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# Podcasting as an Effective Pedagogy for Teaching Chemistry During the COVID-19 Pandemic and Beyond

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## Abstract

*The COVID-19 pandemic has forced all educational institutions worldwide to switch their active routine to ONLINE. With students attending classes virtually, a number of problems arose including the absence of social interaction and the imposed difficulty of digesting the materials of different courses, especially for those with a scientific background. General chemistry (GC), as an introductory course, is usually registered by students from different backgrounds, including Science, Engineering, and Agriculture. At the United Arab Emirates University, the second level of GC (GCII) is more focused on problem-solving as related to various topics. With the absence of face-to-face experience because of the COVID-19 circumstances, students' understanding of the chemical concepts and implementing that in problem-solving has become a challenge. The current work investigates the effect of using professionally-made podcasts of GCII on the extent of understanding of students registered for this course during the period of 2020-2020 over a course of four semesters. The results of surveying the usage and feedback of students engaged in this experiment are outlined. Conclusively, this pedagogy is fully supported by most of the students who regard it as a suitable alternative to the face-to-face settings.*

**Keywords:** Podcasting; General Chemistry; COVID-19; Online; Face-to-face; Flipped classroom

## 1. Introduction

The COVID-19 epidemic has had an impact on many aspects of our existence. Many people were compelled to change their daily routines and behaviors, such as working from home, attending classes remotely, and how interacting with others. For weeks, most of the globe remained isolated in their homes, uncertain if life would ever return to normal. It resulted in the necessity to change teaching approaches in higher education. Face-to-face courses were transformed into online learning due to contact constraints. This shift was accompanied by an increase in demand for online and virtual tools that meet the needs of online learning.

Information and Communication Technology refers to all of the technical tools used to process and distribute high-quality information [1]. Anything connected to using tools to process and send data from one device to another falls under the purview of communication technology. online learning, often known as e-learning, is an example of an innovation that can be achieved via Information and Communication Technology.

One advantage of utilizing e-learning methods is that knowledge can be conveniently gained and accessed. The harvest will undoubtedly make it simpler for learners to obtain instructional information and complete the learning process wherever and whenever they choose [2].

During COVID- 19, Students had more free time, finding new interests and things to pursue in their homes during the quarantine period. One such activity was podcast listening. Podcasts are indeed a medium that was originally developed as a tool for entertainment or to convey information content to the users [3]. Podcasts established a virtual community where people felt more connected during this period of separation. However, the usage of podcasts for pleasure has only grown, and they are now used as a learning tool, among other things. [4]. Traditional podcasts are a digital distribution method for audio content [5]. The delivery is performed via the internet, as podcasts may be downloaded to digital devices such as computers, tablets, or smartphones [6-10].

Podcasts, which are primarily utilized as a tool of education, are referred to as "educast" [6]. Recording a lecture is the simplest and also the most prevalent method of educast [4]. The recording of live lectures may additionally include video [5,11]. Podcasts meant to be watched are called "vidcasts" [4]. Furthermore, podcasts can improve academic achievement by allowing students to study on an individual basis while also allowing lecturers to adjust lectures to students' requirements.

In addition, using podcasts in the classroom makes the learning process much less informal. This encourages students to open up more and provides them with the opportunity to gain a wealth of knowledge and insight. For example, teaching chemistry to students can be difficult since they must understand the composition, structure, and characteristics of matter; quantitative principles, kinetics, and energetics of matter transformations; and fundamental ideas of organic chemistry. Therefore, an interactive Chemistry class is where both the instructor and the students are engaged for an effective learning process. This also allows students to expand their learning beyond standard text-based learning. However, the unprecedented COVID-19 pandemic highly affected this ideal scenario and forced educators to search for alternative approaches to deliver the scientific information in a convenient manner.

One of the clearest advantages of podcasts that teachers should take use of is the ability to record existing courses. Students may simply access them as fantastic study tools this way. When students prepare to take exams, these study resources are essential. Any student who has had trouble grasping a certain topic in class can listen to the audio of that lecture to alleviate their worries. Because the courses are recorded as podcasts, students may learn at their own speed. This option to study the lecture multiple times is very beneficial for students from other parts of the world or those with learning issues. It is also true that convincing students to view an hour-long video of the lecture might be difficult. As a result, providing students with shorter audio recording that they may listen to at their leisure assists them to study outside of the classroom setting. Ince podcasts put students in charge to study and understand the topics quickly, the students feel encouraged to take a more critical view or creative thinking when preparing any tasks. As a result, podcasts have an overall favorable impact on the learning process that extends beyond the classroom. Accordingly, podcasts may be the greatest approach to retain your students' focus on the task at hand. In this study, the effect of using podcasts of General Chemistry II (GCII) on the extent of learning of Science, Engineering and Agriculture students

during the time of COVID-19 pandemic has been investigated.

## 2. Experimental Approach

### *2.1 Course information*

In this study, podcasting was investigated as an alternative pedagogy for General Chemistry II (GCII) course as an introductory course during the COVID-19 pandemic. GCII course is composed of eight (8) chapters and is mainly based on concepts dealing with thermochemistry, thermodynamics of materials, chemical kinetics, chemical equilibrium under different solution conditions, electrochemistry and selected properties of solutions. The main theme of the course is to investigate the concepts of each of these topics followed by problem-solving. The main resources of this course are: textbook; Chemistry: The Central Science, as the latest edition from the published, and is made available for students as an ebook on Blackboard, in addition to the instructor-developed lecture notes, as pdf files that are usually uploaded on Blackboard for students to download and study from. The assessment of the course is carried out through four (4) progress exams and one (1) final exam. All exams are also carried out virtually using a correspondus lockdown browser with a monitor.

During the COVID-19 pandemic, this course was delivered on ONLINE basis using BlackBoard Collaborate Ultra. Through these ONLINE sessions, each instructor shares a pdf of the lecture notes with the students and elaborate on the lecture contents, while a recording of each online session is made available for students to download.

### *2.2 Podcasting experiments*

A set of professionally-made power point files has been developed by authors. These were made colored and animated, as part of the authors' efforts to make it appealing for the students to study from. **Figure 1** shows the cover slide of the GCII lecture notes, which were also used for all podcasts. Lecture notes exclusively cover the entire contents of the course with step-by-step illustrations of solving problems, as shown in **Figure 2** for a typical approach for solving a problem in one of the topics (Chemical Kinetics). The notes also include figures, tables, solved, and unsolved exercises, which are adapted from the textbook for noncommercial educational purposes only.


**Figure 1.** Colourful front pages of all GCII topics (chapters) using graphics that are relevant to each topic

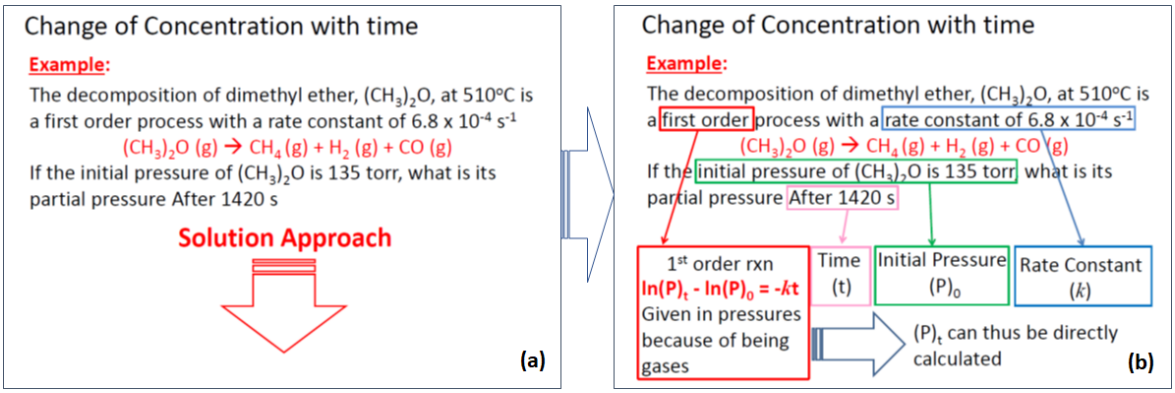


**Figure 2.** A typical podcast slide showing (a) a practice example, and (b) an animated explanation of the approach of solving the practice example as demonstrated in the lecture media file

The development of the GCII podcasts took place over two stages. In the first stage, a software called "Camtasia, TechSmith, USA" was used for screen capturing and audio recording the lectures. During the recording sessions, both power point presentations and Camtasia were simultaneously working, while a noise-free microphone and speaker system were used for the recording, and all recording sessions were performed in a well-equipped noise-free studio to ensure the high quality of the recordings. All explanations of the lecture notes were recorded through the voice-over feature of Camtasia. In addition, all lecture animations were recorded using the screen capturing feature of the software. At the end of the recording of every lecture, a media file (as *.MP4) is generated after confirming the quality of the recording.

### *2.3 Podcasting delivery to students*

The second stage of the development of the GCII podcasts involved the use of "Panopto, USA" platform, where all podcasts were uploaded at the beginning of every semester. **Figure 3** shows a typical layout of the

uploaded podcasts on Panopto during Spring 2021 semester. Panopto is characterized by the feature of generating analytics for the usage (views, downloads, unique viewers and minutes delivered) for each individual podcast as well as end-of-semester analytics for the entire usage of the podcasts.

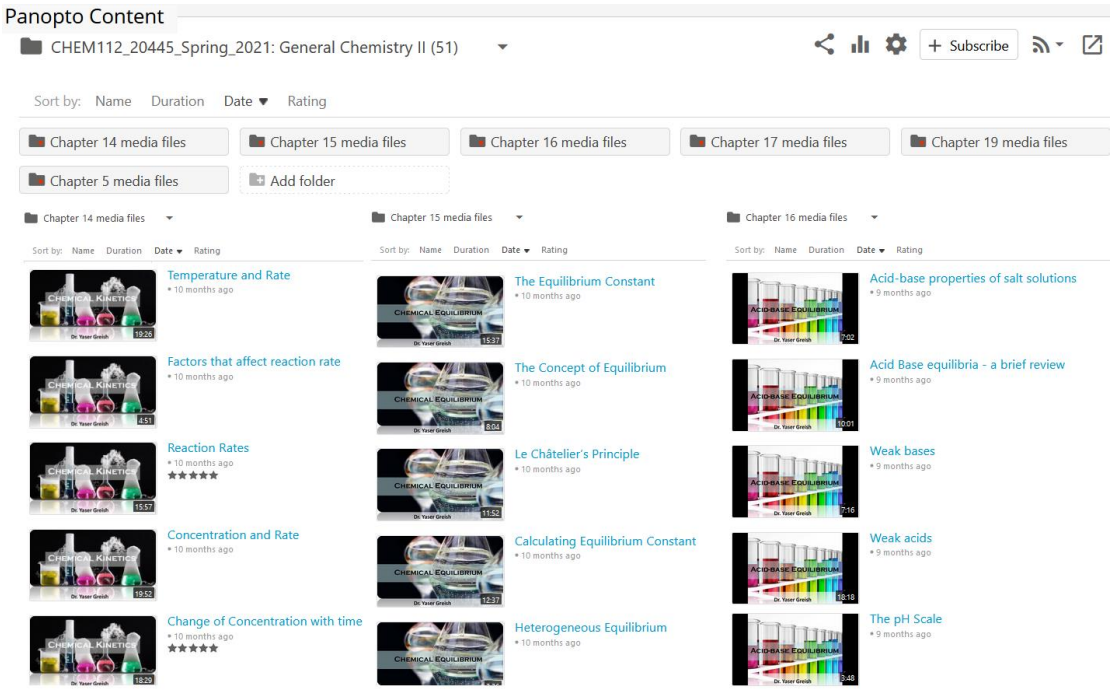


**Figure 3**. A typical layout of the podcasts of three topics (chapters) that were uploaded on Panopto during the Spring semester, 2021.

Podcasts that were pre-uploaded on Panopto were made available for all GCII students, with an estimated number of 150 students, during the COVID-19 pandemic. These students are spread over 5 sections with an average enrollment of 30 students per section during the Spring 2021 semester.

### *2.4 Assessment of the GCII podcasting:*

The effectiveness of using GCII podcasts was evaluated through two approaches. The first approach involved a study of the Panopto-generated analytics, while the second approach was carried out through surveying the students' feedback of using the podcasts as compared with the recordings generated form the online BlackBoard collaborate ultra sessions and the textbook as well as the lecture notes of the course.

## 3. Results and Discussion:

With the availability of the GCII podcasts on Panopto platform, students actively started to download the podcasts, especially during the time where every topic is being studied. **Figure 4** shows analytics of the views, and downloads of selected topics of the GCII course as a function of time during the Spring semester 2021. However, due to the relative difficulty of the "chemical thermodynamics" topic, students viewed and downloaded the podcasts during the time where this topic was studied and at the end of the semester, as shown in

**Figure 4b**. The variation in the total number of minutes delivered is due to the difference in the overall duration of the podcasts among the different chapters. It should be mentioned that 40-50% of the students showed more interest in the podcasts than the rest of GCII population, as depicted from the analytics showing the unique viewers. This is attributed to the fact that those students were more keen to compensate the absence of face-to-face lectures by sticking to the podcasts as an appropriate alternative.

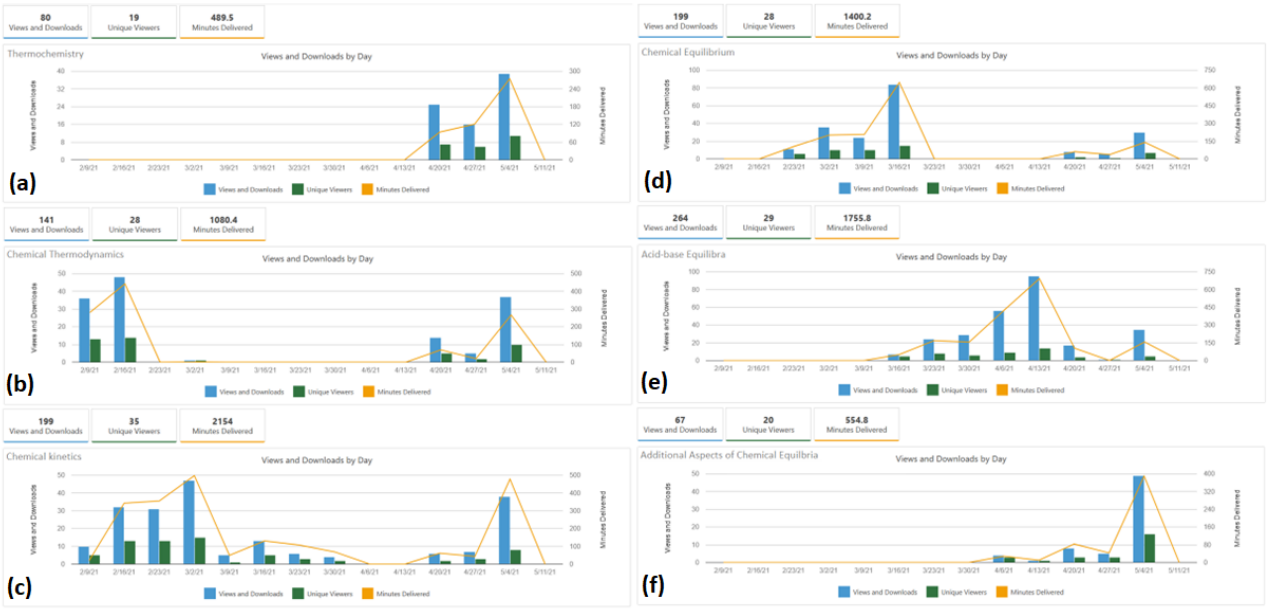


**Figure 4.** Analytics of the usage of GCII different topics (chapters) in terms of views, downloads, unique viewers and minutes delivered throughout a typical Spring semester (Feb 9-May 16, 2021)

A protracted interest in the GCII podcasts was further shown in **Figure 5a**, where a consistent access of Panopto to view and/or download the podcasts was shown throughout the semester. A dramatic increase in the views and downloads was shown during the week prior to the final exam week of May 4, 2021, indicating an unprecedented interest in the GCII podcasts as a valuable reliable source for an effective preparation for the final exam.

A detailed investigation of the views and downloads of the GCII podcasts showed a higher interest in the podcasts of chapter 16 (Acid-base Equilibrium) as shown in Figure 5b. This is attributed to the importance of this chapter in dealing with applications of equilibrium in acidic and basic media as well as the extensive problem-solving sections in this chapter. In contrast, the chapter 5 (Thermochemistry) showed the lowest statistics of views and downloads, which is attributed to the fact that this chapter is the first chapter in the syllabus of the course and is the least among all chapters in the extent of problem-solving. All other topics showed equal share of interest of the students.

A survey was also conducted during the last week of classes, before the final exams week, where students were given specific questions were given to the students to analyse their feedback of using the GCII podcasts thought the semester. Results are shown in **Figures 6-8**. Around 75% of the student showed interest in applying the concept of "flipped classroom" through using the podcasts before class to prepare for upcoming lectures,

as shown in **Figure 6a**. A detailed testimony of the students indicated the importance of the podcasts in this regard and the subsequent benefit of simplifying the concepts being discussed in class as a result of knowing about them through the podcasts before class. Around 70% of the students considered the GCII podcasts an appropriate alternative for completely or partially missing lectures, as shown in **Figure 6b**.

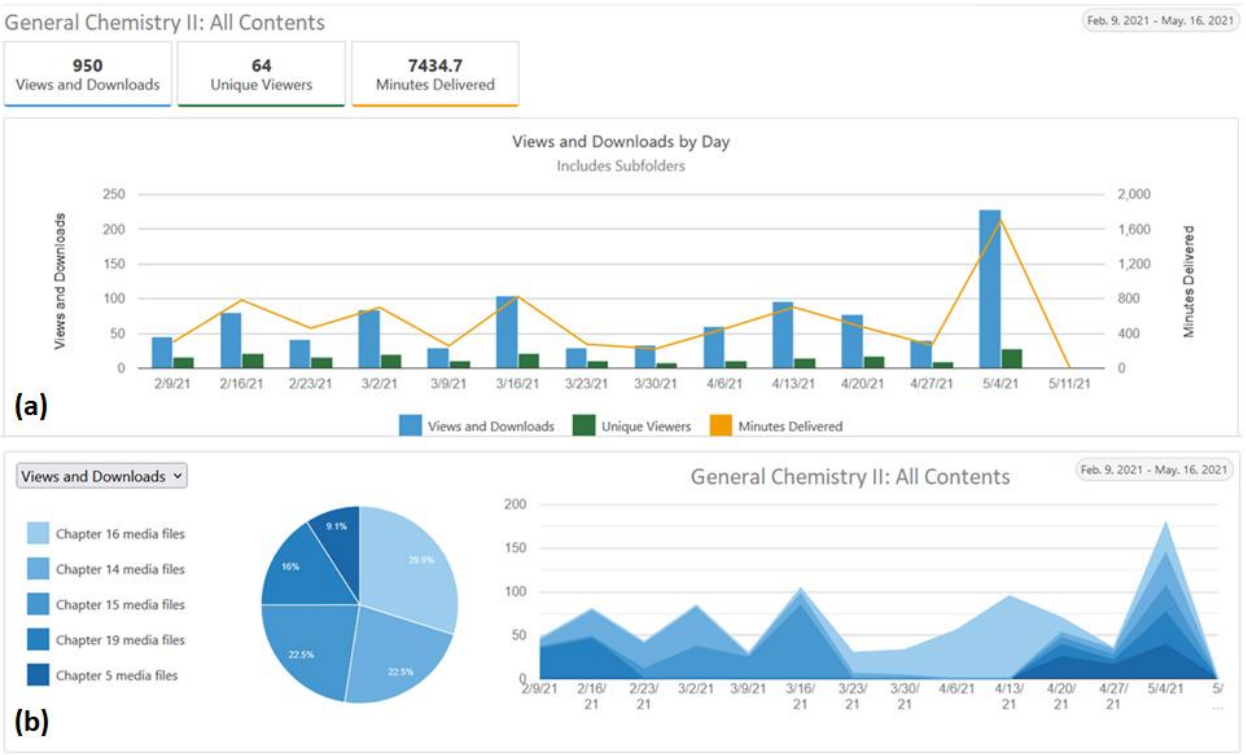


**Figure 5.** (a) Analytics of the usage of GCII all topics (chapters) in terms of views, downloads, unique viewers and minutes delivered, and (b) detailed views and downloads of the different topics (chapters) throughout a typical Spring semester (Feb 9-May 16, 2021)

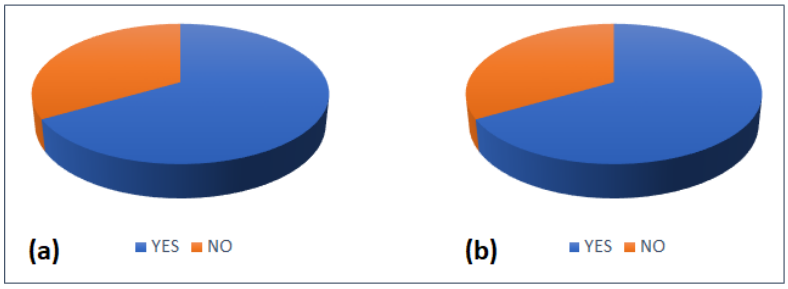


**Figure 6.** Students' feedback regarding (a): using podcasts before (yes) or after class, (b): using podcasts as a reference for missing lectures

During the COVID-19 pandemic, the ONLINE BlackBoard collaborate ultra sessions were routinely recorded and made available to students to download. However, students absolutely considered the GCII podcasts a more convenient resource of study, as shown in **Figure 7a**. Detailed testimony of the students indicated that two main reasons largely contributed to the advantage of the podcasts as a unique resource of study. The first

reason was related to the uninterrupted podcasts where all media files were entirely focused on the topics, hence contributed to a better understanding of the subjects. The second reason was related to the shorter duration of the GCII podcasts (10-15 minutes at most) as compared to the collaborate ultra sessions, as shown in **Figure 7b**, which is a further conformation of the fact that shorter podcasts are more appealing to the audience than longer podcasts [12].

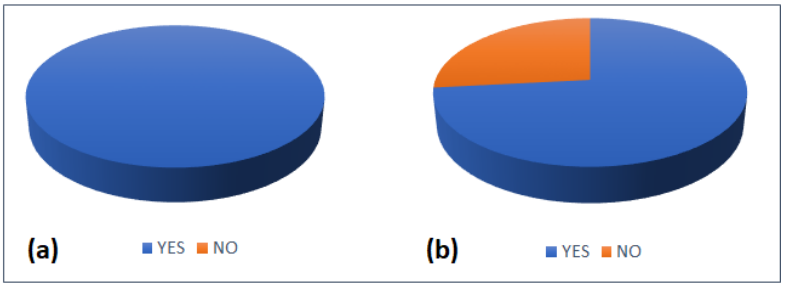


**Figure 7.** Students' feedback regarding (a): Overall convenience of using podcasts as compared with collaborate ultra recordings, (b): Advantage of podcasts as compared with collaborate ultra recordings in terms of streaming duration

The GCII podcasts were professionally made using a combination of well-designed animated power point presentations and Camtasia. Accordingly, around 90% of the students indicated that no further improvement is needed for these podcasts, as shown in **Figure 8a**. Accordingly, 30% of the students considered podcasts a sole resource in case no lecture notes are available and 50% of the students combined the podcasts and the textbook as potential resources as an alternative to the lecture notes, as shown in **Figure 8b**.

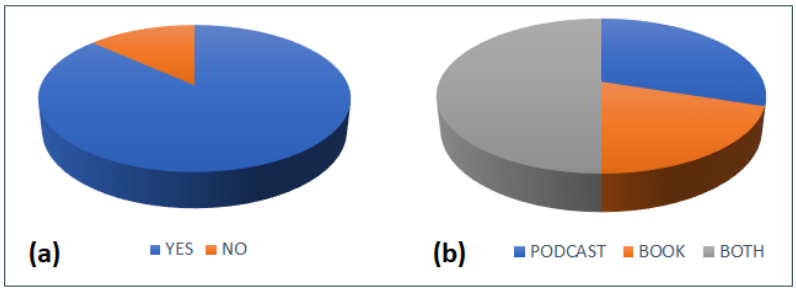


**Figure 8.** Students' feedback regarding (a): possible missing parts in the podcasts, (b): which resource is used in the absence of lecture notes

Based on the analytics provided by Panopto, where all podcasts were uploaded and accessed by the students, and the students' feedback, it is evident that podcasts successfully acted as an alternative for the absence of the face-to-face settings as a result of the COVID-19 pandemic. It should be mentioned that the student test sample of the GCII podcasts in the current study were not involved in the previously developed General Chemistry I (GCI) podcasts that were evaluated in 2017 [13]. It is therefore an advantage for the coming Science, Engineering, and Agriculture student cohorts to have podcasts of both GCI and GCII to rely on for as an additional resource for their studies.

## 4. Conclusion

The current study showed the effectiveness of using podcasts of General Chemistry II as a successful pedagogy during the COVID-19 pandemic and as an alternative to routinely recorded ONLINE lectures. The podcasts developed herewith were professionally recorded using Camtasia and were made available to students using Panopto platform. Automatically generated analytics showed the eagerness of the students to view and download the podcasts throughout the semester of study, while the students' feedback showed their dependence on these podcasts to a large extent as an additional resource as an efficient alternative remedy for the absence of the face-to-face settings. Our studies indicate the likelihood of using podcasts of scientific subjects by the upcoming cohorts of Science, Engineering and Agriculture students due to its proven success.

## 5. Acknowledgement Heading Level-1

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