

## **An Investigation of the Benefits of Short Online Interviews in a Materials Science Course**

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## Introduction

Students need context to translate learning to deeper levels of knowledge and enduring understandings. Academics, many of whom have spent little to no time in industry, often struggle with connecting course learning objectives to the wider outside world. However, students benefit from intentional interactions with professionals in their area of study [1]. Informational interviews, site visits [2], industry-sponsored projects [3], and adjunct instructors from industry [4] all provide educational advantages within the context of an engineering curriculum. Each of these can require a great deal of time on the part of the industry liaison or necessitate curricular changes. Another common tactic is to bring in a guest lecturer for a single class session to give a talk on her specialty or to tie class material to industry. This is a fairly common practice and relatively easy to schedule because one class period is not a large time commitment for the guest and does not require major adjustments to the course curriculum or schedule. Of the 901 papers that are available via ASEE PEER when searching for the term “guest lecture”, nearly all of them are from papers where guest lectures are incorporated as part of the student experience and not the focus of the research [5]. Where the guest lectures are a part of the course assessment, it is often in a general way, with general end-of-semester evaluation questions such as “Guest lectures added a unique dimension to the course beyond that presented by my instructor or text.” [6] The common opinion is that students often appreciate these lessons or lectures, especially if the lecturer is particularly engaging or is discussing something novel and of personal interest to the student. Some faculty have provided best practices in integrating guest lectures into a typical undergraduate classroom setting, practices that have worked for them or that are pedagogically sound [7], [8]. However, little or no research has been done to understand whether there are meaningful benefits for the students in having these “lighter touch” interactions with applications of engineering and practicing engineers [7]. This hole in our understanding is what this work seeks to fill.

If there are sound benefits to having a GL visit a class, such visits could be incorporated more frequently and more intentionally in an online format. The primary barriers to inclusion of guest lecturers are geographical. The potential GL must live in proximity to the school if visiting class in person, with travel the endeavor can easily take 4 or more hours. In the past year, students and all professionals have needed to develop basic web meeting skills to facilitate both teaching and learning online. This provides a powerful opportunity: almost any meeting – and certainly any lecture that involves primarily presentations and conversations - can easily be pivoted to an online environment with a reasonable expectation that all students will be able to participate. GLs can be recruited from anywhere in the world, and only need to devote the time required to prepare for the meeting and be present. This method of including industry in education is now tantalizingly easy, and it will be beneficial to better understand what specific benefits it provides.

The purpose of this introductory study is to explore student reactions to virtual guest lectures with specific research questions of

1. What were student perceptions of the benefits of online guest lecture visits?
2. How did students relate the guest lectures to their personal interests and goals?

## Methods

### Context

In the Autumn 2020 semester, the Engineering Materials and Processes course at Campbell University was taught in a hybrid mode. Students came in weekly for labs in smaller groups, but weekly lectures and review sessions were conducted online in both synchronous and asynchronous modalities. This, coupled with its rural location, has made it difficult to secure in-person visits from professionals doing work related to classroom topics. It is much easier to have professionals “visit” an online class, and four such visits were scheduled in the final third of the course. These guest lecturers (GLs) were chosen from the instructor’s network of former students and acquaintances. All GLs are US citizens working in the United States. GLs discussed their work, their educational and professional pathway, and were available for questions at the end. Each visit lasted approximately 45 – 60 minutes. The instructor communicated briefly with each GL to explain what information had been covered in class, but each GL was allowed to choose the topic of their presentation. The presentations were both informative and engaging, and students asked questions both during and after the presentation. The exact number of questions was not tallied. The four topic areas covered by the GLs are shown in Table 1.

*Table 1: Guest Lecturers’ information and topics.*

Guest Lecturer	Topic	Employment	Background
A	Steel Processing	Major Steel manufacturer	B.S., Materials Science and Engineering
B	Polymer Research and Entrepreneurship	University-based researcher heading a SBIR Phase 1	Ph.D., Materials Science and Engineering
C	Composite Materials Processing	Self-Employed	Ph.D., Mechanical Engineering
D	Sustainable Materials	Major automotive manufacturer	M.S., Materials Science and Engineering

### Data collection

At the end of the semester, students were asked to respond to a course assessment survey administered by the instructor. This survey included questions about the student’s perceptions of the visits from GLs. To encourage meaningful responses, the students were offered extra credit on one of the course exams for providing complete and thoughtful responses. 27 students (of a possible 28, 96%) participated. Survey questions are listed in Table 2.

Table 2: Questions asked in the survey.

Subset	Q #	Question(s)
Word Cloud Analysis of overall tone	1	List 3 words to describe the experience of having presentations and video interviews from visiting engineers and scientists during this class this semester.
Benefits of the visits	2	What were the benefits, if any, of these visits to your learning of Materials Science?
	3	What were the benefits, if any, of these visits to your future career?
Evaluation of online format	4	What do you think you missed out on, if anything, by having these visits virtually instead of having the visitor come to class in person?
Relation to personal interests and goals	5	Which visit was the most interesting to you personally, and why?
	6	Which visit was the least interesting to you personally, and why?
	7	Which visit was the most beneficial to you personally, and why?

## Data analysis

Thematic analysis was used to determine trends in students' responses in a five-phased cycle [9]. A word cloud comprising responses to question 1 established an overall tone for the students' perceptions of the visit. Deidentified responses were analyzed for each question to understand the themes. These themes were not always clearly located within a single question's response – for example, several students discussed the impact the visits had on their career plans when responding to question 2. Thus, themes were identified from three questions subsets: Q2&3, Q4, and Q5-7. Common themes were found using inductive analysis methods, sorting the responses into similar groups as part of disassembling the data [5]. Overarching themes for the response groupings were developed and participant responses were reviewed and assigned to these themes during the reassembly process. Themes were not treated as exclusive; student responses could belong to more than one theme. Not all responses were linked to themes. For these two reasons, the number of student responses shown for the themes in each question subset do not add up to the total number of participants. For questions 5 – 7, the specific GL visits noted by students were tallied to show trends and outliers in student reactions. Interpretation of the data is presented in the Results and discussion section and incorporates the holistic word cloud overview, the quantitative student responses to the visits, and supporting quotes for the themes to develop a descriptive picture of the student responses to the guest lecturer visits.

The course instructor invited the presenters and is the author of this paper. Thus, it is likely that personal biases influence this study. The relatively modest goals of the analysis are still achievable: to help determine how such a practice may benefit students and provide some guidelines for inclusion of guest lecture visits in future courses.

## Results and Discussion

Students responded positively to the GL visits. This result is unsurprising as it is consistent with prior findings, but it is worth noting that none of the responses to question 1 included negative adjectives. The responses to question 1 are represented in a word cloud in Figure 1.



Figure 1: The responses to Question 1. Word cloud was generated using software available at [www.jasondavies.com/wordcloud](http://www.jasondavies.com/wordcloud)

When responding to questions 5 – 7, some students declined to rank the visits in one or more of the question responses, so totals are less than 27. The tallies for questions 5, 6, and 7 are presented in Table 3.

Table 3: Tallies for questions 5 - 7, which ask the students to identify the most interesting and beneficial guest lecturers.

GL	Topic	Q5 – Most Interesting	Q6 – Least Interesting	Q7 – Most Beneficial
A	Steel Processing	5	7	4
B	Polymer Research and Entrepreneurship	11	4	10
C	Composite Materials Processing	3	5	3
D	Sustainable Materials	6	6	8

Students were encouraged to include lengthy and detailed responses to questions 2 - 7, and it was possible to identify a few major themes. The overall results of the thematic analysis can be seen in in Table 4. These themes are presented as first-person statements expressing the perceptions from the student’s point of view. For questions 5 – 7, both the positive statement and its inverse

were coded the same way. For example, one student remarked that one of the GLs was "...least interesting...because I was not super interested in what s/he was speaking about." This statement counted towards the tally for theme G, related to the student's interest in the topic whether positive or negative. Similarly, a student remarking that "...I found his delivery a little more boring than some of the others..." would count towards the tally for theme F.

Few of the students reported that the guest lectures helped them to understand the content of the class. This was not entirely unexpected, though responses to question 2 were much more global than expected, describing student learning as focused more on how materials science and engineering connects to engineers and engineering more broadly rather than to any specific course content. While the timing of the meetings was arranged so that the pertinent class material would have been covered in the week prior, no guidance was given to the GLs regarding how to tie their information to class material. A majority of students identified with at least one of two major benefits, expressed by themes A and B. First, students felt that the presentations helped them identify how engineers use materials science. Second, they found materials science more relevant to their future career. Only one major theme (Theme B) was expressed by more than half of the students – and this is likely influenced by question 3 referring specifically to the student's career plans. Together, themes A and B relate to a valuable outcome specific to Campbell University which offers a single B.S. in Engineering degree. Being able to relate the role of materials scientists and materials engineers to the field of engineering is a key learning objective for the course.

Nearly half of the students felt that the question and answer session would have been much more beneficial if the visits were in person. This result is somewhat surprising because the discussions during these virtual visits appeared to the instructor to be significantly more active than they had been in any online class sessions that semester. In addition, online chat functions allowed students who are typically more reserved to participate.

Most of the reasons that students identified a particular GL visit to be interesting or beneficial did not relate to better understanding the course material; only 6 students made comments reflective of theme I. Instead, students found interest or benefit when the presenter was engaging, the topic was personally interesting, or the field of engineering discussed aligned with their career interests. The tallies shown in Table 3 indicate a slight preference for Guest Lecturer B; the analysis of the students' statements demonstrate that this was largely because this lecturer was very obviously excited about the topic and because this talk touched on entrepreneurship, which several students were interested in.

Table 4: Overview of questions and themes identified from student responses. Direct quotations from student responses are provided as an example and are italicized beneath each theme.

Question		Theme (number of students expressing the theme)
2	What were the benefits, if any, of these visits to your learning of Materials Science?	<p>A. This was beneficial because it helped me understand how engineers use materials science, or to understand how materials engineers interact with other aspects of engineering (12)  <i>“Identifying all of the fields that material science can correlate to really helped my understanding of how much this field in an integral part of engineering as a whole.”</i></p> <p>B. This was beneficial because it gave me a wider perspective on what I might enjoy for a career (17).  <i>“They gave me insight on what it’s like to work as an engineer in the real world.”</i></p>
3	What were the benefits, if any, of these visits to your future career?	
4	What do you think you missed out on, if anything, by having these visits virtually instead of having the visitor come to class in person?	<p>C. It is more difficult to pay attention to a virtual presentation. (4)</p> <p>D. Asking questions and having discussions was more difficult virtually and would have been more engaging in person. (12)</p> <p>E. Nothing significant was lost by making the visit virtual. (4)  <i>“In person is always better than in a video but video is much more accessible making it worth it if it's the only option.”</i></p>
5	Which visit was the most interesting to you personally, and why?	<p>F. The visit was interesting and beneficial if the presenter was engaging or excited, or less interesting if the presenter was less so. (7)  <i>“(Presenter B) was a captivating speaker, which helped me to focus.”</i></p> <p>G. The visit was interesting and beneficial if the presenter was discussing something I was already interested in, or less interesting if I had no prior interesting or knowledge of the topic (11).</p> <p>H. The visit was interesting and beneficial if I could envision myself having a similar career, and less so if I found the presenter’s career uninteresting (8).</p> <p>I. The visit was interesting and beneficial because it directly related to information about materials engineering that we learned in the course (6).  <i>“(The presentation on steel processing) was beneficial because it covered the material that we had spent the most time on in class.”</i></p>
6	Which visit was the least interesting to you personally, and why?	
7	Which visit was the most beneficial to you personally, and why?	

## Conclusions

This is the result of a pilot study with one class, and any conclusions are tentative. Based on the student feedback presented, the instructor intends to continue virtual Guest Lecturer visits in the same materials engineering course as well as other courses. Analysis of this trial clarifies some of the key benefits, which can be used to better prepare future visits. The reduction in face-to-face meetings during the COVID-19 pandemic has highlighted the value of in person teaching. Yet, the overwhelming positive reception of the GL visits by the students indicates that they find a lot of value in the practice even when it is online. Greater care will be taken to establish an effective method for interactions between students and GLs, which is the primary detriment to online meetings identified by students. Because being able to relate materials engineering to other engineering fields is a key learning objective for the course, this aspect of the presentations will be strengthened where possible.

The researchers expected some themes related to course content for this or other courses in questions 5 – 7, particularly question 6 where students were asked which visit was the most beneficial. It is possible that the use of “you personally” directed students to discuss their interests and future careers, aspects that are less transient than the expected responses of connections to recent courses. These results have been illuminating, though did not provide the types of responses expected or desired for exploring the more direct benefits of the GL visits on students’ undergraduate careers. Interviews of a subset of students in addition to the surveys is planned for future iterations to understand more about the personal and educational benefit of GL visits. It is difficult to determine the degree of bias introduced by having the instructor closely involved, and future qualitative analyses would benefit from having outside researchers conduct interviews. Future work may also include a larger quantitative study for GL visits implemented in a larger number of courses or at more than one institution including the development of a survey that can be used broadly by faculty who are interested in assessing GL visits in their courses. The results presented here will help inform these future investigations.

Perhaps the most important conclusion that can be drawn from this study is that relatively simple and short interactions with scientists and engineers within the context of a class can have profound benefits for the students. Virtual Guest Lecturer visits like those proposed are much easier now that all involved parties have been forced to learn to manage online meetings. Thus, it behooves instructors to facilitate these when possible. One of the most poignant responses from a student identified that doing so may help in ways that are both intangible and vital: “The visits gave me hope; they were like my lighthouse and showed me why I was doing all this school”.

## References

- [1] S. Chopra and K. M. Deranek, "Efficiently Teaching Engineering and Technology Students through Effective College-Industry Partnerships," *Journal of Engineering Technology*, vol. 35, (1), pp. 10-15, 2018. Available: <http://proxy.campbell.edu/login?url=https://www.proquest.com/scholarly-journals/efficiently-teaching-engineering-technology/docview/2237803599/se-2?accountid=9858>.



- [2] A. Carbone *et al*, "Connecting curricula content with career context: the value of engineering industry site visits to students, academics and industry," *European Journal of Engineering Education*, vol. 45, (6), pp. 971-984, 2020. Available: <http://proxy.campbell.edu/login?url=https://www.proquest.com/scholarly-journals/connecting-curricula-content-with-career-context/docview/2466210014/se-2?accountid=9858>. DOI: <http://dx.doi.org/10.1080/03043797.2020.1806787>.
- [3] D. Hampton and K. Carichner, "Bringing industry examples to the classroom: IE," *ISE ; Industrial and Systems Engineering at Work*, vol. 52, (4), pp. 44-47, 2020. Available: <http://proxy.campbell.edu/login?url=https://www.proquest.com/trade-journals/bringing-industry-examples-classroom/docview/2403309948/se-2?accountid=9858>.
- [4] M. Hoernicke, A. Horch and M. Bauer, "Industry contribution to control engineering education: An experience of teaching of undergraduate and postgraduate courses," *IFAC-PapersOnLine*, vol. 50, (2), pp. 133-138, 2017. Available: <https://www.sciencedirect.com/science/article/pii/S2405896317335607>. DOI: 10.1016/j.ifacol.2017.12.025.
- [5] American Society for Engineering Education, "Papers on Engineering Education Repository," *American Society for Engineering Education*, Online, Online.
- [6] J. C. Lynch, M. A. Butkus and M. C. Johnson, "Teaching Non-Engineers the Engineering Thought Process with Environmental Engineering as the Instrument," *Age*, vol. 10, pp. 1, 2005.
- [7] E. Tepper, *Guess Who's Coming to Lecture: Using "Virtual Guest Lecture" to Support the Role of the Classroom Professor*. Montreal, Quebec, Canada: McGill University, .
- [8] Y. Dong and J. El-Sayed, "A Methodology for Team Teaching a Course with Industrial Experts," 2009.
- [9] R. K. Yin, *Qualitative Research from Start to Finish*. 2011.