

Enhancing Learning Experience of General Chemistry Using Pre-Designed Podcasts and Flipped Classroom Methodology

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Abstract

Introductory courses such as General Chemistry I, General Physics General Biology and I need special attention as students taking these courses are usually in their first year of the university. In addition to the language barrier for most of them, they also face other difficulties if these elementary courses are taught traditionally. Changing the routine method of teaching of these courses is therefore mandated. In this regard, podcasting of chemistry lectures was used as an add-on to the traditional and non-traditional methods of teaching chemistry to science and non-science students. Podcasts refer to video files that are distributed in a digital format through the Internet using personal computers or mobile devices. The pedagogical strategy is another way of identifying podcasts. Three distinct teaching approaches are evident in the current literature and include receptive viewing, problem-solving, and created video podcasts. Originally, podcasting was the name given to audio files played on Apple's iPod portable media player. The digital format and dispensing of video podcasts have stabilized over the past eight years, the type of podcasts vary considerably according to their purpose, the degree of segmentation, pedagogical strategy, and academic focus. In this regard, the whole syllabus of "General Chemistry I" course was developed as podcasts, which were delivered to students throughout the semester. Students used the podcasted files extensively during their studies, especially as part of their preparations for exams. Feedback of students strongly supported the idea of using podcasting as it reflected its effect on the overall understanding of the subject and a consequent improvement of their grades.

Keywords— Podcasting, introductory course, interactivity, flipped classroom.

1. Introduction

Innovation is a term that has been explicitly used in all aspects of life in the recent years. It involves the use

of new technology in all aspects of life. In fact, it is also mandated to progress in the technology itself. Innovation in education is one of these important fields that are becoming more demanding, especially with the current generations of educators who are, sometimes, more skilled in information technology than their teachers. Therefore, the current generation of teachers is highly recommended to enhance their skills of using technology in teaching young learners [Kim, 2009] who are digital natives [Prensky, 2001]. Moreover, with the continuous constraints of decreased budget for hiring teachers in many countries, concurrently with the expansion in the number of students in undergraduate classrooms, it is becoming more challenging to find ways to engage students in their subjects, especially and typically with non-major students who are less motivated.

Educational researchers classified the major kinds of learning approaches adopted by university students into two approaches; reproducing and understanding information [Marton, 1976 a,b]. The first approach; also known as a *surface* approach, involves passive reproduction of information [Biggs, 2007], while the second approach; known as *deep* approach involves an interactive understanding of the information [Ramsden, 2003]. Studies proved that deep approach resulted in a higher quality education, deep retention of information, together with improved learning outcomes and consequently higher grades [Ramsden, 2003]. Researchers related these results to the fact that deep approach has more focus on a better understanding of the subject as compared surface approach which indirectly forwards students to memorization. It was further noted by students that understanding is an irreversible process, while memorization is a reversible one [Entwistle, 1997]. It was thus concluded that deep approach promotes understanding and application for life [Houghton, 2004].

The current study investigates the use of an alternative method of teaching to students taking an introductory chemistry course at the United Arab Emirates University. Usually, this course is registered by students from science, engineering, medicine, agriculture, information technology and sometimes education backgrounds. Teaching students from a wide range of backgrounds is a usual challenge, especially with the fact that more than 50% of the population in chemistry classes have low interest in the subject and are registered as part of their grade requirements. Moreover, more than 40 % of the students are graduates of UAE governmental schools where their high school education, including science courses, was conducted in the Arabic language. This adds challenge and degree of difficulty to students since General Chemistry I is mandated to be taught in English language only. Therefore, a non-traditional approach that effectively the use of deep approach of teaching, while introduces interactivity in class is believed to be more appropriate than traditional approaches. The unprecedented increase in a wide range of low-cost software makes it appealing for educators to use in the development of non-traditional and reusable learning tools, such as podcasts and vodcasts. These approaches are based on the use of voice and video to record lectures and share it as media or video files, respectively. The word *podcasting* is initially derived from the two words: iPod and broadcast. It was described by the EDUCAUSE in 2005 as a software and hardware combination that permits the use of downloadable audio files for listening at the user's convenience [Educause, 2005]. Therefore, podcasting has been recognized as a method of publishing both audio and video materials using the internet [Clyde, 2005]. Users, students in our case, can listen or view the recorded material on their computers or their mobile devices [Seery, 2012].

Podcasts are increasingly developing and spreading as a powerful educational tool, as shown by the rapid increase of the dedicated podcasting literature and guiding demonstrations to educators at various levels [Fontichiaro, 2008, Richardson, 2010]. Moreover, Newsweek described podcast software, in one of its reports, as tools used to subscribe to what is known as “Real Simple Syndication; RSS” feeds. In this regard, subscribers are notified of updates made available by the podcaster so that they can continuously be linked with the most recent develop podcasts [Newsweek, 2006].

Educational podcasting and screencasts have been classified as substitutional and supplemental [Seery, 2012]. The most recent literature on podcasting indicates that podcasting, as a term, is frequently used to refer to what is also known in higher education, as for *course casting*, were audio recorded media of lectures or tutorials are made available to students. This type of podcasting is referred to as *substitutional* podcasting [McGarr, 2009]. On the other hand, teacher-produced podcasts on key topics, which students can listen to on a needs basis, is referred to as *supplementary* podcasting [McGarr, 2009]. In both cases, podcasting has some advantages such as learner choice and flexibility; the incorporation of student voices in a discussion format (through students’ questions and comments being integrated into recordings); and an alternative way of learning by listening [Rothwell, 2008].

In the current study, the outcomes of using podcast media of General Chemistry I; an undergraduate course, on the teaching and learning experience of instructors and students will be evaluated.

2. Experimental Approach

2.1 Course information

In this study, a General Chemistry I course is used as a model of using podcasting for the enhancement of student learning experience. The course syllabus is made of ten (10) units that deal with different basic titles of chemistry for Science and non-science semesters. The course is usually taught over the duration of 15 weeks with a schedule of two lectures, 1:15 hours/each, a week. The course is evaluated through some quizzes (4), a midterm exam and a final exam. Students taking the course usually use a textbook (Chemistry the Central Science) which is provided by Prentice Hall publisher. Based on the university regulations, students usually use the most up-to-date edition of the book. Moreover and as part of the University policy, the English language is mandated as the only language of instruction in lectures of all science courses, including General Chemistry I.

2.2 Podcasting experiments

A set of professionally-made power point files has been developed by the first author. These were made colored and animated, as part of the efforts of the first author to make it appealing for the students to study from. The power point demonstrations exclusively covered the entire content of the course. Figures, table solved, and unsolved exercises were adapted from the textbook for noncommercial educational purposes only.

A software called “Camtasia” was used for screen capturing and audio recording the lectures. During the recording sessions, both power point presentations and Camtasia were concurrently open. 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.

During recording, lectures regarding power point presentations were rolled with detailed explanations, and the voice of the explanation was recorded through Camtasia through its voice over features. Animations and cursor movements, as well as highlights, were also recorded as part of the file. At the end of every recording, the media file is produced; saved, in the MP3 or MP4 formats after confirming the quality of the recordings.

2.3 Podcasting delivery to students

Podcasts of General Chemistry I was distributed to a total of 175 students over the course of five (5) semesters between 2011 and 2015, with an average of 35 students per class. Podcasts were delivered to students through various methods. A platform is known as “Blackboard; BB” is used by the United Arab Emirates University for all courses being taught at the university. The podcasts were uploaded to Blackboard on the BB course page so that students were able to download it directly. Alternatively, the podcasts were stored on the author’s Dropbox, and a link for each of the files was shared with the students. The last two approaches have been used for the past six years. A third approach was recently used this academic year where the podcasts were made available to students at the university streaming facility.

2.4 Assessment of the use of podcasting

The use of General Chemistry I podcasts was evaluated via two approaches; directly and indirectly. Through a direct approach, a survey was made by the authors and was distributed to students during their last class of the semester to fill in. It contained **14** questions about their feedback of using podcasts of the course in order to evaluate this experience from the students’ perspectives. On the other hand and through an indirect approach, students’ performance during exams was compared with previous records of students taking the course using the traditional lecture-type methodology between 2008 and 2011.

3. Results and Discussion

Using a direct evaluation approach, which is solely based on students’ feedback of being involved in this experience, the results of the questions in the survey that was distributed to students are shown in **Tables 1-4**. Feedback from the students was either strongly agree, agree, slightly agree to disagree. **Table 1** reflects the modes by which students used to use the podcasts during the semester. Most of the students (88%) solely depended on the media files as the main source of study before exams. Students commented that this was attributed to that the podcasts were exclusive for revision and preparation for exams. However, students largely (91%) referred to podcasts as an additional source of study together with the course lecture notes in their studies throughout the semester. This was reflected in the percentage of students (50%) who often used the podcasts only before exams and quizzes that were carried out during the semester. Screening the student's feedback regarding the similarity between the contents of the podcasts and the official course syllabus is shown in **Table 2**. It was shown that 88% of the students agreed that the podcasts were perfectly made to repeat the contents of the lectures and the course syllabus, while 83 % disagreed that the podcasts were different from the course contents. Additionally, 97% of the students

implied the benefit of the podcasts especially when they are absent for any reason. It should be noted that despite that fact that students considered the podcasts a suitable replacement of the lectures, the roles of students' attendance prevented students from skipping classes. On the contrary, having the podcasts in hand before the lectures helped the students understanding the material and encouraged them to attend class discussion as part of their flipped classroom experience.

Having considered as an additional tool for understanding the material, students clearly expressed in the effect of using these podcasts in helping them understanding (85%) the course and in their studies of General Chemistry course in general (88%). Results are shown in **Table 3**. As a result, 87% of the students indicated their increased interest in chemistry as a subject to consider in their career. Students declared that solved examples clearly explained in the podcasts further helped them better understand the principles than just studying them by themselves from the course textbook. 80% of the students stated that, while 93% of the students included in the survey believed that podcasts would strongly help them achieve the highest

Table 1. Modes of use of podcasts by students throughout the semester

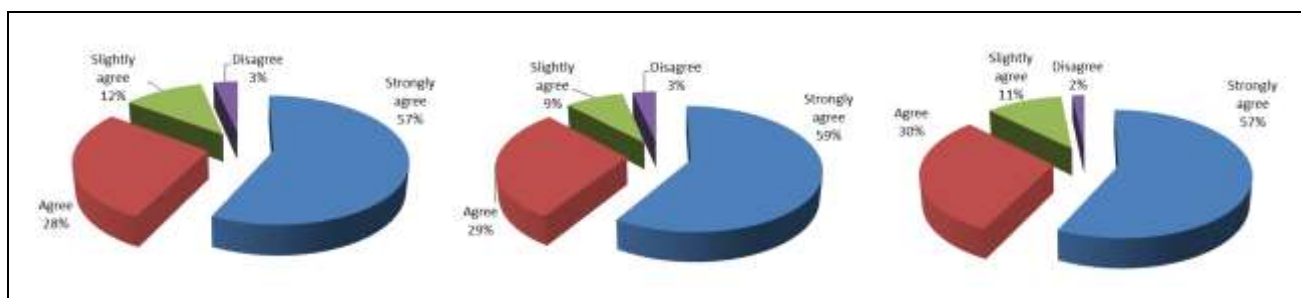
I solely depend on the media files in my study for exams	I use both the media files and the lecture notes in my study	I often use the podcasting media files only before exams and quizzes

Table 2. Students' feedback regarding the similarity of the podcasts to the course syllabus

The files are perfectly made to repeat the contents of the lectures	The files are different from the contents of the lectures	Using these files is a reasonable alternative when I am absent to retrieve the lecture(s) I missed

Table 3. Effect of podcasts on enhancing the learning experience of students

It enhanced my understanding of General Chemistry	It helped me in my study of General Chemistry as a course	These files have increased my interest in Chemistry as a subject



grades in the course. In general, 82 % also believed that the experience of using the media files was great and that it should be generalized to other introductory courses; **Table 4**. It was, therefore, found that 94 of the students strongly recommended podcasts be applied every semester to General Chemistry students, as shown in **Figure 1**. Moreover, **Figure 2** shows that the overall benefit of the course podcasts was strongly encouraging and was not a waste of time.

Table 4. Students’ experience of using the course podcasts

Solved examples demonstrated in the files helped me understand the principles more than the book	I believe that using these files will strongly help me achieve the highest grade I have planned for in this course	The experience of using media files is great and should be generalized to all introductory courses

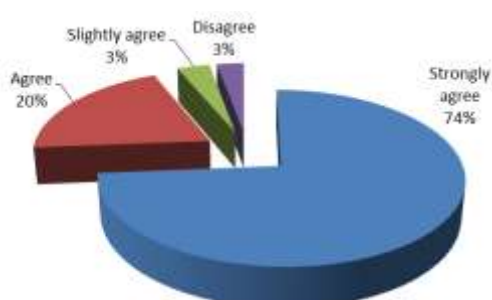


Figure 1. Students’ feedback regarding a question: I strongly recommend these files to be applied every semester to General Chemistry students

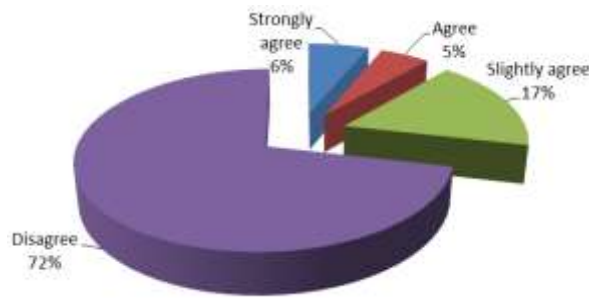


Figure 2. Students’ feedback regarding a question: This is my first experience with these types of files and believe it is just waste of time

It should be mentioned that the survey was given and completely answered by all 175 students since it was performed during the last class of the semester where students were encouraged to attend for an overall revision of the course. Compared with a traditional method of delivering lectures without podcasting, More than 85% of the students strongly agreed or agreed to the use of podcasting in this course and recommended its application to other introductory courses. More importantly, large segments of the students also indicated that the podcasts were of high value in understanding the materials. The main advantage of the podcasts was the consistency of the lecture content and its similarity with what covered in the class. In addition, the podcasts had an added value of being available to students to use for a number of times, especially on topics that were relatively hard to understand. From a psychological point of view, it is also evident that having the same voice and style of teaching of the instructor who used to teach in class made it more familiar to the students to feel more comfortable in studying the course material.

In addition to the feedback of the students shown in Tables 1-4, and Figures 1-2, cumulative final grades of the students were improved during the period of 2011-2015, as compared with students grades during the period of 2008-2011. Figure 3 shows a comparison of the student grades during these time periods.

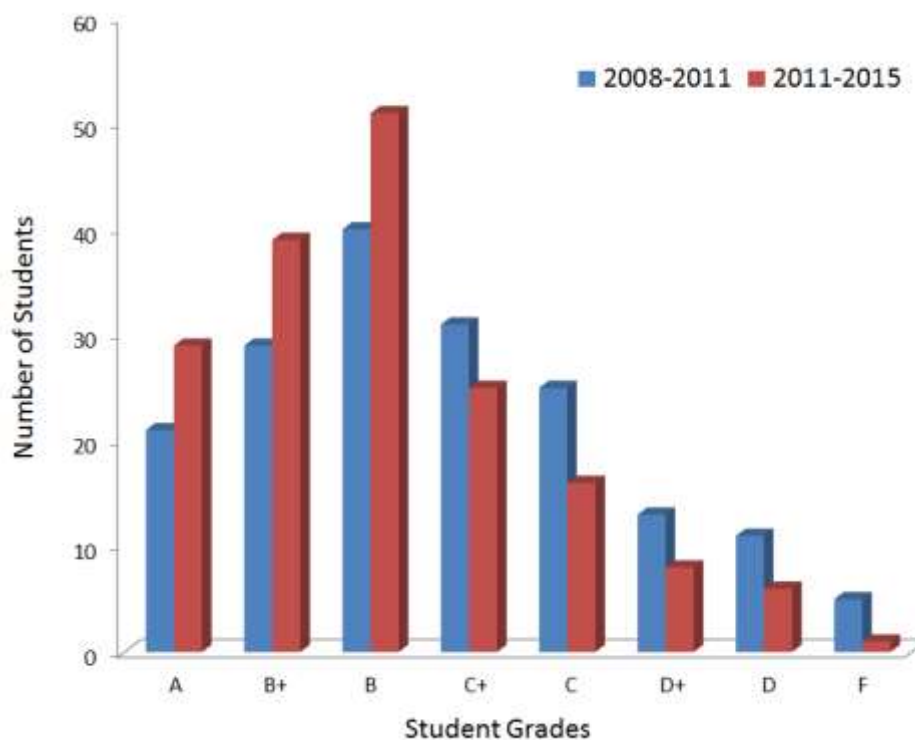


Figure 3. Distribution of student cumulative final grades during the periods of 2008-2011 (Spring semester) and 2011 (Fall semester)-2015, using traditional and non-traditional (podcasting) approaches, respectively

The overall distribution of grades shows an overall improvement in the performance of the students in this course. Moreover, these results reflect their feedback about the benefits students obtained when an additional tool was available to study and review the course material.

4. Conclusion

This study showed the effective use of podcasting as a non-traditional tool for students to better understand General Chemistry I, as an introductory course taken by science and non-science students. General Chemistry I course was completely made into podcasts using a professionally made power point presentations and a screen and voice over capturing software; Camtasia. Students involved in this study clearly indicated the effectiveness of using podcasts in studying the course materials and preparing for exams. Student cumulative final grades reflected student's opinions and demonstrated their strong recommendation of applying the same procedure to other introductory courses.

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