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Student-led Video Podcasting in a Chemical Behavior of Materials Course

Dr. Erick S. Vasquez-Guardado, University of Dayton

Erick S. Vasquez-Guardado is an Associate Professor in the Department of Chemical and Materials Engineering at the University of Dayton. Dr. Vasquez earned his B.Sc. degree in chemical engineering (ChE) at Universidad Centroamericana Jose Simeon Canas (UCA) in El Salvador, an M.S. in ChE at Clemson University, and a Ph.D. in ChE at Mississippi State University.

Student-led Video Podcasting and Recording in a Chemical Behavior of Materials Course

Abstract

Video podcasts, or vodcasts, are a form of podcasting that combines video and audio to deliver various types of educational content effectively. To our knowledge, very few studies have focused on student-produced podcasting for learning technical engineering concepts. This study explores using student-created technical videos in a course on the chemical behavior of materials through three separate assignments.

The first assignment centered on sustainability aspects. Students, divided into groups of three, were tasked to review two influential journal articles on plastic waste input into the ocean and metal recycling. Each group had to prepare and deliver a technical script about the topic discussed. Using the script, videos were recorded in a podcast studio located in the learning and teaching center at the University of Dayton (UD). The video recordings were then shared with the students. Two supplemental podcasts featured a guest from the Hanley Sustainability Institute, discussing recycling efforts and initiatives at the UD, and a second podcast guest speaker hosted a discussion on current trends in semiconductors. Both recordings were given to the students to provide examples of delivering technical content through a podcast. The second assignment required students to individually produce narrated videos about materials characterization techniques, such as X-ray fluorescence and X-ray diffraction. Each student was given 20 – 25 minutes to explain their chosen characterization technique's technical aspects and applications. The third assignment involved a one-on-one podcast session experience, where each student, acting as a guest, discussed with the instructor—the host—a material of interest along with its chemical behavior and structure-property relationships.

To support the research process, an engineering librarian provided guidance on effective strategies for searching technical content through the UD library resources and databases. Brief surveys were administered to assess student perceptions of this learning method, and the results are discussed in this study. Ultimately, this study shows an alternative approach to enhancing student engagement and technical learning by producing podcasts and technical video content.

1. Introduction

In an era when most college students are digital natives, integrating digital media into coursework is important for fostering a sense of connection and belonging. [1] Podcasts, for example, deliver digital audio files through the Internet and are a medium to disseminate, transmit, and communicate information to a broader audience. More than just a tool for communication, they are a powerful resource for enhancing learning. A vodcast is produced when a video is recorded in a podcast session, combining auditory and visual elements of digital engagement. Platforms such as YouTube have significantly enhanced the dissemination of vodcasts/podcasts to diverse audiences. As of February 2024, it is estimated that over 3.2 million podcasts exist globally, with this number continuously growing, demonstrating the high impact on communication.[2]

Numerous podcasts have been developed to support outreach and communication in engineering education; a few are highlighted in this study. For example, one of the most recent podcasts in chemical engineering education is "In the (Fume) Hood (ITFH)."[3] ITFH hosts initially focused on material and energy balance problems and case studies before expanding to include interviews with chemical engineering professors and discussions on broader topics within the field. Another successful podcast, "K12 Engineering Education," aims to promote engineering and design for all ages.[4] Similarly, "Being an Engineer" is a central repository that collects and shares industry knowledge from many companies, technologies, and experts with best practices related to the engineering field.[5] Many more podcasts related to engineering exist and are discussed elsewhere.[6] Few studies, however, have focused on understanding podcasts/vodcasts as a teaching and learning tool to engage students effectively.[7]

Across many college campuses, podcasts are becoming a student learning tool; a few examples exist in the literature. For instance, it has been shown that student engagement and involvement in educational topics can grow through podcasts/vodcasts[8]. A study by Lucas et al.[9] implemented an entrepreneurially minded learning approach with student-led podcasting in an upper-level manufacturing course, deepening subject understanding by translating technical research into spoken media and enabling broader sharing on public platforms to a non-technical audience. In another study, as a team assignment, students created a podcast focused on a topic related to one of the Grand Challenges of Engineering.[10] Each team researched a specific aspect of the chosen challenge, collaborated to develop a cohesive vision for the podcast, prepared interview questions, recorded guest interviews, and structured their segments into a unified and coherent format based on the selected podcast type. The use of podcasts has also been documented and assessed in an Introduction to Environmental Engineering class[11]. Students had a memorable class experience. However, before implementing this educational approach, the study identified several challenges, including video production, post-production, script writing, and videography.

This paper explores using student-created technical videos in a course on the chemical behavior of materials through three separate assignments. It is important to note that the University of Dayton (UD) has access to a Podcast studio with technical support for recording podcasts and vodcasts. However, no assistance is provided for script writing and post-video editing. This work hypothesizes that student-led videos give an in-depth understanding of a particular topic in

materials chemistry and can help students disseminate their knowledge to other peers through technical video communication.

2. Methods

2.1 Participants and video recording

Six students participated in the study: two senior undergraduate chemical engineering students and four graduate students in Materials Engineering. Two international students were also enrolled in the course. It is important to note that podcast recordings occurred during class sessions, and the course instructor hosted each video podcast with assistance provided by staff in the learning and teaching center (LTC).

2.2 Assignments

Assignment 1: Team vodcast. Two teams of three students were formed. Each team was in charge of reading and preparing a podcast script (15 - 25 min duration) for one of the following readings:

- Team 1: Plastic waste inputs from land into the ocean [12]
- Team 2: Challenges in Metal Recycling[13]

The primary goal of this team vodcast recording was to familiarize students with the location of the live recording, microphones, cameras, and audio features in the podcast studio recording in the Learning and Teaching Center. The overall *learning objective* of this activity was to promote active and collaborative learning of materials chemistry by (1) discussing a unique, influential paper in the field, (2) increasing knowledge of plastic wastes and metal recycling, and (3) motivating and introducing students in communicating science and engineering to a broader audience through the use of vodcasts.

Assignment 2: Individual recordings. Each student studied an experimental technique used to analyze the chemical behavior of materials individually. Examples of techniques given to the students included Raman spectroscopy, X-ray photoelectron spectroscopy, X-ray Diffraction, X-ray scattering, and Small Angle Neutron Scattering (SANS). The assignment was open-ended, and each student chose a technique to learn and share with the classroom.

Students were allowed to prepare a technical presentation that could be delivered as a Zoom recording, using the story studio in the library, or recording a podcast in the Learning and Teaching Center (20 - 25 min duration). The recorded video and presentation slides were submitted through the Learning Management System and were made accessible to all students by the instructor [14].

Assignment 3: One-on-one (individual) vodcast recordings. Each student recorded an individual podcast with the course instructor serving as the host. Recordings occurred during the last three class sessions, and the videos were made available to the students following the podcast recording sessions. Some of the vodcasts are also disseminated through YouTube™ with each student's permission only. A link to the vodcast recordings can be found online [15]. For this individual assignment, the students were tasked with the following steps:

- Select a "*material"* of interest (open-ended assignment, the student selects the material of analysis).
- Research as much as you can about that *material* and find key topics to be discussed during the podcast (including references and citations).

- Prepare a podcast script (Q&A style) in which the instructor serves as the host of the podcast, and the student is considered the "expert" on the material selected. The script included citations (i.e., your sources of information). The Podcast should last 15 ~ 25 mins (no more than 35 mins are allowed).

2.3 Resources

To support the research process, an engineering librarian provided guidance on effective strategies for searching technical content through the UD library resources and databases. The students were also provided with an additional podcast prompt and statement example. Participants had access to a podcast studio and a recording studio (story studio) located in the learning and teaching center at the University of Dayton.

3. Results and Discussion

3.1 Team vodcast recording. For one recording session, a student from one of the teams had to connect remotely through Zoom to join the vodcast recording, as shown in Figure 1. Although this presented challenges, the recording was done successfully, and the communication among the four panelists proceeded without difficulties. The second team had all four members joining in the same room, and two video cameras were used to capture each panelist. An example is shown in Figure 2. Some post-processing was necessary to incorporate the audio from the Zoom recording into the video. This process was performed by personnel at the UD library.

Figure 1. Team 1 Vodcast recording to discuss and analyze influential research articles

Figure 2. Example of team recording in the Podcast studio at the University of Dayton

This first team assignment aimed to introduce students to the podcast studio and prepare them for delivering technical content through a podcast. It is important to note that the first podcast recording occurred early in the semester (2nd week of the term). Some students suggested having this introductory recording later in the semester when more topics were covered in the lectures. Only the script was graded for this assignment to motivate students to individually prepare better scripts for their additional video recording assignments (assignments 2 and 3).

3.2 Individual recording assignment. In an open-ended assignment, students could freely discuss and explain an experimental characterization technique used in materials chemistry by recording a presentation for their peers. Although the students had three options for this recording (Zoom, podcast, or story studio recording), they all chose Zoom recordings. This could be attributed to most students' familiarity with Zoom and time-related issues for reserving the story studio or the podcast studio in the library at the UD.

The specific topics that the students chose for this chemical behavior of materials course included:

X-ray fluorescence
Isothermal Titration Calorimetry
X-ray diffraction (x2)
Atomic Force Microscopy
ICP-MS

A link to the complete playlist of these presentations is available [14]. It is important to note that some students preferred video recordings without their faces on the screen, while others preferred

audio files only along with the PowerPoint presentation. The technical content was evaluated for each presentation, and an average score of 185/200 points was obtained. This result indicated the high level of technical content that each student presented. It is important to note that a rubric was not made available for this assignment, and the grading was solely based on the quality of the technical content related to the chosen characterization technique. For the final project and vodcast recording, it was decided to provide students with a rubric to help them prepare better for preparing the script and presenting technical content, as discussed next.

3.3 One-on-one vodcast recording. For this last technical video-related assignment, the students could freely choose a "material of interest" to discuss in a podcast while video-recorded. This assignment was open-ended so the students could choose materials of interest to them. The six types of materials chosen by the students for this assignment varied, and these were:

Biodegradable polymers
Kevlar
Boron Nitride
Magnetic nanomaterials and nanocomposites
Amorphous Metals
Direct Energy Deposited Metals

Each student had at least 15 minutes and a maximum of 25 minutes to discuss these materials in their podcast. A link to the podcast recordings can be found online [15]. The students were also tasked with providing a name for the podcast, and it was agreed that "Break it Down" was a good name for discussing materials chemistry. Two additional podcasts were recorded before the delivery of this final assignment to demonstrate to students how other guests discussed topics related to materials chemistry. One of the guest speakers was a staff member from the Hanley Sustainability Institute at the University of Dayton, and a discussion about plastics recycling at the university level and in the Midwest area was held. On a second podcast, the guest speaker was an Assistant Professor in the Department of Chemical and Materials Engineering. The discussion was centered on semiconductors, which is this professor's primary area of research. Both examples helped the students prepare a script for their final individual recordings. Additionally, a rubric was prepared to assess the student's performance in the last vodcast assignment. The course instructor prepared the rubric using a series of AI interactions (ChatGPT). Once generated, the rubric was shared with the students before their assignment due date. The rubric can be seen in Table 1.

As noted in Table 1, several aspects of the vodcast recordings were evaluated. Most of the grade was assigned to the technical content or content knowledge that the students demonstrated throughout the video recording. Other aspects of the evaluation included relevance and focus, structure and organization, delivery and engagement, use of supporting materials, and creativity and originality. The students participating in the study obtained an average score of 93/100.

Table 1. Rubric used to evaluate the podcast scripts of a selected material of interest

Criteria	Exemplary	Proficient	Basic	Below Expectations
Content Knowledge (50 Points)	Demonstrates deep and accurate knowledge of the topic; effectively explains complex materials science/chemistry concepts with clarity and precision. Sources are well-researched and appropriately cited. (45-50 Points)	Shows good knowledge of the topic; explanations are generally clear and mostly accurate, though there may be minor omissions or simplifications. (35-44 Points)	Displays a basic understanding of the topic; some explanations may be unclear or contain inaccuracies. (25-34 Points)	Limited understanding of the topic; explanations are unclear, incomplete, or incorrect. (0-24 Points)
Relevance and Focus (20 Points)	Topic is highly relevant to materials science/chemistry; stays on topic throughout; content is focused, providing appropriate depth and insight. (18-20 Points)	Topic is relevant; generally stays focused, with minor digressions; content is mostly at a good level of depth. (15-17 Points)	Topic is somewhat relevant; focus may shift at times or lack depth. (10-14 Points)	Topic is not relevant, lacks focus, or is very shallow. (0-9 Points)
Structure and Organization (15 Points)	Podcast is well-organized, with a clear introduction, logical flow of content, smooth transitions, and a strong conclusion. (13-15 Points)	Podcast is organized, with a few rough transitions or areas where clarity could improve. (10-12 Points)	Podcast has a somewhat clear structure but may be missing key elements, have rough transitions, or be hard to follow at times. (7-9 Points)	Lacks structure; difficult to follow. (0-6 Points)
Delivery and Engagement (15 Points)	Engaging delivery with excellent pacing, clear articulation, appropriate emotion, and energy that captures the audience's attention. (13-15 Points)	Good delivery with mostly clear articulation and engagement, though there may be moments of flatness or pacing issues. (10-12 Points)	Somewhat engaging delivery; articulation may not always be clear, with notable pacing issues. (7-9 Points)	Lacks engagement; poor articulation, flat delivery, and pacing problems. (0-6 Points)
Use of Supporting Materials (10 Points)	Effectively uses supporting materials (e.g., sound clips, interviews, data references, technical studies, appropriate websites) to enhance the content; all references are relevant and cited appropriately. (9-10 Points)	Uses supporting materials appropriately, including some technical studies or references, though they may not always significantly enhance the content. (7-8 Points)	Uses supporting materials but may lack depth or integration, or the references may not always be relevant. (5-6 Points)	Minimal or no use of supporting materials or references; content lacks supporting depth. (0-4 Points)
Creativity and Originality (10 Points)	Highly creative presentation that shows original thinking, interesting insights, and an engaging approach to the topic. (9-10 Points)	Demonstrates creativity; offers some unique perspectives or engaging approaches. (7-8 Points)	Somewhat creative but may be derivative or lacking originality. (5-6 Points)	Lacks creativity; overly derivative or uninspired. (0-4 Points)

3.4 Assessments. A *survey* was prepared to gauge the students' interest in using podcasts as a learning tool in the classroom. The survey emphasized aspects of the three assignments involving a video recording: the team podcast, the recording of a characterization technique, and the individual podcast. The survey was given three weeks before the end of the semester, so students were still waiting to record the individual podcasts. Table 1 shows the results for each survey question with average scores, standard deviation, and percent of agree/strongly agree answers. Interestingly, the question related to the first assignment—I enjoyed preparing the first podcast for this class (in groups), and it prepared me for the final podcast recording—was the lowest evaluated of all the survey questions (3.17/5). After discussing this with the students, it was found that most felt the podcast was conducted too early in the semester. Students would have preferred to do this activity later in the semester. Some students were also confused about preparing a podcast discussing a technical paper. Although the papers chosen to be discussed were highly cited studies related to plastic debris in the ocean and metal recycling, both of which are topics of interest in the chemical behavior of materials, the production of a podcast became challenging. It was also the first time students had to refer to a technical paper to prepare a podcast script. Another possible limitation of the study is that no rubric was initially provided to the students for this team podcast assignment, limiting their ability to know what to expect when preparing a podcast script based on a technical paper. Because this was the initial assignment and a relatively new form of learning, it did not significantly impact the students' grades and counted only as a homework assignment.

Table 2. Students' average rating of podcasts/video-recording material using a Likert scale, where 5 = strongly agree and 1 = strongly disagree

Questions	Average	Std Dev.	Agree /Strongly Agree %
Q1. I enjoyed preparing the first podcast for this class (in groups) and it prepared me for the final podcast recording	3.17	0.75	33.3
Q2. The material characterization techniques presentations (video recorded) were interesting, and I learned a lot of new concepts	4.33	0.52	100.0
Q3. The student-led learning experiences (video recordings, podcasts, in-class activities, paper reviews) are helpful to my learning in this course	4.00	0.63	83.3
Q4. The technical content taught in the podcast about semiconductors was very useful	4.33	0.82	83.3
Q5. For the podcast final assignment, I will learn my topic of interest well enough to explain it to the class	4.50	0.55	100.0
Q6. I look forward to watching the podcasts that my classmates will prepare as part of their final assignment	4.50	0.55	100.0

All the additional survey questions averaged four or higher, meaning most students agreed or strongly agreed with the survey questions, which focused on the remaining assignments and an additional podcast example where an Assistant Professor with expertise in nanomaterial semiconductors presented a technical topic in a podcast setting. The second assignment, recording a materials characterization technique, was well received. Results for Q2—The material characterization techniques presentations (video recorded) were interesting, and I learned a lot of new concepts—averaged 4.33/5, with all the students agreeing or strongly agreeing with the question. To further motivate student learning, each student who recorded a video had to provide two additional questions about their video recording. This was done to encourage the students to listen to each other's video recordings to learn material characterization techniques not covered in the classroom. A homework assignment was also given to the students based on the questions provided by each student on their video recordings.

As it is hypothesized, this study seeks to demonstrate that students learn effectively by using a variety of video recordings (e.g., vodcasts). The results for Q3—The student-led learning experiences (video recordings, podcasts, in-class activities, paper reviews) are helpful to my learning in this course—averaged 4/5. Despite the low number of student participants, the results encourage using alternative technical communication and learning methods through video recordings. To further confirm the hypothesis, students were asked about their learning when watching a podcast prepared by the course instructor and an assistant professor discussing topics of semiconductors. Results for Q4 were 4.33/5, which indicated the students' interest in learning through a technical podcast. This podcast, however, was watched by all the students during a class session. This was done to observe the students' behavior while watching the technical podcast.

Some took notes, while others decided to listen and watch only. All the students knew the podcast was available after the class. The video recording lasted approximately 18 minutes and was followed by a technical presentation by the podcast guest speaker. With some background knowledge, the students actively listened and participated by asking questions during the in-person session. This further confirms that video recording can be effectively used for learning and delivering new technical content to students.

Results for Q5: For the podcast final assignment, I will learn my topic of interest well enough to explain it to the class, and Q6: I look forward to watching the podcasts that my classmates will prepare as part of their final assignment, which were 4.5/5. This high score for both questions revealed the students' interest in preparing their technical podcasts and wanting to watch the additional vodcasts. Note that the course instructor provided release forms to the students so they could make the videos freely available through YouTube™ or not. Two of the six participants decided to distribute their videos privately (the link is needed to watch the recording, and only the course participants had access to it). The release form was also provided to guarantee that the students agreed to be part of a podcast recording session. Additionally, each student had to provide two questions about their recording to their peers, which were included in the final exam study guide. The course instructor asked a few of these questions as extra credit during the final exam.

The survey provided to the students also included *two qualitative questions*. The results obtained are discussed separately for each question.

> Q1: What are your general thoughts about preparing a podcast as part of the final project of this course? How do you see learning technical content through podcast recordings?

Most students showed interest in the communication type and the unique opportunity to provide technical content to their peers through a podcast recording. Additionally, students were intrigued about doing research to communicate a topic of their interest and being seen as the "expert" on a particular topic. Below are a few quotes from the student responses related to learning new technical content in the course that support the hypothesis of this work.

> *"The podcast is good for having students learn the content because they need to be prepared to deliver it in a conversational format, which means the content needs to be understood well enough to not be read straight from a paper."*
>
> *"I think that this podcast method is a great way to have us students review our topics and have notes prepared for any follow up questions that are given. It's a format that really allows for students to demonstrate their understanding and expertise."*
>
> *"I think being able to present a good podcast requires high understanding of the topic and very good research. So, this could be a good way to understand and analyze the topic."*

For future studies, there is also additional feedback that could help. For instance, some students suggested time to work on the podcast script during class sessions. Another finding of this study is that podcast recording may not be a helpful tool for visual learners. For instance, one student mentioned the following:

> *"I personally do not really benefit from learning content through podcasts because I am a visual learner. I don't retain information well when it is only audio like in podcast. Subtitles in the podcast would help me follow along better."*

While the addition of subtitles is possible, it requires significant post-processing of the recording, which is a limitation of the study, as no additional support was provided to the course instructor to incorporate subtitles in the video recordings. One additional comment was related to the rubric given to the students. The course instructor provided the rubric two weeks before the first recording session. Some students complained that more time was needed to produce a podcast script using the rubric effectively. Future interventions/courses should provide the assignment along with the evaluation rubric to the students to avoid these issues in the future.

> Q2: Please describe and explain the learning activity that you enjoyed (or will enjoy) the most in this class (e.g., video recordings, podcast, in-class assignments, etc.)

By the time the survey was passed, the students did not have access to the final podcasts, which is a limitation of this question. For instance, one student mentioned:

> *"I am interested in hearing the final podcasts to see how each person's interests and backgrounds impact the topics of discussion."*

The final podcast recordings were performed during the last three sessions of the class, so there was no opportunity to meet as a group to discuss/watch the podcast recordings. For future interventions where podcasts are used as a learning tool, it is highly recommended that time in class be given to watch at least some parts of the recordings for each student. After watching podcast-recorded video presentations, follow-up Q&A sessions with technical questions or discussions could proceed. This could provide a better way to engage students with their topics of interest.

4. Conclusions and Recommendations

As demonstrated in this study, video recordings led by students, either in the form of a podcast or a Zoom recording presentation, can improve students' learning of technical concepts in a chemical behavior of materials course. We supported this hypothesis with the grades obtained by students on a video recording of a materials characterization technique (185/200), individual podcast recordings evaluated with a rubric (93/100), and responses to a few survey questions. Future efforts for this or any other course that plans to use podcasts as a learning tool should allow in-class time to discuss the video recordings the students prepared adequately. This follow-up class session could increase student participation and could be used to provide feedback on student research efforts.

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