A Research and Educational Perspective from a Teaching University

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Abstract.

We all know the benefits and impact of research and teaching in our society. Throughout my experience in academia, I have found that the common denominator between research and teaching is learning. Furthermore, learning is a requirement for research and teaching to occur as there is no single way to approach it. Learning in computer networks and distributed systems, is best approached by using a wide range of methods and techniques. Thus, it is well accepted that a diverse set of experiences for the students generally produces the best learning outcomes and many approaches have been developed over the last ten years. We argue that GENI as an experimentation facility, can be used to change the way students are learning about networks and distributed system, hence enhance the skill set students are required to do research. Our efforts seek to use GENI as an experimental platform to showcase networking and distributed system basic concepts. We discuss below the preliminary ideas of our work in progress design of a flipped computer network class that engages students through collaborative practical hands-on projects (i.e., practical exercises).

1. Introduction

Throughout my experience in academia there has been an educational divide between "researched-oriented" and "teaching-oriented" institutions. Although these institution have different goals and different student populations they both promote the acquisition and creation of knowledge. The creation of knowledge can not be achieve without learning, thus a common denominator between "researched-oriented" and "teaching-oriented" universities is learning. Learning about computer networks and distributed system requires learning a depth and breath of concepts that rarely can fit in a one semester course. We argue that GENI (i.e., as an experimental facility) with well known practices such as Peer Lead Team Learning(PLTL) and collaboration; can show students a depth and breath of concepts normally not at their grasp. Although, there are

many existing challenges in using GENI as an experimental facility for learning, we think experimentation with GENI enhances student learning and research skills. GENI would then be used to integrate research and teaching into the curriculum and research practices. We present in the next section we give the preliminary ideas of a flipped computer network class that engages students through collaborative practical hands-on projects (i.e., practical exercises). Additionally, we supplement the classroom experience with a learning activities outside the traditional classroom to provide better training and expand opportunities for students to participate in authentic scientific or professional activities.

2. Learning using GENI

Northeastern Illinois Univeristy (NEIU) goal is providing students access to quality education while respecting the diversity exhibited by our student population. NEIU can be classified as a "teaching-oriented" university as many other institutions. Thus, learning is the fundamental process that drives the revenue/budget of these type of institutions. Thus, finding a model for learning is of significance but can be a challenge. Each institution usually has financial constraints that limit the maintenance and acquisition of infrastructure. We think GENI can provide these institution with the cyberinfrastructure to discover new learning models while enhancing student learning and research skills. Thus, we briefly discuss three questions regarding the impact and future planning of GENI. Also, describe the preliminary ideas of our work in progress encompassing the design of a experiential flipped computer network class.

2.1. Future Planning in GENI

1. What GENI capabilities are most important?

   The GENI capabilities that I have found most important is the experimental aspect of GENI and user friendliness when compared to other testbeds. It is of great value to my classes and graduate projects to reserve resources across the country using existing GENI tools. Students can define an experiment and actually run real test to prove an idea or concept. For example, a graduate student is using GENI. She will study the performance of a Web Conference Tool use for distance learning. Also, I have participated in numerous GENI conferences and workshop that build my capacity as en educator and researcher.

2. What activities should GENI continue, expand, or wind down?

   The activities that I would continue is have an annual GENI conference as a venue for GENI experimenters to publish their work and expand on the idea of building regional GENI communities of practice. This can be achieve by regional workshops, GENI student chapters, GENI student competitions, and other mechanism that bring together regional or local GENI users, operators, developers, researchers, educators, and stakeholders.

3. How should GENI be governed and sustained?

   GENI should be driven by research but governed in such a way that allows each stakeholder to be accountable for their resources while having limited liability. For example, *swiss verein,* where accountability is limited to each GENI site and control over GENI is decentralized. This type of structure is used by law firm mergers in different countries. Since, my students and I have obtained direct benefit from using GENI without any cost. I would argue that GENI should remain free for educational and research purposes. GENI could be sustained if technology brokers would be in charge of finding technology transfer opportunities that bring revenue and are distributed among GENI sites.

3. Work in Progress

We describe below the preliminary ideas of our preliminary ideas of a design of a flipped computer network class that engages students through collaborative practical hands-on projects. The topic we will be using the GENI testbed for is Network Security.

1) Concept: “Network Security” is a variable, not an absolute, so it’s not embedded in systems security It is achieved through an understanding of user privacy, regulatory compliance and business sustainability, and thereby relies on shared expectations to make management decisions on its structure and communication.

2) Course Model: The teaching model of the course we propose takes the ideas behind of flipped classroom, project based learning, and inquiry-based learning to engage and activate the learning process in the classroom. These ideas support experiential learning as student learn by doing and then reflect on what they have learned. It allows students to not only learned the required

practices in network security but also form the bigger picture that encompasses network security. The traditional lecture model of lectures does not work for all students, as they may not have the maturity, commitment, background, and independence that lectures may demand. This is especially true for minority and non-traditional students. Ideally, we would like students to see patterns that connect network attacks and defenses with the broader/social context as well as the real world.

3) Why are we teaching the course this way and not normal lectures? The learning process of traditional teaching models usually occurs outside of the classroom when students are doing homework. Further more it focuses on conveying content and not experience. Our teaching model differs from the traditional as students gain experience in the classroom that allows them to activate the process of learning and discovering solutions or in our case hacking. From a broader perspective we wish to student to learn problem solving using inductive, deductive or abductive reasoning ("guessing") or any combination of theses. This approach diverges from traditional teaching because difficulties and conflict are encouraged. Students are encouraged to fail and they are incentives to show experimental failure where other students can learn from. Failing is an important part of learning. We think failing is a required step that allow student to see patterns that connect the technology with the broader/social context.

4) Model Structure: The course would be divided into four experimental projects with each having a duration of four weeks. We estimate the duration of the project introduction during the first week is 75 minutes while the student will spend six hours or more hours weekly doing the project or in meetings with other students.