Report on the Fall 2019 STS 4500 course innovation
Exploring University-Community Partnership through Smart City Design:
A Local-Global Approach

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1.0 INTRODUCTION

"I see a university community that is a strong partner and good neighbor with our surrounding communities."

"I see a university even more global than it is today, one that offers every student a real opportunity to have at least one international experience before graduating."

"I see a community that understands the growing importance of engineering, computer science and data science, but one that also recognizes that the liberal arts are a vital part of this university, and that preparing students to be ethical citizen-leaders requires exposure to the enduring and profound questions encountered in the humanities, basic sciences and social sciences."

These three quotes were from President Jim Ryan's inaugural speech delivered on Oct 19, 2018. Who could find fault with these great visions? As two Engineering & Society (E&S) faculty who have shown leadership in bringing local and global community engagement into our research and classroom we are advocates of the vision. These statements do not, however, bring to light the complex intellectual and institutional challenges that might support reconsideration for how we bring new forms of knowledge and practice as individuals and partners. This is critical to determining how we situate our academic expertise and American viewpoints into a rapidly changing globe.

How do we prepare students and faculty to move beyond living in an academic environment that often avoids the messy, real-world full of diverse values, cultures, and hierarchies? Are we aware of our bias when interacting with people and communities from various racial, cultural and national backgrounds? How can we be sure that we are "solving the world's problems" without knowing if we are imposing our values onto others? We find it is essential to bring more curiosity and empathy in order to more fully develop an understanding about what "the world" is.

As the Engineering School works to reimagine its curriculum and role as active community partner, E&S's Science, Technology, and Society team can bring their unique strengths to contribute to addressing these challenges and bridge between the local and global understanding of engineering practices, cultures and ethics. This will require substantial investment in redesigning courses, developing faculty, and piloting these strategies in a rigorous fashion. The following documents one such experimental pilot in the Fall of 2019 that brought together community engagement training, hands-on outreach and research, experiences with Chinese engineering partners, and a co-teaching strategy. The course was a challenging one for the instructors and students. There was evidence of a desire for the students to seek out new ways of seeing the world, but also corresponding trepidation to take on challenges that are so very different than what they have been enculturated into. We conclude with recommendations based upon our assessment of the course and feedback from our students.

2.0 OUR APPROACH

"STS and Engineering Practice" (STS4500) is a required course for each UVA engineering major, which guides students in examining the societal and ethical issues involved in their capstone design projects and professional engineering practice. In order to structure the course around a shared knowledge space that was both complex and open to personal reflection on lived experience we focused on "Smart City". This theme links to a number of cross-cutting initiatives in the School of Engineering and brings with it concerns over privacy, gentrification, progress, and equity. The Smart City phenomenon requires research and educational demands for incorporating more social science perspectives into current engineering design. However, over the years we have seen increasing numbers of Smart City related capstone projects that solely focus on the technical aspects of sensors or system optimization without sufficient understanding of the "context" that makes the design adaptable and appropriate for diverse local and global contexts and communities.

In order to address these challenges, two STS instructors Sharon Ku and Sean Ferguson redesigned the STS 4500 into an interactive and borderless educational platform focused on instructor supported research and coursework that encourages meaningful application of our shared learning experiences. We co-taught four sections, with a total of 120 enrollments who experienced interdisciplinary learning and collaborations with different members of society from the area surrounding Charlottesville as well as our Global Classroom partners. With support from the Center for Teaching Excellence's Thrive grants, we were capable of bringing in multiple TAs for instructional support and an RA with ethnography experience to document student experiences with the course, emphasizing documentation of the global classroom experience. These grants also supported a long term financial commitment with SmartCville, a local non-profit advocating for more civic technology, local entrepreneurship, and empowerment of citizens use of data and technology to better their neighborhoods. The President of SmartCville, Lucas Ames, was an active supporter of the blueprint development and local engagement strategy.

To effectively structure this interdisciplinary and international curriculum, we divide this course into two tracks: 1) Global Community Engagement and 2) Local Community Engagement. Each track had its community engagement plan built up over the semester with early evidence gathering and then direct community outreach. Depending on their interests, students enrolled in either the local or the global track. Incorporating both tracks was an essential feature for developing a diversity of perspectives on value-sensitive, contextualized design and advantaging sustainable smart city research. Without this training, future engineers will be less capable of facing a world with growing tensions in techno-economic inequality and large scale social and environmental problems. Each track was responsible for learning about their community partners. The Global Track students were paired with engineering students attending Tsinghua Graduate School in order to develop more cross-cultural understanding about the values of design and divergent worldviews. Local Track students were tasked with seeking out community members from a variety of backgrounds that would provide insights into a "Smart Charlottesville" project. Each team was made up of members of both local and global tracks and given a set of shared questions to explore in their outreach efforts that would help broaden each team members understanding of the issues. For example, many locally adopted smart cities' infrastructures, such as E-Scooters, rely on technologies and labor from foreign countries. The students would become aware of how everything from design elements to integrated payment systems to local ordinances shape smart projects. They were led to question if there are universal designs that can solve local problems or must we be aware of divergent material and cultural needs? Tracking the flows of people, information, and artifacts encouraged developing the connections and consequence of how local choices impact global value chains, environmental justice, and individual rights.

Addressing these issues relies on not just technical or STS knowledge. Rather, we need to break down some of our classroom boundaries to enable students to work across disciplines and find opportunity to be productively disrupted in their way of thinking. Communicating with peoples from diverse social and cultural backgrounds during the earliest design phases reshaped a mentality away from fixing problems. We structured the experience so that the work, expertise and identity of students were not isolated, but rather connected to local and global communities. Offering such highly integrative and complex teaching and learning platforms required new partnerships, as well as innovative pedagogies to redefine and reconstruct the relationships between professor and students. This course contained the following elements: 1) Co-taught interdisciplinary lecture; 2) Contemplative exercise; 3) STS-informed design studio mentored by each instructor and TAs. Each is summarized in the next sections.

2.1 Interdisciplinary co-teaching with UNST 1400

Under guidance from the Vice Provost of University Outreach, Professor Louis Nelson, and the Chair of the Engineering and Society Department, Professor Bernie Carlson, an additional lecture period focusing on an Introduction to Community Engagement was added to the STS4500 course. The course integrated Community engagement concepts & theories with

practical guidance offered by guest speakers with working experience in community engagement or advocacy work. Students experienced the challenges of "doing good" when one doesn't listen or care effectively to those impacted by well intentioned, but often misguided, action. They also learned how the built environment, UVA's campus in particular, was built in such a way as to maintain systems of oppression. Learning theories and implemented strategies in community engagement built skills in how to learn with community members. Further, given the learning goals in STS4500, seeing how technological systems propagate power and norms over time is an essential insight as they turned to their Smart Charlottesville research.

2.2 Contemplative pedagogy

Facing the currently increasing economic frictions and political tensions, we believe a globally competent engineer or STS scholars needs more than just critical thinking. An ability to be aware of and process his/her own biases encourages more racial, religious, cultural and political diversity to be present in their thinking and action. Cultivating such awareness requires students to connect to their internal world as driven by cognitive, spiritual and emotional components. We found it necessary to develop resilience in the face of challenging circumstances and empowerment to develop their own agency when working with diverse stakeholders, dealing with different opinions, emotions and uncertainties. A series of contemplative activities including mindful reading, walking, listening and observation were linked to students overcoming the frustrations, insensitivities and emotional reactions when interacting with people from different social and cultural backgrounds. The results showed that students who devoted themselves in these exercises have developed more in-depth conversations and mutual understanding with Chinese partners, as well as created more engaging projects with local community members such as applying digital apps to document invisible communities' stories. The experiences were also notable for bringing new intentional practice in unpacking the relationships of people and our built environment.

2.3.0 STS-informed Community Engagement Design Studio

This course valued hands-on experiential learning through connecting students' research based designing with actual social, cultural, legal and ethical concerns. We dedicated Thursday class time for creating a smart city design studio, mentored by each instructor and TAs. Students formed into research teams of five—three from local track and two from the global track-- to work on a collective research project under the umbrella of "The Future of Smart Charlottesville". Each team selected their research focus based upon student submitted topics that related to smart cities and urban transformation, e.g. transportation, stormwater management, health or fair housing. The process of building a guidance "blueprint" that could be shared outside of the classroom was structured around a value-sensitive design process. Students would learn about the actually existing values and norms in the city through document analysis and interviews. Once documented, they constructed a vision statement that supported the values they deemed important.

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The vision statement would then guide the entire team to consider the rest of the research needs and how to begin the process of reimagining the technologies, policies, and use of a smart city intervention. Students would work to incorporate what they had uncovered from interacting with local community members, industrial stakeholders, government regulators, standard developers and international smart city researchers. Part way through the semester, each student was tasked with developing their own research question. The question would match with critical knowledge needed for the blueprint, but also acted as the thesis for the STS Prospectus development. Without this structuring, there would be no means of conducting both a team based community informed project and an individual research paper. The creation of a city blueprint helped students situate their engineering design in relevant social contexts where local regulation, cultural diversity, national competitiveness and international coordination intertwine with technical choices. Tuesday lectures were tailored to understanding relevant concepts and methods.

2.3.1 Global Engagement

We worked with Tsinghua Graduate School in Shenzhen to develop a global version of this design studio. Students from two sides were involved in smart cities design projects directed by their own local community engagement plans. Students first learned a set of STS frameworks and methods to unpack the politics and values underneath technical artefacts. Then they applied the STS knowledge to their capstone projects, interviewing residents, companies, as well as conducting participatory observation in town hall meetings to engage practitioners, policymakers and community representatives in the design process. The integrative approach has improved students' understating of local communities, while generating interesting design ideas ranging from digital story-telling Apps for community building, communication platform for smart lighting and city zoning, to the AI makerspace for public schools. Moreover, they were required to conduct mutual interviews and exchange design thinking to compare different design philosophies grounded in different socio-political contexts. The results have shown that students in the US and China have distinct socio-technical imaginations toward what smart cities should be. These comparative cases not only helped students understand cross-cultural innovation, but also provides the seeds of cultivating ongoing dialogues between the local and global communities regarding the risks, benefits and ethical consequences associated with the design and implementation of smart city devices.

2.3.2 Local Community Engagement
Input from students on community engagement, thesis writing, and differences between individual and team work suggests the importance of differentiating the learning goals and assignments. In order to facilitate a community engagement strategy that could also support individual student thesis development we constructed a hybrid plan. Students allocated themselves to a topic they found interesting, producing a team with a shared set of goals. Each team member would then produce a question that mirrored the structure of an STS research question. A constant challenge was to align the knowledge needed to understand the local and

global context of their topics and also produce a question that would lead into an STS Prospectus. Often, the students would determine that a set of information was critical for supporting development of the Smart Charlottesville Blueprints. These questions would then have little bearing on useful additions to the STS research. While this could have been negotiated more effectively one-on-one, doing this with 90+ students across several projects became an impossible task. Yet, the process lent itself to insights on the dispositions of the students to the Prospectus writing and community engagement efforts.

3.0 LEARNING RESULTS AND ASSESSMENTS

The following section contains a high level overview of the projects and activities students engaged in within the course.

3.1 Blueprints & Prospectus

Blueprints from UVA	18
Blueprints from Tsinghua	9
Prospectus' Developed	93

|	Number of Students*
UVa. Local Track	49
UVa. Global Track	44
Tsinghua	46

Note: one student from the global track partnered with two Chinese students. And another UVA student is in both local and global track, which has a global partner as well.

	Project Topic
UVa.	- Accessing the Charlottesville Community Economic Opportunities - An Optimized Space for Contemplation and Collaboration - App to reveal invisible city components - Collaborative Makerspaces with Charlottesville school system - Designing a new contemplative collaboration space

	● Fake News and Disinformation ● Food Donation ● Intelligent Waste Management ● Invisible Energy ● Learn through Play: AR Sandbox for Charlottesville Storm Water Communication ● Smart and Efficient Transportation ● Smart City Parking ● Smart Construction ● Smart Medicine: Emergency Medical Boxes ● Smart Security ● Smart Waste Planning for Charlottesville ● Soft Cities: Integrating Shared Spaces In Existing Infrastructure ● Telemedicine and smart health
Tsinghua	● Discovery City App ● Facial Recognition on Security ● Intelligent Ambulance System ● Smart Bin for Garbage Sorting ● Smart Cockpit of a Car ● Smart Parcel Sorting ● Smart Parking App ● Smart Street Lamp Project ● Urban Study Room

3.2 Community-University Workshop

On the final day of the semester, we hosted a community workshop at the city center in downtown mall to showcase the Blueprints and solicit information from any members of UVA and the city who attended. The space was given freely through partnerships with the city IT team who requested the use of the CitySpace conference rooms. We juxtaposed designs from UVA and Tsinghua to show different design ideas around similar topics. In total, we have 18 posters created by the UVA teams, 9 posters from Tsinghua teams. Community members were invited to provide feedback and comments. Ellen Blackmon from the UVA Outreach Offices, Lucas Ames of Smart Cville, and a communications team from the Engineering School were also present to document the event.
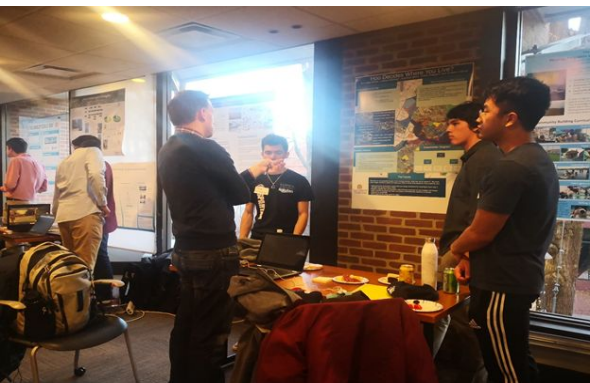
4.0 DISCUSSION & LESSON LEARNED

4.1 Linking team-based work and STS research projects

One of the primary innovations developed in the course was a blending of team based research and individual research. Both of which were intended to lead to a shared Smart Charlottesville Blueprint and naturally lead into producing an individually constructed STS Prospectus. We conducted a survey at the end of the course to determine student perceptions of this experiment. Each question in the survey corresponded to a learning goal: developing critical skills in sociotechnical understanding, practicing community engagement and integrative learning, and linking multiple domains of knowledge into a coherent narrative. There was an even split on whether understanding socio-technical questions are developed more effectively from team based research or individual Prospectus writing (see Table 1 below). They could make this distinction because there was a period of time where we set aside weeks focused only on the Prospectus development before returning to synthesizing material for the community based blueprints.

On the other hand, there was clear indication that team based work is better suited to community engagement actions (See Table 2 below). This ends up situating the goals of the course at cross purposes with the demands of the curriculum. On the one hand, students almost universally claimed that team driven community engagement was a necessity. From conversations with the local track students, they found it helpful to have support to seek out and work with community members. The process of conducting outreach and interviews was a terrifying experience for many of the students.

Table 1. Do you feel that a team based model of research and assessment or the individual STS research Prospectus is more aligned with incorporating community engagement?

Team	41
Individual	7

Table 2. Focusing on the Prospectus and Thesis: Do you feel as if you have learned about your topics and how to navigate socio-technical questions more through 1) the group research plus team interactions or 2) individual Prospectus work

Team work	25
Individual Prospectus	29

However, the considerable time to coordinate with the team, share their ideas together, and then reformulate their shared research projects made it very challenging to then turn to working on individual research tasks. The STS research project is already a challenge for most students. They haven't developed a research paper for years, sometimes don't know what peer-reviewed means, struggle with bridging from STS theories to application, and haven't practiced the many methods in social science necessary to construct a credible research plan. This is one reason that the STS research paper spans two semesters. We acknowledged well before the semester started that we were taking on an ambitious experiment. While the plan for integrating all the core course components make considerable sense on paper, the logic escaped the students. We were challenged by a disconcerting tendency among our engineering students to dissect team projects into individual responsibilities, and then have little need to engage with one another in an ongoing dialogue. Often, team members would ignore one another, even in the workshops, as they worked on their own slice of the overall blueprint. The intended integrative thinking we had hoped to achieve met a cohort of students enculturated to compartmentalize, segregate, and place hierarchies on different forms of knowledge.

The following are several quotes drawn from student submitted survey entries at the end of the STS4500 course. These quotes indicate both the strengths of the approach taken in the course as well as critique from multiple perspectives:

- *Team work makes sense given how the group research needed to encompass the efforts from multiple disciplines of engineering. I do think that justifies the importance of the group research.*
- *I think the group research helped to ground our individual research questions in a bigger picture.*
- *Definitely through the group research plus team interactions because everyone was able to bring in a new perspective of how others view our project and potential fix that could make our overall project better.*
- *We did gain some skills in navigating socio-technical questions through the group research but not in any way that could apply to the individual Prospectus work.*
- *The individual STS research prospectus doesn't fit well here. I would say a team based model of STS research doesn't work well.*
- In a class where everyone has different timelines for Capstones, different projects, and the fact that everyone has different passions the fact that we had to focus on smart cities and a single topic for an entire group took away my dedication for the individual STS prospectus.

Students were also led to feel concern for reaching out at all given that much of the education they received in the UNST course was critical of most attempts at engagement, that too often university led outreach has led to toxic relationships within Charlottesville, and even that act of

soliciting information from some neighborhoods might be seen as problematic. Many students expressed support for learning this material, but the end result was not empowered students interested in tackling the challenge. Due to our interest in opening up the boundaries of the classroom where students would seek out community input rather than having guests take on the burden of coming to the University, students and instructors struggled to develop sustainable community partnerships. It would be more advisable to either have a Professor build a stable relationship with a small handful of partners and then have students build around the needs of those partners. Any attempt at launching hundreds of engineering students into the city to "do engagement" would be ill advised and likely to undermine the vision of President Ryan and the goals of the University. The global classroom participants struggled less with this part of the course because they knew that they would have a partner given to them. They could focus on the process of understanding another person rather than overcome their fears of moving beyond the classroom setting.

With the above in mind, many teams were remarkably successful in negotiating the overlapping responsibilities. The individual STS questions developed as part of the blueprints were developed in such a way as to require a) sharing information among the team members and b) ensuring that their individual research was both socio- and technical- in nature. Where successful, the former practice yielded coherent blueprints and a depth of understanding unachievable with individual work. The latter synergy lended itself to any easy transition from blueprint work and STS research Prospectus development. As we had hoped, there were instances where their team and individual work were so well aligned that we had to promise them that they would not be self-plagiarizing by using material from the Blueprint in their STS Prospectus.

4.2 Contemplative pedagogy

Integrating contemplative practices into the classroom proved to be both inspiring, at times, and frustrating at other moments. When the contemplative practice was directly linked to some type of "output" there was considerable interest among the students to buy into the practice. One of the earliest responsibilities was for our students to go to two locations in downtown Charlottesville and document how the people and space related to one another. We encouraged them to use photos, videos, and text coupled to self-reflective questions and a poem evoking emotional response to the mundane in our surroundings. This "city sensing" turned into a productive first step to develop skills in knowing differently. We also came to realize how uncomfortable some students were in even attempting to leave grounds. Another in class activity required bringing in any object that carried meaning to the student. They were then walked through a process of writing about and drawing the object in order to help them explain where meaning is located in the interaction of individual and object. Due to the nature of the reflective exercise and emotional attachment to the objects, many were inspired to bring in their personal experiences to the classroom.

While these were helpful contemplative practices, other options did not consistently support meaningful learning. According to conversations with students and the survey data, daily meditations were either comforting or completely disregarded as necessary to the course. More than 50% of those surveyed indicated they did not find contemplation useful to "support greater awareness, openness to transformation, collaboration, curiosity, generosity to self and others, and reflection." This could be partially due to the expertise of the instructors. However, there was also a powerful reluctance among some students in the course to even attempt contemplation in its simplest forms.

4.3 The integration of Global and Local aspects in team-base project

The following subsections draw from direct quotations of students and our teaching assistant's experience leading the global classroom. They speak of how the process of working with those of different backgrounds can powerfully change one's worldview. In order to encourage discussion among team members who were in the local and global tracks we developed a shared set of question prompts. Each prompt was designed to encourage the students to seek out different opinions from community members on topics ranging from privacy to what might a smart city look like to who should govern data and IoT systems. They were then encouraged to share their insights during the Thursday workshops and development of the Blueprints. Several teams were capable of harnessing what they learned from the local and global, primarily those that were working on easy to comprehend similarities and differences in transportation, trust in government, and the more integrated smart city systems in China. Where students selected projects without clear linkages between local and global phenomenon, shared learning was absent. Projects on makerspaces, fake news, and smart parking struggled to find overlap between what they were learning from their local research and what they learned from the global classroom.

4.4. Feedback from Global-track Students (Direct quotes)'

"...His thoughts on the disadvantages of creative STEM education for lower socioeconomic levels was something I never considered and have been thinking about a lot since... He was nervous about his English but we were able to communicate pretty easily. He gave a lot of praise for American technology, more so than I thought he would. Overall I think I did a good job of leaving my bias out of the conversation...This definitely showed the key divide between the Chinese and American citizens understanding of privacy, data, and government. I think the most interesting thing Deng shared was that he wouldn't trust anyone but the government to handle his data. This deep trust of the central government is just so foreign to me as someone who harbors some healthy skepticism of our government..." --Conor Grubbs

"... At the beginning, I thought our answers will be similar since I am also a Chinese. However, the answers suggest a different result. I have left China for three years and some thoughts and understanding in my mind might have changed... Although we both mentioned about traffic in the future, we vision this part in different aspects... This interesting phenomenon caught my

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attention and also confused me. What defines my personality, my childhood experience and my hometown or my current circumstance and recent experience? ....” --Bowen Xiang

“...Overall good experience. Communication was difficult due to the language barrier. We both did not have too many assumptions about each other from what I could tell; I tried to go into our interview with a very open mindset. I was correct that Yiyun agreed with many of my points but surprised to actually hear how similar our answers were. For many questions we named some of the exact same point (1st interview)...I would say this was our most productive interview yet. We both learned about two different driving methods of smart city growth, and as a result of this symbiotic communication, I hope that both Yiyun and I can go out and apply some of the ideals we learned to help improve smart city growth within our own respective communities (2nd interview)…my assumptions were right in some ways, but usually did not encapsulate the entire truth of how smart city growth works in China. This is due to my lack of knowledge regarding specific Chinese government economic plans (3rd interview)...This was probably the most Yiyun and I have disagreed during our smart city conversations.(4th interview) ...My assumptions were actually mostly correct this time. I believe this is because I have started to build a strong relationship with Yiyun. I understand her thought process when it comes to the ideas of smart cities, and I believe this is why today’s interview had a lot of agreement….(5th interview)” -- Michael O'Hanlon

4.5 Feedback from TA (Global track)

Global classroom is an innovative and inspiring means that gives students opportunities to reach out to individuals in real life on the other side of the globe. By jumping out of the traditional form of learning global contexts through text, literature or social media, students get a chance to talk to students of their ages from top elite schools in China in a real-time face-to-face manner.

Such experience of communicating with real people from a very different country indeed induces various outcomes. Emotional discomfort like frustration, confusion arise during different conversations related to topics such as political regulations on technology, perception of public safety and personal privacy. Students explore this on-going process for a whole semester, trying to understand how sociotechnical system differs in different contexts by talking with individuals who actually live in a different societal, economic, political and cultural environment. This kind of experience is out of the scope of traditional lecturing in class, listening to instructors talking through concepts and materials, but create a dynamic learning process for students to take the initiative of inquiry on the complex relationship between technology and society by concretizing their knowledge and understanding through communication with real people.

However, communication with people from the other side is never easy. As a matter a fact, students have been going through substantial difficulties like language barrier, time difference, knowledge gap, communication tool (since most of the social media like google, facebook, twitter can not be used in China, students from UVa. has to use WeChat, a social media from China to communicate with their Chinese partners) etc. At the very early stage, many negative

feelings would happen that consequently arise resistance or withdrawal to communicate. But after a few rounds of continuous talk and discussion, they become more familiar with each other and can better speculate and understand their partners' opinions and standing given their personal experience and background. Therefore, more intimate personal relationships are established between them, and enable them to get more extensive and deeper conversations about each other's lives, where technical and social conditions are closely embedded everywhere. It is a very unique way to let students get real-life contact with individuals that they seldom have the chance to reach out to, and expose themselves in unknown global contexts that they used to know from paper or the Internet.

By my observation, students especially from engineering school have achieved a lot from global classrooms with more open minds. They will realize by person how communication matters. Engineering practice is not just about calculation, modeling or other scientific techniques, but the perspective, identity and vision. Especially if you want to get involved in more international projects or programs in your engineering career, you cannot take solutions as universal. There are people living all around the world with different perspectives and experiences. If you want to make a difference, you have to first recognize the difference. Good or bad, right or wrong, they are never binary values. You can not give them a clear cut and make a call, claiming that it is eternal truth. The boundary is never clear, and more so dynamic. It can be shifted, blurred or erased. The key lesson learned from global classroom is that we are different, while we are also similar. We might be heading in the same direction but with different implementations. Reflect before judging. And never give up communication. It is a path of endless reinforcement learning.

5.0 CONCLUSION

Our teaching experiment indicates that to realize the "Great and Good" University, there is still a long way to go. Such a noble goal is hard to be achieved by existing curriculum design, conventional pedagogies and temporarily short-term investment. Instead, it requires faculty and students willing to be innovative to challenge the classroom boundary, creating an open and interactive learning environment to engage local and global communities. Institutional investment to support and sustain the faculty/students development, interdisciplinary and cross-school collaboration, and community/international partnership are the key components to sustain such a program.

With the engineering school rethinking core curriculum elements and seeks a new leadership role in the new outreach oriented mission, this experimental pedagogy comes at a useful time to inform the discussion. On the one hand, developing the syllabus and associated learning management platforms as co-instructors was incredibly helpful. Each brought different perspectives on how best to integrate the components of the course, develop effective assessments, and note instances of possible ambiguity. However, the process of co-teaching, as we understand it, requires significant allocations of time and emotional investment to build all the necessary strategy and infrastructures for the course, not to mention maintaining the course as it progressed. Both instructors submitted applications to the week long Center for Teaching

Excellence summer syllabus workshop. The expertise of those who have been trained to teach effectively encouraged deeper consideration for each aspect of the teaching plan. We learned a great deal in how to teach more effectively and learning who we were as instructors. However, beyond the considerable time it took to develop the syllabus, every lesson needed to be vetted, every communication cross-checked, roles needed to be delineated constantly, students didn't know who to speak to, and any minor deviation from any short or long term plan required a negotiation. Any future co-teaching would require significant training and trust building among the participating faculty.

Second, as the entire university considers new opportunities to be better neighbors and globally engaged scholars, we must note opportunities and challenges of this promise. These are not easy commitments to achieve. They demand rigorous experimentation informed by best practices in teaching and research excellence. It is not enough to simply have a lesson on global engineering ethics or a reading on community engagement. The classroom experience indicated that the practice of working with global and local partners can be a significant learning experience, but also one that comes fraught with fear and responsibility. Many students noted that they appreciate the idea of engagement, but that they need to have more significant scaffolding to feel confident in the engagement. With considerable time and emotional investment required to conduct any engagement activity the timing of the course experiment in the fourth year created constant tension. Even where students were excited about the experience, they were also conflicted by the responsibilities of their technical capstones and the constant presence of the job hunt. In addition, despite significant attention to how the early teamwork would build into the STS research, students felt panicked over the Prospectus. Several noted that the STS research should be the only focus of STS4500. We acknowledge that it is likely impossible to integrate training in community engagement and social science research methods in one semester.

There are several alternatives that might overcome the challenges presented. There is the possibility for reconsidering the thesis as starting in the 2000 and 3000 level courses as an "ethics in action" document. This could emerge as an individual or team based assignment targeting more applied training in the values that propagate between people and socio-techincal systems. Some of the courses could integrate community engagement strategies, with partners coming into the classroom or students and faculty developing sustainable relationships with external groups. The latter comment on sustainability became an ongoing conversation with SmartCville and repeatedly came into discussion in the UNST Introduction to Community Engagement Course. To facilitate mutually beneficial engagement, the school must support long term projects that might span years of development. The temporality of community engagement is often ignored, with funding cycles too short and unstable that might support UVA's mission to be a better partner locally and globally.

As a start, we need more substantial visions of what are the learning goals and commitments to those goals. Whether it be developing more cross-cultural engineering ethics training or more applied engagement experiences we will collectively need to develop practical guidance for how

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to achieve these commitments. Practical guidance will need to include curriculum innovations that come from holistically evaluating student education over time. This will likely require training and more substantive communication between instructors so that the learning outcomes from one course lead into another STS course. Finally, the experience in this course indicates several challenges in the institutional culture, student mindsets, and rewarding systems that stymie the out of the box thinking and risk taking we claim are important in training future engineering leaders.

6.0 APPENDIX

The following contains qualitative and quantitative analysis from a survey delivered at the end of the course. Not every student answer complied with the intent of the question or students skipped some questions entirely. Any off topic statements were excluded and the resulting statements were coded for themes. The results are listed in the Tables. In order to capture some of the nuance of student opinion, anonymized quotes were pulled from the survey and listed according to theme.

6.1 Statistical Evaluation of Survey

1. Learning through team work or individual Prospectus: Focusing on the Prospectus and Thesis: Do you feel as if you have learned about your topics and how to navigate sociotechnical questions more through 1) the group research plus team interactions or 2) individual Prospectus work

Team work	25 (46%)
Individual Prospectus	29 (54%)

2. Community engagement as a team or individual: Do you feel that a team based model of research and assessment or the individual STS research Prospectus is more aligned with incorporating community engagement?

Team	41 (85%)
Individual	7 (15%)

3. Methods to obtain info: When you were confused about an assignment, the Prospectus, or other elements of the class what were your primary resources to find answers or clarification (suggestions: TA, Instructor, in-class peers, friend in another STS4500, or no one)?

Instructors	28 (27%)
TA	12 (11%)
Collab	4 (4%)
Piazza (mostly for questions to TA and Instructor)	12 (12%)

Peers in the team or class	33 (32%)
Friends in other STS class	14 (13%)
Online resources	1 (1%)

4. Contemplation: Contemplation: We had several assignments, practices, and conversations about contemplation in the classroom. The intent was to support greater awareness, openness to transformation, collaboration, curiosity, generosity to self and others, and reflection. Did the integration of contemplative practice in the course support any change in these skills or dispositions?

Working	32 (46%)
Not working	38 (54%)

6.2.0 Excerpts

6.2.1 Strengths

On community engagement:

I have learned more about how to navigate sociotechnical questions more due the community engagement class

Team work makes sense given how the group research needed to encompass the efforts from multiple disciplines of engineering. I do think that justifies the importance of the group research.

I think this research did show working from the bottom up to define the problem and research question from a community standpoint is effective.

Voices heard from real community members are always more convincing than data taken from the Internet, and exchanging ideas and debating about technology especially from China was more challenging and bonded our team together better.

Our research and classes with the UNST section made me aware and realize how to look at situations from a different perspective

I think the group research helped to ground our individual research questions in a bigger picture.

On team based model:

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Definitely through the group research plus team interactions because everyone was able to bring in a new perspective of how others view our project and potential fix that could make our overall project better.

When doing research pre-empting the Prospectus, the opportunity to read some works and get new information was really interesting.

The group research gave me the opportunity to explore public transportation at a high level, and also aided in my decision to choose my topic for the research prospectus.

6.2.2 Weakness

On team based model:

There were a lot of times that I felt as though I was the only one contributing a lot of the time.

I don't feel like anyone else ever exhibited any significant level of leadership during the project

Sometimes I felt like as if I was alone on the project

My particular question was not as closely knit to our project as some of the other topics

I do believe so but since my research question does not have much in common with my peers', I feel like I get more out of my individual works.

The individual STS research prospectus doesn't fit well in here. I would say a team based model of STS research doesn't work well.

Group work is a little harder to efficiently grade and mangae.

In a class where everyone has different timelines for Capstones, different projects, and the fact that everyone has different passions the fact that we had to focus on smart cities and a single topic for an entire group took away my dedication for the individual STS prospectus.

The larger the teams get, the more difficult it becomes to perform simple tasks.

On effective instruction:

I think I could have used more direction on the thesis itself because I was often unsure of what I was doing

Sometimes our team felt lost on the next steps of the project.

The introduction to the group project at the beginning of the semester was very ambiguous.

On the structure of the class:

> We did gain some skills in navigating socio-technical questions through the group research but not in any way that could apply to the individual Prospectus work.
>
> I am still lacking in combining the two into a navigating a sociotechnical question
>
> The prospectus was very confusing and forced.
>
> I think I learned a lot about group research but almost nothing about individual prospectus work.
>
> I was not expecting to have to incorporate community engagement into my thesis/prospectus. Would be nice to know these details in the syllabus.
>
> Another critical mistake of this semester was the timeframe of prospectus writing.
>
> The research and literature portion suffered because of the time it took to incorporate engagement.
>
> The Tsinghua component was very underdeveloped and is not well connected to the rest of the course.
>
> Also we are kinda combining global track and local track through brutal force.

On the content of teaching:

> I feel we could have dived a little more into frameworks as I was a little lost when choosing one, and the slides left a lot to be desired.
>
> But was very confused at the way these topics were presented. I wish we were given more examples since we were only given vaguely outlined requirements for how the project and prospectus should be done.
>
> I do not believe the prospectus was well thought out. I do not think the professors spent enough time going over the point of a prospectus and what it should really look like (good examples etc.). The process felt rushed, and often times professors gave me completely opposite advice to follow.
>
> I just had a hard time relating the prospectus to the community work we were doing, simply because of the nature of the assignment.
>
> We were not taught how to engage with the community, limiting our results.

On community engagement:

> Not every prospectus should have a focus on community engagement and the class forced us to do so.
>
> This class (STS 4500) should not have a team component

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Individual would force everyone to be engaged with the community, as opposed to having a few members do the bulk of the interaction

I think that group projects and community engagement are pretty mutually exclusive, unless members of the community are a big part of the group project

There was very little actual community engagement.

Community engagement should be a more natural endeavor, not a forced group activity.

I think we didn't have enough actual community interaction, nor did we even have the opportunity to explore ways of reaching out.

I feel as if everyone on the local track with a few exceptions were lost. For one thing the questions on the prompts were not aligned with the group's topic and it felt like asking random questions out of the blue.

6.2.3 Suggestions for Improvement

On team based model:

The prospectus itself could be a bit more linked between teammates. I think ideally they should all focus on different aspects of the collective group project.

The team should discuss their personal research questions and how they cover the scope of the project as a whole more carefully.

More individualized products within a group context. Not be so vague with team member roles.

Larger teams

A larger team would be resourceful

On effective instruction:

Overall, I feel like the instructures should have been much clearer in all of the assignments.

Making the expectations very clear early on, maybe providing a pathway to reach out with the community

Goals could be more clear at the start

I think expectations needs to be more clear

It would've been great if there was an example to refer to rather than a simple template.

Deadlines and commitments for community engagement assignments should be more strict

A better and planned out schedule. Better assignment due dates and expectations.

For our project, Professor Ku gives us her ideas and almost makes us feel as if our ideas are wrong

On the structure of the class:

More focus on the prospectus

Prospectus separated from the group project

Redesign the process to find a project topic

More flexibility in terms of allowing students to choose topics for their prospectus

Maybe choosing the topic by oneself and then researching on our own.

The prospectus should have been presented at the start of the class. The research project then can help further the end product, rather than distract from it.

Interview for Prospectus research only

A standalone course, not associated with the prospectus at all

Lower-level class discussing the ways we get feedback from a community

Make it an STS 2500 class

Make this a 2500 class

Community engagement in an earlier class

Have everyone focus primarily locally and secondarily globally

Incorporate the prospectus more with the community outreach

On the content of teaching:

Introduce methods helping student locate a research topic

More organization and learning more about the research project in class so that we are more aware of how the two integrate from the beginning of the class.

Information could be given on the part of developing more community awareness and maybe have some class time to discuss what we have gathered from the field.

Potentially some structure in how you would interact with the community.

Perhaps leave community engagement as an optional supplement to the class as opposed to mandating it.

I feel that the prompts could be better integrated in a way that it aligns more with the specific groups project.

Project was perhaps a bit too open ended

More speakers come in to class to give their perspectives

Small discussion sections with expert guest speakers

I just want a standardized STS 4500/4600 track.

On community engagement:

More interacting with the community about matters that aren't necessarily related to our group project.

Get resources that actually pertain closer to the community, rather than big businesses and power in positions

Surveys to more local Charlottesville residents

A list of more "typical" Cville residents that we knew were open to interacting with students would have been useful.

Interviews with local citizens

Consistent and time intensive meetings with community members

More interviews

Physical meetings with the local community members

Partner with members of the community so that they are actively involved with our projects

Person to person interactions (such as volunteering)

A speed date with the community members

Have some sort of community problem solicitation event

Prompt topics were a bit limited

Having to answer the prompt questions was a bit silly and unnecessary