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Teaching Preservice Teachers about COVID-19 through Distance Learning

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ABSTRACT

Due to the COVID-19 pandemic, almost all universities in the United States switched to online learning in March 2020. We, as educators, faced the reality of switching to online teaching using Zoom. Our approach was to use COVID-19 as the course content to help motivate preservice teachers (PSTs) and alleviate some of the challenges of online teaching, an approach that was also used recently by Sadler at al. (2020) with high school teachers. The present paper describes the challenges we encountered during the six-week period of online teaching and the strategies we used to overcome these challenges. We briefly describe the course, the revisions we made to the course using the COVID-19 pandemic as content, the challenges we faced with online or virtual teaching, and the opportunities we provided the PSTs. Finally, we reflect on what we have learned from this experience.

Introduction

Due to the COVID-19 pandemic, almost all universities in the United States switched to online learning in March 2020. We, as teacher educators, faced the reality of switching to online teaching using Zoom. Our approach was to use COVID-19 as the course content to help motivate preservice teachers (PSTs) and alleviate some of the challenges of online teaching, an approach that was also used recently by Sadler et al. (2020) with high school teachers. The present paper describes the challenges we encountered during the six-week period of online teaching and the strategies we used to overcome these challenges. We briefly describe the course, the revisions we made to the course using the COVID-19 pandemic as content, the challenges we faced with online or virtual teaching, and the opportunities we provided the PSTs. Finally, we reflect on what we have learned from this experience.

Science Course for Preservice Teachers

Course Content

We designed the course called *Science for Elementary Teachers* for undergraduate PSTs to learn about major scientific concepts. The goal of the course is to model inquiry teaching, engage PSTs in constructivist science inquiry, and provide PSTs with the knowledge they will need to teach science in

elementary classrooms. In a standard semester, the course addresses the physical, biological/earth, and astronomical sciences, following the Next Generation of Science Standards (NGSS Lead States, 2013). For each scientific topic, PSTs complete hands-on activities in class to help build understanding through active learning experiences. Once the quarantine was in place, and our teaching switched to online, we faced challenges, especially since we based this course on inquiry activities. The literature already shows that distance learning poses some daunting challenges, including poor quality in both audio and video for teachers and PSTs (Murphy, 2009). Additionally, teachers must consider how the virtual classroom differs from the physical classroom, considering the need to vary teaching practices, skills, strategies (Barrett, 2010), and online communication and interaction (Guasch et al., 2010) as well as constructing an online community for the PSTs (Barbour, 2015). Using the ideas from the literature to apply to our specific course, we grouped these challenges under two main themes: motivation and continuing inquiry throughout distance learning.

Sadler (2009) believes that socio-scientific issues (SSI) are a key component of the science classroom, where these issues serve as a platform for both teachers and PSTs to explore social ideas, problems, and issues related to the sciences. In addition to engaging PSTs in real-life events and problems, teachers can capitalize on SSIs to develop in PSTs an epistemological understanding of the nature of science (NOS) (Zeidler, 2014). As such, we decided as a team to address these challenges by involving PSTs in learning about COVID-19. Our rationale was that COVID-19 is a current SSI that would address the motivation problem, keep PSTs engaged, and allow us as educators to create activities and assignments to promote PSTs' learning. The NGSS for structure, function, and information processing in sixth grade include types of cells, cell structure and function, and human body systems. Viruses and disease align with this standard, especially that PSTs must understand human cellular structure to, in turn, understand how viruses work.

Teaching During Quarantine

The week before the COVID-19 lessons, we uploaded PowerPoints for the PSTs to view and complete questions, watch videos, and look at links for a discussion in the next class. During synchronous online lessons, we set up the class to be inquiry-based to engage PSTs in thinking about the material. We were in the middle of a DNA lesson when the pandemic started and knowing that the spread of diseases in general requires an understanding of genetic material, we kept the DNA lesson.[1] A simple DNA experiment allowed us to assess how PSTs complete hands-on activities remotely. For the DNA lesson, the PSTs did a DNA extraction with strawberries at home using household items (Figure 1), and then shared their work during the virtual class time. During synchronous teaching, we then discussed the method in class and clarified any questions or confusion. One PST expressed her excitement about this activity, which she shared with her sixth grade sibling. Her excitement motivated us to keep thinking of similar engaging activities.

[1] The COVID-19 virus works through its RNA, but knowing about DNA first provides a basis for understanding. Therefore, we kept the DNA lesson, and we later explained how the RNA of the virus changes the human DNA and makes it produce more virus cells.

Figure 1
PST's DNA Activity

COVID-19 Unit

We then moved into the lessons related to the COVID-19 unit, which included four sections: general information about diseases, COVID-19 information, treatment/prevention, and the relation of learning about the pandemic to the NOS. For each of these sections, we created several lessons (Table 1). The first section related general information about the diseases and included two lessons. The first lesson addressed pandemics, epidemics, and outbreaks using the Center for Disease Control (CDC) definitions and examples. PSTs used the CDC website to discuss details about the current pandemic to compare and contrast it with past pandemics, epidemics, and outbreaks. The second lesson focused on the definition of a virus, virus structure and function, and the way viruses differ from bacteria. PSTs completed a Venn diagram over viruses and bacteria using their definitions, characteristics, and examples (Figure 2) before the class discussion.

Table 1
Activities for COVID-19 Lessons

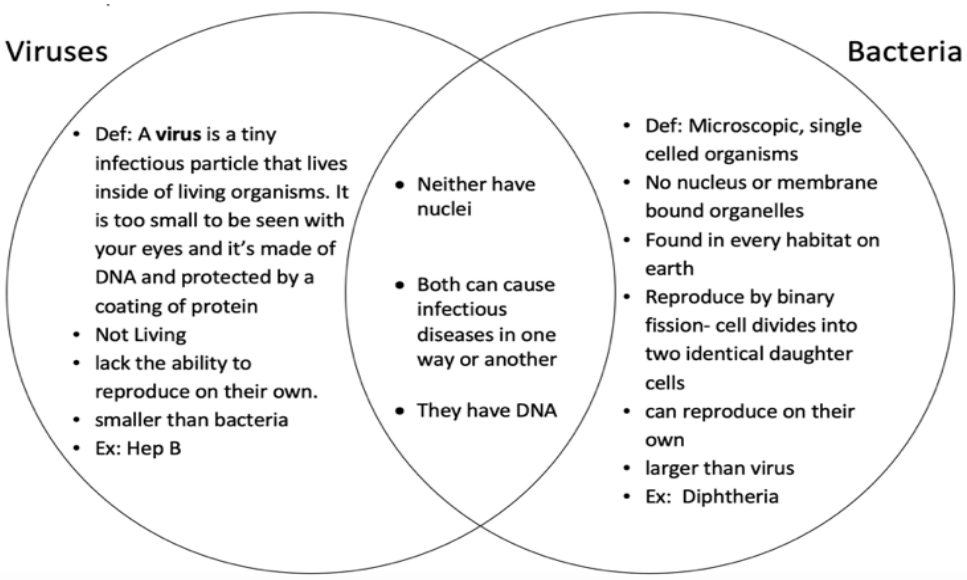
COVID-19 Unit Sections	Lessons, Discussions, and Activities
General Information About Disease	1. *Pandemics, Epidemics, and Outbreaks* – Using the CDC website, we discussed the definitions and some examples of the disease level classifications and PSTs compared the COVID-19 pandemic with past pandemics, epidemics, and outbreak. 2. *Viruses* – We discussed the definition of a virus, virus structure and function, the way viruses differ from bacteria, and we watched an animated video over how viruses reproduce. The PSTs then completed a Venn Diagram over viruses and bacteria including definitions, characteristics, and examples.
COVID-19 Information	1. *COVID-19* – We discussed the origin and spread of COVID-19, structure and function, what scientists know and do not know about the virus, how it differs from the seasonal flu, and how doctors test for and diagnose COVID-19 in patients. We used the CDC website and other reliable medical university and hospital websites for information about virus like structure, transmission, incubation period, R-naught numbers, and symptoms. 2. *Spread of Disease* – PSTs used the Johns Hopkins real-time COVID-19 map on their website to view the number of COVID-19 cases in the world, the U.S., Texas, the county in which TCU is located, and the county where they live. We compared statistics PSTs found, analyzed, and discussed our findings for variation in cases across the world. We also compared the spread of COVID-19 to H1N1 by viewing timelines of each and each student created their own timeline of major COVID-19 events. Each timeline event had a date, description, and an emoji for the PSTs' feelings about the event (Figure 3).
Treatment/ Prevention	1. *Containment Strategies* – We looked at past pandemic strategies from the CDC website and the improvement of current strategies. We focused on the importance of contact tracing and how this process is carried out. 2. *Vaccines and Cures* – We discussed how vaccines are tools to prevent disease outbreaks and not cures. Cures are to help patients already diagnosed with the disease. We also discussed the timeline of vaccine creation for novel and common viruses.
Relation of COVID-19 Pandemic to Nature of Science	1. *COVID-19 and NOS* – We discussed the tenants of NOS and how science being tentative relates to the current pandemic. With COVID-19 being a novel virus, scientists' knowledge and information about the virus is changed and updated every day. PST's completed a questionnaire to determine their view of science. 2. *If I Were President Essay* – To tie together the unit, PSTs pretended they were President of the United States and created a plan of action to contain and stop COVID-19 supported by the information given throughout the unit. PSTs discussed their plans in Zoom breakout rooms and presented to the class one action plan based on evidence.

These two lessons set the foundation for learning about the COVID-19 virus. The next lesson examined COVID-19 origin and spread, structure and function, what scientists know and do not

know about the virus, how it differs from the seasonal flu virus, and how doctors test for and diagnose COVID-19 in patients. We provided PSTs with information about virus structure, transmission, incubation period, R-naught numbers, and symptoms from the CDC website, and reliable research from university and hospital websites (e.g., Johns Hopkins). This lesson provided an opportunity to teach PSTs about researching and using credible information from trusted resources. The fourth lesson focused on the spread of disease, and PSTs used the Johns Hopkins real-time COVID-19 map to view the virus spread across the world. PSTs looked at the map and identified the number of cases the United States had compared to the rest of the world. They also had the chance to identify current cases in their own county and Tarrant county, the location of Texas Christian University (TCU). After analyzing the map, one PST concluded that, "Certain countries can be reporting more cases than others because they can have more tests available that allow them to confirm more cases than other states/countries." Reports on news media used this map as a source, so PSTs ability to to read and understand it was important. After the discussion of the spread of COVID-19, we compared this pandemic to the spread of the 2009 H1N1 flu spread. We gave our PSTs the CDC's timeline of the H1N1 and COVID-19 pandemics to answer questions about the similarities and differences of the viral spread and ways health organizations handled each pandemic. Together as a class, we used the COVID-19 timeline to create our own smaller timeline of the important events. We decided on 14 events, and the PSTs each added seven events individually before turning in their timeline. The timeline showed the date, a brief description of the event, and an emoji for how the PST felt about the event (Figure 3).

Figure 2

PSTs' Virus and Bacteria Venn Diagram



For the third section about treatment and prevention, we discussed past epidemics, pandemic containment strategies, and ways in which health organizations and officials have worked to contain and stop outbreaks and epidemics from becoming pandemics like the SARS epidemic in 2003 and the outbreak of measles in Pennsylvania in 1934. We compared past containment strategies to the strategies being used today with COVID-19, detailing how strategies have improved over time based on the CDC website. For example, the class emphasized the success of contact tracing with SARS and ways for health officials to improve these strategies today. For the lesson on pandemic prevention, we taught PSTs about vaccines as prevention tools and cures for treating infected patients. We discussed

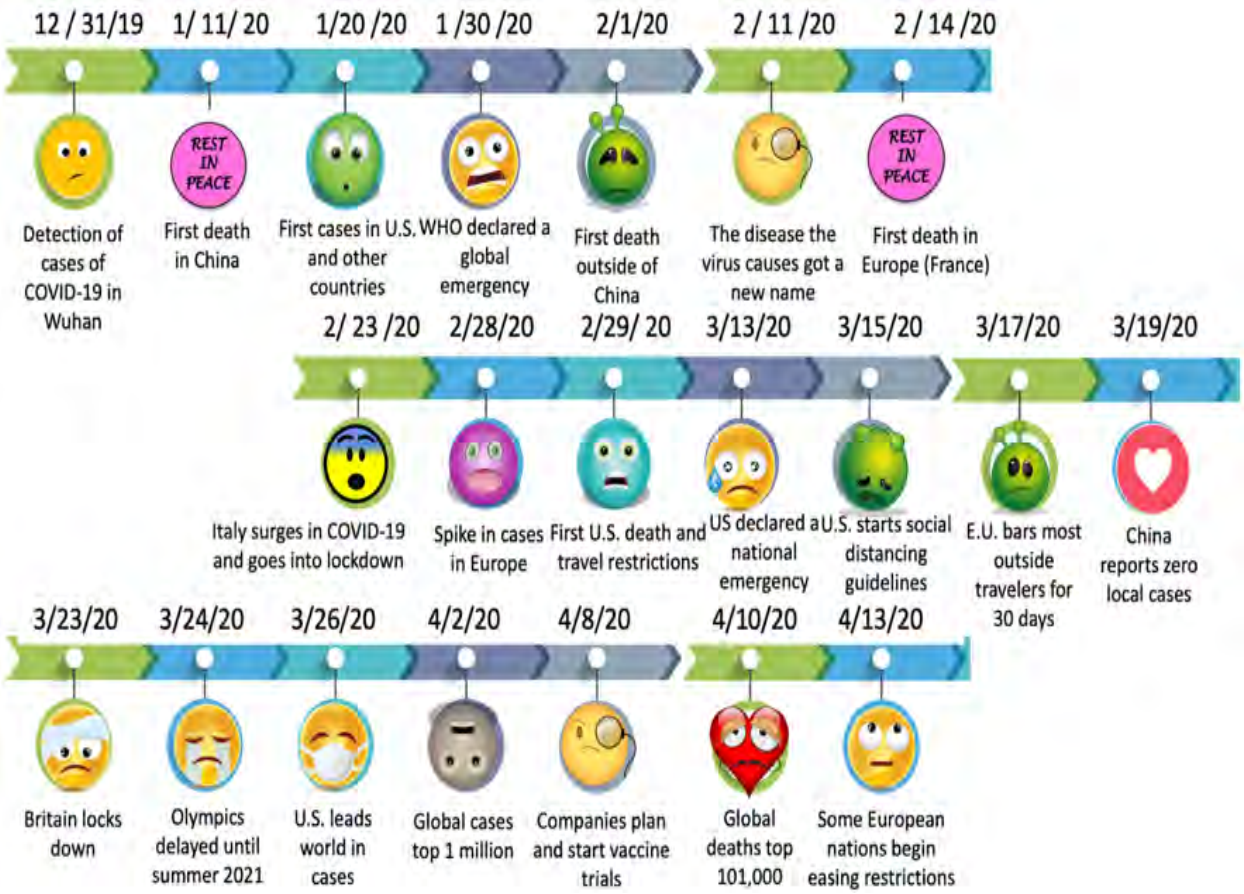
the potential timeline of vaccine creation and the different methods of cures that were being attempted.

We finished the unit by relating the COVID-19 pandemic to NOS, a topic that PSTs had discussed and completed related activities at the beginning of course before the online teaching. We reiterated a discussion about the tenants of the NOS, specifically the tentativeness of science. We related this tenant to the case of the COVID-19 virus, because a novel virus, science research changes every day as researchers revaluate or disregard information. We designed an online Kahoot activity for which PSTs filled out a questionnaire to determine their view of science concerning the COVID-19 pandemic. Most PSTs agreed that science is a complicated affair that is not easily reduced to one or even a few simple descriptions.

To wrap up the unit, we used a culminating activity for PSTs to apply their knowledge. We asked PSTs to answer a writing prompt stating what their plan would be to stop this pandemic if they were President, using information from the COVID-19 unit. In the last Zoom meeting of the semester, we broke PSTs into groups using Zoom breakout rooms and had them each discuss their plan of action and, as a group, agree on one plan based on evidence. PSTs from each breakout room presented their action plan to the class, told the class why they chose this plan, reviewed how they resolved differences within the group, and explained what data or evidence backed each of their actions. In one essay, a PST used evidence from previous epidemic containment plans to support her action plan stating, "I would ask researchers to prioritize contact tracing. During the SARS Epidemic in 2003, scientists were able to isolate patients and conduct successful contact tracing. Because of this,

Figure 3

PST's Timeline of Major COVID-19 Events



epidemic was contained within eight months." This essay activity served as a reflection of PSTs' knowledge over the COVID-19 unit and their ability to use resources to support their understanding. All PSTs generally agreed that, if they were President, they would engineer a slow, gradual reopening over the summer months, based on information from health officials and scientists like Dr. Anthony Fauci and research we viewed in class. Many PSTs stated that one of their major goals would be to increase testing, and some even said they would want everyone tested. Almost every student mentioned social distancing guidelines and the need to reopen the economy soon.

To sum up, our COVID-19 activities addressed two main challenges in distance learning, motivation and lack of physical contact required for certain inquiry lessons. We provide a summary of the challenges and opportunities in Table 2.

Table 2

Overcoming Distance Learning and Pedagogical Challenges

Lesson/Activity	Learning or Pedagogical Challenge	How the activity overcomes the challenge
Venn Diagram	Learning	PSTs listed the characteristics and definitions of bacteria and viruses with examples of each
Spread of Disease/Johns Hopkins Map Activity	Pedagogical	Showed the spread of disease on an online interactive map since we could not do an activity to see how a virus spreads in a classroom
Timeline of COVID-19	Learning	PSTs were able to choose the events PSTs thought were important to them
History of Vaccines Timeline and How Vaccines Work Slideshow	Learning	PowerPoint slides show how vaccines work with our immune system and how far vaccines have progressed in history
If I Were President Essay	Learning	Allowed PSTs to apply knowledge from the class as evidence for their opinions of what the actions should be to stop the spread

Reflection on the Unit and Conclusion

To gather some data about what we did in this unit, we asked PSTs to fill out an anonymous survey about our COVID-19 lessons and activities. The PSTs enjoyed the hands-on activities during the synchronous class meetings based on their evaluations, and the results collected from the activities helped start group and class discussions. One PST added in her course evaluation that she enjoyed the relevant material very much and was happy to learn about the pandemic which made her more aware of the situation and attentive to the news. When asked about which activity was their favorite and why, one PST answered, "I enjoyed the timeline the most because you can see how things developed, and it was very hands-on." Another PST added, "It was fun pretending to be in control of the country during this time," when asked about the essay for an action plan as President. However, we had an interesting response from a couple of PSTs who said that learning about COVID-19 increased their anxiety.

After this experience, we plan to use this unit in our future course syllabus, but we also plan some revisions to address the limitations, the first being the anxiety about the pandemic. In a similar

project, Sadler et al. (2020) also reported the anxiety of the in-service high school teachers planning a teach a COVID-19 unit, and therefore, the researchers invited a pediatric neuropsychologist to alleviate the teachers' concern by explaining the power of knowledge in handling stressful times. In the future course, we will provide PSTs with resources and activities about reducing anxiety during the pandemic. These resources show how knowledge is the best way to face our fears and avoid danger (Brooks et al., 2020). Effective and rapid information is key to help PSTs understand the current pandemic. The aforementioned study suggests that providing clear information and meaningful activities for PSTs could help during the pandemic.

The second revision is to increase hands-on activities that can be done during synchronous instruction. We, therefore, plan to include more activities that we recently found after finishing the unit. For the first lesson about disease spread classifications, we will add a video over modeling, predicting, and simulating epidemics (3Blue1Brown, 2020). Adding to the spread of disease activity, we will complete activities showing the spread of germs through direct contact. PSTs will use petroleum jelly on their hands and place them in glitter, representing germs, to see how quickly germs spread to everything touched in the classroom. The last revision is adding an extra activity to emphasize social distancing by introducing PSTs to COVID Crush (University of Wisconsin-Madison, 2020), a game that they can play online, as it shows the need for social distancing to prevent disease transmission.

Finally, apart from COVID-19 being the reality of the world today, it also provides teacher educators with an opportunity to include science in PSTs' everyday lives. Science educators, regardless of their level and experiences, must understand how SSI influence science discourse, and how a student's perception and understanding of NOS conversely affects SSI. Partaking in these discussions today can help strengthen science teaching practice as we navigate a post-COVID-19 classroom and society. Therefore, we provided the PSTs with a creative model of how we can teach the biology of the pandemic virus and its influence on our daily lives in the hope they, too, can use such a model with their students in the future.

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