The Future of Engineering Education
2024 Annual Conference & Exposition
Oregon Convention Center
Portland, OR . June 23 - 26, 2024
ASEE
Paper ID #41143

Motivating Students to Engage, Collaborate, and Persist with Classroom Podcast Creation

Dr. Thomas Lucas, Purdue University

Dr. Lucas' primary goal as a professor is to engage with students in the classroom and inspire them to develop their passion, understanding, and appreciation for STEM-based research and industry roles. This is accomplished by providing well-crafted and innovative learning experiences in engineering technology courses and through extracurricular outreach. His research background is in 3D (out-of-plane) micro-electromechanical systems (MEMS) sensor and actuator design. His current teaching load primarily consists of courses related to advanced embedded digital systems, IoT, and smart devices.

Bhavana Kotla, Purdue Polytechnic Graduate Programs

Ph.D. Candidate at the Department of Technology, Leadership & Innovation, Purdue Polytechnic, Purdue University, Indiana, USA

Dr. Katey Shirey, EduKatey

As the founder of eduKatey, Dr. Katey Shirey supports science and math educators worldwide to bridge their content areas and bring engineering design and creativity to their students. Dr. Shirey earned her BA in physics, BA in studio arts, and MT in secondary science education at the University of Virginia, followed by her PhD in science teaching, learning, policy, and leadership at the University of Maryland. Building on her background in physics, sculpture, art history, and high-school physics teaching, Dr. Shirey is passionate about using integrative-STEAM education to reach more students, engaging students in real-world explorations using science and math content, and helping teachers and students to grapple with complex problems in novel ways.

Dr. Lisa Bosman, Purdue University, West Lafayette

Dr. Bosman holds a PhD in Industrial Engineering. Her engineering education research interests include entrepreneurially minded learning, energy education, interdisciplinary education, and faculty professional development.

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Abstract

Research shows that college students generally rate the learning environment and perceived outcomes of courses delivered in person higher than those of an equivalent version delivered online. Without a deliberate pedagogical transformation of the material for remote delivery, online courses are often less engaging and effective due to a lack of social interaction and a more passive learning environment. Despite these barriers, the number of students taking online classes is increasing due to the flexibility, affordability, accessibility, and personalization that online learning offers. In light of these factors, an ongoing challenge for educators is to develop and employ innovative pedagogies to address the impediments to learning in an online environment. This proceeding describes the motivational impact on students from participating in a semester-long asynchronous project to create a nature-inspired and entrepreneurially minded podcast in an online Engineering Technology course. The project's duration was intentionally an entire semester to encourage students to remain engaged in the overall course content. Thematic analysis of student reflections indicates that participants were motivated in areas corresponding to Alderfer's proposed categories of basic human needs: existence, relatedness, and growth. The results are presented and discussed concerning the motivational framework. Additionally, podcast analytics are presented to support the estimated high impact and geographic reach of the project. While the data in this report was created in a course within the Engineering Technology discipline, the opportunity to implement this project in any field of study is possible. The podcast project was able to overcome the motivational challenges often reported with online courses, engage students in the learning process, and help them to persist in the course.

1. Introduction
1.1 Problem Identification

Research has shown that students generally perform better in in-person classes than in online classes. Recent studies of student groups at for-profit and public institutions found that students in online courses were less likely to complete their courses and had lower GPAs than students in in-person courses [1-3]. Online classes can be less engaging and effective than in-person classes for several reasons[4, 5]. Lack of social interaction is one factor that contributes to this problem. Online classes can be isolating for students, who may miss the opportunity to interact with their classmates and instructors face-to-face. Another challenge is to utilize delivery methods that do not exclusively rely on passive content presentation. Common active learning activities such as discussions, group work, and hands-on projects cannot be directly translated into an online space. Instructors with the specialized knowledge to translate such methods online are limited, and students are more commonly asked to watch lectures and read materials, which can lead to less effective learning.

Nevertheless, the number of students taking online classes has been steadily increasing in recent years [6, 7]. The increasing trend of offering online classes is likely to continue in the years to come due to many advantages for students and institutions alike [8]. For students, online learning offers flexibility, affordability, accessibility, and personalization. For institutions, online learning can help to reach a wider audience of students and reduce costs. Therefore, this growth

is likely to continue, it is important for students and instructors to be aware of these challenges and to take steps to address them.

1.2 Current Approaches to the Problem and Associated Gaps

Online classes commonly incorporate social interaction in many modes, such as with the use of discussion forums, live video office hours, and assignments utilizing social media [9, 10]. For example, discussion boards allow students to post responses to assigned material, and other students and the instructor can respond and critique the work. In the best case, this can help to create a sense of community and encourage students to learn from each other. However, when students are required to post on discussion forums regularly, they may feel like they have to "fill up" their posts with words, even if they do not have anything meaningful to say. This can lead to superficial discussions that do not contribute to student learning. Similar concerns have been noted regarding virtual office hours and social media posts, and in combination can lead to students feeling overwhelmed and disengaged from the course.

1.3 Proposed Solution

In response to the motivational challenges present in online learning, this work documents the implementation of an entrepreneurially minded project that utilizes modern media technology. The entrepreneurial element allows students to personally invest their perspective while developing creative and innovative solutions. The opportunity to invest their values in their work and to see the direct impact of their efforts can be very motivating and engaging. Also, the use of modern technologies can enhance the experience for learners as they learn new tools and resources that may be beneficial in other areas. This study will seek to define the motivating factors more specifically by addressing the following research question:

- *What elements are reported by students to be motivating following the creation of an entrepreneurially minded manufacturing podcast with a focus on digital distribution to a non-technical audience?*

2. Background
2.1 Real-World Projects

A real-world project in a classroom is one that connects the knowledge, and skills students are learning with current, relevant issues and challenges outside the classroom walls [11, 12]. In general, working on 'real-world' projects can have a highly motivational effect on individuals and teams. Specific motivating elements include:

- **Purpose**: Real-world projects often have a clear and meaningful purpose, such as solving a real-world problem or creating something new and useful.
- **Integration of academic skills:** Students apply and connect knowledge and skills from various subjects to address the project's challenges.
- **Application of critical thinking and problem-solving skills:** Students learn to analyze information, synthesize ideas, and address complex problems.
- **Reflection and evaluation:** Students have opportunities to reflect on their learning journey, the impact of their project, and what they could do differently next time.

Overall, working on real-world projects can be a highly motivating experience that can provide individuals and teams with the opportunity to learn new skills and knowledge. This can make them more competitive in the job market and more successful in their careers.

2.2 Asynchronous Online Learning

Asynchronous online learning is a type of distance learning in which students and instructors do not interact in real time [13, 14]. Instead, students can access course materials and complete assignments at their convenience. This contrasts with synchronous online learning, in which students and instructors must attend class sessions at a predetermined time. Asynchronous online learning has many advantages over synchronous online learning in areas of flexibility, accessibility, and scalability. In addition, asynchronous online learning can also be more effective than synchronous online learning in certain cases. For example, asynchronous online learning allows students to review course materials multiple times and to complete assignments at a time when they are most focused. These advantages have led to its widespread adoption in K-12, corporate, and collegiate education.

2.3 Classroom Podcasting

Audio podcast usage in the classroom has been increasing over the last decade [15]. Both teacher and student produced podcasts have been implemented in K-12 and higher education settings in a broad range of disciplines [16]. Student-led podcasting has the potential advantages of engaging students by utilizing a modern and familiar format, deepening learning of the subject by requiring a translation from technical research to spoken media and allows students to share their work broadly on a publicly accessible platform. However, podcast implementation within engineering education is more commonly used as a content delivery pedagogy by instructors [17, 18]. In cases where the podcasts are student-generated, content was only distributed among close peers through non-public channels [19, 20]. The work created with the following methods was intended to have students synthesize their research into a format appropriate for a general audience, produce podcasts with standardized tools, and distribute their work through publicly accessible services.

3. Methods
3.1 Study Design

The participants in the latest asynchronous iteration of this project included fourteen students enrolled in an upper-level undergraduate course (Introduction to Industrial Controls) offered to both Electrical (as ECET 30201) and Mechanical Engineering Technology (as MET 28400) students at a large research-focused university in the Midwestern United States. In the 14 respondents to the project reflection, eight accessed the course from within the United States and eight were located internationally.

The nature-inspired podcast creation curriculum was implemented over an 8-week semester in the form of six steps that occurred concurrently with the regularly scheduled weekly topic lectures and laboratory activities for the course. In general, the project flow guided students through researching their topic from multiple perspectives (Steps 1 and 2), translation of their compiled research to a format appropriate for a general audience (Steps 3 and 4), and finally to refinement, production, and distribution of their podcast episode (Steps 5 and 6). Students received the assignments and interacted with the course content and discussion boards via a

learning management system (LMS) widely adopted in higher education. The details of the assignment at each step are in Table 1 and were presented to students in text form and one-minute videos recorded by the instructor. The curriculum represents an evolution from a previously reported in-person podcast creation rubric in Engineering Technology [21].

Step	Topic	Assignment and Deliverables
1	Historical background research	Preliminary Research + Online Discussion: Watch a video "Introduction to biomimicry." Then, research to find a manufacturing product/process of interest that was inspired by a biological process. Summarize your findings in a short paragraph on the course discussion board, review the other posts, and reply with your thoughts to two other posts with the least replies.
2	Entrepreneurial application research	Market Analysis + Online Discussion: Watch a video introduction discussing "Skillset vs Mindset." Then, focus on the modern applications of your process from the first step. Identify the companies, products, and industries that are affected by this process. Summarize your findings in a short paragraph on the course discussion board, review the other posts, and reply with your thoughts to two other posts with the least replies.
3	Translation from technical research to storyboard	Present Storyboard: Watch a video "Introduction to Storyboarding." Then, create a storyboard for your podcast and submit it to the instructor.
4	Storyboard Concept Pitch	Create a 2-minute spoken summary of your storyboard, as if you were sitting down at a table with me and I asked you to explain your topic. Record your two-minute "pitch" using any tool you want (such as Windows Recorder or the Recorder Android app). Submit the file to the instructor.
5	Revision with Peer Feedback	Start a new thread on the course discussion board and share your storyboard and two-minute pitch so it can be viewed/listened to by your classmates. Go review your classmates' threads and respond to **THREE** threads with the least responses with two things (**for credit**): 1. A question to the presenter starting with "I notice..."

		2. A question to the presenter starting with "I wonder...:

6	Podcast production and distribution	Review the critiques from your classmates, then:
		
		1. Record an audio file based on your work. This should be 5-8 minutes of content total.
		
		2. Determine intro/outro music and other media required. Google "YouTube free music" and the first link is an extensive list of license-free music clips that you can download.
		
		3 (ON YOUR PC). Edit/mix/add/chop/etc. in Audacity
		
		  1. First, view a video tutorial introducing the software to get a general idea of how it operates and where to download/install.
		  2. You can record in Audacity or have everything recorded already from any other recording software/app.
		  3. Gather your 5 files: intro recording, transition music 1, body recording, transition music 2 (might be the same as 1), and outro recording.
		  4. Import your files into Audacity as shown in the tutorial above. https://www.youtube.com/watch?v=tSmtJU2LU54&ab_channel=TutorTubeWatch a tutorial video on "Crossfading in Audacity." You will do this to transition between your tracks.
		  5. Refer to the tutorial and export your overall file as a .wav, ready for submission.

Table 1. Completion date schedule for assigned podcast development modules.

After completing the assignments above over the semester, there are three final requirements for the project. First, the student must submit a one-line episode description in the format of "In this episode, NAME will be discussing TOPIC". Second, the student must upload their completed podcast audio file in .wav form. The final requirement is to complete an assigned metacognitive reflection (described in section 3.2) and submit it with their episode. Completed episodes are then uploaded by the instructor to the podcast.omplete an assigned metacognitive reflection (described in section 3.2) and submit it with their episode. Completed episodes are then uploaded by the instructor to the podcast.

3.2 Data Collection

The data was collected using a metacognitive reflection assignment consisting of two sections, with three questions in each section. The first set of three questions (Table 2) made use of photovoice reflection prompts [22] that asked students to reflect upon lessons learned by completing the semester-long project. The second set of questions (Table 3) was comprised of three standard reflection prompts that assessed the students' opinion of the course-level implementation, experiences, and transferrable skills obtained. Students submitted a single document containing their responses to the six prompts at the time of their final podcast submission.

Directions	
Please respond to the photovoice reflection prompts using three pictures (e.g., photo) and writing a narrative (e.g., voice). The narrative (minimum of 200 words for entire response) should reference the pictures and their relationship for your response.	
Assessment Topic	**Prompt**
Entrepreneurial Mindset	Photovoice Reflection Prompt A (Entrepreneurial Mindset): The entrepreneurial mindset is defined as "the inclination to discover, evaluate, and exploit opportunities." Explain how participating in the newly developed curriculum incorporated the entrepreneurial mindset, and lessons learned relevant to the entrepreneurial mindset.
STEAM	Photovoice Reflection Prompt B (**STEAM**): STEAM (science, technology, engineering, arts, math) goes one step beyond the well-known STEM to acknowledge the importance of integrating the arts and humanities into more analytical coursework such as that found within engineering. Art can be incorporated through pieces, process, and movements. Explain how participating in the newly developed curriculum incorporated STEAM (specifically, the arts), and lessons learned relevant to STEAM (specifically, the arts).
Bio-Inspired Design	Photovoice Reflection Prompt C (**Bio-Inspired Design**): Bio-inspired design uses the nature-focused context of sustainability, security, and/or biomedicine and health outcomes to motivate analogical thinking and improve the engineering design process. Explain how participating in the newly developed curriculum incorporated bio-inspired design and lessons learned relevant to bio-inspired design.

Table 2. Assessment topics and prompts for part 1 of the data collected.

Directions
Directions: Please respond to the open-ended reflection questions with a minimum of 200 words per question. Be sure to check assignments for spelling and grammar before submission.

Assessment Topic	Prompt
Interdisciplinary	Open-Ended Reflection Question A (**Interdisciplinary**): The interdisciplinary approach of integrating the entrepreneurial mindset, STEAM (specifically, the arts), and bio-inspired design has been shown to improve student engagement, motivation and learning outcomes. How did this interdisciplinary learning experience affect your ability to engage with the newly developed curriculum?
Project Debrief	Open-Ended Reflection Question B (**Debrief**): What went well? What did not go so well? What will you do differently next time?
Connection to Real World	Open-Ended Reflection Question C (**Connect to Real World**): What skills did you learn? Please consider both professional skills (e.g., communication, collaboration, etc.) and context specific skills (e.g., topic area). Why are these skills important for engineers in the real world?

Table 3. Assessment topics and prompts for part 2 of the data collected.

3.3 Data Analysis

The authors performed a preliminary thematic analysis [23] of the qualitative data to determine common outcomes of the students' experiences. The three most prominent themes (e.g., patterns discovered across at least four students) were selected for discussion in this article, and direct quotes are included with this analysis to allow the reader to independently judge the conclusions drawn by the authors [24].

4. Results

The themes that emerged from the preliminary thematic analysis are (1) Self Improvement, (2) Job Safety, (3) Seeing Value, (4) Peer Connection, and (5) Interest-driven Engagement. These themes were further categorized into three branches based on Alderfer's ERG theory [25] (see Visual Summary of Themes, Figure 1) as viewed in the context of online learning motivation [26]. Quotes have been selected from this preliminary data to highlight student experiences in each area.

4.1 Theme #1 - Self Improvement

The participants acknowledged that they observed personal growth while participating in the newly developed curriculum.

- "I first thought that this class was going to be simply assignments and tests, however the project allowed me ***to be excited*** since it was something we were able to design and choose to our own pleasing to express what we thought was great. This allowed me to ***improve my engagement and motivation*** in the course. Without the incorporation of STEAM into this course I would have been much more reluctant in my motivation to complete assignments. Regardless of that, the arts also allowed me to ***attach a piece of myself to my work*** giving it identity. This just seemed to ***boost my self-esteem***."

- "The interdisciplinary learning experience has ***greatly impacted my ability to work*** with the newly developed curriculum. This has led to a holistic approach to teaching in which different disciplines intersect and complement each other, leading to a ***broader understanding*** of the subject matter. The integration of this area ***piqued my curiosity*** and gave meaning to my research as I understood how these different areas work together to contribute to innovative and meaningful solutions."

4.2 Theme #2 - Job Safety

The participants acknowledged acquiring job readiness skills while participating in the newly developed curriculum.

- "Through my interdisciplinary learning experience, ***I have acquired diverse skills, both professional and situation specific. Professionally, I have developed important skills such as communication, collaboration, critical thinking, and problem solving***. Participating in collaborative projects with colleagues from diverse backgrounds has improved my ability to communicate ideas effectively and work together as a cohesive team. This experience has also improved my critical thinking and problem-solving skills when tackling complex challenges and seeking innovative solutions that integrate multiple disciplines."

- "Some of the ***skills I learned from this project, and are crucial for engineers in the real world, are verbal and written communication, podcast recording, and creative problem-solving***. This project allowed me to intensely work on my communication skills."

4.3 Theme #3 - Seeing Value

This theme showcases how the participants viewed the course content and activities as a valuable opportunity to prepare them for their future careers.

- "The labs also helped a lot with learning logic ladder programming as I know that will be a good skill to have in the future regardless of what space I go into. Overall, majority of the topics learned in the class helped further develop my entrepreneurial mindset and helped me develop skills that ***will help further my career in the future***."

- "Before doing this project, I also had not heard of biomimicry. I will now be able to keep turning to nature for possible solutions in the back of my mind as I enter into the professional realm of engineering and must produce solutions to problems. Especially as the world as a whole begins to turn towards more environmentally friendly alternatives to modern technology, ***I can see biomimicry coming up a lot in my future career***."

4.4 Theme #4 - Peer Connection

The participants acknowledged that collaborating with their peers was helpful as they could improve their work based on peer feedback.

- "My collaboration skills were also improved with the use of discussion boards. The prompts allowed for constructive criticism. I did take some ***advice from my classmates and incorporated them into my podcast assignment***."

- "The discussion assignments throughout the course were also useful as they enabled us to ***both give and receive feedback*** and also communicate with each other which is significantly

important particularly in an online course where interaction among students is limited."

- "Learning from others is helpful for engineers to gain more knowledge about different topics. Then there will be other people's comments on my post, and by ***communicating with others I can refine my assignment***."

4.5 Theme #5 – Interest-driven Engagement

The participants acknowledged that participating in the new curriculum reinforced their interest in pursuing their current majors and helped them engage with the course.

- "Incorporating the entrepreneurial mindset and STEAM into the course also made it ***more interesting for me as part of the reason why I chose my major is that it combines aspect from engineering and management together*** which is why I believe this approach was suitable for me and enabled me to engage with the material throughout the course."

- "Overall, I think that ***incorporating arts and nature into this engineering course gave me a level of interest and connection to the course material*** that I otherwise would not have gotten has it focused solely on the technical side of engineering."

4.4. Summary and Discussion

Within the framework of Alderfer's ERG theory, online college courses offer a unique landscape for understanding the interplay between individual needs and academic motivations. The themes discovered can be categorized by their alignment the Existence (level 1), Relatedness (level 2), and Growth (level 3) parts of the framework as shown in Figure 1:
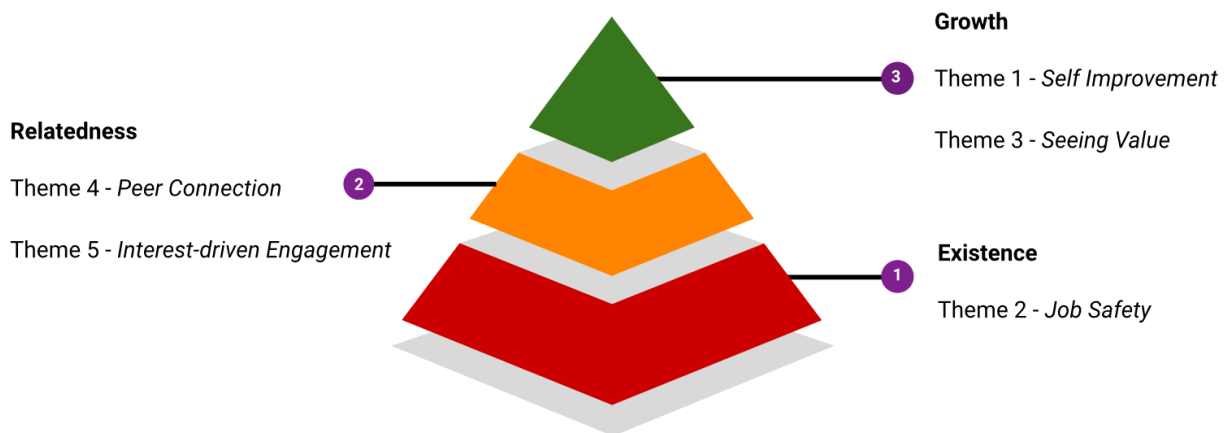

Growth

3 Theme 1 - *Self Improvement*

Theme 3 - *Seeing Value*

Relatedness

Theme 4 - *Peer Connection*   2

Theme 5 - *Interest-driven Engagement*

Existence

1 Theme 2 - *Job Safety*

Figure 1. Alignment of the five discovered themes with Alderfer's ERG Theory

Existence (level 1) prioritizes basic needs for survival and security and underpins Job Safety (Theme 2) in that the student feels in the moment that they are in an effective learning environment and anticipates usefulness of the course content is anticipated to help an individual thrive in a future role in the manufacturing workforce. Additionally, within the context of an online course, a clear pathway to completion of coursework and attainment of academic goals fulfills basic needs for security and well-being. This sense of accomplishment paves the way for

higher-level needs to emerge, allowing students to focus on Relatedness (level 2) and Growth (level 3).

The themes of Peer Connection (Theme 4) and Interest-driven Engagement (Theme 5) connect to Relatedness (level 2). The analysis indicated that the structure of this Online learning module fosters a sense of belonging and connection despite the virtual setting. Collaborating on projects, sharing insights, and offering support create peer relationships, enriching the learning experience. This sense of community, in turn, fuels engagement as students are empowered and motivated to participate actively and contribute their unique perspectives.

The themes of Self-improvement (Theme 1) and Seeing Value (Theme 3) align with Growth (level 3). Students engage in self-improvement through active learning to expand their knowledge and gain skills. This pursuit is further fueled by their recognition of value in the material, where meaningful coursework and real-world application create intrinsic motivation to participate with full effort. The synergy between these two aspects creates a positive feedback loop that amplifies the academic mastery and personal growth of participants. academic mastery and personal growth of participants.

Understanding this interplay is crucial for educators and course designers. By incorporating elements that address all levels of ERG's hierarchy, online courses can better cater to diverse student needs and foster a more engaging and fulfilling learning experience. For instance, Self-Improvement (Theme 1) can be encouraged through personalized learning paths and feedback mechanisms, while Seeing Value (Theme 3) can be fostered through real-world applications and relevant coursework. Additionally, fostering Peer Connections (Theme 4) through online communities and collaborative projects can strengthen Relatedness (level 2) and further drive Interest-driven Engagement (Theme 5) as participants strengthen their viewpoints with various perspectives. By appreciating the dynamic interplay between these themes, we can create online learning environments that not only equip students with knowledge and skills but also nurture their personal growth and sense of belonging, ultimately leading to a more successful and enriching academic journey.

5. Conclusions
5.1 Practical Summary
Motivation is essential for effective learning. When students are motivated, they are more likely to pay attention, participate in class activities, and retain information. This leads to better learning outcomes. Online courses are known to have challenges to their success. Students often do not have the opportunity to interact with their classmates and instructors in person, which can make it difficult to stay motivated and engaged. Furthermore, online courses can feel that they are more time-consuming than in-person courses due to requiring deliberate scheduling of time for reading assignments, watching lectures, and completing assignments. However, engaging in online courses can help to address all of these challenges. When students are sufficiently motivated, they are more likely to persist in the course and achieve their learning goals. The preliminary results in this study indicate that the podcast project was able to address these challenges. The preliminary results in this study indicate that the podcast project was able to address these challenges.

5.2 Analytics

A benefit of most podcast hosting platforms is the collection of detailed analytics on the podcast's performance and listenership. It is standard practice for podcast services to provide content creators with detailed summaries of their listeners' geographic location, platform, gender, and age. Also, episode-specific data such as date and total count of plays is available. These items are beneficial to educators and students as a means of quantifying impact and investigating the reach of these projects.

5.3 Limitations and Future Research

This exploratory study must be considered within the context of relevant limitations. First, there may be more conclusions that could be drawn if the demographic information of participants were more fully documented to capture participants' specific geographic data. Additionally, multiple students did not complete the assignment during the semester discussed. The cause for this is not clearly understood but may have to do with the non-mandatory nature of this assignment within the course. Although points were lost, students were still allowed to pass the course without submitting their final podcast episode. Finally, post-upload opportunities regarding analysis of the analytics and usage of listener feedback channels such as comments and polling have not been explored in this study. There are likely learning opportunities available regarding the reach and impact of the podcast for student creators possible with these tools. Nevertheless, this work has shown success in asynchronously delivering a nature-inspired podcast creation curriculum. The project will continue to be included as an asynchronous enrichment component to the Industrial Controls course used in this study.

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