STEM-Oriented Alliance for Research (SOAR): An educational model for interdisciplinary project-based learning

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STEM-Oriented Alliance for Research (SOAR)

An Educational Model for Interdisciplinary Project-Based Learning

Abstract—**This article details the development, design, and implementation of an interdisciplinary project-based learning approach. The project offers a transformative educational experience to students, merging coursework across three different academic disciplines. Science, Technology, Engineering, and Math (STEM) education has been challenged by industries to incorporate business and communication experiences (and vice versa) that prepare students for the workplace. Incorporating interdisciplinary project-based coursework provides experiential learning for students, a skillset that employers indicate as desirable.**

To facilitate the interdisciplinary academic project, we began with group social interventions. These interventions were used in a multi-component plan to improve student resiliency and empowerment to support social, emotional, and academic development. This paper presents the development of the interdisciplinary course, preliminary observations, and redesign of the course.

Phase one developed an interdisciplinary course launched in the spring of 2019. A total of 59 students participated in the project, working on seven industry-sponsored projects. While all students were required to work together, each discipline was responsible for separate deliverables in their respective courses. All students collaborated on presentations to the clients. This project involved surveys and observations during team-building activities.

Initially students expressed fear, trepidation, and excitement regarding the proposed interdisciplinary collaboration. Team-building activities were introduced through an escape room experience. This allowed the authors to observe and measure the teams' success, which revealed a high level of positive interdependence, group processing, and social skills. Later, students demonstrated relatively high levels of satisfaction, enjoyment, and agreed this was a unique educational experience. However, students rated the group structural components relatively lower than other aspects; this data guided and informed the redesign into phase two.

Phase two developed additional structure to our interdisciplinary project. We built a project road map over summer 2019 based on the feedback from students in phase one. The road map details major milestones and events. The student teams meet weekly for these events and milestones and have additional course modules to complete.

Our data suggest collaboration in interdisciplinary project-based learning does initially produce disorientation, some trepidation, and confusion. However, ultimately these disorienting dilemmas lead to transformative learning, increased confidence, and cohesion among disciplines. The results of this paper will inform and guide engineering educators in creating interdisciplinary project-based coursework that meets the growing demands of the workplace of today and the future.

Keywords— Interdisciplinary, multi-disciplinary, engineering, communication, business, STEM, STEM communication, merged coursework, transformative educational experience, project-based learning, intellectual dexterity

Introduction

We have entered what is being referred to as the 4th Industrial Revolution [1]. Like the three previous revolutions, the 4th Industrial Revolution of cyber-physical systems, which are built on digital technologies and the internet, is a disrupter. We are already seeing the impact of robotics with tens of thousands of workers displaced worldwide [2]. Artificial Intelligence (AI) looms on the horizon and we have only a vague notion of what it will mean economically, culturally, and socially. What appears clear is that students and instructors must be plugged into the matrix of interdisciplinary thought in order to attain the intellectual dexterity necessary to succeed. Interdisciplinary collaborative learning is a key element to success. Exploring ways to better prepare students for the rapidly changing landscape, we have identified the need for industry-responsive adaptations to current curricula.

College and school-based professional learning communities (PLCs) utilizing project-based learning have proven track records. Additionally, industry research like that done in Google's Oxygen and Aristotle programs has concluded that interdisciplinary teams achieved the best performances [3], [4]. We are taking these models a step further by creating interdisciplinary research and collaboration among science, technology, engineering, and math (STEM), business, and liberal arts curricula. We are bringing the emerging marketplace design to the college classroom. Entrepreneurs, scientists, and engineers, who are some of the world's most cerebral people, often have difficulty conveying their vast knowledge and concepts. Many of our business and communication students are often equally challenged in trying to comprehend the complex ideas in science and technology. As we prepare students to deal with the challenges of this internet-digital-technological age, it is imperative we bring the students of these various disciplines together to foster an environment where each can benefit from the knowledge of all. Additionally, by including transformational change interventions in our merged coursework we hope to foster a growth mindset that will enhance the skills, knowledge, satisfaction, and comfort of the students.

Although there is a general understanding of the value of interdisciplinary project-based learning, the logistical and pedagogical challenges have led to limited implementation and exploration of such ventures. STEM education has been challenged by stakeholders to incorporate business and communication experiences (and vice versa) that prepare students for the marketplace. Development, design, and implementation of an interdisciplinary project-based learning approach offers a transformative educational experience to students by merging coursework in three different academic disciplines. The merged-coursework project will offer a transformative educational experience delivered to students through lectures, research, and experiential learning.

For this study, group interventions in a multi-component arena were utilized to improve student resiliency and empowerment to support social, emotional, and academic development. This paper presents the development of the interdisciplinary course, preliminary observation data, and redesign of the course.

Literature review

A project-based interdisciplinary course design has been one of the key interests among researchers in the field of engineering education. A cross-disciplinary learning (CDL) framework noting that CDL facilitated effective learning which increased motivation and satisfaction of students was presented in [5]. The importance of project-based interdisciplinary learning was highlighted by [6] asserting that entrepreneurial mindsets are significantly enhanced through taking interdisciplinary engineering capstone courses.

Advancements in various engineering foci require interdisciplinary cooperation, yet studies have found the lack of communication between engineers and other fields of study is often a limiting factor in developing effective working teams. Special efforts to design those learning environments are necessary to build an understanding of the interdependence of these various fields [7]. Studies on the effective implementation of interdisciplinary project groups also suggest that they set up an environment conducive to creativity as well as transformative learning. Specifically, they were found to encourage students to "think outside of their comfort zone and expertise," to "experiment," and to "change their routines and think laterally" [8].

Previous research identified key components of cooperative learning, including positive interdependence, individual accountability, group processing, social skills, and promotive interaction [9]. Without those elements, cooperative learning would be no different than group work. Those key elements of cooperative learning are highly required in multidisciplinary industrial environments and should be incorporated in designing interdisciplinary courses.

There is an emerging understanding by many accrediting agencies that our students require stronger career preparation. The National Association of Colleges and Employers (NACE) has identified eight career readiness competencies: 1) Professionalism/Work ethic; 2) Oral/Written communications; 3) Critical thinking/Problem solving; 4) Teamwork/Collaboration; 5) Leadership; 6) Digital technology; 7) Career management; 8) Global/Intercultural fluency [10]. These competencies are echoed by our governing accrediting bodies, the Association to Advance Collegiate Schools of Business (AACSB), the Accreditation Board for Engineering and Technology (ABET), and the Accrediting Council of the Association for Education in Journalism and Mass Communication (ACEJMC) [11], [12], [13]. While there is increasing need from engineering education seeking people with entrepreneurial mindsets, such as leadership or teamwork, there is also a growing need from business and communication education for enhanced technical understanding. Thus, we aim to develop a project-based interdisciplinary team project among engineering, business, and communication to offer a transcendent educational experience using industry-sponsored projects.

Initial development of course

It is the authors' experience that collaboration in teaching across disciplines is difficult. To overcome the somewhat balkanized atmosphere of the university environment, the authors took part in a faculty development component of a transformational change initiative designed to improve student outcomes. It was here that we discovered the corresponding needs of our students

and learned to effectively collaborate with each other as educators. This is where the seeds of the project were planted.

Our first step was to modify existing course projects within three current courses to include the interdisciplinary component. The courses which were modified include Marketing, Engineering Design Management, and Communicating Science and Technology. The initial layout of the modified courses and corresponding course deliverables can be seen in Figure 1.

Phase one developed an interdisciplinary course launched in the Spring 2019 semester. A total of 59 students (28 Business, 10 Communication, and 21 Electrical Engineering students) participated in the project, working on seven industry-sponsored projects (clients include Boeing, Fluke, etc.). While all students were required to work together, each discipline was responsible for separate deliverables in their respective courses. Electrical Engineering students designed product prototypes, Business students designed marketing plans for the products, and Communication students created videos and infographics used in presentations. All students collaborated on presentations to the clients. Assessments were conducted before, during, and after project launches and team-building exercises.

Preliminary results

A kick-off meeting was held at the beginning of the Spring 2019 semester. Students were given details about the interdisciplinary project. Students were asked to anonymously answer a set of opened-ended questions to attempt to ascertain both their expectations and what they perceived as the challenges they faced in participating in the project. This informed the instructors and allowed them to begin the process of designing survey questions.

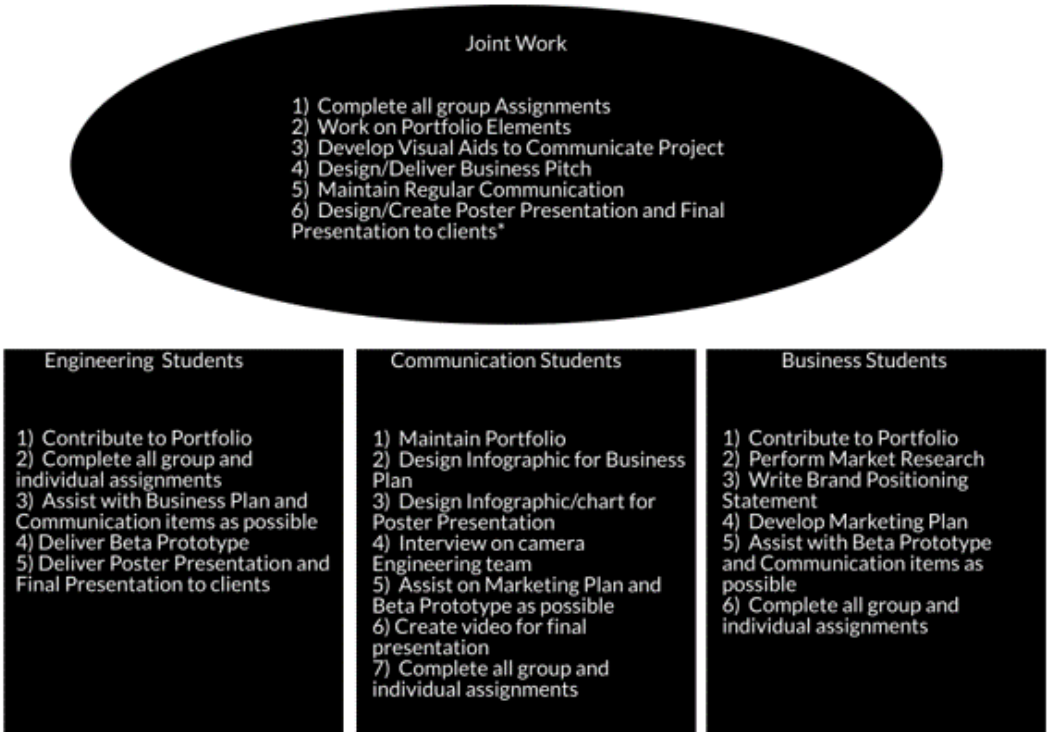

Figure 1: Interdisciplinary Course Deliverables

Initial questions during the kick-off meeting included: “What do you think that you could gain from working with other disciplines?” and “What concerns do you have working with other disciplines?” Some of the general themes regarding the first question included gaining perspective, group cooperation, communication, and career skills. Some of the themes regarding the second question included lack of group coherence and communication, self-doubt, unequal workload, conflict, scheduling time to meet, and not having enough time to meet.

Following the kick-off meeting, we planned an escape room activity as a team-building exercise for the groups. This exercise gives students early in the semester the opportunity to practice communication skills necessary for their developing projects. A few of the areas of team success during an escape room activity include:

- Large- and small-scale perspectives – students must keep both the larger picture and the minutia of the task in view. This simulates the experience of their interdisciplinary project.
- Communication – students must make sure that they voice their ideas and that their teammates heed those ideas. Everyone on the team is valuable and could contribute to solving clues toward escaping.
- Leadership – students need to know when to step up and when to step back.
- Collaboration – students must strive to work cooperatively.
- Positive thinking – students who succeed in escaping will have had practice in positive thinking as most groups who complete an escape room do so with only seconds left.

Introducing the escape room experience into the project was intended to build, observe, and measure the teams’ successes based on the following indicators: positive interdependence, individual accountability, group processing, social skills, and promotive interaction [9]. A similar study conducted at Ball State University concluded that gamifying learning experiences for career development is worthwhile [14]. In this first escape room experience it was the instructors’ goal to develop systems and surveys to measure specific outcome variables both quantitatively and qualitatively. The surveys developed included students’ anonymous responses (quantitative) and instructors’ observation of students (qualitative).

The instructors noted that the activities in the escape room reveal a level of interaction and supportive collaboration among the students from the different disciplines within the groups. It was the instructors’ observation that for the purpose of analysis it would be sufficient to rate the groups “high,” “medium,” or “low” for the following specific learning observations:

- Positive interdependence – as a specific variable outcome measuring how team members communicate with each other in a way that an individual member’s work benefits the team and the team’s work benefits the individual, in order to show group cohesiveness for accomplishment of the group task.
- Individual accountability – as the measurement of how individual team members take responsibility for individual effort and contribution to the group.
- Group processing – as the measurement of the ways group members improve the effectiveness of members contributing to the interdisciplinary efforts of the group.
- Social skill – as a measurement of the ways group members develop proactive communication and interpersonal skills to effectively collaborate as a group.

- Promotive interaction – as the measurement of how individual team members encourage and facilitate efforts of others to achieve and complete the task. As such, this interaction promotes success through a supportive, encouraging, and praising environment.

Overall, initial observations seemed to suggest that the student groups were relatively successful (medium or above) in positive interdependence, individual accountability, group processing, and promotive interaction, while social skills among members of the group was the weakest category during the initial escape room activity.

The instructors determined that at the end of the semester it would be necessary to again anonymously survey the students regarding the project. This allowed the instructors to analyze the progression of the students from the different disciplines through the various stages of the project. Initial feedback regarding phase one of the project included some themes regarding strengths of the project, such as "working with other majors," "working on real world products," "earned knowledge from other majors," "communication skills," and "understanding group responsibility." Some themes regarding weaknesses of the project included "needing more time," "needing more activities and cooperation," "better communication," and "better clarification of objectives."

Additional anonymous feedback from students suggested that they experienced both fear and excitement participating in the collaboration. Those who completed the phase one of the SOAR project noted a sense of accomplishment. One of the objectives of phase two was to develop better qualitative and quantitative survey methods.

Discussion and course restructuring

Our general observations of our students' reactions to the collaborative work were that collaboration in interdisciplinary project-based learning does initially produce disorientation, some trepidation, and confusion. However, ultimately these disorienting dilemmas lead to transformative learning, increased confidence, and cohesion among disciplines. We noted that in these environments a loose course structure was not beneficial. Students appeared to want and need a more defined pathway. We noted it was important to erase the false perception of unequal burdens among the disciplines by clearly defining roles and deliverables.

Phase two of this work was focused on redesigning the student experience. During the summer of 2019 a far more detailed and specific course design was established. The culmination of the redesign described below is being launched in the Spring 2020 semester. In the Spring 2020 semester, 51 students (22 Business, 14 Communication, and 20 Engineering students) are participating in the project, working on five industry-sponsored projects. Note that several students are registered for two of the classes simultaneously, affecting the overall count shown above. Those students are required to participate with multiple deliverables from this interdisciplinary work for each course respectively.

We began by creating a road map to guide the students through the interdisciplinary work, which can be seen in Figure 2. The course structure is broken into three major sections for student work and collaboration. These include structured group meetings or "sessions," group tasks culminating

Figure 2: SOAR Project Road Map

in a project portfolio, and individual tasks both inside and outside of class. We designed lab sessions where the instructors could guide the groups, group projects outside of class where the students would navigate their own team-building, and individual assignments designed to foster self-reflections. It is important to note that while team members had specific responsibility for certain deliverables, the collaborative sessions, group assignments, and various presentations required harmonious orchestration following an Aristotelian model: the whole being greater than the sum of its parts.

Interdisciplinary sessions are intended to increase the teams' capacity to complete the project while also becoming more aware of themselves in the process. They include:

1. Kickoff session – The purpose of this session is to form connections, elicit and correct misconceptions, and begin preliminary introductions to the interdisciplinary project and groups. It is also a chance to survey fears and doubts and bring them to the forefront.

2. Assumptions session – The purpose of this session is to provide another opportunity for students to get to know each other, reflect on assumptions, and collaborate to complete a statement of purpose. This session will serve as reinforcement of a team-meeting outside of class and a blueprint going forward.

3. Interdisciplinary workshop and escape room session – The purpose of this session is to provide a real-time opportunity to learn and assess cooperative learning within each team. It is also a chance to reflect on this experience and think about personal development. Finally, students are given a chance to regroup around the project.

4. Business pitch – The purpose of pitching the business of a product is to simulate the experience of a product unveiling with a focus on business perspectives. Team representatives will present their product to broad audiences in an oral presentation.

5. Final pitch rehearsal – The purpose of this session is to provide an outlet to express the diverse voices of the team through refining a product pitch. Students will be assessing one another, and themselves, so they can more easily focus their joint efforts in creating and delivering the perfect pitch.

6. Final pitch and poster presentation – The purpose of pitching the final product is to simulate the experience of a product unveiling from synthesized engineering, communications, and marketing perspectives. Team representatives will present their product to broad audiences in a poster presentation.

In a workplace setting, team members are expected to work together to complete projects. The group project emulates this process by the group's engagement in taking a potential product from development to the world. As in a work environment, students will be evaluated as individuals and as a team for the work they do together. As students work towards engineering, business and product marketing plans together, they will be expected to submit deliverables. They will then revise those deliverables at each iteration based on feedback received and growth in their own and the collective group's understandings. Each group assignment extends the work from the previous, culminating in a SOAR Portfolio. The portfolio includes:

1. Project vision and summary – This assignment requires students to:
    a. Briefly describe what the product-in-development is and what it can do.
    b. Examine what they need to do, how they are going to do it, what they will need to accomplish it, and then define what success looks like. They will be required to list several goals for their group to collectively envision the path to completion.
    c. Describe who will be impacted by the product. Think beyond the client and the university.
    d. Define how this product will impact stakeholders, communities, and the world at large. Additionally, consider the ethical, economic, environmental, social, local, and global issues associated with the product.
    e. Create a road map to completing the interdisciplinary project.
    f. Craft a joint statement that encompasses the previous questions.

2. Product description, significance and rationale, and market description – This assignment requires students to:
    a. Describe the product, design, and application.
    b. Provide a well-articulated rationale for the product and its effects. The rationale and significance of this product should be supported by research. Why is this product needed for those who will use it, and how has the group considered the various impacts this product will have on the world?
    c. Describe the market for this product. This should be a research-based description of the niche and broad markets for this product.

3. Business pitch – This assignment requires students to:
    a. Prepare an oral (20-minute) presentation of the product in a Shark Tank-like format. This pitch should include elements the students have prepared from the previous assignments.

4. Media release and the product pitch draft – This assignment requires students to:
    a. Create a draft media release for the product as it might appear in a newspaper publication.
    b. Prepare a preliminary written, oral, and visual display.

5. Media release and the product pitch – This assignment requires students to:
    a. Finalize a media release for the product as it might appear in a newspaper publication. This communication should be crafted in a way that connects stakeholders to the usefulness of the product and its financial, cultural, social, and environmental impact on the world.
    b. Finalize written, oral, and visual display (poster and video) of the product for a broad audience.

To gain a better understanding of themselves, their team, and their project, students will engage in a series of anonymous reflective activities which survey their current thinking. The individual tasks include:

1. Think to yourself survey – This survey is intended to identify a student's prior understanding of what people in other programs do. The questions in this survey include "What does an {Electrical Engineering, Communications, Business} major do?" "What are their strengths for your project?"

2. Thinking about my team survey – This survey is intended to have a student define the expectations of their team members, themselves, and their project. This survey asks students to explain in a few sentences the roles of each participant.

3. Team-building survey – This survey is intended to gather a mid-semester checkpoint for how the teams are performing. The questions in this survey include "How have your understandings about other disciplines changed?" "Overall, what can you and the team do together to ensure you meet your goals?"

4. Reflect and what's next survey – This survey is intended for students to reflect on their business pitch presentation. The questions in this survey include "How did you feel you did in giving the team's pitch?" "How confident are you about your team's success? Why or why not?"

5. Letter to me – This assignment is intended for students to write a "Letter to Me." In it, students will write to their previous self, the person they were on the first day of the semester. Students will give advice to themselves, consider assumptions they had about others, things they have learned, and things they would have done differently. Students should encourage themselves to take on challenges and explain ways to approach them.

6. 360° Peer Review – This assignment is intended for students to reflect on how each member of their group contributed to the project. This will provide students with a means of keeping each other accountable throughout the semester.

The combined output of the sessions, the portfolio, and the individual tasks will culminate in a robust interdisciplinary learning experience for the students involved. The interdisciplinary learning objectives that we have defined for students to achieve are:

1. Identify ways their knowledge and skills can contribute to an interdisciplinary challenge.
2. Identify the value and contributions of others through collaboration.
3. Synthesize concepts and approaches from multiple disciplines to develop an integrated product.
4. Critically reflect on and assess their own core values, cultural assumptions, and biases in relation to those held by others.

Lastly, we plan to utilize a set of research methods to evaluate student experience from this interdisciplinary course project. We plan to add two additional assessments into this phase of the project, a pre- and post- interdisciplinary survey as well as analyzing the individual tasks. In order to assess the learning outcomes, including interdisciplinary knowledge and mindset, we designed an interdisciplinary survey which will be administered at the beginning and end of the semester. We expect to assess how their entrepreneurship mindset and technical understanding have improved throughout the semester after participating in the interdisciplinary project. Individual tasks described above will also be analyzed to gain a deeper understanding of the student experience within the interdisciplinary course project.

Conclusions and future work

This paper highlights both the challenges and benefits of working to bring real world models into the classroom. We found both fear and excitement from students at the beginning of the course. These emotions stabilized over time as the students became familiar with their projects and their roles. Students enjoyed the escape room experience, which was found to be a good team-building activity. There were still discomforts and complaints due to group dynamics and personal differences, which challenged both students and instructors. Students showed a high level of satisfaction towards the project while expressing some concern over the loose structure of the project in phase one.

Student feedback was useful to restructure the course design to have more clarity and deliverables for phase two. Phase two includes three major sections for student work: professor-guided collaborative sessions, unguided collaborative tasks, and individual tasks. These were developed with the intention of providing clearer guidelines to students. The analysis of student surveys during phase two will provide deeper insights into how we refine this project further in order to enhance student learning experiences.

The continued work and results from phase two will inform interdisciplinary project-based engineering educators with the ultimate goal of creating interdisciplinary project-based coursework that meets the growing demands of the marketplace of today and the future. This

paper can serve as a blueprint for others hoping to establish similar interdisciplinary projects and merged-coursework curricula.

The authors anticipate adding significantly to the research aspects of this project with the completion of phase two at the end of the Spring 2020 semester. They plan to report on the findings of the qualitative and quantitative research design developed and discussed in the work following the completion of the semester.

References

[1] K. Schwab, *The Fourth Industrial Revolution*. New York: Penguin Random House, 2017.

[2] J. Manyika, S. Lund, M. Chui, J. Bughin, J. Woetzel, P. Batra, R. Ko, and S. Sanghvi, "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation," McKinsey Global Institute, Technical Report, Dec. 2017.

[3] D. Garvin, A. B. Wagonfeld, and L. Kind, "Google's Project Oxygen: Do Managers Matter?" Harvard Business School Case 313-110, April 2013.

[4] C. Duhigg, "What Google Learned From Its Quest to Build the Perfect Team," *The New York Times Magazine,* February 25, 2016.

[5] S. Schaffer, K. Lei, L. Reyes, W. Oakes, and C. Zoltowski, "Analyzing Cross-disciplinary Design Teams," in *Proceedings – Frontiers in Education Conference, FIE 2006*, *San Diego, CA, USA, October 28-31 2006*. pp. 17-22.

[6] E. Kim and G. J. Strimel, "The Influence of Entrepreneurial Mindsets on Student Design Problem Framing," *IEEE Trans. on Education*, pp. 1-10, June 2019.

[7] R. Coger and H. De Silva "An Integrated Approach to Teaching Biotechnology and Bioengineering to an Interdisciplinary Audience*," *Int. J. Engng. Ed.*, vol. 15, pp. 256-264, 1999.

[8] R.B. Gorbet, V. Schoner, and B. Taylor, "Best Practices for Enabling Effective Crossdisciplinary Learning in Interdisciplinary Project Groups," *Int. J. Engng. Ed.*, vol. 24, no. 3, pp. 495-508, 2008.

[9] A.L. Kern, T.J. Moore, and F. C. Akillioglu, "Cooperative Learning: Developing an Observation Instrument for Student Interactions," in *Proceedings – 37th Annual Frontiers in Education Conference, FIE 2007, Milwaukee, WI, USA, October 10-13 2007*. pp. 1-6.

[10] NACE, "Are College Graduates "Career Ready"?," Feb. 19, 2018. [Online]. Available: https://www.naceweb.org/career-readiness/competencies/are-college-graduates-career-ready.

[11] *AACSB Business Accreditation Standards*, 2018. [Online]. Available: https://www.aacsb.edu/accreditation/standards/business

[12] *ABET Engineering Accreditation Standards*, 2019. [Online]. Available: https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2020-2021/

[13] *ACEJMC Journalism and Mass Communications Accreditation Standards*, 2012. [Online]. Available: https://www.acejmc.org/policies-process/nine-standards/

[14] D. Waggoner, S. Martin, J. Eads, and R.D. Branson, "Using an Escape Room as Gameful Training with Students," *NACE Journal*, Feb. 2019. [Online]. Available: https://www.naceweb.org/career-readiness/competencies/using-an-escape-room-as-gameful-training-with-students/