KENAN FELLOWS PROGRAM FOR TEACHER LEADERSHIP

NC STATE

Journal of Interdisciplinary Teacher Leadership 2023, Vol. 7, No. 1, pp. 161-192

When Life Gives You Lemons, Do Outreach! A Program for University Professors to Virtually Connect to K-12 Students during the COVID-19 Pandemic and beyond

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Abstract

At the beginning of the coronavirus pandemic in the Spring of 2020, North Carolina (NC) public schools moved to distance education in which all students attended classes on video conferencing programs. During this time, NC State University faculty offered virtual guest talks to NC K-12 students. Eighty-eight faculty from three NC State colleges volunteered and 161 teachers requested talks, with approximately 5,400 students. Overall, significantly more teachers from the NC Piedmont region requested speakers ($p<.0001$); significantly more urban teachers requested talks ($p<.0001$); and, significantly more elementary school teachers requested speakers than middle ($p<.0001$) or high school ($p<.0001$) teachers. The program was beneficial to teachers and students, exposing them to real-world research. In the future, the program should be expanded to include more teachers, students, and disciplines, and continue beyond the pandemic.

Keywords: STEM education, scientist, outreach, video-conferencing, scientist-teacher collaborations

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Global disease pandemics occur sporadically, decimating human populations (Saunders-Hastings & Krewski, 2016) and disrupting most areas of life (World Health Organization [WHO], 2010). Many examples are available in the human historical record, but one of the deadliest and most prescient examples is the 1918–1919 influenza pandemic, which began in the United States (US) around March 1918 and lasted until April 1919 (Breitnauer, 2019). During that pandemic, many non-pharmaceutical interventions were used to attempt to halt the spread of the flu. Hygienic practices such as washing hands, wearing masks, and better sanitation were implemented, public gatherings and travel were restricted, and schools were closed (Bell et al., 2006; Markel et al., 2007; Breitnauer, 2019). Banning public gatherings and closing schools for a median duration of four weeks resulted in a significant reduction in deaths (Bell et al., 2006; Markel et al., 2007; Breitnauer, 2019). During the coronavirus epidemic of 2019 (COVID-19), the United States followed many similar non-pharmaceutical interventions such as discouraging large gatherings and business and school closures (Gourdarzi, 2020).

COVID-19 was first detected in North Carolina (NC) on March 3, 2020 (NC Department of Health and Human Services [NCDHHS], 2020). To help halt the spread of COVID-19, on March 11, 2020, North Carolina State University (NC State), located in Raleigh, NC, one of the largest land-grant universities in the state (36,284 students and 2,124 faculty [North Carolina State University Office of Institutional Research and Planning (NCSUOIRP), 2018]), announced that they were moving all undergraduate instruction to remote/online learning (Woodson, 2020). Then on March 14, 2020, NC's Department of Public Instruction (NCDPI) closed the NC Public School System (NCPSS) and switched to distance education instruction (North Carolina State Government [NCSG], 2020). This meant that 115 school districts—with a total of 2,592 K-12

schools, 1,583,323 students, and 101,446 faculty (NCDPI, 2019)—were abruptly transitioned from teaching seated face-to-face classes to Distance Education (DE) using video-based software. Most importantly for this case study, NCDPI also waived all required end-of-year testing (NCSG, 2020; USDE, 2020a), meaning that teachers had the flexibility to incorporate new academic content in a way that was not possible in normal years because so much time had to focus on preparing students for state end-of-course and end-of-grade (EOG) testing.

Although there was stress and anxiety surrounding the COVID-19 public health crisis and the immediacy of moving instruction online (Burke, 2020), people also felt a desire to help others, which can happen during times of crisis (Staub & Vollhardt, 2008). One small way to help others presented itself when one of us (Gates) initiated the *Chat with a Scientist* program at NC State for faculty to offer remote virtual guest talks to K-12 teachers and their students across the state. Through their combined efforts, faculty from NC State and East Carolina University (ECU) spoke with approximately 5,400 students across the state of North Carolina between May and December of 2020. This case study documents the implementation and results of the impromptu outreach drive at the beginning and in the middle of the COVID-19 pandemic.

Constructing an Impromptu Virtual Outreach Program

As originally conceived, the plan was to gather a cadre of NC State University College of Sciences (COS) faculty to provide an outreach opportunity to K-12 classes in the vein of the *Skype in the Classroom* (e.g., Beattie et al., 2020; Krebs et al., 2020), *Talk To A Scientist* (Mhade et al., 2023) and *Skype A Scientist* (2023) programs. Programs like these help children by increasing their excitement about science and their access to scientists (Morgan, 2013). To begin NC State's *Chat with a Scientist* program, on April 10, 2020, co-author Gates, an Assistant Teaching Professor in the Department of Biological Sciences at NC State, contacted the Director

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of Curriculum Enhancement Programs for Wake County Public Schools (WCPSS) proposing the idea of NC State professors speaking to Wake County students in their *newly* virtual classrooms. WCPSS expressed interest in the program with a restriction that the scientist-conversations occur on weekdays before 11:00 a.m.

Next, Gates sent an email on April 24, 2020 to NC State COS faculty across six departments (Biological Sciences, Chemistry, Mathematics, Physics, Statistics, and Marine, Earth, and Atmospheric Sciences) gauging interest in the program. In the initial email, Gates acknowledged that faculty were under a lot of pressure to teach, conduct research, and do service and/or outreach remotely because of coronavirus pandemic restrictions, and that NC public school teachers were facing similar challenges. Gates further stated to the faculty that the COVID-19 public health crisis also presented a unique opportunity to share science with public school students, and he encouraged faculty to help expand K-12 students' experiences and exposure to science by volunteering to give real-time virtual 30–45 minute talks.

An NC State faculty member who was interested in participating filled out information such as Name, Areas of expertise, and Availability in a Google Form, which was then compiled into a spreadsheet for teachers to peruse (Appendix A).

On April 27, 2020, WCPSS emailed all science teachers in the district about the proposed program, and included access to the Google Sheet (Appendix A) with NC State faculty's presentation information. Once a teacher selected the topic and scientist they wanted, they also filled-out a Google Form (Appendix B) and submitted their Name, School, City, Grade level(s) taught, Approximate number of students, Scientist preference, Topic preference, and Preferred dates and times. The Science House (a STEM outreach organization at NC State) and WCPSS also shared information about the program with other school districts across the state.

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Once requests from teachers began arriving, Gates received numerous requests from public school teachers for academic subjects outside of COS disciplines. At that point, he requested help from faculty in the College of Natural Resources (CNR) and the College of Agriculture and Life Sciences (CALS). Next, Gates and an undergraduate research assistant compiled the form requests into a spreadsheet (Appendix C) and then manually matched NC State faculty to the public school teacher requests. Gates then sent introduction emails to both parties to arrange a virtual presentation. When more than one teacher selected a subject and/or faculty member for a talk and their schedules coincided, they were included on the same introductory email so the scientist could speak to multiple classes at one time, which potentially increased the number of students attending one talk. Presentations from NC State faculty took place from early May until early June 2020.

Methods

At the end of the *Chat with a Scientist* program, we were interested in several research questions including: 1. How many NC State faculty would offer to give video talks to K-12 students? 2. How many NC K-12 teachers would request NC State faculty to give video talks to their students?, 3. What topics would faculty offer to present and how much discipline-specific jargon did faculty include in the topic entries, 4. What subjects would the teachers choose?

Data on the NC State *Chat with a Scientist* program was retrieved directly from the compiled spreadsheets of faculty volunteers and teacher requests. Information to address research questions 1 and 2 was acquired by counting the number of entries in both target databases. Research questions 3 and 4 required classification (discretizing) of presentation topics by one of the authors (MN) and a paid undergraduate research assistant. To assess whether the topics offered by the NC State faculty were written largely with discipline-specific jargon or in

colloquial language for non-experts (which was not specified as a requirement on the faculty interest form), the keywords that faculty listed as their talk topics were scored independently by both data collectors as being either discipline-specific or non-discipline-specific terminology. Discipline-specific jargon was defined as terminology used in a specific academic discipline, but not broadly in the public domain (Oxford Languages, 2022). When both data collectors rated 51% or more of the words a faculty member used to describe their potential topics as non-discipline-specific terminology, this was considered to be using 'colloquial' words.

Regarding the research on which topics teachers would request, we were interested in determining whether teachers would request more topics associated with grade-specific curricula. Specifically, we were curious to see if teachers requested more biology-oriented subjects than other subjects since NCDPI incorporates biology in many grade levels (NCDPI, 2023) while other topics are restricted to only a few years of public instruction. The same data collectors independently grouped the subjects requested by teachers into broad categories such as biological sciences, chemistry, environmental sciences, math, or physics. The two scorers had to agree on the category of a topic for it to be put into that category. Topics categorized as biology were those relating to life and living organisms including chemical processes, molecular interactions, physiological mechanisms, development, physical structure, and evolution (Martin & Hine, 2008), whereas chemistry subjects were those surrounding the composition, structure, properties, behavior, and changes among elements and compounds composed of atoms, molecules, and ions (Daintith, 2008). Topics categorized as environmental sciences included how environmental systems operate and the impacts of human interactions (Park, 2007). Math subjects were the science of space, number, quantity, and arrangement (Oxford English Dictionary, 2019), physics topics included motion and behavior through space and time, and the

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related entities of energy, force, and matter (Daintith, 2009). When the data collectors disagreed, another author was asked to rate/rank the item to break the tie.

Given that much of the data were categorical, the Chi-square Goodness of Fit Test (X^2) and One Proportion Z-test were used for statistical analyses using JMP® Pro Predictive Analytics Software 14.2.0 (SAS Institute, 2018). Figures were made using Google Earth (Google, 2020) and GraphPad Prism Software (GraphPad Software, 2020). This study was conducted with NC State University's Institutional Review Board approval (IRB Protocol #21102).

Results

During the *Chat with a Scientist* program, 88 NC State faculty and two ECU faculty volunteered to give talks to public school students with 49% of faculty volunteering from COS (n=43), 43% from CALS (n=38), and 8% from CNR (n=4) (this equated to 14%, 10%, and 4% of NC State faculty from the respective colleges [NCSUOIRP, 2018]). Faculty members suggested 57 topics, with plants being the most common topic offered (11%), followed by food production (9%), and anatomy, bioengineering, and paleontology (7% each). When listing subjects, 85% (n=75) of the faculty used 'colloquial' keywords for at least half of the topics.

Eighty-five percent of the faculty were matched to teachers. Of the 13 faculty who were not matched to a class, over half of them listed the same subjects as faculty who were already matched to a class listed, whereas five suggested topics that were not requested such as math and breastfeeding. In total, 132 classes were visited virtually with faculty speaking to approximately 5,400 students between May and June, 2020. Faculty gave an average of 1.69 talks each (range = 1–7 talks per faculty member).

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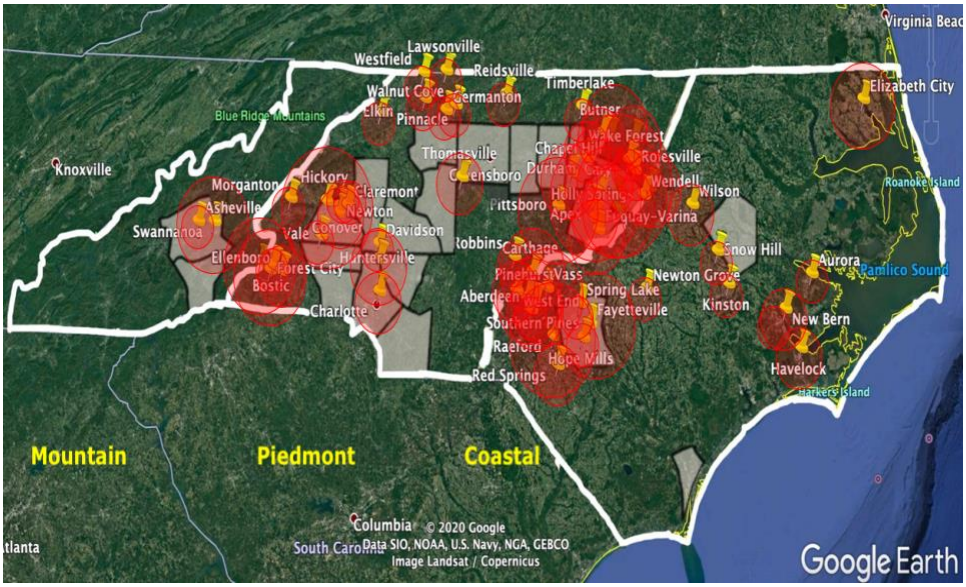
One hundred and sixty-one teachers from across the breadth of North Carolina requested scientist chats from NC State faculty (Figure 1). Significantly more teachers from schools in the Piedmont area (n=127) requested guest speakers than in Mountain (n=23) or Coastal (n=11) regions (X^2, p<.0001). Also, significantly more teachers in urban school districts (n=137) requested scientist chats than teachers in rural school districts (n=24) (Z Test, p<.0001).

Figure 1. *Google Earth (V 9.3.113.1) map of North Carolina showing locations of requests from K-12 teachers for NC State faculty scientist chats.*



Note: The pins indicate the locations of the schools where teachers made requests for scientist chats, and the size of the red circles show how many requests were made. The gray regions denote urban areas, whereas the white lines show physiographic divisions of NC (Mountain, Piedmont, and Coastal regions). *Urban clusters were defined as those with populations of 2,500 to 50,000 (United States Department of Agriculture: Economic Research Service [USDA ERS], 2007).*

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Elementary school teachers (n=93) requested guest speakers more than middle school (n=46) (Z Test, p<.0001) or high school teachers (n=22) (Z Test, p<.0001), and significantly more middle school teachers (n=46) requested guest speakers than high school teachers (n=22) (Z Test, p=.0025) (Figure 2). On average, there were about 18 requests for scientist chats per grade level with significantly fewer requests from kindergarten and first-grade teachers (n=10 each; Z Test, p=.0224 for both). Note that only four kindergarten and six first-grade classes had a guest speaker out of a total of 22 requests. In contrast, there were significantly more requests from 4th (n=27; Z Test, p=.0163), 5th (n=30; Z Test, p=.0021), and 8th (n=26; Z Test, p=.0291) grade teachers (range=10–30 requests; see Figure 3) than from other grade teachers.

Figure 2. *The number of teachers and the educational stage they teach (elementary, middle, or high school) that requested NC State faculty give virtual guest talks in their classes* (**p-value $\leq$ 0.01, ***p-value $\leq$ 0.001).

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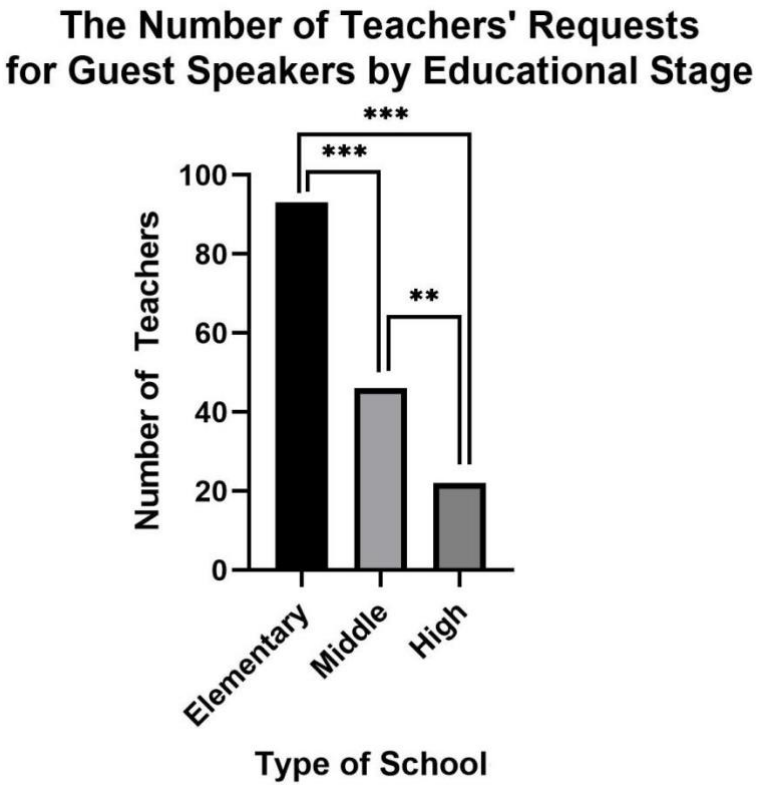

Figure 3. *The number of teachers and the grades they teach (K-12) that requested NC State faculty remote scientist chats in their classes* (**p-value ≤ 0.01, ***p-value ≤ 0.001).

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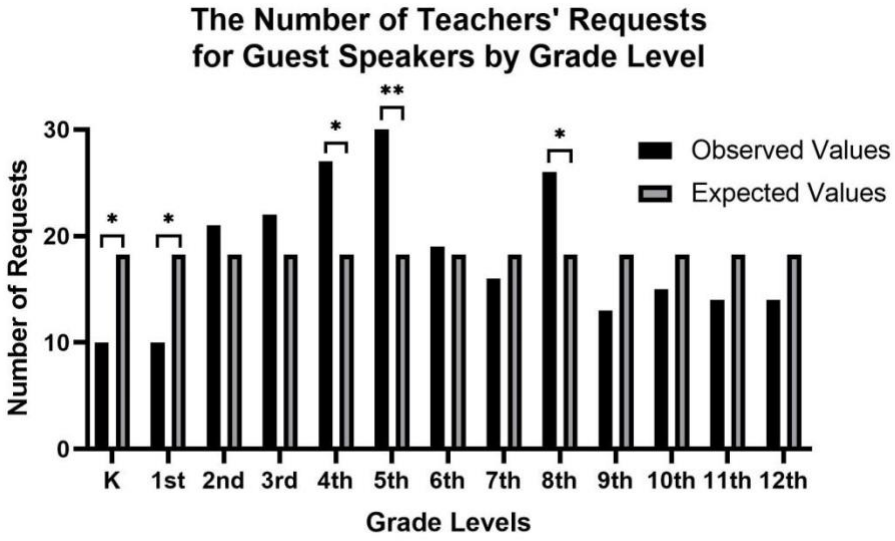

Table 1 shows the general categories of topics chosen for guest talks. Significantly more teachers (n=68) requested talks about environmental sciences than any other topic (X^2, p<.0001). The second most requested topics were in biological sciences (26%). Fourteen teachers (9%) chose to have talks on two or more subjects from different disciplines, whereas 17 teachers (11%) requested to have a speaker give a talk on any topic.

Table 1. *The categories, topics, and number of requests teachers (n=161) made for remote NC State scientist talks in their classrooms* (*p-value ≤ 0.05, **p-value ≤ 0.01).

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General Topic Category	Category Topics	Total Requests
Environmental Sciences	Climate Change, Earth, Environmental Challenges, Natural Disasters, Water (Quality and Pollution), Wildlife	68
Biological Sciences	Animal Behavior, Animal Conservation, Adaptations, Biological Systems, Biodiversity, Biotechnology, Cells, Diseases, DNA, Ecology, Evolution, Family Science, Genetics, Life Cycle, Parasites, Plants	42
Physics	Electricity, Energy Conservation, Energy Transfer, Force, Machines, Magnetism, Matter, Motion, Power, Sound, Work	17

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Interdisciplinary	Paleontology, Petrology, Archeology, Ecology, Astronomy, Food Science, Oceanography	14
Chemistry	Chemical Reactions, Molecules, Stoichiometry	3
Math	Mathematics, Statistics	0
Any	Any Topic Available	17

Note. Teachers could request more than one subject.

Discussion

The initial closure of schools in March and April 2020 threw a wrench in the practiced pedagogy of public-school teachers, but it also opened the door for university faculty to engage with K-12 students from across North Carolina in ways they may not have done so before. NC State University faculty stepped up to the challenge by offering their time to speak to 5,400 students in the early part of the pandemic. The data provided here show clear evidence that NC State faculty have a desire for public outreach. Below we discuss several aspects of the *Chat with a Scientist* program including lessons learned and recommendations for similar outreach efforts.

Faculty Engagement Preparedness

Our analyses showed that the majority of faculty used colloquial language to describe their expertise, which demonstrates that faculty understand how important it is to make subjects with uncommon names understandable to the public (cf. Shermer, 2002). Half of the 15% of the faculty not selected by K-12 teachers listed subjects that are not taught in NC K-12 classes (e.g., breastfeeding) or a subject not thought to be topical for a guest speaker (math). Although introducing students to subjects that are not in the K-12 NCDPI curriculum may sound like a good idea, K-12 teachers are expected to follow the rigorous guidelines set by the state, and likely do not have time for subjects outside of their curriculum (Farmer & West, 2019). Also, math may not have been selected as a topic because few to no math teachers may have received emails explaining the *Chat with a Scientist* program.

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One explanation for the accessible language used in presentation topics is that many of the faculty who volunteered have previous experience with public outreach. As such, in many cases, preparation for a rapid outreach initiative was minimal for them since they already had "canned" presentations ready to go and topics already using K-12 appropriate and understandable language. There were other cases in which volunteering faculty did not have much if any, prior outreach and engagement experience, yet they also simplified their topic's language.

Teacher Requests

The hypothesis that teachers would request more biology-oriented topics than any other topics because NCDPI incorporates biology into many years of the curriculum (NCDPI, 2023) was not supported. Although the second most requested topics were in biological sciences, significantly more teachers requested talks on environmental science topics than biology or any other topic. This aligns with the NC Public School curriculum too though, as there are units dedicated to environmental science in grades 3-8. In addition, students have the option to take environmental science (ES) or physics in high school (NCDPI 2023). Moreover, earth and environmental science is an N.C. graduation requirement. This means that all N.C. high school students must pass an earth and environmental science course to graduate high school (NCDPI 2023). Thus, it is likely that many of the science teachers are teaching an ES course and/or related subjects, and want their students to learn more about it. NCDPI incorporates biology into each year of the K-8 curriculum, and students in high school are required to take one course solely dedicated to biology. Other sciences, such as chemistry, are only taught in NC in grades 1, 3, and 6, and to high school students who choose chemistry instead of physics (NCDPI, 2016a, 2016b; 2023). Since other sciences are less frequently incorporated into the curriculum than

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environmental sciences or biology, this is likely why other science topics were not requested as much.

Perhaps the most influential reason for choosing certain topics was to provide students with a presentation about the curricular material they were learning at the time. Many teachers mentioned in their requests that their class was studying a particular subject and that they would like a person to speak about that specific topic. For instance, one of the most popular subjects requested was Climate Science, which included topics such as hurricanes, climate change, weather, etc., because this unit was taught towards the end of the school year in some districts. Other commonly requested topics - plants, food production, anatomy, bioengineering, and paleontology - were also likely a reflection of what students were learning and/or subjects that the teachers thought students would find interesting. For example, students learn about plants in grades 1, 3–6, and 7 (NCDPI, 2019a). In contrast, paleontology is not listed as part of any specific grade curriculum, although during fourth grade, a unit is dedicated to earth materials, which includes fossils, minerals, and rock cycles (NCDPI, 2019a). This implies that over half of the scientist chats catered specifically to what students were learning in class or not learning, and what the curriculum was lacking.

Long reach of virtual engagement

Although NC State's *Chat with a Scientist* program was created to serve the Wake County Public School System where NC State is located and where the initial interest email was originally disseminated, faculty reached students in 161 schools from the mountains to the coast. The program spread quickly across North Carolina - albeit unevenly. Statistically more teachers in urban school districts requested guest speakers than teachers in rural school districts, but this could at least partially be explained by the presence of more schools in urban districts. By

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definition, populations in urban districts are greater than those in rural districts, and 60% of NC's public school system students live in urban areas, i.e., there are 87 rural K-12 traditional public school districts compared to 63 urban school districts (Lavalley, 2018). Populations are also higher in the Piedmont region of the state (North Carolina Office of State Budget and Management [NCOSBM], 2019), which may explain why significantly more Piedmont teachers requested guest lectures than teachers in the mountain or coastal regions. It is important to note that another potential bias is the unknown spread of the original email. Aside from the widely distributed email notification from NC State's The Science House, we do not know what other teachers received news about the program.

Significantly more elementary school teachers requested lectures for their classes than middle or high school teachers. This can be an artifact of there being six grade levels (K-5) in elementary school in NC, as compared to only three grades in middle school and four grades in high school. However, this may also be explained by elementary school teachers having to teach multiple subjects, whereas middle and high school teachers usually specialize in one area and/or subject such as science, mathematics, etc. (Wilkins, 2009). Thus, K-5 teachers may either lack expertise in one specific science subject and/or want guest speakers to help with a subject so that the teacher can allot more time to one of the many other subjects they have to teach. The difference between lower- and higher-grade teachers' requests for speakers may also be a result of high school teachers feeling the pressure to focus on the material required by the curriculum for their soon-to-be test takers and graduates (Ball et al., 1996).

Obviously, sixth through eighth grade students are exposed to specific science courses and topics at a more in-depth level than elementary students (USDE, 2020b). Although both middle school and high school students may be exposed to more science, middle school teachers

often teach multiple science subjects (Sadler & Sonnert, 2016). Thus, significantly more middle school teachers may have requested guest speakers than high school teachers because they may have felt like they could use some help covering one of the many science subjects they teach. In contrast, following the NC curriculum, high school teachers specialize in science courses such as biology, chemistry, environmental science, etc. (USDE, 2020b), and therefore, may have been more likely to choose one topic and guest speaker.

Teachers from every grade level requested guest speakers, with kindergarten and first grade teachers having the fewest requests. This is most likely due to the level of science taught at the kindergarten and first grade levels not matching well with the NC State faculty areas of expertise. The most requests came from 4th, 5th, and 8th grade teachers, which may be partially explained by the particularly heavy emphasis on science in fifth grade, with a curriculum that focuses on human body systems, weather systems, and ecosystems (NCDPIb, 2016; 2023). The most requested topics for fifth grade were weather, ecosystems, and anthropogenics, which aligned with the NCDPI 5th grade science curriculum (NCDPI, 2016b). Fourth and eighth grade teachers also requested significantly more scientist chats than expected. There is a particularly heavy emphasis on biology and ES throughout both the 4th and 8th grade curricula (USDE, 2020b). Fourth grade focuses on earth materials, landforms, and animal studies, whereas eighth graders learn more about earth systems, ecosystems, evolution, and genetics (USDE, 2020b). This seems to explain why biological and environmental sciences were the most requested subjects.

Diversity, Equity, and Inclusion Considerations

The *Chat with a Scientist* program indeed made huge gains in reaching students across all geographic regions of the state. Our glimpse into the lives of these regions made clear the

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Diversity, Equity, and Inclusion issues that exist in North Carolina. First, the unequal internet infrastructure between urban versus rural communities dramatically shaped the experience of our program. Although teachers may have more access to technology for their work than their students do, this may not always be the case. For example, during one of the scientist chats with author LP, an 8th grade rural teacher drove to the local high school to access WiFi, then sat in her car to participate. Rural areas often have higher levels of poverty (Lavalley, 2018), and rural students are more likely to lack adequate resources at home as well as have less access to enriching activities outside of school (Organisation for Economic Co-operation and Development [OECD], 2010; Echazarra & Radinger, 2019). Unreliable internet may have made some teachers choose not to request a scientist chat, or similarly, unreliable internet may have caused students to miss a portion or the entire presentation and/or lose concentration because of discontinuity.

At-home learning environments differed drastically between students (TAG and LP, pers. obs.), making the ability to concentrate on the faculty speaker different for each student. During our conversations with students, we noticed the level of disruption varied between households. In a classroom, all students would receive a similar level of disruption, making the learning experience more equitable. The variation between at-home environments made this experience less equitable than it could potentially be.

Lessons for Future Programs

The NC State *Chat with a Scientist* program created a mutually beneficial opportunity for university faculty, K-12 teachers, and students. Faculty were able to improve their communication skills by explaining science topics to general and younger-aged audiences (cf. Clark et al., 2016), in addition to fulfilling their outreach responsibilities and/or goals (*College of*

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Sciences Post Tenure Review of Faculty, 2016). K-12 teachers were able to have an expert teach subjects that aligned with current NCDPI standards (NCDPI, 2023; Wilkins, 2009). Furthermore, video conferencing allowed K-12 teachers to organize virtual sessions for free or without much cost (Oreopoulos et al., 2020). We hope that being able to virtually listen to and speak with a scientist increases students' enthusiasm for, and knowledge of, science (cf. Clark et al., 2016). Also, scientists can help the public make better and more sound choices about complicated science-related issues (Fischhoff, 2013), and likewise, public input can enrich science disciplines by offering new perspectives and stimulating new inquiries (Pace et al., 2010). Unexpectedly, after the *Chat with a Scientist* program, extension and outreach groups already established at NC State requested help from Gates in expanding their initiatives.

Many lessons were learned that will be useful to other institutions wishing to start similar outreach efforts. 1) Be cognizant of the communities that you want to reach and specifically direct advertisements toward them. The NC State initiative was hastily put together in light of the pandemic shut-down and did not have the foresight or time to organize with many groups who could help with the broad advertisement of the program; *Chat with a Scientist* leadership simply used their connections for advertisement. 2) Individual school districts rely on different video platforms for communication. Therefore, faculty need to be proficient with common technology platforms such as Google Hangouts©, Zoom©, and Microsoft Teams© before connecting with classes. 3) Be aware of any data you want to collect about the program before initiation and acquire IRB approval if necessary. One of the major limitations of this study is that this is a *post hoc* evaluation and assessment of the program. Evidence that would be useful to evaluate the effectiveness of this program would include the spread of advertisements; the number of students attending each presentation; the number of students and teachers that attend more than one chat;

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pre- and post-surveys to measure student growth and/or teacher motivations as well as faculty participants. 4) Many faculty are interested in outreach to educate society and to include outreach activities in their annual reviews, *curriculum vitae*, and grant proposals, especially during a pandemic when there were not many other feasible outreach opportunities. 5) A program coordinator is necessary to make connections between faculty and teachers. Demand for scientists' talks was/is so high from public school teachers that faculty can feel overwhelmed. As such, we recommend having a person in charge of uniting the requesting teachers with faculty to satisfy the needs of the teacher as well as serve as a guardian for the faculty members' time commitments.

The lessons learned from the NC State *Chat with a Scientist* program were that in general, outreach can easily be implemented with the use of conferencing software. The NC State scientist chats program was especially beneficial to NC public school teachers, as it provided them with a minute break from creating a new and/or altering a lesson plan that could be delivered virtually. Students benefited because they were able to learn more about course content from real scientists and real-time contemporary science.

Conclusion

In this paper, we reviewed the implementation of North Carolina State University's *Chat with a Scientist* program. NC State University faculty were beamed into 161 public school kindergarten through 12th grade classrooms and spoke to approximately 5,400 students. The students were exposed to real-world problems and/or research questions that scientists were working on solving and answering. These findings shed light on how simple it was to incorporate outreach opportunities for university faculty during a pandemic, while also benefiting NC public school teachers and students; albeit, at a cost of administration time to the project coordinator

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(TAG). Positive exposure to science during primary and secondary education is crucial to advancing interest in a Science, Technology, Engineering, and Mathematics (STEM) careers (DeJarnette, 2012). STEM careers are vital to meet the demands of a dynamic and evolving workforce that will help solve future complex problems (USDE, 2020b). Moreover, the NCSU *Chat with a Scientist* program could easily be implemented throughout the country at various universities and in state public school systems. This is particularly pertinent given many countries' and regions' use of lockdowns to manage COVID-19 outbreaks, as well as the drastic increase in remote learning and working since the start of the pandemic. The scientist chats program provides a way to increase outreach and learning not only during health crises, but also more generally as a means of public engagement. Burdens such as time involved with transportation to parts of the state far from campus were removed for faculty wanting to conduct outreach. Thus, for all of these reasons, when life gives you lemons, make lemonade and do virtual outreach!

Acknowledgments

We wish to thank all the NC State University and East Carolina University faculty who gave their time and energy to speak to children across North Carolina. We also are grateful for the assistance in spreading the word about our program from the Wake County Public School System, Dr. Jason Painter of The Science House, and the teachers of North Carolina.

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Appendices

Appendix A. *Google Sheet used by College of Sciences (COS) faculty to express interest in Outreach via Zoom with NC K-12 students.*

Name	Email	Subjects to Speak	Days and Times Available	Number of Classes	Total Number of Students

Note. Columns in the Google Sheet: Name; Email; Subjects to Speak (about); Days and Times Available; Number of Classes; Total Number of Students.

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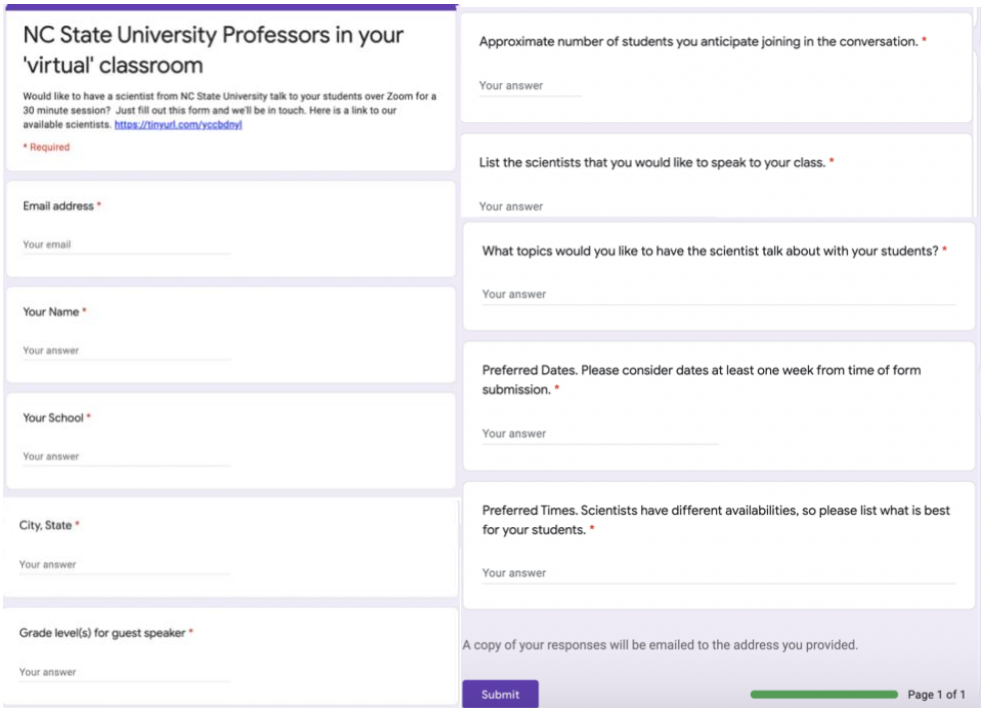
Appendix B. *Google Form used by NC K-12 teachers to request a virtual talk from an NC State University professor.*



NC State University Professors in your 'virtual' classroom

Would like to have a scientist from NC State University talk to your students over Zoom for a 30 minute session? Just fill out this form and we'll be in touch. Here is a link to our available scientists. https://tinyurl.com/yccbdnyl

* Required

Email address *

Your email

Your Name *

Your answer

Your School *

Your answer

City, State *

Your answer

Grade level(s) for guest speaker *

Your answer

Approximate number of students you anticipate joining in the conversation. *

Your answer

List the scientists that you would like to speak to your class. *

Your answer

What topics would you like to have the scientist talk about with your students? *

Your answer

Preferred Dates. Please consider dates at least one week from time of form submission. *

Your answer

Preferred Times. Scientists have different availabilities, so please list what is best for your students. *

Your answer

A copy of your responses will be emailed to the address you provided.

Submit

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Appendix C. *Resulting Google Sheet that was used to match NC K-12 teachers with NC State faculty for a 'virtual' classroom guest talk.*

Note. Columns in the Google Sheet: NC State faculty member's Name; Timestamp; Email Address; Your Name; Your School; City, State; Grade level(s) for guest speaker; Approximate number of students you anticipate joining in the conversation; List the scientists that you would like to speak to your class; What topics would you like to have the scientist talk about with your students?; Preferred Dates. Please consider dates at least one week from the time of form submission; Preferred Times. Scientists have different availabilities, so please list what is best for your students; Scientist Schedule; Date, and Time.