. The individual seminars were well attended, and the programme ran for four years as successive student society members took on responsibility for managing the series.

Student Organized Careers Symposium

Following the success of the student seminar series and motivated by the student concerns that most careers events were not sufficiently focused towards Natural Sciences graduates, the Natural Sciences student society decided to create an event that would provide careers information for students who did not have a career in academia in mind. The event took the form of a one-day employability symposium. This involved collaboration with instructors from the course, staff from the University's career development service, course alumni (contacted by student partners via social media), and employers. The organization of the event was student-led with the staff role limited to guidance on some aspects of organization, such as liaising with the catering services and the provision of a small amount of departmental funding.

The event also served to bring back some of the programme's alumni, helping to create an effective student-alumni-staff community.

Developing a Learning Community

Students' active engagement in their learning has long been recognized as a desirable feature of higher education and has been implemented in various ways from project work to Problem-Based Learning. The notion of a student-staff partnership takes this beyond active engagement towards a sense of community (Wenger-Trayner & Wenger-Trayner, 2015). Healey et al. (2014) have emphasized the role of student-staff partnerships in terms of the development of learning communities. There are, however, inevitable "power relations" within that community and different responses to the ceding of control that the notion of partnership is felt to imply. Our framework is designed to recognize how the different facets of that relationship are reflected in the types of collaboration. The framework is intended to provide a structure around which staff-student partnership can be embedded in programmes. If students know that they are making a valued contribution to the development and management of their learning experience, they are more likely to be engaged in the learning process. By embedding student-staff partnerships, staff can begin to recognise the fact that they are co-learners and co-creators of the educational experience (Cook-Sather & Alter, 2011).

The impact of a developmental framework for student-instructor partnerships can be judged by the extent to which it becomes self-sustaining; the extent, that is, to which it changes the culture from, "Why don't you?," to, "Why don't we?" One example has been the revisions to laboratory practice initiated by students discussed in section A2. A more recent example is provided by the approach of McMaster students to one of the consequences of lockdown during the COVID-19 pandemic. The lockdown resulted in the cancellation of the Synthesis conference (section A3). The response from students was to ask to work with instructors to replace this with an on-line version including students from Western University, even though this would no longer count towards assessment.

We hope that the framework may prove of some use as a curriculum development tool in enabling the conceptualization of partnerships as a developmental process. The Leicester team has found it useful in planning the transition to a newer version of the program, somewhat closer in form to the McMaster iSci program, which launched in 2019. For example, module evaluation appears in A1 as essentially the first example of partnership. As much as the goal of obtaining student input into course delivery is a worthy one, the completion of module evaluation forms is scarcely the most collegiate introduction to the concept of partnership. We have

therefore introduced a more informal setting for low stakes (or no stakes) student-staff interactions in the form of monthly staff-student lunches. We have also introduced (in A3) a larger element of peer-marking for formative assessment at the start.

Summary

The framework is an ethnographic description of student-instructor partnerships that evolved by examining practice in two example programmes. We judge the result as successful in enabling us to group the wide range of activities in these programmes. In practice, there will be a continuum of autonomy and ownership that may evolve in the course of a partnership, but for the purpose of curriculum design and planning, a discrete description is more helpful. The grouping adopted is fine enough to distinguish different activities and compact enough to be of use.

A given activity may be found in more than one position in the grid. For example, a "research project" may be tightly defined with clear instructions (what might be called a "do this" project) or may be entirely open-ended (a "do something" project). Specifying its position in the grid enables the formation of a view as to the type and extent of the partnership involved. In this respect we feel that the framework will be useful in the description and evaluation of programmes.

The breadth of experiences from two interdisciplinary student-centered programmes at two international institutions illustrates the potential transferability of the framework. It may be argued that such student-centered active learning environments are special cases since students already experience a higher degree of control than in traditional settings. However, with one exception, none of the examples make reference to Project- or Problem-Based Learning. The one exception is a PBL module in an otherwise traditional framework. One might also argue – correctly – that the framework has been reverse engineered: that the activities came first and the framework only afterwards and has therefore been adapted to the particular circumstances of the programmes. It is, of course, true that we developed most of the activities at both institutions prior to constructing the framework. However, it has not been fitted post-hoc to the examples. Rather, the non-uniformity of the representation of examples in each element of the grid (Table 1) enables us now to reflect on the range of our activities and to use such

reflections in developing the framework and future planning. We therefore believe that the framework is transferable to other higher education programs.

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Workshopping Essay Structure: A Hollywood-Inspired Classroom and Online Model

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Research shows that students write better academic essays if the instructor facilitates a process of preparation that allows for purposeful peer discussion. Drawing on screenwriting pedagogy, this article proposes a workshop model that lets students express their essay's structural elements as single sentences, which allows for effective peer and large-group feedback throughout the research, draft, and revision process. Sharing such elements on a digital workspace creates a sense of audience that motivates better work. Students can also apply insights from this model to other writing formats and oral presentations, which widens the utility of undergraduate writing classes. Particularly for inexperienced instructors, such as teaching assistants, this approach can offer useful step-by-step guidance for turning crowded classrooms or online sessions into workshops with small-group dynamics more commonly found in graduate writing seminars.

Teaching assistants with varying degrees of experience and expertise are often who guide undergraduates in courses with an emphasis on academic writing. Universities can offer sparse training, and many TAs start out with little more than the age-old five-paragraph theme (FPT) to inform their instruction. For undergraduate papers that extend beyond a few pages, the FPT offers minimal guidance for how to plan and execute a convincing argument that develops throughout the paper. Precisely how one structures an academic essay can remain unclear, pedagogical approaches and vernacular vary, and students can be left with trying to interpret how something called the "so what?" applies to the paper they have to submit by a rapidly approaching deadline.

Research shows that this process can benefit if the instructor can facilitate high levels of peer interaction through a discussion-dependent approach (Applebee & Langer, 2013; Juzwik et al., 2013; Krause, 2001). Students who engage in purposeful dialogue with peers are likely to write higher quality papers with more complex arguments (Graham & Perin, 2007). To achieve peer interaction that is purposeful, simply allowing students time to talk about their essays is not enough. Small and large-group discussion should be part of a structured process, one that frontloads essay preparation well ahead of deadlines, and that continues throughout the writing phase (Smagorinsky, Johannessen, Kahn, & McCann, 2011). The instructor should teach methodology that offers students cohesive and practical scaffolding for the entire process of inquiry, discussion, writing, and revision (McCann, 2014).

The much-disputed FPT has for generations been the most common methodology at the high school level. Some find FPT to be too simple, even for short papers (Foley, 1989; Miller, 2010; Wesley, 2000). Others view it as a perfectly suitable stepping stone (Smith, 2006). I have encountered no one who finds the FPT to be sufficient beyond high school, yet no similarly hegemonic model has arisen on college campuses, likely

due to the added complexity of a more mature essay. When an argument must develop past five paragraphs, an approach such as this becomes too bare boned:

> The FPT requires (1) an introductory paragraph moving from a generality to an explicit thesis statement and announcement of three points in support of that thesis, (2) three middle paragraphs, each of which begins with a topic sentence restating one of the major ideas supporting the thesis and then develops the topic sentence (with a minimum of three sentences in most models), and (3) a concluding paragraph restating the thesis and points. (Nunnally, 1991, p. 67)

Comparing Essays to Film

Academia's issue with not having a general model for essay structure, or a detailed, agreed-upon vernacular, is similar to how Hollywood used to lack an explicit screenplay structure. Experienced academics internalize how an argument unfolds, but they can still struggle with passing on their insights. Similarly, experienced screenwriters knew how to keep audiences captivated for two hours, but they did not necessarily have the terminology, or models, to effectively teach the structural mechanics that they themselves knew how to execute. This didactic shortcoming became untenable for an industry that is intensely collaborative, with hundreds, or even thousands, of people working together on the same project, all of whom need to be on the same page. With sometimes hundreds of millions of dollars on the line, strong incentives existed for the development of screenplay pedagogy that promoted shared practices and vocabularies.

Since the 1910s, cinematic storytelling had evolved toward what today can be referred to as Hollywood structure. How one crafts such a structure, or which elements are optimal to include, did not become agreed

upon or formulated cohesively until after *Star Wars* (1977). George Lucas's masterful remediation of Joseph Campbell's monomyth from *The Hero with a Thousand Faces* (1949) convinced Hollywood executive Christopher Vogler, and later the industry, that structural adherence was key to making commercially successful film (Ranieri, 2017). By the 1990s, a detailed roadmap for script development had become commonly available and embraced. Teachers of the craft emphasize different aspects of this structure, and some terms vary, but in the twenty-first century there has been little disagreement over how a typical film is put together, and practitioners broadly agree on terms for narrative elements (Bordwell, 2006; Truby, 2007; Vogler, 1999).

No Hollywood-sized stakes have pushed academic writing toward similarly useful models. On the contrary, teaching students how to write has become less of a priority. After American academia's golden age of composition (1870–1910), the field was demoted to the humbler position where it remains (Brereton, 1995). By contrast, cinema's pedagogical breakthrough made screenplay development more effective—or at least more streamlined—not only in Hollywood, but around the world where this model has become increasingly influential.

For screenwriting students at undergraduate and graduate levels, too, the new approach facilitates more effective workshopping of structural elements before the script writing itself commences. Such elements include, among others, a protagonist's problem and weakness, an inciting incident, a first act break with a goal, a climax choice, and a resolution. By expressing the protagonist's weakness in one precise sentence, the student can discuss its suitability with the instructor and other students more effectively. It can quickly become clear whether the climax choice—also expressed in one sentence—has the right connection to the weakness that the protagonist must overcome. At this early stage of development, changes can be frequent and uncostly. If a poor connection is discovered only after a hundred-page screenplay is drafted, a complete rewrite is likely required, which can drain motivation. Particularly in undergraduate sections of twenty students or more, being able to discuss structural elements early and effectively is key to progress and student satisfaction.

Similarly, in an academic writing course, if students can get early feedback on their thesis statements being too obvious, their approach can be adjusted before excessive efforts are wasted, which helps keep motivation up. Adding additional elements to the familiar thesis statement helps focus students also on those other aspects of their text that allow for a complex argument to develop. Combined, these elements compose what I, mostly for the purpose of a catchy title, refer to as a Hollywood-inspired essay

model. To argue for the model's utility, this article will (1) outline how Hollywood structure helps facilitate effective pedagogy for classrooms both physical and online, (2) present an essay structure that builds on similar pedagogy, (3) suggest how this essay model can be taught using a Google Doc as a shared digital workspace, and (4) offer an example of how these insights can be applied to other formats.

Juxtaposing fictional film and academic essays as two expressions of long-form storytelling can be seen as controversial because "a sort of cold war has ensued in English studies, slowing the exchange of ideas between creative writing and composition, despite encouragement for such exchanges" (Winkler, 2018). Winkler shows that there exists a long tradition in which composition borrows tools and techniques from writers of fiction and non-fiction. Although screenplays and essays are very different, showing what commonalities divergent types of writing share helps students adapt to unfamiliar formats (Roderick, 2019). Research shows that those who identify similarities write better because they trust that habits that worked for them in the past can be applied to novel challenges (Beaufort, 2007). Such practices of writing transfer have been shown to promote sophisticated writing across diverse formats (Yancey, Robertson, & Taczak, 2014).

With the long-standing crisis of composition (or at least perceived crisis), promoting practices with wider application than academic essay writing makes sense for a variety of reasons (Dobrin, 2011; Horner, 2015; Smit, 2004). Critics have argued that composition courses do not sufficiently prepare students for the writing requirements that they are likely to encounter after graduation. This article attempts to offer methodology that speaks to both sides of this debate. Its approach extends not only "across the disciplines," but to other types of long-form fiction and non-fiction, such as oral presentations, narrative memos, dissertations, novels, long-form journalism, et cetera.

The core commonality of such formats is that one-way communication over an extended period of time requires an engaging beginning and a satisfying end, with deliberate adherence to a cohesive agent throughout. If students can master those elements in an essay, the insights they acquire apply more widely, too. For most undergraduates, writing-course papers are among the last academic essays they will write. If they can learn an effective structural approach, the writing course can impart an understanding of, and a methodology for, storytelling that can be useful for students throughout their lives. Such an approach can help students clearly and convincingly communicate to others whichever insights they arrive at, whether for professional, civilian, or leisurely purposes.

Figure 1

The Hollywood structure prescribes how to unfold an emotionally impactful argument for overcoming character weakness.

Act One		Act Two			Act Three	
	10	25 min. or %		50	75	100
Set Up	Decision	New World	Little Battle	Intensification	Big Gloom	Big Battle	End
	Inciting Incident	*First Act Break*		*Mid Point*		*Second Act Break*
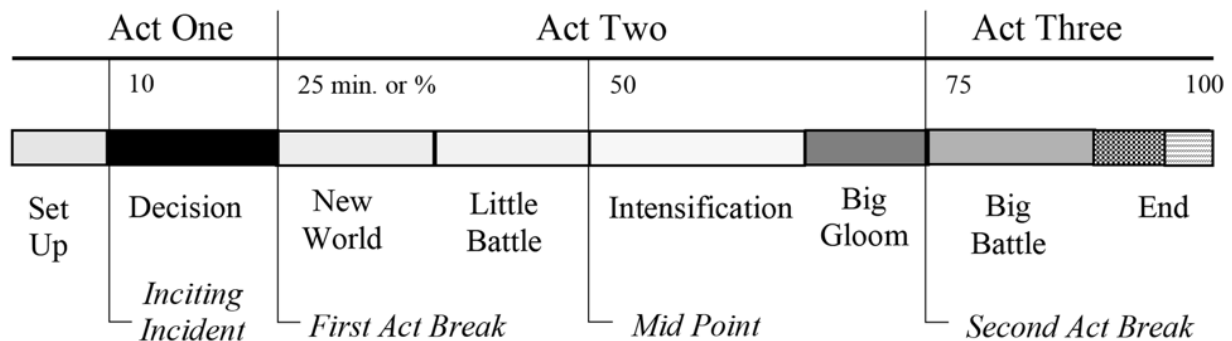
Hollywood Structure

Novice filmmakers who only have the bare bones of an Aristotelian three-act structure to guide their screenwriting face a similar challenge like that of essay writers who only know the five-paragraph theme. Aristotle can be instructive for a brief narrative, but when you have over ninety minutes to fill, a beginning, an end, and two act breaks offer insufficient guidance. To shape a compelling journey for the protagonist, a more detailed breakup of the first act and additional turning points later in the story can be of tremendous help. This is what the Hollywood structure offers. Figure 1 lays out my interpretation of this model, but all elements and their formulations rely on the work of Christopher Vogler (1999), David Bordwell (2006), John Truby (2007), and many more.

Most modern films are about a protagonist who has a character weakness and a problem that is related to this weakness. In an emotionally satisfying climax, the problem is solved by overcoming the weakness, which turns the story into a journey of self-realization. In tragedies, the protagonist succumbs to the weakness. The Hollywood structure is a recipe for how this journey is made compelling through applying structural elements in a certain order.

The purpose of the Set Up sequence (see Figure 1; capitalized terms refer to model-specific elements) is to show how the protagonist struggles with her character-related problem. When the Inciting Incident occurs around the 10-minute mark, audiences therefore understand how this "call to action" offers an opportunity for growth. At the First Act Break, the protagonist commits to a goal that she pursues until the climax choice after the Big Battle. At this crux, what she has learned from the story's previous sequences lets her act in a way that would have been inconceivable at the beginning of the film. The story thus becomes an argument for how a person can overcome a certain weakness so that the person can become whole, which allows for a more authentic life.

Simply plotting these structural elements into a screenplay is no guarantee for a great film. Neither films nor essays can be reduced to structure; formulaic boredom is always the result when well-structured content has little to convey. Like essays have ideas, argument, prose, et cetera, films have character, aesthetics, thematic argument, and so forth. Focusing on structure is never an alternative to any of those other elements, but rather a foundation that allows those elements to be put to better use. Structure alone did not make *Citizen Kane* (1941), but without the innovative film's structural mastery, its other elements would have mattered less. The same is true for essays. Exquisite prose, penetrating analysis, and persuasive rhetoric all lose potency if not expressed within a suitable frame. Good structure helps readers understand the argument, read more efficiently, and remember more of what they have read (Meyer, 2003).

When students have been taught Hollywood structure, they can assess whether the story they want to tell is a good fit. Not all stories are suitable as feature films, similar to how not all arguments can be turned into great essays. Yet most starting points can be developed into something more conducive, a process for which—I argue—a structural approach is likely the most effective, at least in the context of crowded classrooms. Students can share their one-sentence expressions for character weakness, problem, act breaks, climax choice, and resolution. Not all elements at the same time, but as the course progresses. Because all students have learned what the structure requires in order to promote effective storytelling, everyone knows what to look for and how to offer useful criticism and advice.

Sharing these sentences on a Google Doc, which can be projected to the classroom's screen or viewed

Figure 2
The model identifies structural essay elements that students should focus on during development. Sharing vocabulary and an understanding of structure helps facilitate effective peer interaction and large-group workshopping.
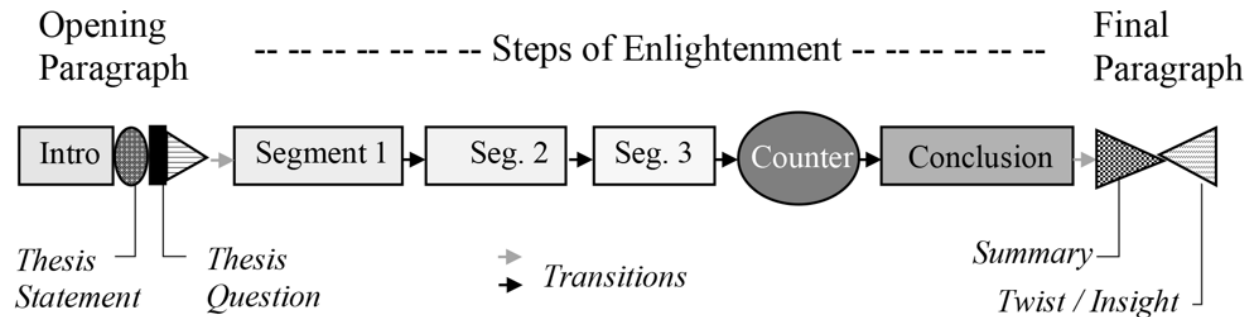
communally in online classes, lets the instructor workshop examples in front of everyone. Students get to experience how poor starting points can be developed into something more useful, while the instructor also establishes considerate practices through compassionate vernacular. Being a role model and setting the right tone is paramount. Sharing one's creative work can make students feel vulnerable, so for this model to work it is crucial that the instructor sets low bars of expectation and makes students understand that there is generous room to experiment. For less talkative students, too, such a communal, dialogic approach has proven beneficial (Schultz, 2009).

From Film to Essay

An essay of more than a few pages faces many of the same challenges as a cinematic narrative that lasts more than ten-twenty minutes. Ask any comedian who has tried to write a film without first learning structure; just stringing funny scenes together—no matter how great they are—becomes repetitive. Similarly, an FPT-inspired argument that keeps making the same claim with new evidence remains flat and unappealing. Each segment of the essay—like each sequence of a film—should build on what preceded it, then push toward what is to come. To cultivate this strong argumentative through-line, it is imperative to know what ties everything together.

Within Hollywood structure, this cohesive agent is the protagonist's character weakness. Film narrative should be structured so that it constantly challenges this weakness, imparting lessons that the protagonist will bring together in the climax. If the film has succeeded in making the audience care about the flawed protagonist, they will invest emotionally in her character arc and feel that sequences are connected through how they facilitate her growth. The stronger this though-line is, the more

complexity and multitude the story can contain. A poorly defined hero with an unclear goal—no matter how good singular scenes may be—is likely to lose audiences, and the film will fail to get its thematic argument across.

Similarly, an essay's Segments should develop insights that are necessary for the reader to understand the essay's Conclusion (see Figure 2; here, too, capitalized terms refer to model-specific elements). The cohesive agent for the essay's argumentative journey is what this model terms Thesis Question. This element relates to what many instructors refer to as the "so what?" Both terms—Thesis Question and "so what?"—attempt to convey a more abstract concept, for which scholars have offered a multitude of terms and interpretations. This article strives for specificity and clarity by dividing the Thesis Question into its two elements: Thesis Method and Thesis Purpose (for a more detailed visual model, see the pedagogical one-page in the article's appendix). What this model most importantly adds to the FPT's Thesis Statement are the elements Thesis Question and Steps of Enlightenment. Before we examine those, we must touch on the elements that precede them.

Elements of the Opening Paragraph

For an undergraduate essay of around five pages, or 1500 words, the Opening Paragraph is typically less than a page, as is the Final Paragraph. The purpose of the Intro is to convey the information that is necessary so that when the Thesis Statement is presented, the reader understands the relevance of its claim. Experienced writers could turn a weak Statement into a strong essay, but for the novice a poor thesis tends to doom the exploration. Crucial to the Statement's potential is formulating something so specific and/or bold that a reasonable person could disagree (Lunsford & Ruszkiewicz, 2015). If the Statement makes everyone

nod in agreement, the student has already conveyed the case, and no essay is needed. The student would likely run out of purpose early, then descend into meandering, tangential support that no one cares about. A Statement should engender resistance, of some form, so that an investigation is needed to bring the reader along.

If the student formulates nothing but a Thesis Statement, all that is called for is finding evidence for its support. The FPT would suffice as guidance, but the essay's argument would have little to build toward. This is where the Thesis Question comes in. This element, when expressed as "So what?," does encourage deeper thinking. But what I term Thesis Question becomes clearer and more useful when broken up into its two components. The Question's Method is what the author will do in respect to the Statement. The Method is straight-forward to find, and students quickly master this element. Simply engage the core specificity of the Statement.

For instance, if the prompt asks students to "explore the depiction of disability in Petter Næss's film *Elling* (2001)," a student's initial Statement could be that "the film shows that in these cases of mild intellectual disability, it is better to integrate people in communities instead of in institutions." This is a relevant claim, but most who have seen the film would immediately agree. To engender resistance, specificity could be achieved through a suggestion of causation. The student could add, "because living similarly to those without disabilities is key to happiness." We can now agree that in cases like with the film's intellectually disabled protagonist, apartments are preferable to institutions. But we can disagree on whether this is because people with disabilities should mimic the lives of those without disability, which gives the writer something specific to fight for. After this brief workshopping, the core specificity of the Statement—which the Method will engage—has become "living similarly is key to happiness."

The Method has two sides. One is the exploration of the presence of what the Statement regards itself with, which is "people with disabilities living similarly." The other side is the absence of this, which is "people with disabilities not living similarly." If the subject matter—in this case the film *Elling*—does not portray the absence, the Statement could be less suitable. The student should consider finding a new one in order to avoid a one-sided exploration. Fortunately, *Elling* shows both sides of the Statement's claim. The Method could therefore be expressed as "to explore in *Elling* which aspects of living similarly to people without disabilities most effectively promote happiness for the disabled." Wording could vary, but content-wise it is usually obvious how an undergraduate should go about exploring a Statement, based on the prompt's formulation, the subject matter at hand, and the Statement's core specificity.

That the article should concern itself with finding evidence to support this claim is also obvious. This is what the ensuing Segments will do. But, importantly, insights gleaned from this investigation will be put in service of a particular Purpose. The student will bring those insights together in the article's Conclusion to answer what the Purpose part of the Thesis Question posited as its goal. While the Method is dictated by the Statement's core specificity, the Purpose can be many things. A good Purpose directs the essay to where the student has the most significant insights to offer. For the *Elling* prompt, the Purpose could be "to suggest which parts of the Scandinavian disability model would be implementable in the U.S." Or, "to show how neighbors of the disabled can contribute to effective integration." With the Purpose, the essay establishes its potential. It is therefore an element that should be workshopped extensively, particularly at later stages of the course, once students have mastered the Thesis Statement.

In the essay text itself, the Thesis Question does not have to be expressed in a single sentence, but it could. For workshopping purposes, it should. Such a sentence can be patterned as "by [doing the following] (Method), this paper seeks to [answer the following] (Purpose)." Thesis Statements should be specific and not hold back information. By contrast, Purposes only pitch what will be revealed in the Conclusion. Once the Question is conveyed, the Opening Paragraph is concluded. The reader knows where the student stands, what the article will do, and what the argument seeks to achieve. Because the Purpose is ambitious, the student will have no choice but to craft a complex argument, which will build from Segment to Segment toward a convincing—or at least interesting—Conclusion. Throughout this exploration, the reader will know what is at stake and how to judge the student's efforts. The writer is ready for argumentative battle.

Steps of Enlightenment

In a short essay, a Segment is typically one paragraph, and there is room for two to four such Segments. The content of each should be expressible through a declarative sentence. Importantly, each Segment's claim should be different; this is how an argument builds. Workshopping Segments that are reduced to sentences reveals if a student is on course to simply add more evidence to the same claim, in an FPT-like manner. A difference in formulation could camouflage that a claim is more or less the same as the previous claim, which students themselves may be blind to, but which peers are quicker to pick up on.

The first Segment usually offers evidence to make the most straight-forward case for the validity of the Statement. From this starting point, the argument builds toward the question that will be answered in the

Conclusion. Because students have a Purpose, they know which insights to look for, which are those needed for the reader to understand the Conclusion. Sometimes, the argument itself must be postponed until Segment 2. If concepts are left undefined from the Opening Paragraph, Segment 1 is where such is taken care of. This first Segment is also where methodology or additional introduction can be unloaded. Whatever ducks there are, get them in a row, then head for the argument.

In essay instruction, a perennial challenge is to define what an argument is (Lunsford & Ruszkiewicz, 2015; McCann, 2014; Smagorinsky et al., 2011; Wingate, 2012). The concept can bewilder even seasoned scholars. In her bestselling *Writing Your Journal Article in Twelve Weeks*, Wendy Laura Belcher writes, "I have found through teaching argument that it isn't that useful. The most useful way to learn to construct a journal article argument is to study examples" (2009, p. 83). I concur, but instructors should not point students only to examples from published scholars, as such work can be hard to relate to undergraduate efforts. Students should workshop each other's arguments, a process which tends to be more eye-opening when learning essay writing than staring yourself blind on your own structure-in-progress. We seem to have an easier time recognizing the shortcomings of a text we did not invest in ourselves, and lessons drawn from giving feedback to peers help us recognize our own weaknesses as well.

Using Steps of Enlightenment as a framework for such an analysis focuses students on how an argument consists of parts, or steps, which lead the reader to the enlightenment that the Conclusion is meant to provide. The steps, or Segments, are the legs that the Conclusion's case will stand on, making its complex insights comprehensible. It is a bad sign if, during workshop, a student can simply tell peers what the Conclusion is and everyone fully understands and agrees without being familiar with the Segments. Likely, the Conclusion is not sufficiently complex to warrant its surrounding essay; a mere paragraph would have sufficed.

These Steps form the essay's argumentative through-line. To diagnose this line's tightness, look at between-paragraph transitions. After the Opening Paragraph, and before the Final Paragraph, the transition can be weak. Between Segments, the counter-argument, and the Conclusion, transitions should be strong. What one paragraph ends with should relate to how the next paragraph begins, and instead of mere verbal transitions, content should be what connects.

Ending the Essay

As the essay reveals its argument to readers, they examine it for weakness. Before hitting them with the Conclusion, it can be strategic to quiet their critical minds. Belcher writes, "To persuade readers, they must

first have doubts, or believe that others have doubts that your argument is right. So, to construct a sound argument, build in a consideration of opposing voices" (2009, p. 84). For workshopping purposes, ask students to express the most intelligent counter-position to their own argument as a single sentence. This should demonstrate that students are aware of which premises their argument rests on. But once they have made their opponents' case, they have to—in the essay—sweep the legs from under it. The reader should be convinced that, despite disagreement, the perspective of the paper in question is the most relevant one, or at least an interesting one. Ideally, the Counter should be so alluring that the reader wonders whether the author is about to fail. Those are exciting stakes. But the Counter cannot have the most convincing position. If it does, students should reconsider their thesis, or as a last resort, simplify the Counter. Great films can have tragic endings, but academic essays cannot.

Not all essays benefit from including a Counter, but students should be encouraged to develop one. Examining what we feel intuitive resistance against can be an eye-opening exercise, because most positions—even the foulest and most populist ones—tend to be logically constructed. When two positions are mutually exclusive, yet both are logical, what remains is to weigh relevance. Few lessons are more demanding and potentially valuable than getting across to students how our ever more intricate reality can be better understood from a position of weighing relevance than from one that pits good against bad, or right against wrong. Once students have formulated a counter-position and weighed its relevance, they must consider if including this element strengthens the essay or not. Counters can be omitted, and they can also be placed in other positions than right before the Conclusion.

When Segments have conveyed the necessary insights, and the Counter has appeased the critical reader, it is time to answer the Thesis Question in the Conclusion paragraph. As the course progresses, more time should be spent pushing students to think further. Have them present their tentative Conclusion, then ask, "So what?," or, "What are the consequences of that?" Students are often surprised by their ability to offer more significant insights on the spot, but they will eventually get stuck. Ask them to reexamine the subject matter, to research additional sources, or to simply lie awake at night, with the mobile out of reach, ruminating. This process can lead to Conclusions that are more significant, but that no longer answer the Thesis Question. A new thesis would then need to be formulated. This can often be done by turning the previous Conclusion sentence into a Thesis Statement, then coming up with a new Purpose sentence that points to the new Conclusion. And, yes, if the paper has already been written, most likely a complete rewrite is required. In an ideal world, we

workshop until we know our final Conclusion before we start writing. In our world, we revise.

After the essay's exploration is brought to a climax—answering all questions—no transition is needed into the Final Paragraph. From a research perspective, the student's work could be done, but long-form storytelling begs for "one more thing." First, sum up the argument to let readers know what the investigation achieved. Then, ideally, offer a Twist that brings the essay from the specifics of its exploration to a more general application of insights gleaned. This is difficult, and few students master it by the end of the course. The reader should not anticipate what the Twist is, but it must be prepared for. Segments developed insights that were necessary for the Conclusion to be understood, and this was done openly. Likewise, the information that is necessary for the Twist to feel relevant must have been shared, although more sneakily. The end should be somewhat unexpected.

Advice on which Twist to look for is elusive. This element often shows how the essay's insights could apply within a larger structure, or it can point to interesting new areas for research. Tell students to experiment, but not to despair if their Twist lacks brilliance. A poor thesis has consequences for the entire essay, but a poor Twist only leaves a slightly dull aftertaste. Alternatively, settle for a Final Insight to end on an up-note. Summarize, then offer one more insight that furthers the argument but without sending it in a grander direction. Many students instead taper off with well-meant advice or motivational exclamations. This may feel appropriate, but it is a poor substitute. With all long-form storytelling, end strong.

Workshop via a Google Doc

Few, or none, of the elements and insights here described should be unfamiliar to experienced scholars. Conveying a general understanding of this model to students, however, typically takes a few weeks. It is, after all, quite a bit more complex than the FPT. Mastering the model's main elements requires months, and not all students will be able to execute everything successfully. But understanding the model's elements, as well as letting students experience how the model helps them offer each other purposeful feedback, provides a foundation upon which students can continue to improve long after the course is completed. Likewise, the shared Google Doc helps instill habits of preparation that will be beneficial for all types of writing. In which order elements are workshopped on this shared digital workspace is informed by how the more challenging elements build on the students' mastery of more foundational elements. For the first essay's draft and revision, focusing on the Thesis Statement suffices.

The instructor pastes students' names in the Google Doc, requiring that students submit their sentences before each section. An early homework can be to submit one sentence for each of the following: (a) Intro, (b) Thesis Statement, and (c) Thesis Question with Method and Purpose.

At first, element (c) is likely to confuse, but workshopping will make it clearer. Once students experience how flat their essays remain without a Thesis Question, they tend to become enthusiastic about incorporating one. Later homework can switch (a) out with (d) Conclusion, it too expressed as a single sentence. Once the Thesis Question is mastered, the element (e) Steps of Enlightenment becomes the new challenge. When students experience how crucial it is to plan deliberate steps in order to craft an argument that builds throughout the paper, this element becomes embraced, too. Homework could be this:

> Try to use only 3–6 words per statement (more is allowed). After your name, share each essay paragraph's claim. Pattern example: (0) Thesis Statement, (1) Segment 1, (2) Segment 2, (3) Segment 3, (4) Counter, (5) Conclusion, and (6) Twist/Final Insight.

From the progression of these claims it should become clear whether the student has constructed an argument in which each element builds logically upon what preceded it. Students can work in pairs or small groups in the classroom or in online breakout rooms, critiquing each other's steps. To initiate or round off a session, the instructor can workshop a few submissions in front of the whole class. In-depth instructor analysis of a few is preferable to shallowly covering many. Those whose material is not commented on can benefit just as much, and knowing that everyone has access to read their sentences incentivizes better work.

Because this model distills elements into mere sentences, students can vary their efforts. Those who are eager can spend hours producing material, while busy or less ambitious students can jot down the day's submission in minutes. This flexibility is meant to engender a positive attitude toward having mandatory homework before every section, which is key to promoting a long period of preparation. Even with hasty submissions, essays are given time to percolate in the student's mind, which has a positive effect (Torrance, Thomas, & Robinson, 2000).

Early in the course, the instructor provides much of the in-class feedback. As students gain mastery, large-group student feedback and small-group peer interaction takes over as the instructor speaks less. Irrespective of which phase the feedback occurs in, the result is what Belcher refers to as a "community with a strong sense of audience," within which "the best writing

Figure 3

This article's "Hollywood structure" is a particular film structure, which can be further refined to include more detailed, genre-specific elements. Similarly, "essay structure" refers to papers within the humanities, although the model can be adjusted to fit other disciplines or refined to fit a particular field. Insights from these two models can also be used to structure other long-form story formats, whether the one in question is included in this illustration or not.
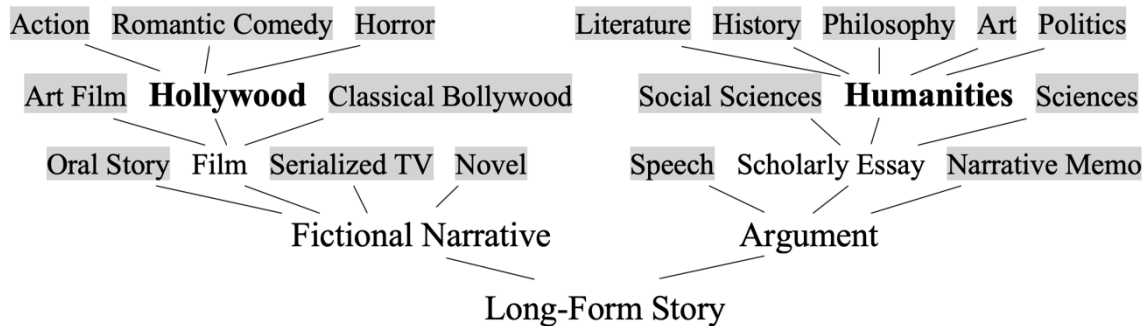
is created" (2009, p. 7). Such communities are more often found in graduate writing seminars. With fewer students and more hours, such seminars provide time to assess everyone's work more holistically. In twenty-plus-person, fifty-minute undergraduate sections, I argue that a structural model, such as the one outlined here, is likely to be the most efficient approach. Research shows that shared digital workspaces can help instructors compensate for larger class size, without adding to the instructor workload (Ferriman, 2013).

Lessons for Other Formats

How I have formulated the essay model's elements optimizes for wide applicability within the humanities. In other disciplines, the ordering of elements and which terms they are given should be adapted to the field in question. The underlying structure should remain the same, as all effective long-form storytelling unfolds in a similar manner. Note also how when essays become longer and include an abstract, figure 2 must be slightly revised. Figure 3 is how I conceptualize a hierarchy of structural formats for the context of this article. The advantage of using Hollywood structure as a pedagogical starting point is that everyone is familiar with the format, and more importantly that mainstream screenplay structure has become so defined that it offers the most detailed map for comparison.

After accounting for two structural models, one for commercial cinema and the other for undergraduate essays, we can identify quite a few parallels. Not all of the elements that follow below are equally analogous, but—as Roderick, Beaufort, and Yancey et al. argue— pushing students to look for commonalities promotes

confidence and adaptability when they face novel writing challenge. To compare, we saw that the essay needs an Intro for readers to understand the relevance of the Thesis Statement. Similarly, films need a Set Up for audiences to understand that the Inciting Incident offers the protagonist an opportunity for a better life. In the Decision sequence, the protagonist decides what to do, which evokes the essay's Method. The film's Act One ends—like the Opening Paragraph does—by establishing a goal that will be achieved near the end of the film/essay.

From a structural viewpoint, the New World is similar to Segment 1. We prepare for battle, but only in the Little Battle and Segment 2 do we give the impression of trying to achieve the goal. We fail to fully succeed, yet we do this in a way that pushes our quest onward. For regular-length films, as with undergraduate essays, three sequences/Segments can suffice between the goal-setting and the Big Gloom/Counter. We then journey into near defeat, only to escape for one last push toward solving our weakness/Question. In the film's End, harmony is restored, but a new seed of conflict is planted, not unlike how a good essay Twist points to new questions. Throughout the film, audiences should know how the protagonist progresses toward overcoming the weakness, just like readers should know how Segments illuminate what the Thesis Question promised to answer.

Hopefully, this comparison sheds light on how story formats share structural traits. We could apply a similar structure to, for instance, a business presentation. You may be in charge of finding novel ways to attract clients for a senior care franchise. To

convince your colleagues that a new 5G device is both helpful for seniors who fear falling, and for selling additional services, you want to present your case as effectively as you can. Instead of speaking whatever comes to mind, you prepare a presentation that you structure similarly to an essay, or film. Building on what you learned in college, you first present what your company's current situation is and why this is suboptimal. You let your colleagues know what you will present—which engages what is suboptimal—and hint at what your conclusion will be. You have now grabbed their attention and let them invest in your thesis. Go through your segments, one at a time, accounting for the new device, how it can help seniors and also alleviate family concern. Emphasize advantages for marketing and upsell, and also how your brand will appear more modern. Account for extra cost and potential downside; address the negatives your colleagues may be pondering as you speak. Then, conclude by sharing the specifics of your suggestion, which follows organically from the content of your segments. Sum up why you think your suggestion is the best course of action, and then, if you can, point to how your plan could lead the franchise in a new, exciting direction.

As you plan this presentation, you can express its structural elements in single sentences, which are easy to change and also to request feedback on from trusted colleagues or mentors. Because you were able to master this structure in an academic context, you are confident that you will be able to pull it off also among colleagues, so that your argument becomes both clear and convincing. And, if your presentation falls short, you know that your next presentation will be better, just like your second essay was better than your first. Or, encouraged by how your company decides to pilot your plan, based on the strength of your presentation alone, you decide to rely on the same structure for the speech you will make in your friend's wedding. To conclude, whether putting together a speech, a TED Talk, or a six-page narrative memo for your Amazon colleagues, you must first set up your exploration's world (Intro), then introduce conflict (Statement). Tell us how you will investigate this conflict (Method), and what we stand to learn (Purpose). Account for what you must, but get swiftly to your argument. Develop insights that build on each other (Segments). Then share what goes against your position (Counter) before you bring everything together to fulfill your purpose (Conclusion). Briefly remind us of what you achieved (Summary), end on a strong note (Twist), and drop the mic.

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Appendix A

Prezi presentation of essay and screenwriting model.

Link to Prezi presentation: https://prezi.com/view/9iIt8MhYxNCsYQrcy6df

Appendix B

Pedagogical one-page of essay structure.

Essay Structure

Effective academic essays are structured like all long-form storytelling, with an engaging beginning, a satisfying end, and a strategy for making the middle cohesive and meaningful. Focusing on a ***Thesis Question*** and ***Steps of Enlightenment*** helps students craft an ambitious argument that builds throughout, toward a significant and convincing conclusion. This model integrates a shared digital workspace with undergraduate classroom or online workshops.

Few rules govern essay writing and this model adds none; it is a practitioner's approach for identifying which structural elements students should focus on during development to optimize progress. The below illustration offers a good starting point, but structure is flexible and should be adapted to your essay's unique argument.
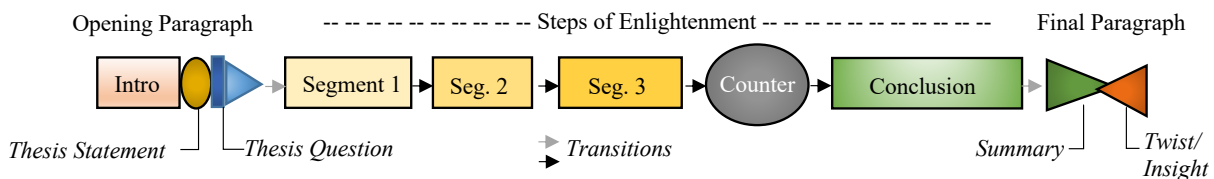
Introduction:	Write what the reader needs to know to understand the relevance of your *Thesis Statement*.
Thesis Statement:	Make a claim so specific or bold that a reasonable person could disagree with it. Focus on a topic for which you can offer significant insights and craft a complex argument.
Thesis Question:	Let the reader know how you will investigate your *Statement*—and with the insights gleaned from this exploration—which question your *Conclusion* will answer.
Method:	The *Question's Method* engages the core specificity of your *Statement*. Let us know how and where you will analyze both the presence and the absence of what your *Statement* claims.
Purpose:	The *Question's Purpose* establishes what your exploration ultimately seeks to answer. A *Statement* gives all information away, but the *Purpose* only pitches what is to come.
Segment 1:	Make the straight-forward case for the validity of your *Statement*. Begin with your argument, then draw in narrative from subject matter, or findings from other sources. Illustrate and build your claim. Can also be used to clarify method or concepts, or to offer additional introduction.
Segments:	What a *Segment* concludes with should push toward what the next *Segment* explores. Make sure you have tight *Transitions* and a strong argumentative through-line. Each segment should make a new claim instead of reconfirming the previous claim with new examples.
Counter:	Identify the premises of your position and make the intelligent *Counterargument*. Let the reader know why your perspective is still the most relevant. With particularly bold *Statements*, your *Counter* could come as early as in the second paragraph. It can also be spread out or omitted.
Conclusion:	Your *Segments* developed the insights necessary for the reader to understand the complexity and significance of your *Conclusion*. After being led through these *Steps of Enlightenment*, the reader is now ready for you to make your most important point.
Final Paragraph:	*Summarize* your argument. Then, ideally, make a *Twist* where you go from the specifics of your exploration to a more general application of insights gleaned. This must be prepared for, and a good *Twist* is difficult to execute. Alternatively, offer a *Final Insight* to end on a strong note.

For more, see Mads Larsen, "Workshopping Essay Structure: A Hollywood-Inspired Classroom and Online Model," *International Journal of Teaching and Learning in Higher Education* 32.3 (Open Access).

Appendix C

Pedagogical one-page of Hollywood structure.

HOLLYWOOD STRUCTURE

Most modern films structure their story around a protagonist's journey of self-realization. A problem forces the character to deal with a personal weakness, which must be overcome by making the right choice in an emotionally satisfying climax. ***The Hollywood Structure*** is a recipe for how this is achieved through applying narrative elements in a certain order.

This is one interpretation of this model. The closer to it you are able to mold your story, the more likely your film will be to endear audiences. Your application should not feel forced, and not all narratives fit the film medium. It is possible to ignore this structure yet still write a masterpiece, but this is not a recommended approach for beginners.

Act One		Act Two			Act Three	
10	25 min. or %	50		75		100
Set Up	Decision	New World	Little Battle	Intensification	Big Gloom	Big Battle	Final Battle

Inciting Incident   First Act Break   Mid Point   Second Act Break

Set Up: Your protagonist struggles with a ***PROBLEM*** that is connected to her ***WEAKNESS***. This character flaw prevents her from living as her true self and also leads to ***BAD BEHAVIOR***. Sometimes a ***GHOST***, which is an event in the past, holds your protagonist back.

Inciting Incident: Around minute 10, a *Call to Action* occurs, which the protagonist refuses or postpones accepting.

Decision: After a sequence of deliberation, she commits to her journey at the ***FIRST ACT BREAK*** by setting a goal that she will pursue until the climax in act three.

New World: The budding hero meets opponents and allies and learns the rules of her new world. She prepares for battle against her ***ANTAGONIST*** who is the ideal person to challenge her weakness.

Little Battle: She has not overcome her flaw, so your protagonist loses. Yet she gains something that lets her continue. At this ***MID POINT***, she crosses the *Point of No Return* after which it is too late to go back to who she was. She must either change and win, or remain the same and face drastic defeat.

Intensification: Your hero keeps getting in worse trouble until she runs out of options.

Big Gloom: Isolated from her allies, all seems lost. Then, with the help of a mentor or ally, she gets one last chance at the ***SECOND ACT BREAK***. In tragedies (where the weakness is not overcome), this sequence could be cheery instead of gloomy to contrast the ensuing unhappy ending.

Prep | Big Battle: After *Preparation*, all scores are settled and loose ends tied up, except the most important one.

Final Battle: Facing a ***CLIMAX CHOICE***, the hero finally acts like a whole person by overcoming her weakness. She wins, but not without sacrificing something valuable earned during the journey.

Resolution: The hero lives as her new self, with ***GOOD BEHAVIOR***. But a new seed of conflict is planted.

For more, see Mads Larsen, "Workshopping Essay Structure: A Hollywood-Inspired Classroom and Online Model," *International Journal of Teaching and Learning in Higher Education* 32.3 (Open Access).
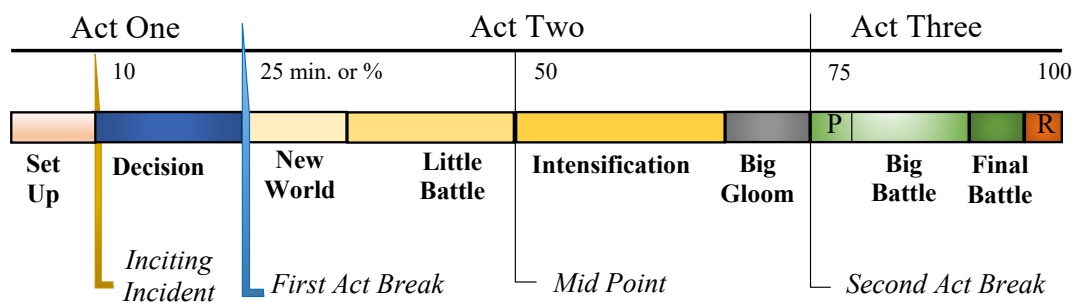
The Currency of Studenthood: Behavioral Economics in the Higher Education Classroom

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Students may not always be intrinsically motivated to complete learning activities in our courses. For these instances, we suggest taking advantage of heuristics, discovered through behavioral economics research, as one way to nudge students toward task completion. To date, most educational applications of behavioral economics' heuristics use grades or points as the "currency." We propose that time and effort may be additional currencies to employ when making use of the heuristics of loss aversion, goal framing, attribute framing, and anchoring. However, educational research first needs to be conducted to determine if using heuristics with these currencies is effective.

A perpetual challenge of the college instructor is to find ways to entice students into doing fully engaged work for the class. Although our course material may be of deep interest to some students in the class, oftentimes we assign tasks that students may not be interested in completing (Ryan & Deci, 2000), either because of the task characteristics themselves or because the course is compulsory (e.g., general education studies) and not necessarily of interest to the student. At such times, we may need to look at particular ways to extrinsically incentivize students to approach the task with the appropriate effort (Ryan & Deci, 2000). Patterns of behaviors that have been discovered through the field of behavioral economics may inform educational approaches to extrinsic motivation, particularly among those students with low motivation. However, these patterns of human behavior have largely been explored as they apply to financial decisions (Tversky & Kahneman, 1991); in the higher education classroom, the influential "currency" takes other forms. Further, these currencies may have interrelationships that impact whether behavioral patterns are as effective in the classroom as they are in financial decision-making. The purpose of this article is to conceptually explore the potential currencies in higher education to which some behavioral economics heuristics may apply.

Motivation in Higher Education

As college instructors, we value our course material and are typically intrinsically motivated to learn more about it. However, we often have students who either do not share those values or do not value a certain assignment, despite its contribution to students' learning of the material. In particular, students' intrinsic motivation is lessened if they do not feel a sense of autonomy or competence, or if the content lacks intrinsic interest for any one individual (Ryan & Deci, 2000). Despite our best efforts, we can often undermine students' intrinsic motivation to learn material in our

classes because common instructional behaviors, such as assigning grades (i.e., as performance-contingent rewards; Deci, Koestner, & Ryan, 1999), providing task quality limits (Koestner, Ryan, Bernieri, & Holt, 1984), and setting deadlines (Amabile, DeJong, & Lepper, 1976) are all factors which contribute to a reduction of intrinsic motivation. We must therefore consider methods of enhancing extrinsic motivation for those many instances when students are not intrinsically driven to learn through completing a course task. Extrinsic motivation, however, can be stronger and more agentic or impoverished and more coerced, and thus it is essential for us to enhance self-endorsed extrinsic motivation (Ryan & Deci, 2000).

Ryan and Deci (2000) propose that there are four categories of extrinsic motivation which follow the state of *amotivation*, or an absence of intention to act. For external regulation, external rewards are the primary driver; operant conditioning focuses exclusively on this type of motivation (e.g., Staddon & Cerutti, 2003). External regulation is followed by introjected regulation, wherein one is motivated to act in order to maintain a sense of self-esteem. External regulation and introjected regulation are considered less autonomous than the remaining two forms of extrinsic motivation: Identification, wherein the individual identifies the personal importance of the action, and integrated regulation, in which one associates the outcome of an action with an instrumental value that is separate from the behavior.

As the descriptions of these forms of extrinsic motivation suggest, whether an action aligns with individuals' valuation of its importance has significant impact on their senses of autonomy and subsequent level of externally-derived motivation (Ryan & Deci, 2000). Further, attributional tendencies may impact the level of extrinsic motivation, particularly those related to growth and fixed mindset. Specifically, those with a growth mindset are willing to take on challenging activities because they perceive the benefit to their personal growth in doing so, whereas

those with a fixed mindset are less willing to approach challenges as the outcomes (particularly possible failure) are tied to their self-perception and self-esteem (Dweck, 2006). Thus, students with growth mindsets regarding our course material may be more prone to identification and integrated regulation, whereas those with fixed mindsets may be more influenced, albeit in a less engaged manner, by external and introjected regulation.

Behavioral Economics

Tversky and Kahneman (1974) introduced ground-breaking research about the psychology of judgments indicating that, all benefits being equal, human behaviors and choices vary depending on how the situation is presented. These choices often defy basic logic and remain in place even when the individuals are made aware of the parameters that indicate logical fallacies (e.g., Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993). One reason choices may not be logical is because, in some situational contexts, they are based on heuristics, or mental short-cuts that speed our decision-making but may disregard some important information (Kahneman, 2011).

Although several heuristics identified by behavioral economists could arguably be used within the realm of education, three which seem to easily transfer are loss aversion, framing, and the anchoring effect. Loss aversion is the term used to label the paradox in which individuals are willing to do more to avoid a loss than to achieve an equivalent gain (Kahneman, 2011). For example, people may be reluctant to sell a good, or will increase the price at which they will sell it, whereas to acquire that same item, they would pay less. Loss aversion may at times be influenced by status quo bias, or a preference to keep things as they are. The attraction to the status quo is the valuation of what could be gained by a change, as compared to the risk of what could be lost; losses are more salient than gains, and so the status quo is preferentially retained (Kahneman & Tversky, 1984; Samuelson & Johnson, 1988). In addition, the manner in which a situation is framed can impact individuals' evaluation and subsequent decision (Samuelson & Zeckhauser, 1988); thus, framing an option as a risk of loss if not taken may garner more endorsement than framing it as a gain.

Valence framing effects, or framing, was originally described within Kahneman and Tverksy's (1979) prospect theory. According to this theory, individuals differ in their endorsement of a risky option, as compared to taking a sure option, depending on if the risk is framed as yielding a positive impact or an equivalent negative impact. This type of *risky choice frame* may be less applicable to the classroom than two other types of framing that have been identified under the umbrella of valence framing effects: goal framing and attribute

framing (Levin, Schneider, & Gaeth, 1998). Goal framing, or promoting a behavior that will end with a desirable outcome, using either a positive frame (if you engage in this behavior, you will gain the benefit) or a negative frame (if you do not engage in this behavior, you will not acquire the benefit), is similar, if not identical, to the conditions of loss aversion explained above, as the language included nearly always emphasizes loss or gain (Levin et al., 1998). As with loss aversion, studies assessing goal framing typically find that negative framing results in greater persuasiveness (Levin et al., 1998), although individual characteristics, such as independence, an avoidance/approach orientation, or a promotion/prevention regulatory focus, may impact which type of framing works best (Chen, 2016; Holler, Hoelzl, Kirchler, Leder, & Mannetti, 2008; Mann, Sherman, & Updegraff, 2004). Attribute framing, by comparison, occurs when positively or negatively framed descriptions of an object or event, despite being equivalent, differentially impact evaluations of that object or event (Levin et al., 1998). Thus, whereas goal framing impacts the likelihood of engaging in a behavior, attribute framing impacts the likelihood of a favorable perspective regarding an object or event.

The anchoring effect occurs when individuals' judgments or valuations are influenced by some initially presented value, or anchor (Furnham & Boo, 2011). More specifically, judgments change due to a biased adjustment toward the anchoring value (Tversky & Kahneman, 1974). This judgment heuristic has been robustly supported in a broad number of contexts, from probability estimates to valuations and negotiations (Furnham & Boo, 2011).

Behavioral Economics in Education: Applications and Currencies

The researched application of behavioral economics in the context of educational settings exists but is nascent. For educators, behavioral economics may provide a set of methods by which educators can better motivate students to complete required tasks or additional, optional learning tasks. Most often, the existing behavioral economics research in education centers around the use of tangible rewards or grades as the currency to be manipulated (e.g., Grijalva, Koford, & Parkhurst, 2018; Levitt, List, Neckermann, & Sadoff, 2012); however, we posit that other types of "currency" may also be viable when applying behavioral economics to an educational advantage, particularly in the higher education setting. Below, we explore these currencies as possibilities; where empirical support is thin or absent, we encourage an interested research community to investigate whether these methods are effective enough to warrant their practice. Table 1 includes a summary set of examples for these approaches.

Table 1
Definitions and Examples of Behavioral Heuristics Using Currencies in the Classroom Setting

	Goal Framing: Prospective						
	Loss Aversion/Status Quo Bias		Assurance		Attribute Framing		Anchoring
	Individuals will do more to avoid a loss than to earn the same item		*Framing a behavior as the likelihood of a gain (positive) if the behavior is engaged in or a loss (negative) if it is not*		*Describes attributes of an object, event, or person in a positive or negative manner*		*When given an anchor, people bias their estimates nearer the anchor provided*
Currency	Gain	Loss*	Positive	Negative*	Positive*	Negative	
Points/Grades	"If you complete this assignment well, you can earn up to 10 points."	"You already have 10 points for this assignment. If you complete it well, you will keep all of those points."	"If you complete the tutorial, you have an increased chance of getting an A on the exam."	"If you do not complete the tutorial, you have a decreased chance of getting an A on the exam."	"About 75% of students tend to earn a C or above on this assignment."	"About 25% of students tend to get a D or below on this assignment.	"The average score earned on this assignment is about 90%."
Time	"If you make a B or higher on 4 exams, you will earn a buy-out for the 5th exam."	"You currently have a buy-out for Exam 5. If you make a B or higher on Exams 1-4, you can keep that buy-out."	"Those who complete the optional tutorials are more likely to earn their Exam 5 buy-out."	"Those who do not complete the optional tutorials are more likely to lose their Exam 5 buy-out."	"About 75% of students finish reading this chapter in an hour or less."	"About 25% of students take over an hour to read this chapter."	"The amount of time this assignment is estimated to take is 2 hours."
Effort	"If you complete 5 assignments at 90% or above, you will not have to complete Assignment 6 [a task clearly requiring deeper mental effort]."	"You currently do not have to complete Assignment 6. If you complete Assignments 1-5 at 90% or above, you will be able to keep your Assignment 6 buy-out."	"Those who complete the optional tutorials are more likely to do well on course exams and earn their buy-out for the final, comprehensive exam."	"Those who do not complete the optional tutorials are less likely to do well on course exams and will lose their buy-out for the final, comprehensive exam."	"On a scale from 1-10 (10 being maximum effort), about 75% of students rate the level of effort required for this assignment at 6 or below."	"On a scale from 1-10 (10 being maximum effort), about 25% of students rate the level of effort required for this assignment at 7 or above."	"On a scale from 1-10 (10 being maximum effort), I estimate the effort required to successfully complete this assignment at around 6."
Time x Effort	"If you complete three [effortful] activities at B+ or higher, you will earn a buy-out from the final [time-intensive] project."	"You already have a buy-out from a final [time-intensive] project. If you successfully complete these 3 [effortful] activities at a B+ or higher, you will keep that buy-out."	"Those who spend focused, intensive time studying are more likely to earn an A on exams 1-3 and thus earn a buy-out for the final exam."	"Those who do not spend focused, intensive time studying are less likely to earn As on exams 1-3, and will lose their buy-out for the final exam."	"About 70% of students rate the level of effort for this assignment at 7 or below, and took less than an hour to complete it."	"About 30% of students rate the level of effort for this assignment at 8 or above and took over an hour to complete it."	"I estimate the effort required to successfully complete this assignment (i.e., to earn an A) would be around a 7, and that it should take about 2 hours to complete."

Note. *Predicted to be the more impactful application, based on previous research in other domains.

Grades or Points

In an educational setting, grades or other use of points as a currency is the most apparent means by which behavioral economic principles might be applied. The principle of loss aversion, for example, can be tested or applied by first assigning students full points for a course assignment, which they then complete per requirements in order to retain those points. Some educational studies have explored this possibility, with mixed results. Grijalva and colleagues (2018) found that the probability of students in the loss condition for turning in extra credit assignments was no different from those in the gain condition; neither did the effect on overall grade vary by condition. Apostolova-Mihaylova, Cooper, Hoyt, and Marshall (2015) also found no course grade differences by condition when total course points were assigned in advance (loss condition) versus earned over the semester (gain/control condition). However, they did notice gender effects, such that male participants' course grades were higher in the loss condition than control condition, whereas female participants' course grades were lower in the loss condition than control condition (Apostolova-Mihaylova et al., 2015). Finally, McEvoy (2016), also assigning course grades in advance or earned over time, found that after controlling for other factors that might impact student grades, those in the loss condition had significantly higher grades than those in the control condition. Importantly, the extant research on loss aversion in the classroom setting has remained focused on academic outcomes; an exploration of impacts on motivation and other internal processes that may inform these outcomes is warranted.

Goal framing using grades or points may be applied very similarly to those studies reviewed above, with prospective *assurance* of loss or gain. That is, conditions are set such that if a behavior is engaged in (e.g., successful assignment completion), points are either earned or lost. However, another form of goal framing that might be applied to point values or grades is that of prospective *probability* of loss or gain. In this instance, information might be shared with students to encourage their engagement in a desirable behavior, with possible outcomes framed either positively (gain) or negatively (loss). For example, instructors may wish for their students to prepare well for an exam by completing an ungraded tutorial. Framed positively and as a probability, students might be told that those who complete the tutorial have an increased chance of getting an A on the exam, whereas negative framing would state that those who do not complete the tutorial have a decreased chance of getting an A. Corroborating goal-framing results from non-education settings, Zhang (2016) found that those students with a promotion regulatory focus were more persuaded by gain framing, whereas those with a prevention focus were more persuaded by loss framing.

Attribute framing using grades may indirectly impact student behaviors by differentially impacting their attitudes about a task. For example, instructors might present an assignment by stating that 75% of students tend to earn a C or above on it (positive framing); framed negatively, students might be told that 25% of students earn a D or below. In contradiction to typical projected outcomes for goal framing, research indicates that positive attribute framing is more likely to result in favorable evaluations (Levin et al., 1998).

Points may also be used as anchors, as instructors communicate expectations regarding a particular assignment. Many students are disappointed when scores are below full points (Ackerman & Gross, 2018), which are typically the de facto "anchors" provided within a course. Research examining the application of prospect theory in the secondary classroom indicates that as the difference between expected grade and actual grade increased (with the actual grade being lower), so did students' dissatisfaction (Galdón & Gonzálbez, 2013). Therefore, setting a lower anchor that is neither dishonest nor demotivating may help students have a more positive view of their course performance and academic efficacy. This approach may improve students' perception of the course material and the instructor, factors which are related to student performance (Frisby & Martin, 2010). An anchoring example might be to include in assignment instructions a statement such as, "The average score for this assignment tends to run around 90%. Of course, some students score higher and others lower."

Time

Compared to previous generations, college students now spend less time studying outside of class and more time working (Nonis & Hudson, 2006). Further, students now balance additional responsibilities, such as family/caretaking demands (Taniguchi & Kaufman, 2005) and other social demands (e.g., participation in student life organizations). Whether due to time constraints or simply disinterest, students expect to spend very little time for weekly out-of-class studying (Thibodeaux, Deutsch, Kitsantas, & Winsler, 2017). Although we believe students' expenditure of study time is well-spent, it is likely that students who are not intrinsically motivated to learn course material will wish to streamline the amount of time spent studying. Thus, their time becomes a currency, and we may thus be able to use it to potentially impact motivation by applying loss aversion, framing, and anchoring.

When applying time to loss aversion, how do we create conditions in which students earn personal time or lose it, while still encouraging mastery of our course material? In this instance, time may need to be symbolically represented and tied to performance. For

example, a course may have five short assignments (four are deemed necessary to the course; the fifth, no greater in difficulty than its predecessors, is available as a supplement to encourage further mastery). Loss aversion could be applied to this scenario by telling students at the start of term that they have been given a "buy-out" for the fifth assignment (i.e., they have more personal time already given to them). However, if their performance on the first four assignments falls short of some academic criterion, such that the instructor feels it necessary for that student to demonstrate better mastery, the "buy-out" will be removed and the student must complete the fifth assignment.

The buy-out scenario above is again an example of using time within goal framing in a prospective assurance application. To encourage students' engagement in additional course activities (or, alternatively, use good self-regulatory strategies), however, we might instead apply prospective probability goal framing. Notably in this instance, we are encouraging students' *use* of time to *save* time; thus, the expenditure we are encouraging must be less time than the gain of time that is awarded. For example, perhaps each of the four assignments includes a 10-minute interactive, tutorial video. Using positive goal framing, the message might be shared that students who complete the tutorials are more likely to keep their buy-out; if this outcome were framed negatively, students would be told that those who do not complete the tutorials are more likely to lose their buy-out. Similar framing could be used to encourage students' use of checklists or rubrics before submitting assignments, referencing instructor feedback for iterative assignments, or using particularly effective study strategies (shared by the instructor) if the buy-out were to apply to an exam rather than an assignment.

Time may also be effective to use as currency within attribute framing, to influence student perceptions of a course assignment or assessment. For example, letting students know in advance that "about 75% of students read this chapter in an hour or less" may garner a more positive approach to completing the assignment than stating that "about 25% of students spent up to two hours reading this chapter." Admittedly, students will differentially value varying expenditures of time, such that an hour to one student may be perceived as little time, whereas to another it would be perceived as too much. Further, this application should be used judicially, as a low time estimate could result in students rushing through work with little care for its quality. Thus, it may be best to reserve this application of framing to assignments that generally require little time to complete and that are low-stakes but necessary for student success and learning, such as brief (but meaningful) discussion posts, an assigned reading before class, or use of a checklist before submitting an assignment.

Students can be poor estimators of the time required to successfully complete a learning task (Cerrito & Levi, 1999) and thus may have pre-set low time anchors against which they evaluate the demands of a course. In this case, it could be useful to apply a time anchor to certain assignments (or an amount of adequate study time), particularly those that have a history of surprising students. For example, students might be told, "I estimate that the amount of time it takes to successfully complete this assignment is about 3 hours." Students then may be less frustrated when they expend near this amount of time completing the assignment, may have the expectation to set aside more time to complete it, or may be less surprised by a poor evaluation if they spent significantly less time on the assignment than the anchor provided. Buehler, Peetz, and Griffin (2010) examined the manipulation of a time anchor on the prediction and completion of a literature review for students and discovered that although predictions varied in expected directions based on the anchor provided, completion times were unrelated to predictions. However, this study used anticipated "date of completion" as the time anchor, rather than the amount of time required to complete the assignment. Thus, the question remains open as to whether using this specific type of time-based anchor in a class will yield positive benefits for students.

Effort

As Kahneman (2011) notes, we follow a "law of least effort," wherein we are predisposed to complete a task with the minimum effort required. Indeed, Kahneman (2011) states, "In the economy of action, effort is a cost" (p. 35). Prévost, Pessiglione, Météreau, Cléry-Melin, and Dreher (2010) found that greater physical effort (a grip squeeze) was less often chosen in order to receive a larger reward, confirming Kahneman's claim. For our classes, learning and its associated assignments and study practices are inherently effortful tasks. As our students are likely to want less effortful tasks, we may be able to leverage this desire as a currency, perhaps even without giving up the effort required to achieve successful learning in our classes. Although Levitt et al. (2012) speculate that "effort costs" may impede the effectiveness of using financial incentives to increase student performance, we are unaware of any research examining the use of effort as a leveraged currency in instruction; our suggestions remain only conceptually based as a consequence.

The use of effort as a currency introduces the natural question of what kinds of learning or assessment activities require greater or less effort. Westbrook and Braver (2015) caution us that although cognitive effort can be closely related to attention, motivation, difficulty, and cognitive control, we should not confuse

effort with any of these things. Cognitive effort is subjective and may be evaluated based on the demands a task makes on working memory as well as cognitive control (Westbrook & Braver, 2015). Interestingly, although cognitive effort is generally viewed with aversion (Westbrook & Braver, 2015), it may be related to greater engagement (Aston-Jones & Cohen, 2005). It is therefore possible, though remains to be confirmed, that learning tasks categorized as more active, such as discovery learning or guided inquiries, may be viewed by students as both more effortful and more engaging than passive tasks such as viewing videos, and yet will still be avoided by students if given a choice. Further, assessments that require longer cognitive control and greater demands on memory are likely to be perceived as requiring more effort than briefer assessments over a more limited body of material.

Applications using effort as a currency for loss aversion are similar to those using the currency of time. That is, loss aversion using effort can be leveraged with buy-outs; however, in this instance, the buy-out may clearly save the student substantial additional effort as opposed to time. Thus, for example, students may be told that the successful completion of several semi-effortful learning tasks will permit them to keep – or earn – their buy-out of a clearly more effortful task. For purer leverage of effort without the confound of time, the buy-out task should not require significantly more time, only noticeably greater mental effort; it may thus be a relatively short task but one requiring deep mental processing.

Goal framing using effort is again applied similarly to applications using time: in order to save effort, students must first expend some effort. Students will need to perceive that the expenditure of effort is worth the gain of effort removed (or its absence maintained). For example, the buy-out might be a comprehensive, closed-book (and thus very effortful) test of applied knowledge; successful completion of prior exams or quizzes is required for students to earn or maintain the buy-out. Meanwhile, an option provided to students is to complete brief, interactive tutorials which guide students to apply material as it is introduced, perhaps even interleaving prior course concepts. For positive prospective assurance framing, students might be told that those who complete the tutorials are more likely to successfully complete the quizzes and thus earn the buy-out; as a negative prospective assurance, this would be framed such that those who do not complete the tutorials are less likely to keep their buy-out.

As when time was our currency, attribute framing using effort as our currency follows similar suggestions and cautions. For example, students might have a more positive view of an assignment when told, "On a scale from 1-10 (10 being maximum effort), 75% of students rate the level of effort required for this assignment as 6 or below," rather than the reverse statement, "25% of

students rate the level of effort required for this assignment as 7 or above." Such statements should not be fabricated by the instructor, but instead should be based upon previous student polling, in order to be relatively honest and accurate. Because students may not have initial ideas of how to approach more vs. less effortful assignments, instructors may wish to provide rough guidance as to what more or less effort looks like, for example: "Levels 1-3: You can probably leave on your headphones; Levels 4-6: Sit in a designated space and put away your cell phone; Levels 7-8: Go to a quiet space and turn off your cell phone and any other distractions; Levels 9-10: Commit to focusing intensely on completing this assignment." Given that the more positive outlook from students will be on the statement emphasizing the lower end of the effort scale, judicious application of this tactic is recommended, as students may interpret such statements as indicating the assignment in question can be done with little effort. Thus, it may be best applied to assignments for which students can be successful with mild to moderate effort.

Finally, and again as for time, anchoring for effort may eliminate student misconceptions about what is required for a particular assignment in terms of their focus and attention. Therefore, adjusting student expectations regarding effort with an anchor may help them to understand the need for greater processing when such is required for their success. For example, students might be told, "On a scale from 1 – 10 (10 being maximum effort), I estimate this assignment to be at approximately a 6."

Time x Effort

We have discussed the possibilities of using time or effort separately as currencies in a classroom setting. However, the two can be interrelated; Kahneman (2011) suggests that more effortful thinking is "slow thinking." However, research indicates that effort, as defined by increased time on task, may not be the best route to success; for example, Plant, Ericsson, Hill, and Asberg (2005) found that time spent studying did not correspond to academic performance, whereas concentrated, deliberate (that is, effortful) practice positively predicted academic success. Thus, when spent with increased cognitive effort, time dedicated to a task or on studying may be shortened, yet success still achieved.

If saved time is the more valued outcome by students – and this is an assumption that would need to be empirically assessed – then there may be ways to leverage student attitudes and motivation by combining both time and effort as currencies. For example, using loss aversion, we could again offer a buy-out that is earned or kept; here, perhaps we require focused, effortful, and excellent completion of several shorter assignments for a buy-out that is not only effortful but

also more time-intensive, such as a longer project. Although some instructors may balk at not requiring all students to complete a more intensive assignment, we posit that the preceding shorter, challenging assignments are likely to ensure students know the material well, and those who do not demonstrate an adequate level of mastery on these shorter assignments will be provided another opportunity for learning, although they may not appreciate it, through the additional assignment (i.e., the lost buy-out). Thus, the strategy is not merely manipulative of students' extrinsic motivation but applies instructional ethics that are in students' best educational interests.

Considering goal framing as we apply both time and effort as currencies, we again can leverage greater front-end effort for a buy-out that saves students both time and effort. For example, students can be encouraged to dedicate intensive, focused study time during the semester, or once again, complete optional but learning-intensive tutorials for the prospective assurance of gain or loss in the course. Thus, framed positively, students might be told that those who regularly dedicate 2 or more hours a week to intensive self-quizzing and review of course material are more likely to earn high scores on exams, and thus earn a buy-out from a longer final exam or a final research paper. Framed negatively, and perhaps with more impact, students could instead be told that those who do not regularly dedicate 2 or more hours a week to review of course material are less likely to earn high scores on exams, and thus may lose their buy-out.

For attribute framing, we should maintain care when communicating levels of effort and time to students; we neither wish to convey that an assignment's completion should be rushed nor done with less effort. However, for assignments that students seem reluctant to begin due to a misinterpretation that it requires greater time or effort than is the case, we can positively frame an assignment. For example, we may be able to beneficially impact student attitude with a positive framing of, "About 70% of students rate the effort for this assignment at 6 or below, and indicated it took them less than an hour to complete it." Framed negatively, and perhaps to lesser benefit, students could be told, "About 30% of students rate the effort for this assignment at 7 or above, and indicated it took them over an hour to complete it." Surveying former students and finding relatively accurate values based upon their experiences will be necessary for the ethical attribute framing of any assignment.

Anchoring for time x effort would adjust both time and effort expectations for students; one possible value to anchoring both is that the value of effort over time can be communicated. For example, students might be told, "I estimate the effort required to successfully complete this assignment is at about a 7, but should only take about 45 minutes to complete." Thus, students can be made aware that effort is required, but the dedicated time is short. Over a semester, with communications such as this, students might begin to understand that learning and academic success lie more in the effort invested rather than the time spent on an assignment (Plant et al., 2005). In addition, students are less likely to be surprised when an assignment is effortful.

Particularly for the use of time, effort, and time x effort as currencies in the classroom, research to determine the efficacy of these approaches is largely absent. Important beginning steps, however, will be to empirically determine where the breakpoint between a "reasonable amount of time" versus "too much time" tends to fall for students, which types of learning activities are perceived as more or less effortful, whether students value time over effort or *vice versa*, and the best methods for delivering frames and anchors for these currencies.

Conclusion

We are strong advocates of active, student-centered instructional methods as the best and most proactive way to garner student engagement in the college classroom (Prince, 2004). However, we recognize that students in higher education must economize their time and effort when balancing the demands not only of multiple classes, but also those of work, family, and their social lives (Choo, Kan, & Cho, 2019; Nonis & Hudson, 2006). These competing demands may be particularly heavy for non-traditional students. In these instances, when arousing the intrinsic interest of all students to complete a class is difficult, taking advantage of the heuristics discovered within behavioral economics to supplement active learning methods may influence students to make decisions to their educational benefit. The instructional strategies related to these heuristics are unlikely to have staggering results but may provide for some students a type of academic "nudge" which can positively impact choices and performance (Feild, 2015).

The application of behavioral economics using the currencies of points, time, and effort have the potential to be effective in any academic setting, from primary grades through higher education. However, as noted above, saving time and effort may be particularly attractive to college students due to increasing, legitimate demands on their time and mental energy, possibly increasing the efficacy of these methods within the college setting. Further, compared to primary and secondary educators, college instructors are likely to have the autonomy and academic freedom to make the necessary adjustments to assignments and grading methods (Maxwell,

Waddington, & McDonough, 2019), and some adaptations could be simple enough to be easily integrated by busy instructors.

Research examining the impacts of the heuristics we've explored (loss aversion, goal framing, and anchoring) in the higher education setting is limited and, to date, seems only to have investigated the use of points or trophies as the manipulated currency. Within this limited research, gender and regulatory focus have already been identified as influencing factors when applying loss aversion and goal framing (Apostolova-Mihaylova et al., 2015; Zhang, 2016). Because our proposals in this paper are conceptual and thus speculative, we encourage empirical examination of the use of points or grades as the currency, particularly for the potential impact of attribute framing and anchoring, as well as how the currencies of time, effort, or their combination can be used to instructional benefit in the college classroom. Outcomes to be examined will vary by heuristic, but should include students' overall learning, motivation, perceived effort, and perceptions of the course, instructor, and content.

Further, as current research already suggests, these heuristics may impact some groups of students more than others; in fact, it may be possible that their use results in negative outcomes for some groups of students, such as those who already were intrinsically motivated to complete course assignments (Ryan & Deci, 2016). Other negative effects for applying loss aversion, goals framing, and anchoring may include students' decreased well-being or quality of performance as a result of being in an instructional environment perceived as more controlling (Moller, Ryan, & Deci, 2006). Thus, future research should not only explore the potential benefits to utilizing behavioral economics methods, but also any negative outcomes, in order to weigh the costs against any benefits. In addition, studies exploring implementation adjustments may help pinpoint methods that utilize these behavioral economics principles but sustain or increase students' sense of autonomy; autonomy opportunities, such as being offered choices, results in more internalization of the value for the activity (Moller, Ryan, & Deci, 2006). Exploring individual characteristics, such as motivation types, mindset, and self-efficacy, as they relate to outcomes using these methods is also warranted. For example, students with growth mindsets may be more influenced by gain conditions or positive attribute framing than those with fixed mindsets, because this mindset is associated with approach rather than avoidance behaviors, in much the same way as a promotion regulatory focus (Karoly & Newton, 2006). Finally, as research accumulates in the educational realm, examining average effect sizes will help to inform the field of whether any of these approaches are beneficial enough to continue advocating their use.

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Open versus Traditional Textbooks: A Comparison of Student Engagement and Performance

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This study compared student engagement and performance in both open educational resources (OER) (n[open textbook users fall 2018] = 72) and traditional textbook (n[traditional textbook users fall 2017] = 66) classes. Data were drawn from the Learning Management System (LMS). Results show (1) final grades in the OER class were on a par with the traditional textbook class, and (2) OER equalize student engagement and performance by narrowing the dispersions of page views, on-time assignment submissions (OTAS), attendance, and final grades. (3) OER increased attendance and lessened excessive dependence on LMS course materials recorded in the traditional class. (4) The indirect effect of attendance on final grades was stronger than the direct effect of OTAS in the OER class. Attendance provided the opportunity for the instructor and students to be on the "same page," which helps students better assimilate course content and comprehend lectures. (5) The availability of textbooks appears to be a factor influencing student course success. However, it remains unknown how much of the variance was explained by OER. It is apparent that OER are more important than ever in elevating overall student academic success.

Introduction

OER have become an increasingly attractive option for several compelling reasons. They can unquestionably reduce educational costs and increase course material availability (Watson, Domizi, & Clouser, 2017). The National Survey of Student Engagement (NSSE) examined whether students declined to purchase required academic materials (books, coursepacks, supplies) due to their cost. The percentages of students who responded "never" were 45% for freshmen, 36% for sophomores, and 31% for seniors, and approximately 63% of college students chose not to purchase required academic materials such as textbooks due to their cost (B. Gonyea, personal communication, July 16, 2019). Likewise, the U.S. Public Interest Research Group (PIRG, 2014) revealed that 65% of college students have forgone buying a textbook due to its high cost, and of those students, 94% acknowledged they suffered academically as a result.

Many students believe that textbooks are too expensive, especially if used infrequently in their course or if not in their chosen academic major, nor did they plan to keep those books as future resources. Although 34% of respondents agreed or strongly agreed that their school makes textbooks more affordable, 44% disagreed or strongly disagreed (Klepfer, Cornett, Fletcher, & Webster, 2019). Moreover, the Florida Virtual Campus (FLVC) survey (2018) identified five consequences of high textbook costs: not purchasing the required textbook (64%), taking fewer courses (43%), not registering for a specific course (41%), earning a poor grade (36%), and dropping a course (23%). These findings suggest that the cost of textbooks was negatively impacting student access, success, and degree completion.

The Babson Survey Research Group (2019) explored instructors' views on textbooks and found 61% of faculty members believed the cost of course materials was a serious concern for students, and 52% of faculty members responded cost was the primary factor why students did not have access to textbooks; however, 38% believed that students did not think they needed textbooks. Forty-six percent of faculty were aware of OER, up from 34 percent in 2015. Just 61% of all faculty believed that "over 90% of my students have access to all the required textbook(s)," and 57% among faculty teaching large enrollment introductory-level courses agreed. Nevertheless, only 16% of faculty had adopted open textbooks, while 23% of those taught introductory level courses.

Consistent with the FLVC (2018) findings, a large-scale national survey by the Association of American Colleges and Universities (AAC&U, 2018) found that issues surrounding retention and completion, the quality and assessment of student learning, and college affordability were the greatest challenges facing our higher education. Due to the increasing cost of higher education (U.S. Bureau of Labor Statistics, 2018), previous studies indicated that OER textbooks lowered students' educational expenses and increased learning opportunities (e.g., Clinton, 2018). Hardin et al. (2018) found no evidence that use of the OER textbooks impeded students' critical thinking compared to traditional textbooks, even after accounting for instructor characteristics. The lower textbook cost had a positive influence on a student's decision to enroll and remain in the course. Moreover, OER textbooks increased grades (Colvard, Watson, & Park, 2018; Winitzky-Stephens & Pickavance, 2017) and decreased DFW (D, F, and Withdrawal letter grades) rates for all students (Colvard et al., 2018).

The existing research on the efficacy of OER textbooks on student performance has typically shown yield equivalent or better outcomes (Cooney, 2017; Croteau, 2017; Hilton, 2016; Hilton, 2019; Jhangiani, Dastur, Le Grand, & Penner, 2018) in a wide range of disciplines, including psychology (Clinton, 2018; Grissett & Huffman, 2019), physics (Hendricks, Reinsberg, & Rieger, 2017), statistics (Illowsky, Hilton III, Whiting, & Ackerman, 2016), and business, geography, chemistry, and biology (Hilton III, Robinson, Wiley, & Ackerman, 2014).

Attendance and Attainment

Attendance is an important factor that has affected students' performance in higher education. A meta-analysis of the relationship between class attendance in college and grades revealed that attendance has strong relationships with both class grades and grade point average (GPA) (Credé, Roch, & Kieszczynka, 2010). Class attendance significantly improves student performance. Specifically, a 10-percentage point increase was observed in students' overall attendance rates, resulting in a 0.17 standard deviation increase in the final exam score for intermediate level economics classes (Dobkin, Gil, & Marion, 2010). Students with fewer class absences were less likely to repeat the first college-level accounting course (Xiang & Hinchliffe, 2019). Paradoxically, one of the rare studies examining OER and attendance reported that Chilean students who used OER in a college freshman mathematics course had significantly lower attendance than those in traditional textbook classes (Venegas-Muggli & Westermann, 2019). The authors theorized that in this case, student confidence resulting from the availability of OER actually lessened their perceived need to attend classes.

One of the benefits of OER is free or low-cost access to required materials. Materials can be posted on an LMS and projected in class, allowing the instructor to show students the lesson material while simultaneously teaching the concepts. The benefits of this can include increasing student attention and engagement and helping them assimilate the concepts being introduced. Other advantages of using OER are myriad. Students can access OER anywhere and anytime with their phones (i.e., no heavy textbooks to carry) with unlimited retrievals that can potentially expand their learning. Updated information may be disseminated promptly to increase the timeliness and/or relevance of the material being presented.

There are undeniably challenges associated with OER, such as quality concerns voiced by many given that any user can create an account and post material in OER repositories, introducing what is often irrelevant and/or inaccurate material. Other concerns include lower attendance thanks to the availability of materials outside the classroom, which might cause certain students to forgo in-class discussions and miss the instructor's feedback. The OER content may be less user friendly than a bound-and-printed textbook, and reading the textbook online may lead to vision fatigue.

Survey results from national and state levels show that approximately 65% of students did not purchase required textbooks due to high costs, indicating that about 35% did so for other than financial reasons. These results may signify that students' personal characteristics are a factor when making the decision to forgo purchasing textbooks, which could also affect their various learning approaches and engagement and as a consequence their final grades. For example, attendance and turning in assignments on time might be factors that also influence students' final grades. These factors were rarely considered in extant research when investigating the effect of OER on students' overall outcomes.

In addition, the review of the existing studies on OER has shown that most of them typically examined students' final grades without consideration of the dispersions of students' engagement and overall performance. In this study student engagement is operationally defined with components consisting of (1) the number of page views, (2) OTAS rates (excluding late and missing assignments), and (3) attendance. For example, as to the question of whether there is a path for a student to get a good grade in a course: students could comprehend more from the instructor's lectures by attending classes because they become better prepared as a result of the availability of textbooks in the OER classes. In contrast, there is the question of whether students in the traditional textbook classes would adopt adaptive approaches when they did not own a required textbook. An example would be if they opted to view the instructor's notes on the LMS instead of utilizing the course reserves at the library, which lead to higher number of page views on the LMS than those in the OER classes. Conversely, it is possible those owning the traditional textbook did not need to depend on the instructor's notes, resulting in both a lower number of page views on the LMS and an extreme dispersion of page views in the traditional textbook class. In addition, it has rarely been reported whether the availability of OER encourages students' previews/reviews of the course content and better preparedness, which in turn increases their classroom engagement. Hence, the present study explored whether:

1) students' final grades in the OER class can be on a par with those in the traditional textbook;
2) OER equalize students' learning and performance by narrowing the dispersions of:
    (a) attendance,
    (b) page views,
    (c) OTAS, and
    (d) final grades;
3) OER positively influence students' learning by:

(a) lessening excessive dependence on LMS course materials;
(b) increasing on-time assignment submittals;
(c) encouraging students' attendance;
4) OER potentially facilitate assimilation of course content and comprehension of lectures as shown by:
   (a) attendance mediating the effect of OTAS on final grades;
   (b) OTAS mediating the effect of attendance on final grades;
5) the availability of textbooks appears to be a factor for students' course success as shown by:
   (a) attendance moderating the effect of OTAS on final grades;
   (b) OTAS moderating the effect of attendance on final grades.

Textbook Affordability Project

At the instructor's institution, the University Library offers a Textbook Affordability Project that provides faculty with a stipend to cease using a commercial textbook in order to help students have a more affordable higher education. The instructor's proposal to stop using a commercial textbook and to adopt OER was selected for the 2018-19 academic year. The participating instructors are required to complete a course evaluation sharing cost savings data, student performance, and general feedback to the University Library by the end of the semester in which the project is conducted. Portions of this report were submitted to the University Library as a partial fulfillment of the requirements. This report compared final grades, attendance, OTAS rates, and page views on LMS (e.g., Canvas) for two classes of the same course taught by the same instructor in consecutive academic years.

Method

Participants

One hundred and thirty-eight students from two general education (GenEd) quantitative literacy (QL) classes at a large urban publicly funded research I institution in the mid-Atlantic United States were included in this study (n[traditional textbook users fall 2017] = 66 and n[OER users fall 2018] = 72). Details about the students and demographics are displayed in Table 1. Students were comprised of various colleges in the University since it was a GenEd course and freshmen were a majority representation in these two classes. Both classes were comprised of 80-minute lectures by the instructor twice a week. Students were assigned to one of the three 50-minute recitation groups (approximately 24 students each group) with the teaching assistant each week for practice, discussions, and data analysis and graphing. Both courses counted for four credits.

Table 1
Number of Students and Demographics in Classes

		Fall 2017 (traditional textbook)	Fall 2018 (OER textbook)
Class size		66	72
Gender	Male	16 (24%)	21 (29%)
	Female	50 (76%)	51 (71%)
Race/ethnicity	White	34 (52%)	42 (58%)
	Black	18 (27%)	15 (21%)
	Hispanics	3 (5%)	7 (10%)
	Asian/PI	10 (15%)	7 (10%)
	Native	1 (1%)	1 (1%)
Class standing	Freshmen	48 (73%)	55 (76%)
	Sophomore	13 (20%)	12 (17%)
	Junior	3 (4%)	4 (6%)
	Senior	3 (4%)	1 (1%)
Major	Psychology	27 (41%)	26 (36%)
	Other	39 (59%)	46 (64%)

Note: Due to rounding, percentages may not always appear to add up to 100%. Gender: at the class level

Interactive learning has been a favored teaching style for the instructor. Interactive learning is defined as consisting of student-student, student-instructor, and student-computer interaction on in-class and out-of-class activities. For both classes, assignments included on-line examinations and quizzes (multiple-choice items), homework assignments (short-answer questions), in-class group activities and discussions, in-class "bite-sized" interactive learning checks on LMS, and one group project and presentation. For both classes, there were about 45 assignments for 690 possible points throughout the semester. All assignments were interactive and created by the instructor and students responded to all items on the LMS. Assignments were graded and real-time feedback were provided.

Students in both classes did group projects and wrote team papers. There were typically four students in each group for the projects consisting of 7-step assignments such as research questions, development of surveys, data collection and analysis, and the writing of a report. Each group created a survey and collected data online. Upon the completion of the data collection, the teaching assistant helped them with downloading the data, figuring descriptive statistics, and generating graphs and tables during the lab recitations. Afterwards, each group of students wrote a joint report and prepared a poster for presentations. Posters were mounted on the classroom walls when the groups were presenting their projects, and each group presentation was allotted approximately 12 minutes with about six posters per meeting.

For the fall 2017 class, the instructor had adopted a popular introductory quantitative analysis and understanding statistics textbook for psychology majors published by one of the industry leaders in textbook publishing. An OER considered by the instructor to contain up-to-date, clear, and well-organized content was adopted for the fall 2018 class. Instructors in the department have the discretion to make their independent decisions in adopting course materials. The OER class met in a lecture hall with a pitched floor (i.e., tiered seating) and in a regular classroom setting for the traditional textbook class.

For the traditional textbook class, a course reserve was placed at the library and available for review by students who did not purchase the textbook for a maximum of four hours a day per student. However, the University Library did not track for individual students who checked out the text on how long and how often they reviewed it in the library. The link of the adopted OER textbook was posted on the LMS where students could download and review it. Furthermore, attendance was recorded for every meeting throughout the semester for both classes. Data were downloaded from LMS and analyzed using Analysis of Moment Structures (AMOS, 2019) and SPSS (IBM Corporation, 2019) with PROCESS Macro (Hayes, 2019).

Results

Descriptive statistics of page views, OTAS, attendance, and final grades were displayed in Figure 1. Final grades show no differences between the traditional textbook and OER classes (p = .945) (Table 2), indicating that students' final grades in the OER class were on a par with those using the traditional textbook. The dispersions of students' page views, OTAS, attendance, and final grades in the OER class were much narrower with an evidently smaller standard deviations than those of the traditional textbook class (Figure 1*a, b, c,* and *d*). The dispersions were less extreme, resulting in smaller standard deviations in the OER class than those in the traditional textbook class, indicating OER equalized the students' engagement and performance. The dispersions were clustered closer to the means in the OER class despite having an equally high final grade average as the traditional textbook class. Research questions (1) and (2) have been supported.

Results of the independent *t*-test show that students in the traditional textbook class had marginally higher page views on LMS than those in the OER, [$t(88)$ = 1.95, p = .055]. There were no differences in the OTAS rates (p = .469) which both reached 90% or higher. Attendance trended higher in the OER class than that of the textbook class (p = .070), although 90% or higher attendance rates were observed for both classes. Research question (3) has been partially supported in that, 3(a) OER lessened students' dependence on LMS course materials; 3(b) The OTAS in OER class was not significantly higher than that in the traditional textbook class, and 3(c) OER increased students' attendance.

Table 3 presents the correlation matrix of page views, OTAS, attendance, and final grades. Attendance was the strongest predictor of students' final grades and OTAS; however, page views was weakly correlated with final grades and attendance for both classes. The OTAS rates were significantly correlated with attendance for both classes, indicating that students who attended classes regularly were more likely to submit their assignments on time. Since the significant correlations between attendance, OTAS, and final grades were observed, mediation and moderation analyses were conducted.

Mediation

Mediation analyses were employed to understand the observed significant relations between attendance, OTAS, and final grades by exploring the underlying mechanism or process by which one variable (e.g., attendance) influences another variable (e.g., final grades) through a mediator variable (e.g., OTAS). Mediation analysis facilitates a better understanding of the relations between the predictor and criterion variables when the variables appear not to have a definite connection.

Figure 1

Descriptive statistics of page views, on-time assignment submissions, attendance, and final grades in OER and Traditional classes
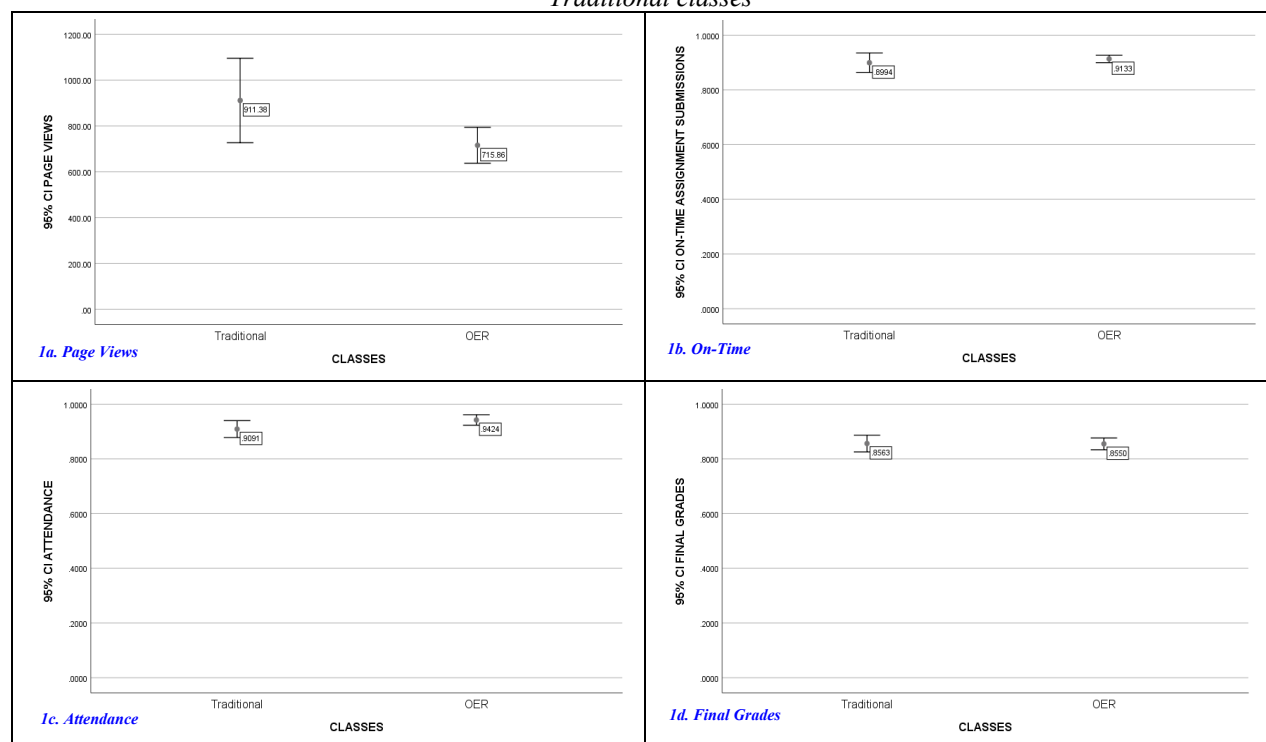
Table 2

Descriptive Statistics and Independent t-test Results

	Fall 2017 (*n* = 66) Traditional textbook	Fall 2018 (*n* = 72) OER textbook	*t*	*df*	*sig*
Grades	85.63 (12.44)	85.50 (9.14)	.067	136	.945
Page Views	911.38 (750.04)	715.86 (334.05)	1.95	88	.055
Attendance	.91 (.13)	.94 (.08)	1.83	110	.070
OTAS	.90(.15)	.91 (.06)	.73	84	.469

Note: OTAS: percentages of on-time assignment submittals; Page Views: each time a user views the page; (standard deviation in parentheses)

Table 3

Correlation Matrix of Grades and Page Views, Attendance, and On-Time Assignments

	Fall 2017 (*n* = 66) Traditional textbook				Fall 2018 (*n* = 72) OER textbook			
	1	2	3	4	1	2	3	4
1. Grades	---				---			
2. Page Views	.11				.21			
3. Attendance	.86***	.20			.74***	.06		
4. OTAS	.87***	.04	.78***	---	.53***	.18	.50***	---

Note: *** Correlation is significant at the .001 level (2-tailed).

Figure 2
Mediation effects of OTAS or attendance on final grades

2a

Total Effect: .8535
Direct Effect: .4667
Indirect Effect: .3868 [.91 x .43]
Bootstrapped 95% CI: .0924 – .5926

2b

Total Effect: .7404
Direct Effect: .4251
Indirect Effect: .3153 [.68 x .47]
Bootstrapped 95% CI: .0727 – .4664

2c

Total Effect: .8250
Direct Effect: .7063
Indirect Effect: .1187 [.36 x .33]
Bootstrapped 95% CI: .0296 – .2100

2d

Total Effect: .8287
Direct Effect: .3338
Indirect Effect: .4950 [.70 x .71]
Bootstrapped 95% CI: .1129 – 1.006

Traditional textbook class. A measure for the indirect effect of OTAS on final grades shows that the effect size was .3868, with a bootstrapped 95% confidence interval, which did not include zero indicating that the effect was significantly greater than zero at α = .05. Using OTAS as the mediator, the total effect of attendance on final grades was .8535, with a direct effect of .4667 from attendance and an indirect effect of .3868 (45% of the total effect) from OTAS (Figure 2*a*). The other measure for the indirect effect of attendance on final grades shows that the effect size was .3153, with a bootstrapped 95% confidence interval, which did not include zero indicating that the effect was significantly greater than zero at α = .05. However, when using attendance as the mediator, the total effect of OTAS on final grades dropped to .7404, with a direct effect of .4251 from OTAS and an indirect effect of .3153 (43% of the total effect) from attendance (Figure 2*b*).

OER class. A measure for the indirect effect of OTAS on final grades shows that the effect size was .1187, with a bootstrapped 95% confidence interval, not including zero, indicating that the effect was significantly greater than zero at α = .05. The total effect of attendance on final grades was .8250, with a direct effect of .7063 (86% of the total effect) from attendance and an indirect effect of .1187 from OTAS (Figure 2*c*). The other measure for the indirect effect of attendance on final grades shows an effect size of .4950, with a bootstrapped 95% confidence interval, not including zero, indicating that the effect was significantly greater than zero at α = .05. The total effect of OTAS on final grades was .8287, with a direct effect of .3338 from OTAS and an indirect effect of .4950 from attendance (60% of the total effect) (Figure 2*d*). The two models revealed that attendance was a major factor in students' final grades in the OER class.

Full mediation was observed when the presence of the mediation variable (e.g., OTAS) dropped the relation between the predictor (e.g., attendance) and

Table 4
Moderation Effects (Fall 2017)

Model Summary	R	R²		F	p
	.9248	.8889		165.32	.0000
		b	s.e.	t	p
ATTEND17		.32	.07	4.46	.0000
OTAS17		.24	.07	3.63	.0006
Interaction		-.80	.15	-5.49	.0000
(Unconditional)		R²-chng		F	p
ATT17 x OTAS17		.0539		30.10	.0000
Conditional effects		b	s.e.	t	p
OTAS17	-.1455	.44	.07	6.49	.0000
(Figure 3*a*)	.0000	.32	.07	4.46	.0000
	.1245	.22	.08	2.77	.0074
ATT17	-.1254	.34	.06	5.72	.0000
(Figure 3*b*)	.0000	.24	.07	3.63	.0006
	.1136	.15	.08	1.99	.0511

criterion variable (e.g., final grades) and became a weaker, yet still significant path, with the inclusion of the mediation effect for all four models. The total effect was lower in Model 2*b* in the traditional textbook class than Model 2*d* in the OER class when attendance was a mediator. The results support question (4) indicating that undergraduate students need textbooks to better comprehend and assimilate course content and lectures thanks to the large amount of direct and indirect effect from attendance on the final grades in the OER class.
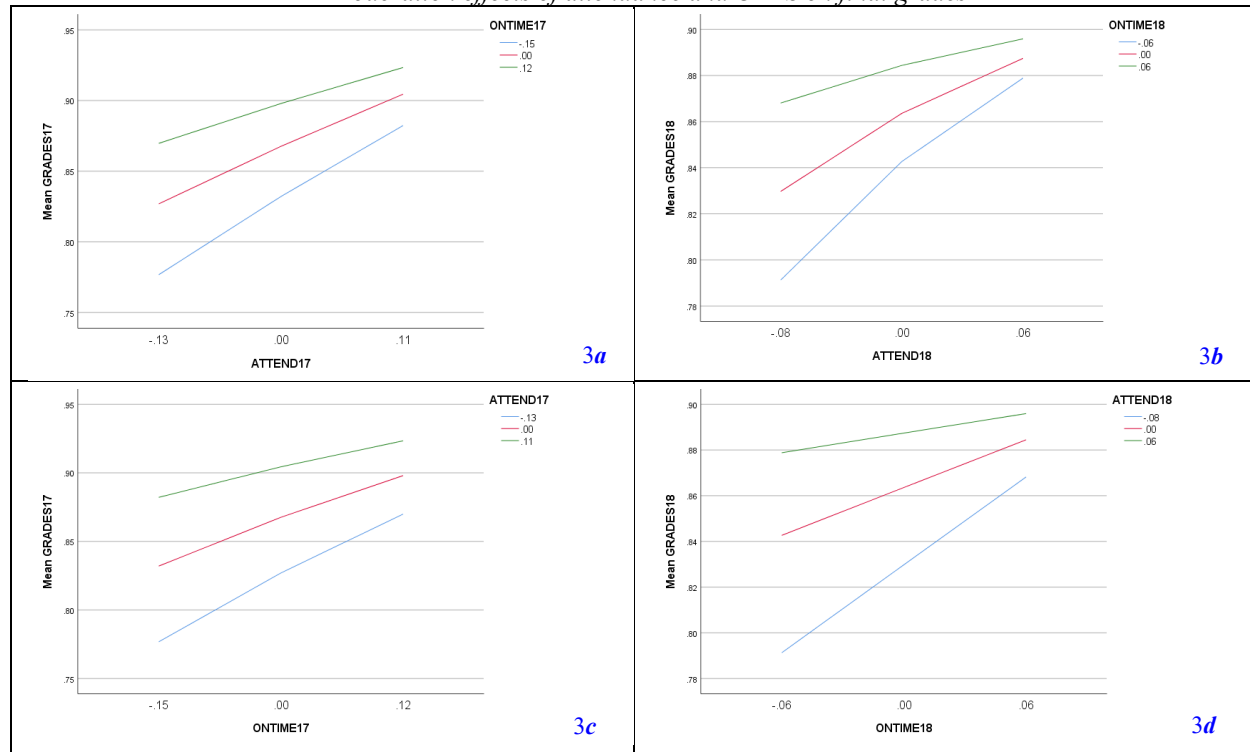
Moderation

Moderator analyses were conducted to determine whether the relationship between two variables (e.g., attendance and final grades) depended on (was moderated by) the value of a third variable (e.g., OTAS). Although mean centering is not a requirement when carrying out moderated multiple regression, it can facilitate interpretation of the regression parameters (Hayes, 2018). The (continuous) moderator variables (e.g., OTAS) were segmented into "-1SD, Mean, and +1SD" to represent "low," "medium," and "high" values for that variable (e.g., Aiken & West, 1991). Therefore, the relation between attendance and final grades was tested at those three levels.

Traditional textbook class. In the traditional textbook class, the interaction term was significant (*b* = -.8027, *p* < .0001), indicating that OTAS was a significant moderator of the effect of attendance on final grades. The R^2 change from adding in the

interaction term was .0539, indicating the interaction effect accounted for 5.39% added variability in final grades. The effect of attendance on final grades was positive and significant (*b* = .3237, *p* < .0001), conditional on OTAS = 0, indicating that the effect of attendance was .3237 for those individuals scoring at the grand mean on OTAS. In addition, the conditional effect of OTAS was positive and significant (*b* = .2346, *p* = .0006), conditional on attendance = 0, indicating the effect of attendance was .2346 for those individuals scoring at the grand mean on attendance.

Since the interaction term was statistically significant, additional analyses were performed to examine the relationship between attendance and final grades at three levels of the moderator (i.e., OTAS). At -1SD on the centered OTAS (representing low OTAS), the relationship between attendance and final grades was positive and significant (*b* = .4405, *p* < .0001). Next, at the mean (i.e., at .0000) on the centered moderator variable (representing medium OTAS), the relationship was positive and significant (*b* = .3237, *p* < .0001). Finally, at +1SD on the centered OTAS (representing high OTAS), the relationship was positive and significant (*b* = .2238, *p* = .0074) (Table 4, Figure 3*a*). However, when using attendance as the moderator, at +1SD on the centered attendance (representing high attendance), the relationship was positive but not significant (*b* = .1524, *p* = .0511) (Table 4, Figure 3*b*). The value that defined Johnson-Neyman significance region was .1129 (*p* = .0500), with 98.48% below and 1.52% above this value of .1129.

Figure 3
Moderation effects of attendance and OTAS on final grades

OER class. In the OER class, the interaction term was statistically significant ($b = -3.6640$, $p = .0033$), indicating that OTAS was a significant moderator of the effect of attendance on final grades. The R^2 change from adding in the interaction term was .0504, indicating the interaction effect accounted for 5.04% added variability in final grades. The effect of attendance on final grades was positive and significant ($b = .4131$, $p = .0032$), conditional on OTAS = 0, indicating that the effect of attendance was .4131 for those individuals scoring at the grand mean on OTAS. In addition, the conditional effect of OTAS was positive and significant ($b = .3580$, $p = .0093$), conditional on attendance = 0, indicating the effect of attendance was .3580 for those individuals scoring at the grand mean on attendance.

Since the interaction term was statistically significant, additional analyses were performed to examine the relationship between attendance and final grades at three levels of the moderator (i.e., OTAS). At -1SD (i.e., at -.0583) on the centered OTAS (representing low OTAS), the relationship between attendance and final grades was positive and significant ($b = .6266$, $p < .0001$). Next, at the mean (i.e., at .0000) on the centered moderator variable (representing medium OTAS), the relationship was positive and

significant ($b = .4131$, $p = .0032$). Finally, at +1SD (i.e., at .0583) on the centered OTAS (representing high OTAS), the relationship was insignificant ($b = .1996$, $p = .3014$) (Table 5 and Figure 3c). The moderator value that defined Johnson-Neyman significance region was .0261 ($p = .0500$), with 59.72% below and 40.28% above this value of .0261. Similarly, at +1SD (i.e., at .0576) on the centered attendance (representing high attendance), the relationship was insignificant ($b = .1468$, $p = .3210$) (Table 5 and Figure 3d). The moderator value that defined Johnson-Neyman significance region was .0242 ($p = .0500$), with 45.83% below and 54.17% above this value of .0242. Furthermore, the R^2 value which is the percent of variance explained by the model dropped to 63.03% in the OER class from 88.89% in the traditional textbook class (Table 5). Table 6 displays a summary of the statistical analysis results.

Discussion

The mean of the final grades for both classes were indistinguishable, albeit with a widespread dispersion in the traditional textbook class, indicating when every student had access to a textbook the class performance distribution narrowed. The results also show that

Table 4
Moderation Effects (Fall 2017)

| | | | Fall 2017 ($n = 66$) | | |
| | | | Traditional textbook | | |

Model Summary	R	R^2		F	p
	.9248	.8889		165.32	.0000
		b	s.e.	t	p
ATTEND17		.32	.07	4.46	.0000
OTAS17		.24	.07	3.63	.0006
Interaction		-.80	.15	-5.49	.0000
(Unconditional)		R^2-chng		F	p
ATT17 x OTAS17		.0539		30.10	.0000
Conditional effects		b	s.e.	t	p
OTAS17	-.1455	.44	.07	6.49	.0000
(Figure 3*a*)	.0000	.32	.07	4.46	.0000
	.1245	.22	.08	2.77	.0074
ATT17	-.1254	.34	.06	5.72	.0000
(Figure 3*b*)	.0000	.24	.07	3.63	.0006
	.1136	.15	.08	1.99	.0511

Table 5
Moderation Effects (Fall 2018)

| | | | Fall 2018 ($n = 72$) | | |
| | | | OER textbook | | |

Model Summary	R	R^2		F	p
	.7939	.6303		38.6450	.0000
		b	s.e.	t	p
ATTEND18		.4131	.1353	3.0534	.0032
OTAS18		.3580	.1336	2.6789	.0093
Interaction		-3.6640	1.2036	-3.0443	.0033
(Unconditional)		R^2-chng		F	p
ATT18 x OTAS18		.0504		9.27	.0033
Conditional effects		b	s.e.	t	p
OTAS18	-.0583	.63	.10	6.36	.0000
(Figure 3*c*)	.0000	.41	.14	3.05	.0032
	.0583	.20	.19	1.04	.3014
ATT18	-.0818	.66	.17	3.85	.0003
(Figure 3*d*)	.0000	.36	.13	2.68	.0093
	.0576	.15	.15	1.00	.3210

students in the traditional textbook class viewed the instructor's notes marginally more than those in the OER class, suggesting that those who did not have the textbook depended more on the materials posted by the instructor. It appears that students who owned the traditional textbook were less likely to display excessive dependence on the LMS notes than those who did not buy the textbook, resulting in extreme distribution of page views in the traditional textbook class. In contrast, students in the OER class only needed to download the

textbook once and could review it anywhere and anytime they wished, whereas those in the traditional textbook class had to download them by the units organized by the instructors. The results show that the dispersions of page views, OTAS, attendance, and final grades were narrower in the OER class and persuasively support the question that OER equalize students' engagement and course success. One intriguing implication is that OER might have elevated the performance of students lacking the traditional textbook, thus resulting in a narrower dispersion of the final grades. To further elaborate, it appears from this study that OER spurs a convergence of students' final grades closer to the class average (i.e., equalizing), contrary to the larger standard deviation recorded in the traditional textbook class. In addition, OER narrowed the standard deviation of attendance, page views, and OTAS.

Inconsistent with the findings by Venegas-Muggli and Westermann (2019), students in the OER class had marginally higher attendance rates than those in the traditional textbooks. The fact that an almost equal number of in-class activities and assignments for both classes occurred suggests that if students had previewed and/or reviewed the materials they might have been better prepared and attended class more regularly. When attendance served as the mediator in the OER class (i.e., Model 3d), it was the only model where the indirect effect was stronger than the direct effect. In comparison, in the traditional textbook class attendance could not generate as much effect as that in the OER class, resulting in lower total effect of the model when attendance was a mediator. The results of all four models suggest that textbooks may potentially help undergraduate students better assimilate course content and comprehend materials covered in class as reflected in their final grades. Note that the indirect effect of attendance on final grades was stronger than the direct effect of OTAS in the OER class. The instructor projected the PowerPoint slides, OER text, and related videos and information during lectures throughout the semester and encouraged students to have the OER text on their laptops. Correspondingly, students could easily locate the materials discussed in the lectures, with resulting increases in attention and comprehension. In other words, when the instructor and students are on the "same page" students seem to better assimilate course content and comprehend lectures. In contrast, attendance could not generate as much of an indirect effect in the traditional textbook class, even though the instructor had similar classroom practices but without projecting the traditional text in class. There are few things more satisfying for instructors than seeing their students comprehend the lectures.

In addition, the proportion of variance explained by variables in the OER class declined to 63.03% from 88.89% in the traditional textbook class. Since one of the major differences between the two classes was the availability of textbooks, this suggests that textbook availability appears to be an influential factor impacting students' course success. However, how much of the variance can be explained by the availability of textbooks needs to be determined.

Results from the present study indicate major benefits for students' learning and performance when textbooks are available to them such as OER, including equalized students' engagement and performance and better comprehension of lectures. Regrettably, findings from the Babson Survey Research Group (2019) show that only 16% of faculty had adopted open textbooks, and 23% of those taught introductory level courses. Colleges and universities across the country should commit to promoting the benefits of OER and encourage faculty to adopt OER to foster overall students' success and not just with the goal of making college education more affordable.

It is paradoxical that there was merely a distinguishable mean difference in final grades between these two classes, yet there were many noteworthy disparities among other aspects observed. Future research should broaden to examine variables beyond students' final grades (i.e., product) and to measure difference between students' engagement and performance throughout the semester (i.e., process) for both OER and traditional textbook classes. Data for variables other than final grades and perceptions on OER commonly investigated in the extant studies should be recorded throughout the semester to closely monitor students' engagement. The current study using continuous data from LMS to investigate students' performance and to find patterns of college students' learning unreported in the previous studies can be considered the strength of the study.

Conclusion

Some of the major implications that can be drawn from the current study are as follows: (1) Final grades in the OER class were on a par with those in the traditional textbook class. (2) OER equalize students' engagement and performance by narrowing the dispersions of page views, OTAS rates, attendance, and final grades. OER appear to have elevated the performance of students lacking the traditional textbook. (3) OER narrowed the dispersion of page views and diminished excessive dependence on the instructor's notes. When students had access to textbooks, they displayed less dependence on the instructor's LMS notes, hence the reduced number of page views. Not surprisingly, when students did not have a required traditional textbook and did not utilize the course reserve, viewing the LMS notes became their default method of learning, resulting in extreme distributions of page views. (4) When students have free

access to textbooks (e.g., OER), they apparently were better prepared, would attend class more regularly, and had better assimilation of the course content and comprehension of the lecture material. (5) Finally, the availability of textbooks appears to be a factor impacting students' course success. Thus, OER equalize college students' learning and performance, foster engagement, and facilitate their comprehension of lectures while still maintaining the same level of quality in final grades as that in the traditional textbook class.

Limitations

There are limitations to this study. The findings of this report only measured students in two classes of one instructor at a large publicly funded urban doctoral-granting research university. This should be taken under consideration as readers evaluate the generalizability of these findings. No data exist for students who did not purchase the required textbook in the 2017 class and/or did not utilize the course reserve at the library. Therefore, whether students who did not purchase the required textbook utilized the course reserve is unknown. However, even if the instructor had conducted a survey during the semester as to the access (or lack thereof) of the traditional textbook, the truthfulness of the students' responses would be hard to determine. Additionally, the total activity time on the LMS would be another valuable variable for inclusion in this study; however, the records of the traditional textbook class were no longer available for download despite their availability for the OER class. Finally, this study only evaluated two Gen Ed classes, 75% of which consisted of students taking their first college courses, and 75% of the students were females. Upper-class students (juniors and seniors) were a small percentage of the population under consideration, and the institution is comprised of approximately 54% females and 46% males. Most importantly, this study was not based on an experiment due to the fact that the classes studied had already concluded at the time the idea for the study was formulated.

It would be beneficial if future research could include upper class students from both doctoral-granting and non-doctoral granting universities, courses in different fields taught by instructors with varying years of lecturing experience, and large and small class sizes in an experimental design to see if the results from this study could be replicated. This study evolved from the initial report to the Library's Textbook Affordability Project at the end of the fall 2018 semester. No data were collected during the semester for analysis in a research paper of this scale. In this study, engagement was operationally defined as (1) page views, (2) on-time assignment submissions, and (3) attendance merely because data were available from

the LMS. However, they were not comprehensive in scope. Future studies could try to define engagement by incorporating definitions from Alrashidi, Phan, and Ngu (2016), Kuh, Kinzie, Buckley, Bridges, and Hayek (2006), and McCormick, Kinzie, and Gonyea (2013) to create instruments to collect data. In addition, figuring the percentage of variance that can be explained by the availability of textbooks on students' final grades would be important.

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DR. ISABELLE CHANG has been a faculty member in the department of psychology for more than a decade. She is attracted to the simple logic of mathematics and is interested in statistics and psychometrics. As such, most of her teaching assignments are in quantitative topics such as statistics. She enjoys constructing statistical models using graphics to lay out her hypotheses and testing them on large-scale national and international data. After more than a decade in the classroom, she is increasingly interested in studying college student's learning behaviors and approaches. She is most interested in studying her own student's learning and the long-term benefits that they can realize from her classes. She strongly believes that by studying her own student's learning she can improve her own teaching performance and outcomes.

Prioritizing Ethics: Interdisciplinary Implementations of Principle-Based Ethics in Secondary Teacher Education

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This instructional article describes recent implementations of ethics education in a teacher education course at a large university in the Southwest United States. Using a case analysis framework in tandem with a principle-based ethics schema, a teacher educator and his research assistant designed five content interventions for their content area literacy curriculum in the hopes of helping preservice teachers position their developing pedagogies alongside a cultivation of ethical reasoning and decision making. Rooted in ethics education literature that reveals a lack of empirical data surrounding the impact of professional ethics in teacher education settings, the article explains innovative teaching methodologies while sharing samples of student work along with a review of students' reactions. Finally, questions are posed for further research in higher education regarding the implementation of ethics for future teachers.

Human beings utilize systems of ethics to define their beliefs, values, and attitudes and leverage these understandings to guide their choices and actions throughout their lives (Rennie, 2015). Chowdhury (2016) argues that ethics can be studied in three distinct ways: 1) as synonymous with morality, including standards for human behavior; 2) as a philosophical examination of humans and their social condition; and 3) as referring to the special codes of conduct shared by groups pursuing common professional objectives. While these strands can be applied to ethics across numerous disciplines, education integrates all three. During teaching and learning processes, educators position students to construct knowledge while modeling certain patterns of self-expression and interaction, all within a professional system that has established unique measures of preparation and performance (Gatti & Payne, 2011). Ethics are integral to human experiences within the teaching profession because an educator's pedagogy is grounded in understandings of ethical reasoning and decision-making (Arthur, 2010).

Specifically, the field of teacher education, where experienced instructors guide aspiring teachers simultaneously toward the mastery of their craft and the practice of acceptable professional conduct, presents ideal contexts for ethics to be applied and studied by researchers and educators alike (Boon, 2011). Unfortunately, teacher education has lagged behind other fields in facilitating formal instruction on ethics formation as part of its professional preparation (Freeman & Brown, 1996). Despite scholars agreeing on the importance of professional ethics for future teachers, a lack of research in examining the effects of ethics education in teacher education coursework persists (Winston, 2007). To address this gap, this article explores the integration of ethics education in a teacher education course and is driven by the following question: How can educators integrate ethics education to enhance preservice teachers' developing pedagogies in a content area literacies course?

Literature Review

Faculty within schools of business, medicine, and law at universities across the United States began offering coursework in ethics for both undergraduates and graduate students in the 1960s, but scholarship accounting for preservice teachers' professional ethics education did not appear for at least two decades later, in the mid-1980s (Warnick & Silverman, 2011). Lasley (1987), Reagan (1983), and Rich (1984) were some of the first scholars to theorize discussions of professional ethics for teachers and apply them in teacher education settings. Yet, in the years since these early studies were conducted, research on ethics in education has waned, especially in comparison with other fields (Bowie, 2003). This persistent lack of research on professional ethics education for future teachers could be attributable to a lack of implementation on the part of teacher education programs. For instance, in a recent higher education survey, Glanzer and Ream (2017) found that only 9% of teacher education programs include electives or required courses in professional ethics. Ethics implementation may be lacking in some programs due to a variety of reasons such as time restrictions, alternative curricular objectives, and a solidified emphasis on subject matter instructional approaches (Glanzer & Ream, 2017).

Meanwhile, widespread benefits of ethics education in other fields have been well-documented. Applications of ethics can impact aspiring professionals' measures of moral reasoning in communication studies (Canary, 2007), nursing training (Krawczyk, 1997), marketing (Agarwal & Malloy, 2002), and pre-medicine (Smith, Fryer-Edwards, Diekema, & Braddock, 2004). Students in higher education can experience a positive change in attitude with regard to the ethical dimensions of their professional development when their coursework includes ethics training (Plaisance, 2007). Across

numerous fields of study, ethics education is most impactful when students are asked to consider real-world cases of ethical dilemma through in-depth discussion and workshopping (Warnick & Silverman, 2011). Teacher education courses position preservice teachers to practice standards-based curriculum design, develop culturally responsive instructional strategies, and cultivate competent aptitudes within dynamic school communities; these contexts are optimal for drawing upon real examples from the professional world of teaching (Strike & Soltis, 2009).

While studies from other fields suggest that preservice teachers can benefit professionally from ethics training, embedding ethics education in teacher preparation is also a moral choice, a pursuit of shared commitment toward cultivating personal responsibility and socially-just practices (Campbell, 2008). Teacher educators engaged in professional ethics make choices in curriculum, instruction, and pedagogy based on their core values of the human experience and model those values for their students (Campbell, 2003). Because preservice teachers pursue coursework and licensure with varying levels of experience in maneuvering questions of ethics, effective training is needed to ensure that students emerge from their higher education programs with a sense of ethical efficacy (Fischbach, 2015). By prioritizing ethics alongside familiar components of teacher education such as assessment, classroom management, and data-informed instruction, preservice teachers can see their pedagogical development as a reflection of their moral and ethical identities.

Much like professionals in other fields, new teachers are introduced quickly to the professional codes of conduct unique to their vocation (Barret, Casey, Visser, & Headley, 2012). However, unlike graduates of finance, medicine, law, and psychology, whose licensure and accreditation programs are often constructed around systematic units of field-based ethics education, novice educators are often left to fend for themselves (Huling & Resta, 2001; Moir, 2009). Lacking direct preparation for achieving both moral and professional success in ethically challenging scenarios, many new teachers feel isolated and powerless to do what is right (Mathur & Corley, 2014). Often undertrained and conflicted about a range of issues including personal beliefs, moral obligations, familial traditions, and multicultural perspectives, preservice teachers require hands-on ethics learning to prepare for the complex realities of their future workplace (Cartledge, Tillman, & Talbert-Johnson, 2001).

In his call for the proliferation of ethics content in teacher education coursework, Maxwell (2017) argues that if preparing teachers to impact practice and policy of institutions in ways that better the contexts and futures for teaching and learning on behalf of all stakeholders, then "it is imperative to be rigorous and explicit about introducing future educators to the ethical norms of teaching as they are formalized in existing codes of professional conduct" (p. 320). Prior research in the area of training teachers to successfully navigate the ethical dilemmas awaiting them reveals both a growing demand for the implementation of ethics education across higher education and a lack of empirical cases investigating their results. Clearly, the need to prepare preservice teachers to engage in ethical reasoning and decision making is agreed upon by practitioners and researchers alike. And yet, the field is in dire need of practical investigations of ethics-based education, as a majority of candidates feel unprepared to make important ethical decisions in their classrooms and school institutions (Sahan, 2018). The implementations described in this article attempt to offer an example of how to answer this call.

Dual Framework for Ethics Integration

The Case Analysis Framework

Drawing upon prior research in professional ethics from a variety of fields including business, economics, and law, Warnick and Silverman (2011) constructed a framework for case analysis (Table 1) that "aims to integrate ethics education for teachers to reveal to teachers the prima facie obligations they face" (p. 281).

Table 1
Case Analysis Framework (Warnick & Silverman, 2011).

Step One	Compile Information About the Case
Step Two	Consider Various Participants
Step Three	Identify and Define the Ethical Problem
Step Four	Identify Some Options
Step Five	Conduct a Theoretial Analysis of Your Opinions
Step Six	Consider Your Role as a Teacher
Step Seven	Educate Yourself as Time Permits
Step Eight	Make the Decision
Step Nine	Decide How to Evaluate and Follow Up on your Decision

Table 2
Principle-Based Ethics

Integrity	Act with honesty in all situations
Trust	Build trust in all stakeholder relationships
Accountability	Accept responsibility for all decisions
Transparency	Maintain open and truthful communications
Fairness	Engage in fair competition and create equitable and just relationships
Respect	Honor the rights, freedoms, views, and property of others
Rule of Law	Comply with the spirit and intent of laws and regulations
Viability	Create long-term value for all relevant stakeholders

In their Case Analysis Framework (CAF) Warnick and Silverman (2011) identified nine sequential steps for teacher educators to model with regard to analyzing cases that challenge teacher candidates to practice ethical reasoning and decision-making. CAF prioritizes contexts specific to teacher education settings such as alignment with moral dimensions of schooling as well as the generation of solutions for school-community stakeholders. The framework's systematic versatility across numerous applications allows educators to focus not only on the well-being of individuals, but also on making larger connections to the teaching profession itself (Warnick & Silverman, 2011).

The Daniels Fund Ethics Initiative's Principle-Based Ethics (n.d.)

While the CAF (Warnick & Silverman, 2011) offers a step-by-step guide for maneuvering individual situations of ethical dilemma in school institutions, principle-based ethics (PBE) can be used in ways that afford teachers and students a set of general, interdisciplinary principles to follow. Recently, the Daniels Fund Ethics Initiative (DFEI) has categorized eight principles for ethics learning (Table 2). Named after its founder, Bill Daniels, the late Denver-area businessman and philanthropist, the DFEI promotes ethical standards across higher education communities, including training for instructors and students, as well as ethics programming for campus communities (DFEI, n.d.). DFEI's collegiate program currently partners with eleven institutions across four states to promote ethics education in higher education. Instructors in participating academic units utilize DFEI funding and resources to hold a range of ethics summits, seminars, and workshops throughout the academic year, all aimed at delivering PBE education that extends "beyond philosophy and theory to real world, practical application of ethical principles as a framework for personal and organizational decision-making" (para. 7).

Combining the sequence of analytical procedures offered by the CAF (Warnick & Silverman, 2011) with the clearly defined list of principles posited by the DFEI offers a dual framework for integrating ethics education into the coursework and training of preservice teachers. In the following section, a contextual summary and rationale for ethics is provided.

Contexts and Rationale for Ethics Integration in Teacher Education

Rick is a White male assistant professor of teacher education whose research includes explorations of interdisciplinary intersections of literacy, language, and culture in higher education. A former middle school and high school English teacher, Rick participated in the DFEI Fellowship Program at the authors' large university in the Southwest United States during spring, 2018. Thomas is a teaching assistant and doctoral candidate in the school of teacher preparation within the authors' College of Education. Thomas is a Black male doctoral student who also previously served as a classroom teacher. His research focuses on learning designs and technologies and critical pedagogy. Both authors share a mutual interest in the implementation of ethics education for preservice teachers.

Strategies and materials accumulated through the DFEI fellowship provided us with a unique opportunity to incorporate PBE into our teacher education curriculum. In an effort to introduce preservice teachers to ethics education, we modified various DFEI training modules to fit the interdisciplinary nature of our course. Specifically, Content Area Literacy is a seminal course designed to support secondary education majors in their development of effective literacy instruction within their teaching practice. The course meets weekly and is interdisciplinary, combining preservice teachers from a variety of disciplines such as social studies, English, marketing, science, agriculture, and art. This mix of content area literacy practices and perspectives invites innovative collaborations that contribute to understanding how students' individual contexts can enrich educational experiences (Marlatt & Dallacqua, 2019).

Used in conjunction with PBE, we felt that Warnick and Silverman's (2011) CAF could help us position students to think critically about the role of ethics in their pedagogical development. We approached our ethics implementations using both

Table 3
Ethics Integration Overview

Student Learning Outcomes	1. Describe concepts underlying ethics and apply these foundations to preparation and practice. 2. Understand the necessity for ethics as they apply to teaching and learning in classroom spaces. 3. Discuss perspectives of ethics and articulate their impact on experiences of K-12 learners. 4. Develop individual abilities to discuss and model ethics with others. 5. Recognize the impact of ethics on teaching philosophy and pedagogy.
Content Interventions	1. Defining Ethics *foundational readings, discussions, class activities; introduction to DFEI principle-based ethics 2. Ethics Labs *interdisciplinary groups navigate scenarios inspired by instructors' experiences as classroom teachers. 3. Content Area Ethics Labs *content area groups design their own discipline ethics labs for their peers to complete in class. 4. Ethical Dilemmas and Decisions that Define us as Educators *current and former classroom teachers from a range of content areas serve as guest speakers. 5. Final Ethics Essay *students complete a cumulative writing assignment detailing what they have learned about ethics.

frameworks equally: the CAF allowed for a clear set of steps for students to follow while PBE offered clear conceptual targets for students to work toward in their ethics training. The primary objective of these interventions was to fully integrate ethics education into secondary teacher education coursework with the aim of building a solid ethical framework for preservice teachers that is central not only to their approaches in curriculum and instruction, but also aligned with their decision-making as educators. In redesigning the course to be infused with ethics education, we identified five specific student learning outcomes for the 26 students during the fall 2018 semester. These objectives, as well as the specific interventions which are explained in detail throughout the next section, are provide in Table 3 for a comprehensive overview of the curriculum.

Implementing Ethics Content in Teacher Education

Integrating content area literacy units with ethics training enhanced the preservice experience by positioning students to integrate approaches to curriculum and instruction alongside considerations for ethical principles and practices within the teaching profession. As future teachers synthesized their development as practitioners in tandem with active engagement in ethics activities, they not only co-constructed new understandings about the importance of ethical reasoning and decision-making in education, but also prepared themselves to model moral standards for their own students. These interventions were the result of five content additions which we made to the course in the weeks leading up to the fall 2018 semester. We share the details of these interventions in the following sections, including supplemental instructional materials along with students' work samples.

Intervention 1: Defining Ethics

To introduce PBE and case analysis early on and emphasize the importance of ethics to our coursework, we facilitated a group activity and follow-up discussion during our first class meeting in which content area groups explored the meaning of each principle and collaborated around its connection to teaching and learning. Once each group had shared their thoughts on trust, accountability, transparency, etc., we discussed the DFEI in greater detail, sharing videos and information we learned from the institute. Next, we read and discussed Warnick and Silverman's (2011) article on ethics case analysis. Finally, we introduced our syllabus and semester schedule, all the while emphasizing profound connections between ethical practices and

Table 4
Content Area Ethics Labs Assessment Data (n=8)

Content Area	Score
Agriculture	18 (90%)
Business/Marketing/Management	18 (90%)
English Language Arts	19 (95%)
Family & Consumer Science	16 (80%)
Mathematics	15 (75%)
Physical Education	14 (70%)
Social Studies	17 (85%)
Social Studies	19 (95%)

our work as educators. These initial activities afforded students the opportunity to get to know one another and hopefully begin to see their teacher training as synonymous with ethics training.

Intervention 2: Ethics Labs

During our next three class meetings, we regrouped the students into interdisciplinary teams who completed weekly Ethics Labs, which were cases of ethical dilemma inspired by lived experiences the authors had either been involved in or observed during their time as classroom teachers. The labs positioned students to see ethics not merely as theoretical constructs disconnected from their coursework, but rather as active guidelines for ethical behavior in their schools. Students used the CAF to progress through the case analysis process and then connected their scenario to one or more of the PBE. This experiential learning helped students see ethical reasoning as integral to their work as educators while also modeling examples of how they could consider their responsibilities as active stakeholders within school communities. Appendix A offers an example Ethics Lab, complete with scenario descriptions and objectives, role details, and debriefing of questions for group members.

Intervention 3: Content Area Ethics Labs

As mentioned previously, one of the strengths of this particular course is its interdisciplinary make-up with future educators coming together from numerous fields and backgrounds. With this diversity in mind, we modified our syllabus to feature eight consecutive weeks for each content area to present an original Ethics Lab grounded in their disciplines. During our fifth class meeting, each content area drew a principle at random, around which they then worked to design an Ethics Lab that was tailored to situations in teaching and learning that connected to their principle. Content areas had several weeks to prepare their Ethics Lab during class before facilitating them later on in the semester using the CAF. We offered content areas

minimal assistance as needed while requiring that the scenario groups designed, along with the experiential learning that explored its case, must meaningfully connect to their PBE. Appendices B and C offer sample Ethics Labs from English Language Arts and Mathematics. Appendix D features the scoring rubric we designed and utilized to measure student success. Table 4 illustrates assessment data from the Content Area Ethics Labs. Out of 20 possible points, the highest score was 19 (95%), the lowest score was 14 (70%), and the average score was 17 (85%).

Intervention 4: Ethical Dilemmas and Decisions that Define us as Educators

Part of a teacher educator's impact lies in their ability to share with preservice teachers their previous educational experiences. Unfortunately, experiences related to ethical dilemma are often overlooked in teacher education courses because accountability pressures can force issues such as assessment and a standardized curriculum to outweigh other areas that figure equally into the real world of teaching. To broaden students' perspectives, we solicited commitments from two former colleagues of the authors, both of whom are award-winning secondary educators, to offer their time as guest speakers during weeks six and seven of the semester. Each speaker shared stories from their careers in which they were tasked with navigating complex situations. They offered contexts surrounding their cases, articulated factors involved, detailed possible choices and ramifications, and ultimately revealed their decisions. Speakers then took questions from students and engaged them in discussions on the importance of ethics in education.

Intervention 5: Final Ethics Essay

As part of their culminating activities on exploring the importance of ethics in their approaches and actions as educators, we asked students during one of our final

class meetings to describe what they had learned about ethical reasoning and decision-making in a final essay exam. Preservice teachers discussed their work in analyzing cases using the CAF to illuminate applications of PBE such as respect, rule of law, viability, etc. This assessment allowed students the opportunity to define ethics in their own terms and in conjunction with their content area expertise, while reflecting on their work throughout the semester. Appendix E displays the scoring rubric we created and used to measure student success on this assessment. Appendix F offers a sample essay from a family and consumer science preservice teacher. Table 5 illustrates assessment data from the essays. Out of 100 possible points, the highest score was 98 (98%), the lowest score was 74 (74%), and the average score was 88.9 (88.9%).

Gauging Students' Responses

To gauge the impact of implementing ethics training in our Content Area Literacy course, we asked our preservice teachers to complete a survey at the conclusion of the semester. The survey was comprised of two sections. Section One included five closed-ended statements on a Likert scale with possible responses of *strongly agree*, *agree*, *undecided*, *disagree*, and *strongly disagree*. In Section Two students responded to an open-ended prompt that asked them to describe their experiences in engaging in ethics labs during the course. In the following sections, we present results from the surveys, as well as a summary of student responses, before offering a discussion on how these responses could be interpreted for future teaching and research.

Section One: Likert Scale Statements

Overall, the results of the surveys yielded positive data in terms of how students interpreted their experiences in ethics education. In response to the first two statements, students decisively alluded to both their general understanding of the importance of ethics education while also asserting ethics' influences on their future teaching. Results then begin to vary as students progressed through the survey. While the majority of students strongly agreed that they planned on incorporating ethics in their teaching, a fair number were less convinced, with some even disagreeing entirely. Most students assessed that the course had a helpful impact on their learning of the importance of ethics, although some again disagreed. Finally, students expressed the lowest level of consensus with regard to our course affording them their first opportunity to engage with ethics education. Figures 1 through 5 below illustrate a breakdown of students' reactions to these statements.

Table 5
Final Ethics Essay Assessment Data

Content Area Scores	Average Score
Agriculture (n=5) 94, 90, 88, 86, 74	86.4 (86.4%)
Business/Marketing/Management (n=3) 97, 93, 93	94.3 (94.3%)
English Language Arts (n=4) 98, 97, 94, 91	95 (95%)
Family & Consumer Science (n=2) 92, 88	90 (90%)
Mathematics (n=4) 97, 95, 89, 80	90.25 (90.25%)
Physical Education (n=3) 87, 86, 80	84.3 (84.3%)
Science (n=2) 86, 78	82 (82%)
Social Studies (n=3) 96, 92, 79	89 (89%)

Figure 1
"I understand the value of ethical principles in education."

Understanding Ethics

Strongly Agree: 73%	
Agree: 27%	
Undecided: 0%	
Disagree: 0%	
Strongly Disagree: 0%	
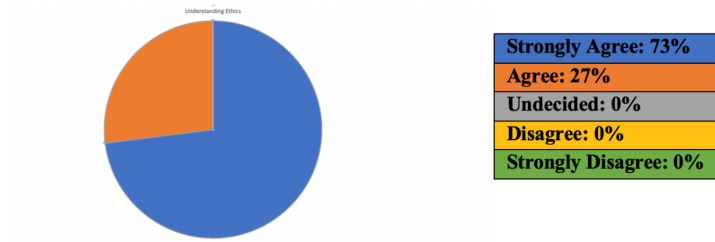
Figure 2
"My teaching will be influenced by ethical principles."

Influences on Teaching

Strongly Agree: 92%	
Agree: 8%	
Undecided: 0%	
Disagree: 0%	
Strongly Disagree: 0%	
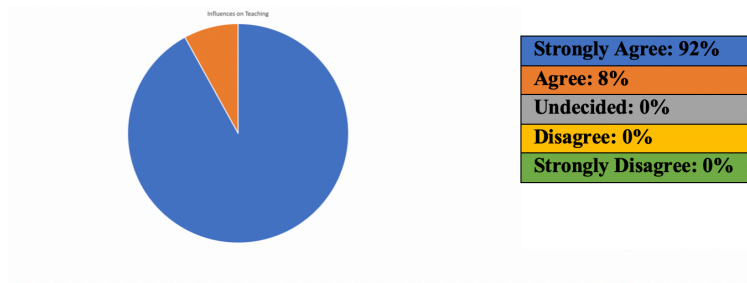
Figure 3
"I plan on incorporating ethics learning in my curriculum and instruction."

Incorporating Ethics

Strongly Agree: 65%	
Agree: 23%	
Undecided: 6%	
Disagree: 6%	
Strongly Disagree: 0%	
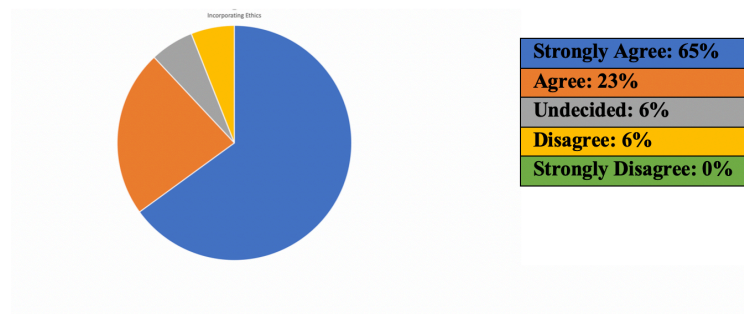
Figure 4
"This class helped me learn about the importance of ethics in teaching."

| Strongly Agree: 65% |
| Agree: 31% |
| Undecided: 0% |
| Disagree: 4% |
| Strongly Disagree: 0% |
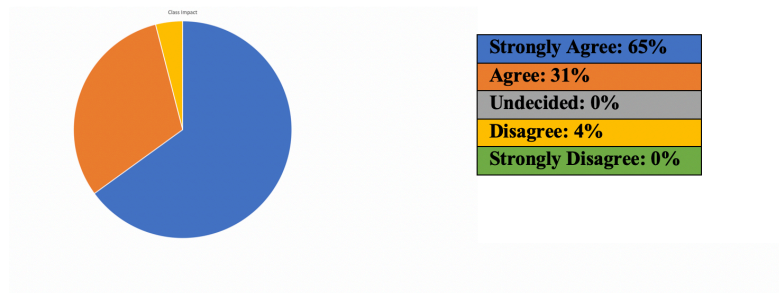
Figure 5
"This class was my first opportunity to engage with ethics in education."

| Strongly Agree: 14% |
| Agree: 64% |
| Undecided: 13% |
| Disagree: 9% |
| Strongly Disagree: 0% |
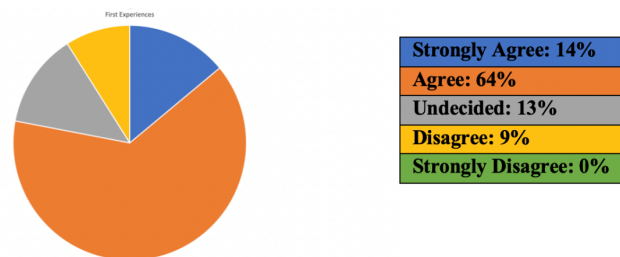
Section Two: Open-ended Responses

Describing their experiences in writing, many students expressed a sentiment of the ethics labs being beneficial to their professional development. A preservice music teacher shared, "I really enjoyed the ethics labs. They were always interesting and fostered a great amount of reflection. Ethics are such an important aspect of pretty much everything, and yet there seems to be no formal education or engagement of it." A social studies candidate added, "We got to visualize ourselves in sticky dilemmas, and we could handle them. We were also able to see the effects of making unethical decisions on others." A science major also wrote, "The ethics labs were my favorite parts of class. It helped me understand the specific struggles teachers in each of the content areas face. I wasn't looking forward to it at the beginning, but it ended up being really insightful." Combined with the Likert scale responses, these statements indicate that students may perceive a benefit to ethics training. Yet, students' overall commitment to sustaining an ethics-based pedagogy is less conclusive, as 6% disagreed with the statement that they plan to integrate ethics in their curriculum and instruction, and another 6% were

undecided. Situating themselves for collaboration around a variety of contexts concerning ethical reasoning and decision-making allowed for immersion in real-world scenarios within the profession.

Similar to the open-ended responses, the final essays also afforded students a platform to describe experiences in their own words. In the following essay excerpt, a preservice agriculture teacher describes her feelings of professional advancement through ethics training:

> Throughout this class, we worked on eight ethics labs in our content areas. From the start, I was skeptical about the knowledge we would gain, how they would relate to our content areas, and how, if at all, I could use this in my future classroom as an agricultural science teacher. Not only did I learn how to teach my students the eight principles of ethics in my class, but I learned the importance of them, and I learned about real-life experiences and the different ways to handle them inside and outside of the classroom.

In this self-reflection, our student shares insight into her personal development by tracking the evolution of her considerations for ethics, both in terms of

classroom spaces and beyond. While this student's introspection centers around her own individual progression, other students were more relational in their essays and affiliated their learning with peer interactions they experienced. For instance, a candidate from physical education touches on ethics-based maturation of the class as a whole in the following excerpt:

> At the very beginning, we all thought about what it meant to be ethical. How does that apply to us? Is it simply to be moral according to our standards, or to those who are around us? I think we can agree that it is not so simple. We need to consider circumstances, but we also need to think about the people involved. I think we established throughout the semester that none of us think alike. That is the beauty of each of us being our own individual. However, that doesn't mean that each of us aren't willing to open up to change. Situations and personnel definitely play a role into our decision-making process. Prior to this class, I had very little information about what these principles meant, but now I have a much better understanding and believe I can apply ethics to daily life.

This student associates his own perceptions with those of his peers, demonstrating an understanding of the social-emotional role ethics can play in unifying professional learning communities. In the collaborative, interdisciplinary setting, preservice teachers encountered multiple points of view and backgrounds on their way to analyzing cases of ethical dilemma and generating thoughtful solutions. They also considered a number of roles and perspectives across the spectrum of educational stakeholders, such as colleagues, administrators, students, community members, and more, allowing them to explore the potential for competing motivations and diverse ideologies operating throughout the teaching profession.

Discussion

In terms of curriculum design, our implementations seem to have collectively achieved all five of our central objectives for the course. Through readings and discussions geared toward defining ethics in the education profession, hands-on labs presenting field-based ethical dilemmas, and opportunities to share written reflections on experiences with ethics-based learning, preservice teachers representing a range of content areas utilized frameworks of ethics education to collaborate in activities designed to facilitate their professional

growth. While our opening week discussion on ethics and guest speaker format did not appear to resonate with students as much as the ethics labs in their responses, we feel that an introductory foregrounding of essential paradigms and approaches is important in an academic setting, especially one in which experienced instructors are modeling concept attainment and instructional methods for preservice teachers (Gatti & Payne, 2011). In upcoming courses we will continue to offer opportunities for preservice teachers to consider the importance of ethics, both from a theoretical perspective and from the ways they approach teaching and learning with their colleagues and future students (Warnick & Silverman, 2011).

We join other practitioner researchers such as Boon (2011), Glanzer and Ream (2017), and Maxwell (2017) in encouraging instructors in teacher education programs to take up the important work of integrating ethics education into their syllabi. Activities such as ethics labs and case analyses afford preservice teachers engaging opportunities to collaborate with peers from similar content areas and disciplines; however, interdisciplinary approaches to ethics instruction can offer numerous chances for cross-curricular interaction (Fischbach, 2015). The strategies we have shared align with examples of ethical reasoning and decision making that are essential for successful teacher preparation (Arthur, 2010). As teacher educators continue to draw on ideas for ethics implementation from other fields, student outcomes such as those shared in this article may contribute to a growing prioritization of ethics in learning how to teach (Barret et al., 2012). We also invite instructors working in various disciplines and program areas across the international higher education community to use the strategies we have shared and to contextualize our tactics to the needs of their institutions and students (Winston, 2007).

Although our primary disciplinary focus is rooted in teacher education, the curricular interventions described in this article could be adapted in numerous ways for many other fields as well. As an essential component of the social sciences involves studying the interactions and relationships between individuals in society, ethics training in higher education could enhance preservice professional development in psychology, sociology, law, and more (Gladwell, 2019). Contexts surrounding the field of economics clearly present connections to ethics integration with potential impacts on developing economic citizenship and literacy (Crowley & Swan, 2018). Teaching and learning about conducting research in higher education could also benefit from supportive training systems to help developing researchers better understanding the ethical dimensions of participant recruitment, informed consent, and inquiry (Zschimt, 2019).

Limitations and Future Research

Our primary purpose in this instructional article is to share details of emerging teaching methods rather than present empirical data. Still, as practitioners, we are encouraged by our students' positive statements about ethics training and its possible connections to their professional development. Returning to the original question of impact that inspired these interventions, students expressed a consistent sense of engagement, and in some cases, enjoyment, in response to the ethics training activities featured in the course. Students' compositions, both in their surveys as well as their essays, reveal some degree of benefit and influence with regard to connections between professional ethics and preservice education. Whole-class and content area ethics labs stood out as perhaps the most prominent of the five syllabus additions. Not only do example labs showcase how students incorporated ethics into instructional design, but they are also referred to numerous times in students' reactions. However, additional investigations are needed in order to produce more definitive, detailed claims on the actual impact of our instruction. More longitudinal studies emphasizing empirical findings of a larger scope and examining experiences of greater numbers of participants are needed in order to produce results and implications that can provide scholarly impact.

While we are optimistic about the level of engagement and interaction students brought to their ethics training throughout the semester, we were continually curious about the actual, measurable impact ethics education may have been having on their developing pedagogies. Interesting questions remain unanswered and may perhaps spark further inquiry. If students did, in fact, benefit from ethics training, in what ways is that impact visible, and how can it be expanded in other settings? Why did students express somewhat inconsistent assessments of their prior ethics learning, and what questions might that raise about teacher education programs? Teaching and learning within which content areas were more or less applicable to using the CAF to navigate ethical dilemmas? Were the PBE we featured in the course the most relatable for the field of education, or is there another framework that can perhaps more accurately portray the challenges teachers encounter? What effect, if any, do implementations such as these have for the future of ethics education for preservice teachers? We would also like to explore whether there was a level of quality in our instruction that contributed to positive outcomes, or if the sheer prevalence of ethics-based activities led students to recount a sense of impact. These are merely some of the questions that could position scholars and instructors for future research.

Conclusion

This instructional article describes recent implementations of PBE in teacher education which were designed to help preservice teachers position their developing pedagogies alongside a cultivation of ethical reasoning and decision-making. Using the framework for case analysis forwarded by Warnick and Silverman (2011) in conjunction with the PBE schema outlined by the DFEI, five content interventions were added to a Content Area Literacy course. In sharing our curricular models and samples of students' work, our goal is to advocate for the inclusion of opportunities for preservice teachers to engage in ethics education during their coursework. We also seek to inspire scholars to investigate the role of ethics in teacher education through empirical studies. While we suggest that our students benefited from a range of experiences including ethics labs and case analyses, we believe further research is needed to understand the actual impact of ethics on the developing pedagogies of future teachers. As the field of teacher education continues to respond to changing tides in policy and practice, one constant remains: the need to position preservice teachers to successfully navigate complicated dynamics of school institutions while mentoring students of their own in ways that reflect moral interactions with self and society. Prioritizing ethics education has the potential to help teacher educators achieve these objectives.

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Acknowledgements

Appendix A

Example Ethics Lab

Objective: Position students to navigate an ethics challenge and begin considering the enormous importance of ethical reasoning and decision-making by applying the CAF to a real-world case.

Expectations:
1) Groups of 4 students will participate in the lab.
2) Each group will have a minimum of 30 minutes to complete the lab.
3) Group members will be assigned lab roles at random.

Roles:
The Principal--As the Principal, you pride yourself on the quality of education provided by your staff members to the school's students. Specifically, you tend to focus almost exclusively on achievement scores students produce on standardized tests, and you make it your personal mission to ensure that all teachers in the school make test scores a priority as well. Teacher 2 is your newest staff member, she/he just started this fall. Early on, you have noticed that her/his students' test scores are consistently lower than you expect, much lower than students of other teachers in the building. You tried to work with this teacher previously, but the scores are not going up. You feel you have spent sufficient time trying to help Teacher 2 improve, but the results are not showing. You have been summoned to attend a meeting between Teacher 2, Teacher 1 who is also the department head and a renowned educator in the district, and a representative from Human Resources who called the meeting. In this meeting your goal is to arrive at a decision where Teacher 2 is removed from the building and reassigned to another school in the district. You feel you have done all you can for Teacher 2, and you feel you have followed protocol by keeping Human Resources informed of the situation along the way.

The Human Resources Representative--You are a personnel official with the school district. You help to mediate situations between staff members and administrators on a fairly regular basis. You are well aware of the school's prestigious standing and excellence in academics. You know the principal well and have known her/him to be a hard worker with very high expectations for both staff and students. You know the department head fairly well, having served in district appointments with him/her in the past. This is the first time you are meeting Teacher 2 in person. The principal alerted you to the situation months ago, and you were told that she/he had placed Teacher 2 in a probationary period for intensive training in an effort to help her succeed. Last week, the principal called to say that the situation was not improving and that she/he would like to explore other options for Teacher 2. You have called this meeting to hear from all sides and to come to a decision. This is your meeting. Lead it.

Teacher 1--You are a well-respected, renowned educator in the school district. You are the school's most senior faculty member and an award-winning teacher known for engaging teaching practices. You have served as the school's department head for 10 years, and you are a strong leader. Your numerous responsibilities in the department and district make you a busy person with many administrative duties in addition to your teaching load. You have learned to manage these tasks effectively while still maintaining your prestigious teaching credentials. Your students consistently score the highest in the district, which makes you sought after for trainings and seminars. For example, Teacher 2 has struggled to increase her/his students' test scores and has been asked to shadow you this semester. Because of your knowledge of the school district and your many assignments in and out of the building, you have devised a system that helps you keep up. For instance, you create the schedule for the department, including student rosters for each class, course assignments for staff members, etc. You are in a position of power, and you use it to your advantage in the best interest of the school.

Teacher 2--You are a brand new teacher to the district, having just graduated last semester. You are excited to work with students, and you feel you have many great ideas for teaching and learning. Unfortunately, students' test scores have not been satisfactory to the principal, though you feel you have tried everything. You have stayed late at your desk, hours into the night, brainstorming new and innovative lessons, but nothing seems to be working. The principal has been patient with you, but you know that your time to produce results may be running out. You have been asked to shadow Teacher 1, a renowned, award-winning educator who you really looked up to and admired. You were excited to learn from the best. You have noticed, however, that as the new teacher, you have no input on

student placement in your course. Your roster changes without notice from time to time. Your highest performing students are often pulled out and placed into other classes, including those of Teacher 1. Your class often receives the school's lowest performing students, many of whom are on behavior plans with the school. Just when you feel like you are making progress, students who show improvement are moved out of your class and are replaced with brand new students. You feel powerless because you are new and want to please everyone, especially your superiors.

Debrief Questions:
Principal:
What factors did you take into consideration during the lab?
Whose points of view where most prominent in the meeting?
Why do you think that was the case?

Human Resources:
What did you feel your role was in this lab?
How did you attempt to fulfill your role and were those efforts successful?

Teacher 1:
Describe your emotions during the lab?
What was it like to be in the hot seat?
How did you handle yourself?
Would you have done anything differently in retrospect?

Teacher 2:
Explain how you felt the meeting went?
What new factors, if any, did you consider during the lab?
Whose perspective(s) was privileged?
Whose perspective(s) was ignored?
Why do you think that is?

Appendix B

Rule of Law Ethics Lab: English Language Arts

Rule of Law: Comply with the spirit and intent of laws and regulations
Mock Trial: Individual Groups use Case Analysis Framework to Mediate

Roles:
● Prosecution team
● Defense team
● A judge
● Teacher on trial

Case: Plagiarism & Pirating

Teacher/Witness: A brand new teacher made copies of a standardized test. She did so in order to better prepare her students to take the test. The teacher wants to know where students are struggling and how best to help them, in part because her final evaluation depends on her students' test scores. Keep in mind test scores also determine student placement and their graduation status. While the teacher guesses that what she is doing might not be protocol, her professional development and new teacher training did not mention that teachers could not make copies of the standardized tests.

Defense Case: The teacher was given the test as a preparation guide from Pearson. She is using the test to prepare her students for the actual test, is that not what the guide was for? Copies of practice tests are handed out for PSAT, so why can the same not be done for standardized test such as PARCC and TAKS? In case of being found guilty, defenders will present possible consequences other than serving jail time.

Prosecution Case: The teacher knowingly plagiarized a standardized test and made a copy. She didn't tell Pearson she was going to make a copy and as a teacher she is not allowed to copy any portion of the test. She does not need a professional development or teacher training to tell her so. While PSAT allows copies of practice test booklets, PSAT scores do not count for things like graduation status. PSAT is also not a Pearson made test, therefore PSAT standards do not justify her copying of the test. It can be assumed the teacher will be distributing copies of the tests to her students, which can add the crime of pirating to her sentence.

Judge Mediation: Judge will mediate discussion, keeping comments professional, factual, and evidence based rather than opinionated. The judge will make the final decision about whether the teacher will be found guilty and will determine what happens to the teacher (i.e. what the consequence of her actions will be).

Appendix C

Integrity Ethics Lab: Mathematics

Part 1. INTEGRITY: How do you define integrity? Use case analysis in the following scenarios?

•As a famous athlete, you are offered a $500,000 endorsement to promote a product that you dislike and would NEVER use. Do you endorse it?

•You are working on a project along with several other companies and you notice that one of the companies is doing shoddy, dangerous work. If you report the company, the entire project may be shut down and you will lose 20% of your revenues for the year. Do you report the problem?

•The taxi driver gives you a blank receipt as he drops you off. You are on an expense account. Do you write in the exact correct amount?

•You're backing into a tight parking space in the work car park and you accidentally dent someone's car. Nobody has seen you. Do you leave a note taking responsibility?

•You know you are attractive and so does your prospective customer. Do you lightly flirt to get a major new account for your business?

•A colleague wants to copy and swap some music CDs. You know it's illegal. Do you do it?

•Your budgets are tight, you procure some business services, the vendor forgets to invoice you… six months go by. Do you remind them to send the invoice?

Part 2. Complete the Integrity Self-Assessment
        1. Do I avoid gossip?
                YES   SOMETIMES   NO
        2. Do I avoid spreading rumors?
                YES   SOMETIMES   NO
        3. Do I avoid inappropriate jokes?
                YES   SOMETIMES   NO
        4. Do I avoid using profanity?
                YES   SOMETIMES   NO
        5. Am I completely truthful?
                YES   SOMETIMES   NO
        6. Am I honest?
                YES   SOMETIMES   NO
        7. Am I dependable?
                YES   SOMETIMES   NO
        8. Am I trustworthy?
                YES   SOMETIMES   NO
        9. I give everything my best attempt?
                YES   SOMETIMES   NO
        10. I'd rather do things quickly than perfectly?
                YES   SOMETIMES   NO

Appendix D

Content Area Ethics Lab Rubric

Teacher Candidate:
DFEI PBE
Content Area:

Category	4: Highly Effective	3: Effective	2: Needs Improvement	1: Ineffective
PBE	TC identifies PBE, explains its significance & facilitates lab in a manner that demonstrates thorough understanding & application of ethics	TC identifies PBE, explains it sufficiently & facilitates lab in a manner that demonstrates some understanding & application of ethics	TC mentions PBE, somewhat alludes to its significance & facilitates lab with only marginal understanding & application of ethics	TC fails to identify PBE or explain its significance in any meaningful way, & fails to demonstrate understanding & application of ethics
Learner Knowledge	TC identifies the nature & needs of diverse learners & uses this knowledge as a basis for creating culturally responsive instruction	TC considers diverse learners to some degree & creates instruction that is somewhat culturally responsive for some learners	TC only marginally identifies the nature & needs of diverse learners & to a small degree creates culturally responsive instruction	TC fails to consider the nature & needs of diverse learners & does not create culturally responsive instruction for learners
Objectives	Lab objectives are clear, measurable, & clearly connected to PBE	Lab objectives are adequately designed and connected to PBE	Objectives are somewhat clear and seem indirectly connected to PBE	Objectives are unclear clear and overly disconnected to PBE
Content Area	TC draws on content knowledge to make sound decisions about engaging learners in ethical thinking	TC draws somewhat on content and makes mostly sound decisions about engaging learners In ethical thinking	TC's content knowledge is marginally visible, and decisions are less than sound about engaging learners in ethics	TC fails to demonstrate adequate content knowledge & makes poor decisions about engaging learners in ethics
CAF Design	TC coordinates knowledge of students, content, & resources to design effective opportunities for case analysis	TC coordinates knowledge of students, content, & resources to design mostly effective opportunities for case analysis	TC marginally coordinates knowledge of students, content, & resources with minimal opportunities for case analysis	TC fails to coordinate knowledge of students, content, & resources; fails to create opportunities for case analysis
Totals				
Total Score:				
Comments:				

Appendix E

Final Ethics Essay Rubric

In 3 pages, describe what you've learned about ethics in education using course ideas including principle-based ethics and case analysis

Points	3	5	8	10
Response	Writer fails to respond to the essay prompt.	Writer somewhat responds to essay prompt.	Writer mostly responds to essay prompt, synthesizing scholarship featured in the course to an adequate level.	Writer integrates the scholarship featured in the course with a clear and complete response to the essay prompt.
Critical Analysis	Paper does not critically address the concepts, scholars, theoretical foundations, and practical applications of ethics education featured in the course.	Paper somewhat addresses the concepts, scholars, theoretical foundations, and practical applications of ethics education featured in the course in a critical manner.	Analysis in the paper is beyond summarization & includes a synthesized and critical approach to the concepts, scholars, theoretical foundations, and practical applications of ethics.	Paper demonstrates critical analysis at a high level, synthesizing the concepts, scholars, theoretical foundations, and practical application of ethics featured in the course.
Scholarship	Paper does not demonstrate scholarly insight and fails to cite and discuss the scholars featured in the course.	Paper adequately explains and synthesizes the scholars and research featured in the course.	Paper features many scholars, theories, and applications discussed in the course.	Paper offers a superb review and synthesis of the scholarship featured in the course and utilizes the literature to substantiate claims throughout the essay.
APA Style	Writer fails to adhere to APA style.	Writer somewhat adheres to APA style.	For the most part, writer adheres to APA style.	Writer demonstrates strong adherence to APA style including in-text citations and references.
Idea Development	Paper fails to address the topic. Focus is unclear. Content is unrelated, insufficient, or absent.	Paper conveys only a vague sense of student's purpose. Focus is somewhat clear. Minimal elaboration.	Paper generally conveys student's purpose. Focus is usually clear. Elaboration is not fully developed.	Paper proficiently conveys writer's purpose of expressing an opinion and convincing the reader that the opinion is valid. Supporting details are logical.
Organization	Purpose is not developed in a coherent, logical manner. No use of transitions. Writing does not move toward any main message.	Purpose shows minimal use of coherent, logical development. Some sense of paragraphing exists. Infrequent use of transitions & sequences	Purpose is developed logically. Paragraphing usually appropriate. Occasional use of transitions. Logical sequencing of ideas.	Purpose is fully developed in a logical manner. Effective transitions used. Organization flows so smoothly the reader does not need to think about it.
Sentence Fluency	Poorly constructed	Poorly constructed sentences are	Clearly constructed sentences. Minimal	Clear, well-constructed sentences. Sentences

	sentences are vague & too wordy. Sentences do not connect to each other and impair clarity. Variation of sentence length is rarely used.	noticeable. Noticeable use of wordy and vague sentences. Some sentences connect to each other helping clarity.	use of vague sentences. Most sentences connect to each other to improve clarity. Occasional variation of sentence length.	concise and to the point—not too wordy. Sentences connect to each other for clarity. Sentence length varies.
Word Choice	Uses vocabulary that is vague, trite, incorrect, or inappropriate No unique or original phrasing.	Noticeable use of vocabulary that is vague, impenetrable, and overly specialized. Student uses vocabulary that is inappropriate. Little use of unique or original phrasing.	Minimal use of vocabulary that is vague, impenetrable, and overly specialized. Writer uses vocabulary that is inappropriate at times. Occasional unique or original phrasing.	Uses vocabulary that is appropriate and is not forced. Lively, unique, and original phrasing throughout.
Voice	The writing takes no risks & does not engage, energize, or move the reader, a lack of enthusiasm.	Tone is rarely appropriate for audience, topic, and purpose. Writer seems reluctant to "let go."	Tone could be altered slightly to better fit the topic, purpose or audience. The voice is pleasant and intriguing.	Tone is appropriate for audience, topic, and purpose. Provocative and lively writing holds the reader's attention.
Convention s	Poor use of conventions. Numerous errors in punctuation and spelling; errors in subject/verb agreement. Verb tense is inconsistent.	Limited use of conventions. Noticeable errors in punctuation and spelling. Noticeable errors in subject/verb agreement.	Capable use of conventions. Minimal errors in punctuation and spelling. Minimal errors in subject/verb agreement. Few verb tense inconsistencies.	Proficient use of conventions. Few, if any, punctuation and spelling errors. Has subject/verb agreement. Verb tense is consistent.

Appendix F

Sample Ethics Essay

Ethics Essay Final
        Through this course I have learned that ethics play a vital in role in order to teach children and others. The one thing that I take from this course is the definition of ethics which is knowing the difference between the choices we make on a daily basis and the impact it may have on others. Life can sometimes put us in a situation where our morals and attitudes may be comprised and we must ask ourselves what the correct ethical decision should be made. Not all the decisions we make as educators may be supported or associated with positive feedback, but we still need to do what is right not only for ourselves but the children we are teaching.
        If we look at integrity which is to be honest in all situations, we as educators must be held accountable to our standards and ensure that our students do the best they can, especially in high stakes testing. Students should also be awarded their rightful grade that they have earned during the entire course. It's easy to feel sorry for certain students regarding certain environmental or social excuses they may have and award them a higher grade instead of their original failing grades. However, we start compromising certain individual's grades and eventually the entire class will be awarded with different grades that they originally achieve. It is best to be honesty and show how our class is actually doing instead of altering documents to improve our rankings.
        Another component that is also vital is the ability to be able to build relationships with our students, administration, and community. One way to do is by remaining transparent and always asking for help or guidance from your administration if you ever feel the need to do so. By having effective communication among our coworkers and administration we will be able to deliver content that is satisfying to our students and meeting the criteria of the administration. In order to have success in the classroom it is vital to build that rapport with everyone and create a culture where students feel welcome and safe. Every student should feel comfortable at school and feel included throughout all activities.
        Most importantly is to always follow policy and law if you happen to be in a situation and do not know what response or action to take the best to do is ask for help or guidance. Once you have established that you must always remember to have the best interest of students and follow the appropriate protocol. If we have any questions or need proper guidance this would be an appropriate time to meet with your administration for any assistance. It's best to have your principle and other staff guide you towards the right direction instead of assuming what the correction action may be and having conflicting effects occur. I believe that education is the field where ethics is an integral part of a student's success, but it all begins with the educator's decisions.
        This course allowed me to critically think about the eight ethics principles and how they all relate and correlate to the field of teaching. Ethics now is engraved in my mind as the "correct thing to do" when your values and morals are compromised not only at work but in our daily lives. It is important to understand that the decisions we make can have a great impact on our students and anyone else around us.

Ambiguous Terminology:
A Challenge in Teaching Social Science Research Methods and Statistics

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Research terminology is an underexamined challenge in the teaching of social science research methods and statistics courses. An important problem in research terminology is that many of the common terms have more than one meaning in English, which students often confuse. For example, the words random, pretest, validity, and regression have more than one meaning and are often problematic for students. Clarification of the most common of these misunderstandings is provided, and teaching strategies are suggested. This issue of ambiguous terminology has not previously been directly addressed in the literature.

Research methods and statistics are important components of higher education in the social sciences. Social science students must learn about research in order to critically evaluate and appreciate the research findings they are taught. In our field of social work, learning research skills also enables social work students to discover best practices, evaluate their own practices and their own agencies, and contribute to the knowledge base of the profession (Cameron & Este, 2008; Moore, Avant, & Austin, 2008; Rubin & Babbie, 2014)

A substantial portion of the teaching of research involves the teaching of research terminology. Learning the correct meanings of research terms allows students to understand research. Acquiring the vocabulary of research also allows students to describe their own research to others, as well as to communicate about research in general with faculty, researchers, and colleagues (Grix, 2002). Being able to understand and use research jargon is an important learning objective of research education in the social sciences. Even internationally, social work research is often taught in English. Here, we attempt to deal with one aspect of research that poses difficulties for some students: ambiguous research terminology in American English.

Since we are social workers, we looked at the research literature on teaching research in social work. This literature on teaching research in social work education covers many topics. A good deal of the scholarship focuses on strategies to overcome students' anxiety, lack of interest, and resistance to research and statistics. For example, several authors have described evaluation projects involving service learning partnerships with community agencies that helped students to overcome their reluctance to learn how to conduct research (e.g., Harder, 2010; John, & Bang, 2017; Kaye-Tzadok, & Spiro, 2016; Postlethwait, 2012; Shannon, Kim, & Robinson, 2012; Taliaferro & Ames, 2010). Others have recommended data mining to help students become more interested and more competent in research (Auslander & Rosenne, 2016; Fouché & Bartley, 2016). Cameron and Este (2008) reviewed several strategies to increase students' involvement in research, including a recommendation that students disseminate their work through publication. Moore and colleagues (2008) espouse including students in faculty research projects. Elliot, Choi, and Friedline (2013) described an innovative online statistics lab that improved students' attitudes toward statistics.

There has also been work on specific topics related to improving the teaching and the understanding of research. Henderson, Acquaye-Doyle, Waites and Howard (2016) presented a culturally relevant research pedagogy that uses the Black perspective and is informed by historical trauma theory. Mapp (2013) and Slayter (2017) provided ideas about how better to integrate social justice issues into research courses. Calderwood (2012) developed a decision-making flow chart to facilitate the teaching of inferential statistics. Baker, Hudson, and Pollio (2011) developed the Practice Evaluation Knowledge Scale, an assessment tool to evaluate the effectiveness of social work research courses related to empirically-based practice. These represent just a sample of some of the more recent topics that have been addressed regarding the teaching of research to social work students. However, we have not discovered any work that addresses the challenges of teaching research terminology, despite its importance.

This article focuses on research terms with more than one meaning in English, which is a prevalent but underexamined concern in teaching research. First, we note that research terminology is a source of concern for students in research classes. We then offer authoritative clarification of the some of the ambiguity in research terms, based on reliable sources. We suggest innovative teaching strategies to improve the understanding and use of these terms by social science students. This article provides helpful attention to an important yet previously unnoticed issue in teaching social research—ambiguous terminology.

Student Concern About Learning Research Terminology

We are two experienced research teachers in a school of social work (30 years and 14 years) in the Pacific Northwest. Between us, we have taught research at all three levels of social work education: bachelor's, master's, and PhD. We both ask students in our research classes to complete anonymous questionnaires during the first class meeting. These questionnaires cover the students' attitudes and knowledge about research before they begin taking our research classes. These questionnaires are used in several ways in teaching the classes. Here, we report some of the data we have obtained through these pre-test questionnaires, which are comments indicating students' attitudes about research terminology. The use of these anonymous data was approved by our university's Institutional Review Board.

Findings from these pre-test questionnaires show that research terminology is a troublesome area for many students. For example, one question on a pre-test asked the students about their negative thoughts and feelings about research. (See Appendix for exact wording of questions.) This question has elicited comments about not being able to understand research and being confused, as illustrated in, "Lack of understanding the terminology," "Jargon is difficult to decipher," "I sometimes feel overwhelmed by the terminology," and "I'm afraid of the language used." On other pre-tests, a question asked the students to name their fears about research. Many students reported that they feared they would not be able to understand the concepts. Students replied, "Getting confused by definitions," "Getting used to the language and terminology," and "It seems like a foreign language to me." These data indicate that some students' apprehension about learning research is partly related to research terminology. The data do not indicate that terminology is the primary concern of most students as they begin a research course, but it is an important concern. There is a corresponding question on the pre-test, asking for students' positive thoughts and feelings about research. There, one student wrote, "I place great value on understanding research methods and terminology—in order to better inform my practice." Another question on the pre-test asks about any topics the student is particularly hoping to learn more about in the course. One Ph.D. student answered, "Get a very thorough understanding of research and research terminology."

Ambiguous Terms in Research and Evaluation

Research is known for its carefulness and precision. By a painstaking process, knowledge is gained, and the strengths and limits of the process to gain the knowledge can also be known. Paradoxically, while research requires precision about language, in social science research the terms used are often confusing. Specifically, some research terms have different meanings in general usage and/or in social work practice theory and/or in research, and some terms have more than one meaning in research. Social science research textbooks introduce these terms and provide research definitions, but they do not often address the ambiguity.

In our teaching experience, these ambiguous terms contribute noticeably to the confusion that students sometimes encounter when learning about research. Students experience difficulties when they have a prior vernacular understanding of a word and are taught an additional new, different, and technical meaning of it. They also experience challenges when one word is used in research in two or more different ways. We have found it more useful to confront and address the possible confusion than to ignore it. To promote the carefulness and precision that are valuable characteristics of the research process, we here point out some of the major sources of confusion and provide clarification. The terms we focus on here are not the only instances of ambiguity in research, but they are the ones that are most likely to be taught at the different levels of higher education and appear to cause the most confusion. Similarly, we do not present all of the definitions of the terms we review here, but only the common definitions that are the most troublesome.

Sources of Clarification about the Terms

To establish different meanings and to obtain all the relevant definitions, we used a variety of current dictionaries and a few research sources. Three types of definitions are presented here: (1) as used in general or vernacular usage, and in one case, slang, (2) as used in theory about social work practice and therapy, and (3) as defined in social science and social work research. We consulted the following dictionaries and sources:

1. For vernacular or general usage, and for slang:
   - *The American Heritage Dictionary of the English Language* (5th Ed.). (Kleinedler, 2016).
   - *The Merriam-Webster Dictionary* (New Ed.). (Merriam-Webster, 2005).
   - *The New Oxford American Dictionary* (3rd Ed.). (Stevenson& Lindberg, 2010).
   - *Cassell's Dictionary of Slang*. (Green, 2006).
2. For practice and therapy usage:
   - *The Social Work Dictionary* (5th Ed.). (Barker, 2003).
   - *APA Dictionary of Psychology*. (VandenBos, 2007).
   - *The Penguin Dictionary of Psychology* (4th Ed.). (Reber, Allen, & Reber, 2009).
   - *A Student's Dictionary of Psychology* (4th Ed.). (Hayes & Stratton, 2003).

3. For research usage:
    - *The SAGE Dictionary of Statistics and Methodology* (5th Ed.). (Vogt & Johnson, 2016).
    - *Pocket Glossary for Commonly Used Research Terms.* (Holosko & Thyer, 2011).
    - *APA Dictionary of Statistics and Research Methods.* (Zedeck, Harlow, Blozis, & Panter, 2014).
    - *Quasi-Experimental Research Designs.* (Thyer, 2012).
    - *Experimental and Quasi-experimental Designs for Generalized Causal Inference.* (Shadish, Cook, & Campbell, 2002)
    - *Research Methods for Social Work* (8th Ed.). (Rubin & Babbie, 2014)
    - *Handbook of Mixed Methods in Social Behavioral Research* (2nd Ed). (Tashakkori & Teddlie, 2010)

The Terms

Random: Two Vernacular Definitions and A Research Definition with Two Research Applications

Random has two related vernacular or general usage meanings, as well as a research meaning. The general usage definition is haphazard, chance, or occurring without intention or design. This is related to an informal or slang usage of unplanned, odd, or unexpected. In research, random refers to processes that are governed entirely by chance. Usually it refers to a process such as a coin toss; or one in which cases or units are assigned numbers, and then a table of random numbers is used to select the units. While the vernacular and the research meanings of random overlap, they also diverge. In this case the research meaning of the term is more precise than, and somewhat different from, the general usage dictionary definitions. Without explicit clarification students may assume that the three types of meanings overlap more than they do, and students may form an inaccurate understanding of the research meaning of random. For example, walking outside and asking whoever one sees to answer a questionnaire does not meet the criteria for a random sample, at all, yet it does meet the vernacular criteria of being unplanned and without design.

There is additional confusion about the word random in research, in that it is applied to different processes. The two major processes are random sampling and random assignment. *Random sampling* refers to a sampling method where the sample is chosen by chance only, and each individual in a population has the same independent probability of being chosen. Usually this sampling method employs a table of random numbers on the sampling frame to obtain the sample. *Random assignment* refers to using a method of assignment of cases to experimental groups, in which each case has an equal chance of being assigned to each condition, and the assignment is made entirely by chance. A coin toss or a table of random numbers may be used on the sample to assign cases to different experimental conditions. A further wrinkle is the term randomization, which usually refers to random assignment. Random sampling and random assignment are two different processes with two different names. One might think that they would not be confused; however, it is our experience that since both random sampling and random assignment begin with the word random, they are sometimes used interchangeably by students. Highlighting the difference between these two separate meanings has been useful.

Chance: A Vernacular Definition, a Research Definition, and Two Research Applications

The vernacular meaning of *chance* is somewhat imprecise, while its meaning in research is technical and specific. But then there are two uses of chance in research that are not as precise as the strict research meaning. In vernacular usage, chance refers to possibility, or accidental, or luck, or without design or premeditation. The general research meaning of chance is the likelihood of a particular event. Chance refers to a purely random process, such as is seen in using a coin toss or a table of random numbers. So, saying something occurred by chance in a normal conversation does not have the same meaning as saying something occurred by chance in a research context.

Moreover, there are two uses of the term chance in research that relate to but do not apply this strict definition of chance. Chance is used to refer to, first, the effects of extraneous unmeasured variables. Those effects may or may not actually be due to chance; they may be attributable to other variables that were not measured in the study. Secondly, while not definitional, chance is sometimes used for sampling error, the difference between a sample statistic used to estimate a population parameter and the relevant parameter. For example, the likelihood that a particular finding of a relationship between variables in a sample would occur where the variables are not related to one another in a population is sometimes referred to as by chance or sampling error. The problem here is that some of these differences (between estimates and the real parameters) are due to chance, but some of them may be due to systematic bias in how the sample was selected.

Therefore, chance should not be used to refer to all sampling error. We recommend using the term

sampling error instead of chance when referring to the difference between sample estimates and the actual population parameters. And it can be misleading to use chance to refer to the effects of unmeasured independent variables, also. More generally, while the overlap in the research definitions and uses can be helpful, it would be problematic and misleading to include the vernacular notions of chance in any of the research definitions. In research, we recommend using the word chance only for strictly random processes.

a (alpha): Three Research Definitions and Several Synonyms for One of the Definitions

The terms alpha level, p value, and Type I error can be confusing to students. While at a theoretical level they differ somewhat, they all refer practically to the same thing, namely, the likelihood that a particular relationship we observed in our findings through our study sample can be attributed to sampling error and not to the general veracity of our research hypothesis. To be statistically significant, the observed relationship's probability of occurring due to sampling error must be below a cutoff point that we have identified in advance as so low that we are willing to risk refusing sampling error as a plausible rival hypothesis. The cutoff point is called the level of significance. The p value indicates the actual probability for a particular finding that the finding is not generalizable to the population. Thus, $p < .05$ indicates that the relationship observed has a less than 5% chance of being observed by sampling error in the study sample; on the other hand, the finding has a 95% chance or more of being observed in population. Since our conclusion to accept/reject the null hypothesis and subsequently support/not support the research hypothesis is based on probability and not on absolute certainty, there is the possibility of making an erroneous conclusion. At this point in the process of learning statistics, students are introduced to Type I error, which is making a false-positive conclusion based on data, or of claiming a relationship where it does not really exist in the population. The probability of a Type 1 error is the same in practice as the p value. When a researcher reaches a statistical conclusion based on $p < .05$ level of significance, there is the same level of probability to commit Type I error. If the p value of a particular inferential finding is .02, then there is a 2/100 or 2% chance of making a Type 1 error, that is, of accepting the research hypothesis when the null hypothesis is accurate for the larger population.

In an effort to distinguish Type I error from Type II error, which is making a false-negative conclusion based on data, or of not claiming a relationship where it does really exist in population, a test's probability of making a Type I error is denoted by α while Type II error is noted by β. In this regard, p value and *a* value are used interchangeably.

These learners face another frustration related with *a*, when they learn Cronbach's α, a measure of the internal consistency or reliability of a measurement or scale. At this point, some students cry, "Too many alphas!" Regrettably, though, there is yet another use of alpha in basic statistics. It is also used as the symbol for the constant or the y-intercept in a regression equation defining a line. Alpha is used in the population form of the equation: $y = \alpha + \beta(x)$, while the sample form of the equation is $y = a + b(x)$.

As usual, we suggest drawing attention to the synonyms and the multiple meanings, as they arise, so that students understand the practical use of the terms when they encounter them. We also recommend using the terms p value or significance level in place of α level for the probability of a Type I error in a particular finding, and Cronbach's α for the indicator of internal consistency of a measurement.

Pre-test: Two Research Definitions

Pre-test has two research meanings. In experimental design, a pre-test is a measure of the dependent variable(s) that is administered before the introduction of the experimental independent variable. For example, in an intervention study where the intervention is supposed to reduce ageism, a pre-test would measure ageism before the intervention begins. The pre-test would usually also include measures of some other relevant variables.

In measurement, a pre-test refers to pilot testing a measure or data collection instrument before it is finalized and used to study the phenomenon. The nearly final version of the instrument is administered to a small number of people who will not be in the actual study in order to discover and fix any problems with the instrument. The purpose of a measurement pretest is to discover problems in the measurement instrument, so that the problems can be solved before the actual study begins. Pre-test is thus used with two distinct meanings in research. Usually the context makes clear which meaning of the word is intended, but the use of the same word can be problematic for students. Calling the testing of a measurement instrument a pilot test of an instrument while reserving the word pre-test for the usage in experimental design would be helpful.

Validity: Three Research Definitions

In research, the term validity is used in different ways. While there may be some overlap among all three meanings, in that validity always refers to stronger, more accurate, and more generalizable methods, we have found that the three different meanings are best differentiated

from each other. The term validity is used to describe the quality of a measure. Validity refers to whether a particular measure does indeed measure the concept it is intended to measure. It could more clearly be called measurement validity, but it is often just called validity.

Internal validity and external validity are terms that refer to study design, usually with respect to experimental and quasi-experimental designs. Internal validity is concerned with the issue of whether the studied independent variable(s) is (are) likely to be responsible for the effects that were produced on the dependent variable(s). The more likely it is that the studied independent variable, as opposed to other possible variables, is the cause of the relevant reactions in the dependent variable, the stronger the internal validity. There is no such thing as the internal validity of a measure; however, students often are confused between internal validity and internal consistency perhaps due to the same word: internal. Internal consistency is an aspect of measurement reliability. Internal consistency is about the issue of whether the different components of a scale or index correlate with one another and thus are or are not measuring the same concept. Internal consistency is about measurement reliability, not about measurement validity.

External validity refers to study design and is concerned with generalizability of study findings. The more generalizable the study's findings, the stronger the external validity. Students sometimes also talk about the external validity of a measure, but external validity refers to the generalizability of an experiment and is not about measurement.

Some students never sort out these differences and use these four terms ([measurement] validity, internal validity, internal consistency, and external validity) somewhat loosely and interchangeably, although they refer to very different phenomena. We recommend that the validity referring to measurement always be called measurement validity to assist in making the distinctions among these terms.

Mortality: A **Vernacular Definition and a Research Definition**

Mortality refers to death and being subject to death in general usage. In research, mortality refers to the dropping out of subjects in an experimental design that may or may not have an effect on the outcome of the study. The dropping out of the study may be a result of death, but it is more often an effect of losing interest in the study, leaving the area, not liking the intervention, etc. For example, if a good number of participants who are receiving the experimental intervention drop out, but the participants in the control group are more likely to stay in the experiment, then it becomes harder to interpret the findings because not only is there differential loss in the two groups, but also the participants who dropped out may be substantially different from those who remained in the experimental intervention.

Students need to be told that experimental mortality does not refer only to death, and that mortality can provide a threat to the internal validity of experiments. The use of mortality in research appears to be declining, while the word attrition may be gradually replacing it. This is a welcome development, as the meaning of attrition is much closer to the meaning of this threat. Students still need to be taught about the word mortality, because they may encounter it, but they can also be encouraged to use the word attrition instead.

Regression: A Developmental Theory Definition, and Two Research Definitions

In some theories of human development, *regression* refers to returning to an earlier and less mature level of development. It is posited to happen for a variety of reasons, for example, experiencing crisis or trauma at one level of development is thought to sometimes lead to regression to an earlier stage of development.

In research, regression has two other meanings. These two meanings overlap historically and at a high level of abstraction, but in their usage in most social science research and evaluation classes, the distinctions between them are far more important than their similarity. The first research meaning is that regression refers to a particular type of statistical analysis of the relationship between one or more independent variables and a dependent variable, ideally where all the variables are continuous variables. This may be called linear regression in the form of simple or multiple regression, logistic regression, or other types of regression analysis.

The second research meaning refers to regression toward the mean. This refers to the tendency of extreme scores to move closer to the average on subsequent measures. Groups of people with extreme scores from a measure administered at one time will, when tested again at a later time, have a tendency to move closer to the mean. This is a threat to internal validity that is often relevant in intervention studies. So, for instance, if a community health center collected data about recent substance abuse on intake forms, then offered an intervention to those whose substance abuse scored at the highest levels, those people on average would tend to show improvement in subsequent questioning about substance abuse, whether or not the intervention was beneficial, because of regression toward the mean. At the intake, some of the individuals scoring the highest would be individuals whose substance use was consistently very high, and some of the individuals scoring the highest would be individuals who had just experienced an unusually high intake of substances in

the previous week or month. So overall the average of this group would tend to decline, getting closer to the mean, at the second measurement point.

Unhelpfully, the modifier statistical is sometimes placed in front of the word regression, but this does nothing to indicate if it thereby refers to the method of statistical analysis or to regression toward the mean; statistical regression may mean either one. Since the use of the term statistical regression adds to the confusion between the two research meanings, we suggest not using this terminology. To differentiate the three meanings of regression, as usual we point them out to students as they arise, and we also talk about the method of statistical analysis as regression and the threat to internal validity as regression toward the mean.

Triangulation: A Family Systems Practice Theory Definition, and a Research Definition

In family systems theory, *triangulation* refers to an interaction in which two people communicate or relate to each other through a third person. Sometimes two people who are experiencing difficulty in communication use a third person to try to communicate with each other indirectly. For example, the third person may be brought in to deflect or to act as an ally to one of the original pair or to transmit messages between the original pair. Sometimes the third person inserts herself or himself into the original pair for control or other reasons. In family therapy, triangulation is usually considered dysfunctional and harmful.

In research methods, triangulation refers to the use of two or more sources of information or interpretations on the same topic. The hope is that the different sources will reach the same conclusion to increase the credibility of the data. For example, a study may include both observation and self-report as methods of data collection. Another study may include both qualitative and quantitative components. A qualitative data analysis may be conducted by two or more different types of coders. This triangulation requires a minimum of two sources because the thing being studied constitutes the third point of the triangle. This concept of triangulation is loosely borrowed from trigonometry and surveying, in which the location of a third point can be determined when there are two other fixed points with a known distance between them, essentially by creating a triangle with the third point. This kind of triangulation, the use of multiple sources, provides extra evidence, and is considered valuable in research.

It is confusing to some students that triangulation refers to two quite different phenomena, and that triangulation is a negative in practice but a positive in research. In addition, due to the connotation of a triangle, some students assume that it requires the use of three sources.

Indications of the Effectiveness of Confronting the Ambiguities in Teaching

Compared to our earlier teaching experiences when we did not directly address these sources of confusion, we have noted improvement in students' understanding since we have started directly confronting ambiguities. As noted earlier, we ask students in our research classes to complete anonymous questionnaires during the first class meeting, as well as sometimes during the next-to-last class meeting. These questionnaires cover the students' attitudes and knowledge about research before and after taking research classes in their social work programs. Here, we report some of the qualitative data we have obtained through these questionnaires related to learning about research terminology. One question on the post-test asks students which aspects of the class worked well for them. (See Appendix for exact wording.) One student wrote, "Excellent and clear presentation of information." Another said, "Cogent explanations—generally clear and easy to follow." Another wrote that the instructor "[w]as a great explainer." A student shared, "I feel much more confident with research terminology," and another wrote, "I was able to complete my assignment with an understanding of what the terminology is, and what it's about." Responding to a more general question about the class, one student wrote, "Teacher was…helpful in clarifying terms." Not that we are universally successful, for example, on the posttest, one student wrote, "I feel all the hard terminology and concepts were in (this class), and it was too much to absorb." Quantitative data about the effectiveness of our research teaching and the classes in general are very positive.

Conclusions

We have argued that research terminology is an important source of difficulty in teaching research and that heretofore has not been satisfactorily addressed. Using multiple authoritative sources, we confronted and clarified some ambiguous terms. We recommend that research instructors in the social sciences address the ambiguity and clarify these terms. In our teaching, we talk about this problem early in the term by noting that ordinary, everyday meanings of words may not be relevant to their research meaning and that even in research a term may have two or more distinct meanings. Then we refer back to this discussion as the terms come up during the course. Often a brief mention with a slide about distinctions and overlaps will be sufficient. We sometimes make jokes such as, "There weren't

enough words, so they had to use this one three times!" Students appear primed to listen when these complications come up. Of course, drawing too much attention to these matters may sometimes increase rather than reduce confusion. We do not suggest that teachers belabor these concerns. This article is addressed to research teachers to suggest topics for clarification, but each teacher should gauge for each class how much detail to provide.

We do not have evidence from validated measures about improvement in our students' understanding of terminology, nor has our success in teaching these terms to students been compared to other methods of teaching. Probably there are even better ways of teaching these ambiguous terms; here we only provide the first steps of acknowledging the problem, drawing attention to it, and providing authoritative clarification.

We have made some recommendations here for alternative or modified terminology that assists in clarifying these terms. Some of these recommendations have a broader application than just to research instruction, and they could be beneficial for social science research in general.

In other cases, the terms remain ambiguous, and we only suggest attention to, and clarification of, the ambiguity. The field of social research is vast and multidisciplinary, so it would be difficult to move the field toward new, different, unambiguous terminology, although such a development would be very welcome.

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Appendix

Exact Wording of Questions on Pretest and Posttest Student Questionnaires

Pre-test Questions (administered at the beginning of the first class meeting)
1. What are your negative thoughts and feelings about research and evaluation?
2. What are your positive thoughts and feelings about research and evaluation?
3. Are there particular hopes or fears that you have for this class that you want me to know about? For instance, are there certain topics you especially hope to learn about?

Post-test Questions (administered at the beginning of the next-to-last class meeting)
1. What about this class (if anything) worked well for you?
2. What about the class did not work well for you? What things did not produce learning? What could have been done better? Do you have suggestions for improvements?
3. Anything else you want to say about the class or the instructor?

Move, Think, Learn: Incorporating Physical Activity into the College Classroom

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Robust evidence links physical activity to positive cognitive and academic performance outcomes, and engaging students in movement within the classroom has the potential to benefit learners at every age. Offering college students an opportunity to be active in the classroom can enhance learner engagement, promote critical thinking, and increase content understanding and retention. Designed to bridge the gap between research and practice, this article shares specific strategies for movement integration at the college level. These strategies have been used successfully across content areas and class formats and can be modified to match student need and classroom environment. Increasing awareness of active pedagogy among educators has the potential to positively impact adoption and implementation of the practice with the ultimate goal of influencing students' learning experiences and academic success. The purpose of this article is to provide college instructors with practical examples to incorporate movement into the college classroom.

Move, Think, Learn: Incorporating Physical Activity into the College Classroom

Jumping jacks in the classroom? You may think that sounds fine for elementary school students, but out of place in a college course. To the contrary, actively engaging students helps them to think more deeply about course content, and, by adding physical activity to active learning, the cerebral blood flow increases the brain's function and performance (Hillman, Erickson, & Kramer, 2008). As college professors ourselves, we teach a variety of coursework, and we consistently and successfully engage our students in movement. Physically active teaching strategies benefit our instruction by enhancing the classroom climate and our students by facilitating opportunities to think critically, gain multiple perspectives, and reset attention. In addition, a culture of movement within the college classroom provides students with a mechanism to decrease inactivity. College students spend about 30 hours per week in sedentary behavior, primarily during class and while studying (Buckworth & Nigg, 2004). As such, integrating physical activities into the classroom can offer a variety of benefits, making it necessary to both increase faculty awareness of the practice and to provide simple, adaptable movement-based active learning strategies to instructors of college coursework.

Background

Classroom physical activity is movement within core-content classes that is facilitated by the teacher as a mechanism to enhance student learning. The link between physical activity and cognitive function and brain health was originally explored in animal studies (Neeper, Gómez -Pinilla, Coi, & Cotman, 1996; Radák et al., 2001). This association was next supported in older adults, linking physical activity with protection against neurodegeneration (Laurin,

Verreault, Lindsay, MacPherson, & Rockwood, 2001; Rabin et al., 2019), increases in brain volume, and improvements in executive control and memory (Colcombe et al., 2006; Kramer et al., 1999; Erickson et al., 2011). Since about 2000, research specifically targeting school-based physical activity has demonstrated both the feasibility of incorporating movement into the classroom (Delk, Springer, Kelder, & Grayless, 2014; Maeda & Murata, 2004; Stewart, Dennison, Kohl, & Doyle, 2004) and the effectiveness of classroom physical activity on behavior and time-on-task (Goh, Hannon, Webster, Podlog, & Newton, 2016; Grieco, Jowers, & Bartholomew, 2009; Herman, Beer, & Morton, 2013; Mahar et al., 2006), concentration and fluid intelligence (Caterino & Polak, 1999; Reed et al., 2010), cognition (Graham, Bremer, & Cairney, 2017), and academic achievement (Donnelly et al., 2009; Donnelly et al., 2017). Furthermore, integrating physical activity into academic lessons can enhance student interest and motivation (Vazou, Gavrilou, Mamalaki, Papanastasiou, & Sioumala, 2012). Limited school-based evidence currently exists with college-level students, but the correlation between physical activity and cognitive function is retained in this population (Hillman, Snook, & Jerome, 2003). In addition, most college students possess positive affect toward movement in the classroom, citing increased focus, attention, interaction, and enjoyment as results of physical activity opportunities (Ferrer & Laughlin, 2017).

When considering the merits of classroom physical activity for students of any age, it is also relevant to review literature on active learning. In the traditional sense, active learning does not require a movement component, but is designed to dynamically engage students in the learning process. The concept of learning as something to be experienced by students has been traced back to Jean-Jacques Rousseau in the 1700s

(Lindsay, 2016; Sălăvăstru, 2012), and popularized in America by John and Evelyn Dewey in 1915 (Dewey & Dewey, 1915). In the 1980s, active learning pedagogy was promoted in higher education (Bonwell & Eison, 1991) with an American Association for Higher Education bulletin stating, "Learning is not a spectator sport" (Chickering & Gamson, 1987). More recently, research supports that active learning in the college classroom improves short-term recall and long-term retention (Prince, 2013), increases student activity and involvement (Pundak & Rozner, 2008), supports critical thinking and collaboration (Rocca, 2010), and fosters academic achievement (Pirker, Riffnaller-Schiefer, & Gütl, 2014). Given that classroom physical activity is inherently active learning, incorporating movement-based activities into the classroom has the potential to enhance students' learning experience and improve academic performance.

American institutions of higher learning are tasked with embracing innovative pedagogy to advance learning outcomes and increase graduation rates, yet there is a disconnect between research and practice (U.S. Department of Education, 2006). While robust evidence supports the benefit of physically active learning, college instructors may be hesitant to integrate movement in their classrooms due to lack of knowledge, classroom layout and environment, timing considerations, or student involvement concerns. Research suggests, however, that implementing activity on a trial basis can decrease teachers' perceived barriers to adoption and that these challenges can ultimately be diminished or overcome through the trial (Howie et al., 2014). Indeed, there are many activities that are fairly simple to implement in the college classroom that can be modified to different classroom formats, teaching concepts, and student needs. With a "tool kit" of movement-based activity learning strategies that can be adapted to fit content and context, college-level faculty can ameliorate current teaching practices.

Applicable Strategies for Engaging Students in Movement

Though we use a variety of activities in our classrooms, the following movement-based activities work well across the diverse content we teach, ranging from education to kinesiology to health. We have also mentored colleagues in business and in anthropology who have implemented these strategies. Along with our colleagues, we have had the opportunity to conduct these activities across assorted content areas and classroom context. Some activities may work best in more open environments, but they can be modified to fit in confined spaces. From large lecture halls to small conference rooms, with class enrollment from 9 to over a hundred, in class durations from 50 to 90 minutes in a

once to thrice weekly timeframe, we have implemented classroom physical activity. Further, activities can be adapted for students of varying cognitive and physical abilities, all to the benefit of our students and their learning experience. As with any effective learning environment, classroom management is critical, and clear guidelines and expectations must be set prior to implementation. Communicating the purpose of movement incorporation and setting the tone for the semester on the first day of class can cultivate student buy-in and promote a classroom climate conducive to movement and engagement. Below, we offer several specific strategies that we have developed or adapted in our own classes for incorporating movement into the college-level classroom that can serve as an introductory "tool kit" of ideas for faculty to engage students across disciplines and learning environments.

Activity: Two Jack Sharing

Think of Two Jack Sharing as a way to facilitate dialogue between students. Each student will find a partner, share the required information, be an active listener, and then complete two jumping jacks (or modified jacks with raised arms and a step out instead of a jump) with their partner. Once the jacks are completed, students will locate a new partner – indicated by other students' jumping jack arm movement – and repeat the sharing, responding, and jacking.

Two Jack Sharing can be used in practically any context and can be used for students to share ideas or tangible assignments. The information exchanged can be a review of, or opinion about, a teacher-provided reading. It could also be something students bring into class, such as a homework assignment, or discussion about a talking prompt. This can serve as a five to ten minute activity or as a longer, more in-depth activity pending the time spent with each partner and the quantity of pairings. Should the classroom space not be conducive to large movement, students can stand and share information with peers near them, doing mini-jacks or another smaller movement between partners.

Unlike traditional question and answer in a lecture, this activity engages all students in the classroom while getting their blood flowing and increasing cognitive functioning to prepare to learn. As with any teaching strategy, it is important to conclude with a recap of new learning. After students have had a chance to share with three to five students, bring the class back together to debrief the information and clarify as necessary.

Example from an Education Class

In an educational psychology class, an introductory class designed for about 30 teacher education majors, students learn about various theories of motivation. To

provide students with a background and to get them thinking about this new topic, students participate in Two Jack Sharing in the first portion of the class period. A question is posted on the screen in the front of the room that asks students, "Think about something you are motivated to do (e.g., working out, cooking, making good grades). Then, share with your partner whether you are motivated because of intrinsic reasons, extrinsic reasons, or both." Students read the question, find a partner, and take turns sharing their responses. After both students have shared, they complete two jumping jacks. Then, they look around to find others who have finished – easily identified because of the arm movement – and share with them. Once students have found two or three partners, they take their seats. Then, we debrief different reasons for motivation, as discussed in the activity, before transitioning to the lecture over the topic.

Example from a Kinesiology Class

In a fundamentals of elementary physical education class, an upper-level course of approximately 20 students in physical education teacher education, the students participate in field experience hours at the local elementary schools. After several observations of an elementary physical education class, they have witnessed various classroom management techniques that align to those discussed in class. Since the students have likely observed different groups of students and/or teachers, Two Jack Sharing is used as a discussion tool to promote best practice in classroom management. Once they find a partner, the student designated "A" shares a classroom management strategy they observed in the elementary classroom, then partner "B" has to evaluate if this is an appropriate classroom management strategy. The partners then switch roles so that partner "B" gives the example and "A" gives the feedback. Once they are both done sharing, they do two jumping jacks and find a new partner. The students change partners at least three times before returning to their seats, which usually takes about 12 minutes.

Activity: Carousel

Similar to the carousel with moving horses, students will rotate around the room in this activity and respond to various prompts posted on the walls. If your budget allows, large self-adhesive pages work well. The primary benefit of the Carousel activity, in addition to the physical movement, is the opportunity for students to discuss content, share perspectives, and collaboratively respond.

Prior to class, prepare the number of prompts needed based on room size and number of students. (The hallway can also be utilized.) If the class is large, a duplicate set of questions can be made, and students can rotate within a sub-group. Ideally, groups will be comprised of three to five students, so students can actively participate in discussion. First, provide directions for the activity. Student groups will go to one of the pages, read the question, write their response, and then rotate to the next page. At each new stop, teams will read the prompt and review prior responses before making changes as they deem necessary and adding new information. Each rotation will last a pre-determined duration; we have used between one and two minutes, depending on the prompt content and quantity. Continue the activity until groups are back to their original page. Then give teams time to review all information on their page and come up with a single "summary statement" to share with the class. The duration of this activity depends upon the number of prompts in the rotation and the time spent at each page. With a minimum of about 15 minutes, this activity can also last up to 60 minutes with a debrief in the end to solicit responses and feedback from students.

We have used this activity to enable students to think critically and relate class readings to course content (i.e., "Considering the article you have read, how does the author's explanation of human development relate to the theories presented in your textbook?") and to address various course content such as, in the context of kinesiology, categorizing physical activities by the health-related fitness concept, writing and aligning objectives for the various domains in physical education, and discussing the characteristics of the varying theories of motor development. It also provides a great course review, with individual topics from throughout the semester on each page (see Appendix).

Example from a Health Class

As a semester review in an environmental health class, the carousel activity has been used in classrooms with as few as 25 students where the desks can be moved away from the walls and in lecture halls with as many as 90 students where desks are bolted to the floor. The course has 14 topics, so 14 pages are posted around the walls of the room. In the lecture hall without an appropriate back wall, the hallway was used as part of the rotating circle. Group size is dependent upon course enrollment that semester, and, in smaller classes, topics were combined on a page. Three to four students per group are ideal, but two or five has also worked successfully.

Once students have found a page, they have 60 seconds to write as much as they can remember about their topic. The collaboration among group members often generates additional ideas, as one will think of a concept, and another will remember the detail. At the minute mark, all groups rotate clockwise to the next page and work on that topic with the new time starting immediately. By the

time students rotate to later pages, more discussion addresses how to expand or modify the thoughts and ideas of previous groups. Once each group returns to their original page, they review all notes and compile a single "take away" statement about their topic to share aloud with the class. One of the most rewarding aspects of using Carousel as an end-of-semester review is the confirmation of new knowledge and the excitement exhibited by students when they conceptualize how much they learned in the course (see Appendix).

Activity: Moving Response

Taking brief assessments before, during, or after delivering content can be helpful. With movement as an assessment tool, professors can do a quick evaluation with minimal advance preparation. This activity is typically short in duration, and all movements can be modified for the amount of space available. When using Moving Response, first decide on the type of assessment questions (e.g., continuum, true/false, or multiple choice). Then, assign different stretches to each answer (e.g., Strongly agree = stretch arms overhead, Agree = rotating torso twist, Disagree = toe touch/forward fold, Strongly disagree = squat sit). Read different statements or questions aloud and have students stretch into the position to indicate their response. As an example, we like to find out how prepared students feel they are for an exam. We may ask them to respond to Likert statements, such as "I thoroughly understand the content we have covered this week," to quickly assess students' beliefs and make adjustments as needed before giving a formal assessment.

Example from a Statistics Class

Because statistics can be a difficult subject for many students, it is important to regularly assess students affectively to determine how they feel about the content. There are numerous examples provided to students for each concept covered, but some students understand more quickly than others. Toward the end of each unit or chapter, a quick movement assessment can help determine whether students are ready to move on or whether we need to cover the information a little more thoroughly. A slide on the front wall indicates a movement for each Likert scale response (i.e., Absolutely disagree: Touch toes, Somewhat disagree: Squat position, Somewhat agree: Stand with arms outstretched in a 'T', Absolutely agree: Stand with arms overhead arching up), which reinforces the concept of Likert scale from course content. A demonstration of each position ensures students understand the response option. Then statements are read aloud, such as, "I have a clear understanding of the different types of

reliability." Students will respond with their movements, allowing a visual assessment of understanding, for each statement.

Activity: Stand Up Yes

Stand Up Yes can also be used as a form of assessment or to collect data, and it is applicable for true/false questions or yes/no statements. The instructor reads each statement aloud or displays them on the screen one at a time, and students either stand up to indicate a response of yes/true or remain seated to indicate a response of no/false. This activity is typically short in duration and works well in small spaces since students only need to sit down or stand up. We have used this activity to assess students' understanding of assigned reading material at the beginning of the class, to explore students' attitudes and beliefs, and to determine demographic-type information. This makes a nice first-day-of-class activity with questions like "Could you explain [insert the main topic of the course]?," or, "I am from [insert the state where you teach]," or, "I am a freshman/sophomore/junior/senior."

Stand Up Yes can alternately be used to gather information where many students may be initially a yes with a continuum toward no. For this activity, all students will start standing and will then sit once they get to a question/prompt/number where yes/true is no longer the appropriate response. As an example, if you asked students to write as many examples of healthy produce they can think of in two minutes, everyone would start standing, and your narrowing questions would be, "I got 5," then "I got 10," and "I got 15," until only one student is standing.

Prior to using either Moving Response or Stand Up Yes, consider the information that will be shared and ensure students will feel safe and comfortable electing to sit, stand, stretch, squat, etc., knowing that others will be privy to their response.

Example from an Assessment Class

In a test and measurement course for kinesiology majors, different types of rubrics are discussed, and students learn how to evaluate the quality of a rubric. After the initial lecture over rubrics, students have to bring in examples of rubrics they find searching the Internet, and we do a Stand Up Yes activity using the rubrics. They are asked various questions about their rubrics, such as, "Do you have a checklist?", "Do you have an analytic rating scale?", "Is there discrimination between the performance levels?", and "Are the criteria aligned to the intent of the rubric?". Various students are invited to share more about why they stood up or sat down to further the discussion. This activity lasts approximately 30 minutes and helps the students to apply theory to practice.

Implications and Conclusion

Collectively, we have 35 years of college-level teaching experience and have observed the benefit of movement integration on learning outcomes and classroom climate. Recently we have conducted pilot studies with our students to capture both student impressions of classroom physical activity and the impact of classroom movement on cognitive functioning. Overall, students appreciate the opportunity to engage in movement. One undergraduate student in our classes reported, "I found the in-class activities and discussions the most interesting way to explore new ideas pertaining to the content," while another stated, "I enjoyed how we were able to include moments of brief physical activity to stimulate our brains." Positive impacts are further supported by data demonstrating an increase in cognitive functioning. An initial test determined baseline functioning, and a posttest was given following a bout of classroom physical activity. Results indicate that cognition scores were significantly higher (t(67) = 6.25, p<.001) following physical activity. These preliminary findings add to the existing literature that justifies classroom physical activity in the college classroom, but further research is needed as adoption of the pedagogy expands.

Classroom physical activity is becoming an accepted practice in primary education but has the potential to benefit learning for all ages and should be utilized in all learning environments. Importantly, engaging students in physically active strategies needs to be presented as a cohesive part of the lesson with expected participation. Students may be initially hesitant, but in our experience, students will come to enjoy the movement with its holistic benefits. When college instructors integrate movement-based active learning into the classroom, students are more likely to exhibit enthusiasm and interest (Ferrer & Laughlin, 2017; Vazou et al., 2012), have greater concept retention (Prince, 2013), and be cognitively prepared to learn (Hillman et al., 2003). By incorporating physically active activities into the college classroom, your students can become more engaged, motivated, and academically successful.

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Appendix

Image of completed post-it from carousel activity as end-of-semester course review
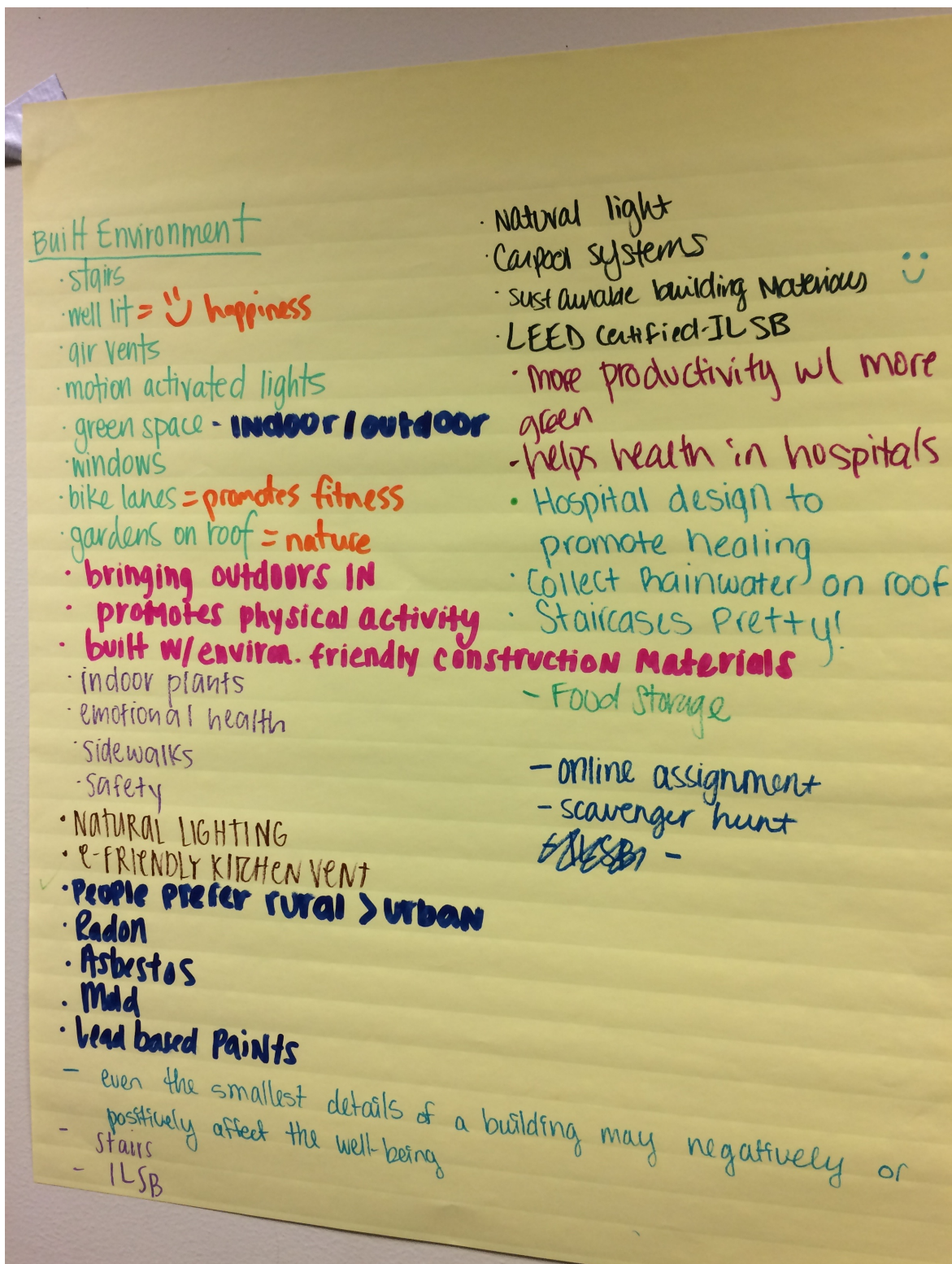
The A-Z of the PhD Trajectory: A Practical Guide for a Successful Journey

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This article reviews The A-Z of the PhD Trajectory: A Practical Guide for a Successful Journey, written by Eva O. L. Lantsoght. This book presents the major milestones throughout the PhD trajectory, covering topics from defining research question, developing a literature review, preparing and executing experiments, time management, scientific writing, academic presentations, to preparing for a career after the PhD. It also offers step-by-step instructions to help readers develop practical skills that support the PhD research process. Overall, this book is highly recommended to doctoral students and their supervisors as well as professors preparing for workshops or courses on research for first-year PhD students. Publisher: Springer (Cham. Switzerland, 2018). ISBN: 9783319774244. List price: $83.40 (U.S.). 406 pages.

There are a growing number of studies that research and document various aspects of PhD education and pedagogy in the interests of "better quality, completion rates, and student satisfaction" (Adkins, 2009: 167). Many of these arouse deep concern about students' abilities in finishing their PhD programs, and more specifically, in utilizing the right tools and resources to support the difficult work of doctoral research. In light of this, effective guidance is needed to help students address various issues throughout their PhD trajectory. This text presents a unique contribution to the literature by providing a complete volume that is wholly concerned with the material that supports students throughout their PhD journey, such as defining the research question, developing a literature review, preparing and executing experiments, managing time, writing and presenting for academic purposes, and preparing for a career. Thus, it provides a comprehensive discussion on issues pertaining to PhD studies and transferable research skills in doctoral work.

To meet the demand of flourishing higher education research, this guide is appreciated for its strong practical orientation. Drawing on the author's personal insights, as well as other researchers' experience about PhD education, the book presents a precise analysis of the difficulties and challenges doctoral students encounter and then offers strategies and actionable guidance for reaching the goals in different stages of the PhD journey. Moving from general themes to specific pedagogical concerns, the text constitutes a logical starting point for novice PhD students and supervisors, enabling them to deploy the materials and resources to support doctoral studies or supervision work.

Structurally, the book is composed of two parts with 15 chapters. Part I runs from Chapter 1 through Chapter 14, and Part II is a single chapter providing a glossary with reference items. The introductory and the concluding chapter in Part I clarify the aim of the book and summarize the topics covered in this volume respectively. The rest of the chapters convey the main information, focusing on identifying the major milestones in PhD study and offering a step-by-step instruction to reach them. Such a reader-friendly organization lays out a blueprint for their PhD life and helps readers develop the practical skills that support the PhD research process.

For novice PhD students, how to prepare for their PhD study and plan their time for the whole journey is usually their first concern. Knowing well their needs, the author starts with introducing necessary skills for them to adapt to the new life, offering tips on socializing with fellow researchers, discussing mutual expectations with the promotor, documenting work, using a schedule, and maintaining harmony between work and life. Then a top-down approach for planning is proposed to help students plan the major milestones in their doctoral study. To make most use of the time, technological applications and To-Do lists are recommended in that these tools gain students a fuller understanding of the amount of time they should spend on various tasks.

After discussing the preparatory work in general, the author then devotes several chapters to offering suggestions on the accomplishment of the dissertation, which is the core task for PhD students. Sequentially, the author deals with the writing of the literature review and formulating of research questions. To cope with the literature review, normally "the first research activity" (p. 55) in a PhD journey, students are advised to find the right references, read broadly, and engage with the literature. It is important to bear in mind that reading can never be "done" even when the writing of the literature review is finished, thus it is advised that students should engage with the literature via summarizing, discussing, questioning, and keeping up-to-date with the research output. A review of literature in this way helps students develop a better understanding of the status quo of a particular research area, identify gaps in the current knowledge, and consequently motivate research questions. Developing effective research questions is "a creative endeavour"

(p.75) which requires creative thinking skills. With the research questions and sub-questions formulated, students need to convince their supervisors of these questions and then turn them into practical actions. For PhD students in STEM (i.e., Science, Technology, Engineering and Mathematics) fields, experimental work is an essential part in the dissertation writing process. To ensure the smooth execution of experiments, various facets of experimental work in the research laboratory are revealed, such as designing the test setup, planning and documenting experiments, processing data, and reporting results. With these steps done, the compiling of the work into a dissertation should be marked on the agenda. Therefore, the author devotes the whole of Chapter 12 to address the issue, focusing on planning writing, structuring the dissertation, self-caring, handling the introduction and conclusion, and preparing for the thesis defense. It is emphasized that a good planning is the foundation for the completion of the dissertation, and routines and other activities are also beneficial to keeping students' minds balanced along the way.

In addition to dissertation writing, presenting and sharing the research findings is also an important part in PhD students' life (Chapters 8-10). To present the academic work, students should pay attention to the planning, the format, the logical order, and the types of presentations. To share the knowledge with a wider audience, students can take advantage of science communication on the Internet, such as blogging, Twitter, and online branding. Another prevalent way to share the research findings is to attend conferences, but attention should be paid to selecting the right conference, choosing proper topics, allocating time, and socializing properly so as to get the most out of it. Overall, attending conferences is of great value as it helps students find a suitable venue for presenting their research work, gaining insights in academic writing, and getting in touch with renowned scholars.

As the PhD needs to respond to the emergence of new academic disciplines (Boud & Tennant, 2006), improving academic writing becomes an important consideration in encompassing academic pursuits. Chapters 7 and 11 examine the development of academic writing skills and the writing of journal articles. Drawing on the experience and practices from researchers worldwide, the author presents vivid examples and practical tips to help PhD students fit academic writing into their busy schedules by focusing on structuring writing, demonstrating the author's voice, handling problems for non-native speakers, and increasing productivity in writing. When selecting the target journal for the first article submission, students need to consider its audience, impact factor, and ranking. After receiving reviewers' feedback, students are advised to write a comprehensive reply to the reviewers' comments to increase their chances for publication or rework the paper to try another journal if it is rejected.

Getting all the way through PhD study, students will walk into a new chapter of life. Therefore, Chapter 13 presents a description of navigating career options for the new doctors. When walking on the career path, regardless of in academia or in industry, one must note that it is not the doctor's title but what you can bring to the table with your unique skill set and your academic experience that determines your success. Finally, attention is paid to some special groups of academics in the increasingly diversified community, offering suggestions to the underrepresented female PhDs, minority PhDs, and academic nomads, and those who are seeking international collaborations. These less researched areas are significant issues and promising fields; however, they are addressed very briefly in this section.

Part II (Chapter 15) forms the literal A–Z part of this book and contains a glossary of topics involved along the whole journey toward the PhD. The glossary list serves as a refresher with short reminders, and each word included in the list covers one particular topic with a brief description.

Compared to previous books on similar topics, the volume is characterized by its breadth of topics covered, the practice-based issues discussed, and the accessibility of its writing style. These features make this book particularly useful for doctoral students and their supervisors, particular in terms of the elaboration on the kinds of challenges in doctoral journey and suggestions on how these challenges can be overcome. Armed with the practical suggestions to identify important issues and meet the needs of PhD students, scholars interested in higher education research may also find this book stimulating and enlightening.

Despite the comprehensive spectrum covered in this volume, we may critique that some learning objectives and actionable tasks presented at the beginning of each chapter are not concise enough and might be overwhelming for some novice students at the first sight. Considering this, we would suggest that the learning objectives be rearranged according to the foci of different phases of the PhD journey, and the recommended tasks could also be simplified for practicality. Nevertheless, the detailed descriptions might also be a strength since they present a clear outline right from the start.

Overall, although this book is mostly aimed at PhD students in sciences and engineering, it is worthy of recommendation. It serves as a practical and valuable reference for PhD students, offering them insights into overcoming a variety of obstacles in their

PhD trajectory. For supervisors and professors preparing for workshops or a course on research for PhD students, this book also serves as a useful guide with its clear elaboration of various aspects of PhD work and detailed discussion on how to encompass academic pursuits in doctoral study.

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