Pivoting Remote: Techniques for Teaching Forensic Science Utilizing Virtual Student-led Case Studies in a Blend Flex Mode

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Abstract: As a result of COVID-19, new approaches are being adopted to improve student learning and accommodate active learning at higher education institutions. At our University, two forensic science courses were taught that combine in-person and online instruction. Using the "Blend flex" paradigm, students alternated between "in person" and "remote" study. Students were invited to create case studies using journal articles and news items in order to increase their participation in the course. Students presented their case studies in virtual or "in person" settings at the end of the semester. Student learning was assessed by data from several evaluations including the Student Perception of Instruction (SPoI) surveys, which were completed at the end of the semester. According to the survey results, students agreed that the case study instruction helped them understand the course subject, piqued their interest in the course, and improved their knowledge of the material. Furthermore, students found that the case studies even when presented virtually were helpful in improving their presentation skills. Based on the data, we believe that including student-led case studies even when run virtually, can help students learn crucial skills for their future careers.

Keywords: virtual, forensic science, case studies

Introduction

Forensic science provides an excellent setting for illustrating fundamental concepts in science (biochemistry and chemistry) and criminal justice as well as connecting those principles across disciplines. Students improve their critical thinking and problem-solving skills by learning how to solve challenging scenarios involving different forensic science specialties. The majority of forensic science courses are taught in a traditional format, with lectures reinforced by laboratory exercises. This model though widely recognized lacks the element of creativity (1). Furthermore, some studies have raised concerns about how this model effectively prepares students for the workplace. Specifically, there appears to be a disconnect between the university curriculum and active case work (2-4). In order to bridge the gap between the two aspects, student driven case study presentations were introduced into two forensic science courses at the University. The use of problem-based case studies has been well documented in many subject areas including biochemistry and chemistry (5-11). Forensic science also provides an ideal setting for the use of case study-based learning (12). Apart from learning the applications of biochemistry and chemistry, students also develop their communication, team-work and analytical skills.

Originally conceived as a special topic elective for chemistry majors, two forensic science courses have been developed at our University with separate curriculum and lab exercises. The courses in forensic biochemistry and forensic chemistry were created to support the university's new Bachelor of Science in forensic science degree.

Due to the COVID-19 pandemic, adjustments were made in spring 2020 to support virtual learning within the entire curriculum at our University. Faculty were given many options, including in-person (for small classes), online, hybrid, and blend flex (for combined laboratory courses). The following were some of the first changes made for online-only classes: i) voice over power points ii) online worksheets iii) online quizzes and exams iv) weekly communication; v) online/in person case study presentations. The two forensic courses were taught in the blend flex mode in fall 2020 and spring 2021. This entailed a mix of "in person" and "online" lectures. Since the class could accommodate only 50% capacity for students, the students were divided into 2 cohorts (blue and green). All labs were held with 50% attendance.

Course Structure

The prerequisites for both the forensic biochemistry and forensic chemistry course are a full year of general chemistry and organic chemistry with laboratory. The forensic biochemistry and forensic chemistry courses are required courses for forensic science majors. Additionally, these courses serve as electives for

biochemistry and chemistry majors as well as a chemistry minor elective. The two courses are worth three credits and meet twice a week for 2 hour and 15 minutes. The first hour of the class is devoted to lecture/problem solving exercises and the remaining hour and 15 minutes is dedicated to class discussions and laboratory exercises. The final grade is based on a two-part assessment. The first part is a set of three exams and weekly quizzes that evaluates critical thinking and problem-solving skills, including interpretation of data (60% of the grade). The remaining 40% of the grade is based on laboratory exercises including course based undergraduate research experiences (CUREs) and case study presentations. For the forensic biochemistry course, students learn the fundamentals of biochemistry and its applications to forensic science including DNA typing analysis. For the forensic chemistry course, students learn the applications of chemistry in drug detection and trace evidence (e.g. polymers, fibers and materials chemistry). Both courses require students to develop a mini research project (CURE) and a case study presentation. For the case study presentations, students work in groups and are tasked with finding a case study which utilizes content that they have learned during the course. Students are graded using a pre-assigned rubric which scores based on content (with in depth coverage) in forensic biochemistry/chemistry, organization and mechanics and finally on vocabulary. Approximately thirty undergraduate students (a combination of forensic science, chemistry, biochemistry, and biology majors in their senior year) were enrolled in each of the courses in fall 2020 (forensic biochemistry) and spring 2021 (forensic chemistry).

Case Study

Students in groups of two were tasked with finding an appropriate case study during the middle of each semester. Students were asked to choose cases based on topics related to course content (mass disasters, historical investigations, paternity testing, forensic drug or trace evidence etc.). The case study presentations were held in the last week of the semester. Due to COVID-19, students were given the option of presenting either "in person" or via Zoom or using a pre-recorded video of their presentation. Some examples for student led forensic biochemistry case studies included: Colin Pitchfork, OJ Simpson, Green River, and the Golden State Killer. For the forensic chemistry case studies, students picked the Chicago Tylenol murders, the Moscow Hostage crisis involving fentanyl, the deaths due to abuse of dextromethorphan, to name a few. The groups of students assigned to a case study were asked to research the case study thoroughly and present a detailed power point presentation with background, biochemical/chemical data available, the tests and instrumentation used and the verdict of the case. The 20-minute presentation was followed by a discussion on the case. Some cases that generated a lot of interest included the Casey Anthony case and the OJ Simpson case, where students had a lively discussion on whether the data obtained from the evidence provided proof for conviction. Students also graded all presentations and took multiple surveys which were used to assess their understanding of the course content using case study presentations.

Methods

To determine the effectiveness of the use of case study analysis in student understanding of course content, a mixed method approach (both qualitative and quantitative) was utilized. Specifically, to assess student learning, we utilized three different anonymous surveys i) Peer review ii) Informal survey iii) Quantitative data and comments from the University managed Student Perception of Instruction (SPoI) survey. The Student Perception of Instruction survey included questions with a Likert scale and short answer questions.

Results

Peer Review

Students were asked to perform a peer review during their final presentation and comment on each of the case study presentations (**Survey 1**). This provided the students with a process of self-assessment and evaluation. For the first question (which case study did you like the best and why?) the responses included the case study they liked best: tied very well with what they learned in the course, was easy to relate to, was well organized, had good information, was interesting and kept their attention, was detail oriented with a lot of research, was thought provoking, led to lively discussions, was easy to understand and well explained and discussed new techniques. Student comments to the second question (criteria for which project they liked best) varied from clear detailed explanation of events, chemical tests performed, relevance to the course content, design layout, style of presentation, followed the rubric, interesting etc. They seemed to enjoy choosing their own case studies based on the topics covered in class. Students were also given an opportunity to grade the case study presentations.

Survey 1: Peer Review

1. Comment on which case study you liked the best and why?
2. What criteria did you use to decide which case study you liked the best?
3. How did you decide on your case study?
4. Give the order of preference of the case studies.

Informal Survey

At the end of the semester, students answered an informal survey where they suggested improvements, reflected on their personal preferences and their learning benefits (**Survey 2**). Students were asked to suggest improvements. Student comments were positive and constructive recommending small but useful changes to the presentation styles. They also commented on what they learned from the case studies they chose as well as the peer presentations.

Survey 2: Informal Survey

1. What improvements can you suggest that students could have done to improve their case study projects?

"Make visually appealing power point presentations with more pictures"
"Include new methods that we did not go over in class"
"Use timelines to develop the background of the case study"
"More appropriate tone while presenting (not monotonous)

2. What did you learn from the case study presentations?

"How frustrating it can be to have a cold case and the importance of constantly improving our scientific methods (growing the DNA database, getting better extraction methods)"
"Awesome to see a cold case solved with new technology"
"Being able to use what we learned in forensic biochemistry to real life cases"
"Importance of proper examination of evidence"

Student Perception of Instruction (SPoI)

Students were surveyed using a questionnaire with a 5-point Likert scale about their perception of the benefits of the case study using a university conducted end of semester assessment (Student Perception of Instruction or SPoI). Based on the results, we found that 88% of the students either strongly agreed or agreed that the instruction included the case studies helped them understand the course material. All students agreed that the case study instruction generated interest in the course. In addition, about 89% of the students strongly agreed or agreed the courses were effective in improving their critical thinking skills. Finally, 90% of the students strongly agreed or agreed that the courses were effective in improving their knowledge of course content.

Students also provided anonymous comments during an end of semester survey of the student perception of instruction (**Survey 3**). Most students admitted that the case study projects supported their learning the most because it provided them with an opportunity to apply everything they learned during the semester. Some students thought the case studies were fun but time consuming. Others felt that though the final case study project was troublesome, it was very beneficial in learning the course content. They also thought that this experience should be introduced in other courses and that they learned a lot by doing the case studies.

Survey 3: Student Perception of Instruction Comments

1. Which assignments (paper, project etc.) supported your learning the most. Please explain.
"The case study supported my learning the most because it provided me with an opportunity to apply everything I learned this semester"
"The case study projects and labs were very helpful with learning course content"
"The case study project was nice as it was a good application of what we learned in the semester"
"The mini project (CURE) supported my learning of forensic chemistry, along with the case study project"

2. Which assignments (paper, project etc.) were the most troublesome. Please explain.
"The final project (case study) was troublesome, but very beneficial to learning the course content"
"The most difficult part about the case study was working with the other people in the group. There is always someone in the group that doesn't care as much and tries to put minimal effort"
"The case study was fun, but very time consuming"
"None, all assignments aided in my learning and were appropriate for learning"

Discussion and Conclusion

Due to the pandemic, two forensic science courses at the University were taught in the "Blend Flex" mode. The "Blend Flex mode involved instructors and students meeting on campus with social distancing at regularly scheduled times. Students were assigned into two cohorts or groups that rotated between on-campus and online meetings. To facilitate active learning, case study presentations were assigned to student groups. Based on end of semester assessment, we found that case studies helped students learn and apply course content to "real

world" cases. Students also learned communication skills and how to work in groups. The information gathered could additionally be used by the department as a tool for evaluating critical thinking and oral communication skills. We intend to use similar case study projects in additional upper-level science courses as a result of these findings. Incorporating case study projects into other classes would allow students to be more creative while also learning critical thinking skills that will be useful in their future employment.

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