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EXPLORING BEST PRACTICES TO OBTAIN USEFUL STUDENT FEEDBACK: CREATING AN ASSESSMENT TOOL FOR THE INSURE COURSE AT CSUSB

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A Project

Presented to the

Faculty of

California State University,

San Bernardino

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science

in

Information Systems and Technology

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ABSTRACT

This culminating experience project examines the current method used to investigate the effectiveness of the Seminar in Information Systems and Technology INSuRE project course (IST 5930) at CSUSB from the student perspective. Currently, the Student Opinions of Teaching Effectiveness (SOTE) survey is the standard practice for gathering a student's perspective on a course. The SOTE is brief and focuses on the feedback of the students on the instructor themselves and how they administered the course. The SOTE is a generalized tool and may not capture specific details about the many learning goals and objectives for a course that uses high-impact practices. The Information Security Research and Education (INSuRE) project at CSUSB employs high-impact practices that utilize elements of project-based learning to carry out research of current problems facing Federal cybersecurity agencies and national laboratories.

This project examined assessment survey questions created based on the Student Assessment of their Learning Gains (SALG) instrument which was created to measure programs funded by the National Science Foundation (NSF). The NSF is the same organization responsible for the initial funding of the INSuRE project. Different delivery methods were explored as to when to administer the assessment tool for optimal results of the student perspective. Research concluded that a longer assessment tool can be used to highlight

precise outcomes of the INSuRE class, to emphasize how this learning approach

has a significant impact on student learning.

ACKNOWLEDGEMENTS

This research paper is made possible by those who have supported me throughout my journey into the cybersecurity world. Despite not always seeing my own potential, those of you who pushed me to make it past the finish line are the people that I am most in debt to. As someone who gained a lot more than they ever thought possible through this program, I am thankful to all you.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE:

INTRODUCTION

Purpose of Study

The California State University of San Bernardino (CSUSB) cybersecurity

program is a significant contributor to developing talented individuals who are

ready to combat the growing cybersecurity threats of the nation and the world. As

seen in figure 1.1, it is estimated that there are over 500,000 cybersecurity job

openings in the United States, 37,000 of which are for the public sector

(Cyberseek, 2021).

Figure 1.1: United States Cybersecurity Job Availability as of April 2021
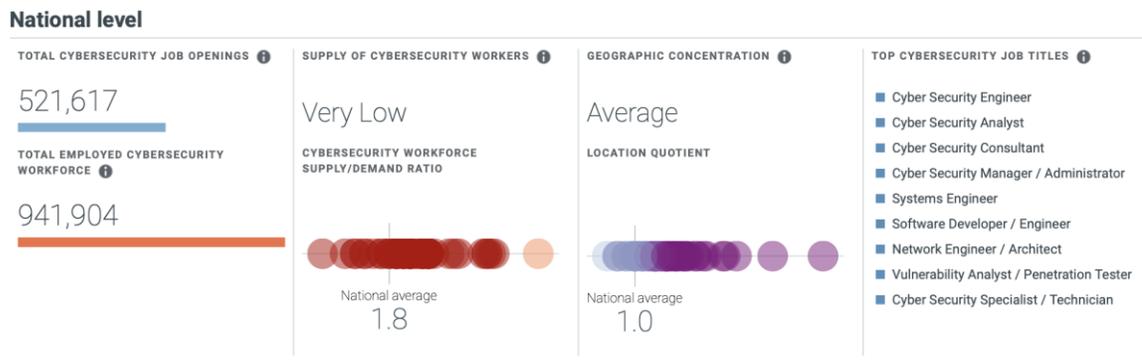
CSUSB, through its Department of Information and Decision Sciences,

has concentrations devoted to the multiple facets of cybersecurity to help fill the

demand. While the majority of the classes within the cybersecurity concentration

follow the traditional education route consisting of structured lesson plans,

repeatable projects, and standardized testing, CSUSB also offers a unique project-based course, specifically, the Information Security Research and Education (INSuRE) project research High-Impact Course.

The Seminar in Information Systems and Technology INSuRE course at CSUSB follows a loose structure instead of a predictable one, with clear expectations detailed by a syllabus. Students are expected to carry out research projects dealing with current problems that can be different from term-to-term led by different Technical Directors from government agencies and national laboratories who act as mentors. These mentors come from leading national laboratories and agencies in cybersecurity research and defense including but not limited to Lawerence Livermore National Lab, MITRE, Pacific Northwest National Lab, Sandia National Lab, and the National Security Agency. A CSUSB faculty member is there to help oversee the students' work, interactions with their Technical Director, guide and support their research, evaluate students' presentations and reports, and grade their overall effort (CAE in Cybersecurity Community, 2020). Towards the end of the course, students can offer feedback to the faculty member in the same way they would for their other courses by filling out a CSUSB specific form, the Student Opinion of Teaching Effectiveness (SOTE) form.

CSUSB has many forms of assessment that are in place to make sure there are continuous improvements to the academic process. CSUSB, specifically the Jack H. Brown College where the INSuRE course takes place,

utilizes the Assurance of Learning process (AoL) empowers faculty to drive academic decisions instead of administration staff leaving more room for stakeholders and potential champions (CSUSB, 2021). The AoL process has allowed for the creation of well-defined goals, collecting data that is analyzed and compared to those goals, and creating program improvements from this information. Assessments are performed annually with form input faculty, students, and others who have something at stake during strategic planning meetings to make sure all voices are heard. Part of the process to ensure learning is taking place is by utilizing the SOTE which allows the voice of the students to be heard clearly on their thoughts of how the program is functioning from their perspective.

The importance of the SOTE is to offer valuable, anonymous feedback to the instructor as to their teaching effectiveness from the students perspective so adjustments can be made for future students. The students are the customer in this educational transaction so it is important that they have an outlet that the decision-makers can review and take into account for future developments. With the INSuRE course being different from most of the curriculum the students will experience, the standard SOTE may not be sufficient. Through examining best practices in research course evaluations, this project examines specific approaches to expanding the course assessment for the high-impact course, INSuRE, to better attain a student perspective on how well it delivers on its promises.

The purpose of this research is to look at other course assessment tools that have been used in research courses to build an assessment tool in the form of a survey that can be sent to students for their feedback. As the Seminar in Information Systems and Technology course offers more than the educational benefits of the subject they are investigating, it will be important that the tool assess the communication, teamwork, and potential career benefits of the course.

The questions that this project will answer are:

1. What other assessment tools are available that examine student perspectives on research programs?
2. How are the other assessment tools different from the SOTE which is used by CSUSB to gather students' perceptions?
3. What applications would a new assessment tool be useful for?

Organization

This project is organized as follows: Chapter 2 will provide the background of the topic the assessment tool is to cover which is project-based learning, specifically the INSuRE project. Chapter 3 will cover the methodology needed to create the assessment. Chapter 4 will analyze the various tools that I was able to discover that have been used to produce meaningful data. Chapter 5 will evaluate and recommend the best questions for the new survey tool with the reasoning for each section. Finally, chapter 6 will provide a conclusion and go

over the next steps for the survey and the different domains it can be used

effectively.

CHAPTER TWO:

BACKGROUND

How High-Impact Educational Practices Benefit Cybersecurity Education

The cybersecurity world is ever-changing and it is important for those that will be entering it to be as prepared for it as possible. Information printed in a textbook has a high risk of becoming quickly outdated as new vulnerabilities, techniques, and technologies are developed and deployed. The cybersecurity industry is in need of fresh talent that can fill their vacancies now as the number of threats is growing but traditional hiring tactics are not doing an adequate enough job to keep up with demand (Sayegh, 2020). While fundamental knowledge of how a system works serves as a good starting point it is not sufficient. Courses that use high-impact practices such as INSuRE have the ability to equip students with the various skills they will need to have outside of the technical know-how, including investigating current real-world problems and developing their self-efficacy (Kinzie, 2012). The strong benefits of intertwining project-based learning practices and research classes into a high-impact course like INSuRE come into play when helping students develop these other valuable skills.

Project-Based Learning Benefits

An option to prepare students with the skills they will need upon graduation is by offering high-impact educational practices. After students learn about the different elements that cybersecurity consists of, the fundamentals

6

about the technical aspects of it, and study on ways to apply this knowledge, the next step is to demonstrate what they have learned. Once the groundwork is laid, project-based learning education has shown benefits for student engagement and success (Wurdinger et al., 2007).

One of the benefits that has been discovered by implementing project-based learning is an increase in student engagement. A 2013 study observed teachers were fighting for attention when given non-project-based learning plans, which meant they had to fight for the student's attention first before educating them on the topic. By instead crafting a project that students found interesting, their interest was held by the topic leading to self-motivated learning (Johnson & Delawsky, 2013).

While the 2013 study was performed in an 11th-grade environment, secondary education has seen benefits of its own. Although students may be pursuing different majors, there will be core classes that will have students with different educational focuses working on the same coursework. Creating a project-based curriculum that incorporates students from multiple disciplines will lead to the unexpected development of professional and academic abilities (Stokes & Harmer, 2018). When project-based learning group tasks were introduced to undergraduate students, improvements in leadership, as well as oral and written communication, were noted. As the world changes and evolves, it is important to understand that the style of teaching will need to be updated to

keep the attention of each generation and meet their needs that non-project-based learning methods may not adequately accomplish (Cramer, 2007).

Benefits of Research Courses

A seemingly natural fit for a project-based curriculum would be to utilize its style in research-based courses. One of the downsides of project-based learning is focused on instructors creating the projects for students to keep their attention and engagement (Johnson & Delawsky, 2013). A way to mitigate this concern is to have the students decide what they would like to perform research on with approval from the instructor. By offering project-based learning research courses in science, technology, engineering, and mathematics (STEM), students will be able to work on projects they have a vested interest in while also developing the soft skills their degrees do not typically focus on but will need (Carter et al., 2016).

By having students develop their communication and leadership skills while also working on their STEM degrees, they are gaining skills that will assist them in their research careers. Research courses have the potential to make positive impacts on students who may be underestimating their abilities which is a result of them never having an opportunity to explore their potential. Offering research courses to students in underprivileged communities will give them an opportunity to perform to a level they have only been told they could achieve, resulting in a higher earning potential for their future career than previously attainable (Carpi et al., 2017). The students who participate in research classes

that do not pursue a STEM path have also discovered value in them by helping to define a career path they were unsure of prior to the course (Yaffe et al., 2014). CSUSB is an institution located in a community that serves a diverse population that can help its community by offering these types of courses that will help propel its students into higher income brackets (CSUSB, 2020; U.S. Census Bureau, 2019). By having research-based courses such as the INSuRE course at CSUSB, the potential to help elevate the community it serves has risen.

The INSuRE Project

CSUSB is designated as a Center of Academic Excellence in Cyber Defense Research (CAE-CD) by the National Security Agency (NSA) meaning they are to produce cybersecurity focused, research capable students who can overcome cybersecurity challenges when faced with them(National Security Agency, n.d.; National Security Agency Central Security Service, n.d.). As a result of the CAE-CD designation, CSUSB is one of the institutions that is allowed to participate in the Information Security Research and Education (INSuRE) project, which is funded by the NSA. This allows students to work on real-life cybersecurity problems presented to them by cybersecurity-focused agencies, national laboratories, private organizations, and the NSA. These agencies, laboratories, and organizations all lend Technical Directors that guide the students through the process (Sherman et al., 2017). The project has grown considerably since its creation in 2012, made possible by the National Science Foundation (NSF) who awarded a grant to foster the development of

cybersecurity research skills in underrepresented populations (National Science Foundation, 2016). The program launched in 2012 at Purdue University with only two Technical Directors but funding provided by the NSF helped grow the program to 12 universities and 11 Technical Directors during the 2016 instance. In 2017, once the NSA began to fund the program, it helped to nearly double the number of institutions participating (CAE in Cybersecurity Community, 2020; Sherman et al., 2017). Through the continued funding from the NSA, the program will continue its efforts. Currently, it has executed over 100 problems, with over 800 students, and 16 partners composed of Federal Agencies and National Laboratories (CAE in Cybersecurity Community, 2020; The National Security Agency Central Security Service, n.d.).

The INSuRE course brings together the benefits of project-based learning and research courses by having students work on current issues instead of theoretical ones that are solved every term. They are given a chance to choose their research topic, supplied by the technical director of the project, engaging the learner which eliminates an opportunity for the professor who no longer has to worry about thinking about new research topics. All research projects for students participating in the INSuRE course are also group based meaning they will be developing those interdisciplinary skills mentioned in the above section. By offering alternatives as to how cybersecurity education is offered and creating well-rounded students that work directly with these cybersecurity organizations,

the INSuRE project will help to fill the deficit of a skilled cyber workforce (Sample et al., 2020).

INSuRE functions through various partnerships between the professors, students, Technical Directors, and the program itself that all serve different purposes to address the cybersecurity problem selected. The Technical Directors will bring forth a problem for the students from different universities to draft proposals as to why they would be the best group of researchers. The Technical Directors choose their student team, and from then on will arrange meetings with the students to provide feedback on the progress of the students research and act as the students subject matter experts on the presented problem for questions related to the topic. The professors will oversee the interactions of these meetings, help to refine presentations and reports for submission and assign the course grade for the student teams based on their efforts (CAE in Cybersecurity Community, 2020).

The INSuRE program, created in 2012, is growing every year as more institutions, Federal Agencies, and National Laboratories become aware of it (Sherman et al., 2017). Despite that growth, there are only a handful of articles that convey the results of parties participating in the program. The silver lining is that of the few articles and studies examining the project, all have concluded largely positive outcomes for students who have participated in an INSuRE project, improving self-efficacy of participants which will only help to serve them later in their careers (Chong, 2018). With INSuRE at CSUSB helping to fill a need

in the community, it is important that the program sees continued success to positively affect more students.

Current Form of Evaluation (SOTE)

Near the end of every term, it is typical to have students evaluate the courses they participate in at CSUSB. As of Spring 2021, typically the most common way that this is done is to have students fill out a Student Opinions of Teaching Effectiveness form known as the SOTE. The primary functions of the SOTE are to allow students to anonymously offer feedback to the professors about the effectiveness of their instruction as well as inform school evaluators as to the teachers effectiveness (CSUSB, n.d.). The SOTE form used to evaluate teaching effectiveness from the perspective of the student is "SOTE Form A" which was last updated in 2006 and has a total of 5 questions. The questions in the form consist of 3 fixed response questions with the 4th and 5th being in two parts, a Likert scale question and a blank section to fill in their justification for the accompanying score. The questions are:

1. Rate your interest in the subject matter of this course before you took the class.

2. How many class sessions did you attend?

3. Why did you take this course? Choose all that apply.

4. How would you rate the overall quality instruction in this course?

    a. Please provide reasons why you gave the above rating for the overall quality of instruction in this course.

5. How would you rate your professor's specific contributions to your learning in this course?

These questions pertain to the students perspective on the overall quality of instruction and the specific contributions the professor made to the students learning.

For the majority of CSUSB cybersecurity focused classes, this is an acceptable form to assess student feedback considering how the classes are structured with one of the main variables from term to term being the professor who will be administering the instruction. The Seminar in Information Systems and Technology INSuRE course at CSUSB currently gathers perspectives from the CSUSB students using the SOTE. The general SOTE is great for general purposes but may not ask specific enough questions about the benefits of a high-impact course such as the INSuRE project course promises. To gain more understanding about the students perspectives of the course, a longer, more detailed assessment tool could be utilized to evaluate the course (Brinko, 1993). By using this more specific assessment tool, professors could obtain specific feedback on the multiple benefits they are tasked with passing to their students that a general SOTE was not originally intended to gather (Andrews et al., 2018).

CHAPTER THREE:

METHODOLOGY

Reflecting on the initial question posed in the introduction, it is important to understand what the key benefits of the INSuRE course at CSUSB, Seminar in Information Systems and Technology, plan to offer. The simplest way is to study the syllabus of the course. The first page of the latest syllabus for the course will be available in Appendix B but the promises are what will be focused on here. Active participation in the INSuRE course at CSUSB promises that by the end of the course, students will be expected to:

- Be familiar with important current cybersecurity challenges
- Think clearly about cybersecurity issues
- Formulate and analyze potential solutions
- Work cooperatively in groups
- Communicate results effectively in a technical report and oral presentation

Considering what was covered in Chapter 2 of this paper, it would appear that the goals of the INSuRE course at CSUSB aim to deliver on the benefits that a project-based research course would deliver. In coordination, the assessment tool should also consist of questions to measure the students perception of the delivery of these goals.

With these goals in mind, research was conducted to discover what surveys and assessment tools of similar research programs exist to examine the

most common types of questions asked and the purpose the line of questioning was in each of them. The primary method to discover these resources was the utilization of the Pfau Library at CSUSB and its access to research articles, past student thesis projects, and the connected databases which contained the examined assessment tools measuring student feedback.

A thorough review of the literature showed many pedagogical studies supporting this type of educational approach, but, as expected, few on the INSuRE program itself. This comes as no surprise as INSuRE was developed by individuals Melissa Dark of Purdue University and Mark Loepker of the NSA, both of whom have expertise in education, instructional design and assessment, unlike other programs/projects/courses that have more historical data available (Sherman et al., 2017). The INSuRE program is based on educational best practices, tied with strong topical research topics, and facilitated by experts. With an absence of information returned and utilized, this was not limited to assessment tools alone as there were also articles that were used to guide the researcher in choosing what would be useful when selecting sample assessment surveys.

After discovering what tools were in existence from the resources utilized, the next phase was to examine them and look for question types consistently asked. Once the breakdown was completed, it was important to identify patterns of surveys that yielded high response rates as a survey is only useful when taken and returned. The final task would be to assemble a student feedback survey to

be used as an assessment tool for INSuRE based upon question types observed from other surveys asked of students, questions commonly found among surveys discovered, and articles that described creating successful surveys including elements of the SOTE.

CHAPTER FOUR:

RESULTS

Surveys Discovered and Selected

Project-based learning courses have multiple factors and proposed benefits to acknowledge and measure. This is why it is important to utilize an effective assessment tool so as to clarify if the course is meeting its intended goals according to its students. From what could be discovered, almost every survey and assessment tool that was identified is a mixture of both qualitative and quantitative information seeking questions in order to gauge what the student feels they benefited from the research program.

Using the University of North Carolina, Charlotte (UNCC) repository which houses a collection of assessment surveys that have been utilized over the years and are broken into categories including Student, Faculty, Mentor, and more to gather different perspectives on the courses they were designed for. The surveys were created utilizing the Undergraduate Research Student Self-Assessment (URSSA) to measure student outcomes and research experiences which is housed on the Student Assessment of their Learning Gains (SALG) site, salgsite.org, which is the foundation for the URSSA (University of Colorado, Boulder, 2018). The SALG instrument was created in 1997 for NSF funded programs focused on chemistry assessment but was refined in 2007 to be usable by more STEM fields to examine how much a course allowed a student to learn (SALG, n.d.). The surveys also include pre and post course surveys which could

be used depending on how the INSuRE assessment is utilized to showcase student growth by taking the course (University of North Carolina, Charlotte, n.d.). All surveys in the repository are advised to be structured in a way to attain information about the students perceptions of the courses, accomplished by using the SALG instrument should center around five questions:

1. How much did the required course activities help the student in their learning? (Lab activities, presentations, resources available)

2. As a result of taking the course, what gains did the students make in terms of their understanding of the subject matter of the course?

3. As a result of taking the course, what progress did the students make on skills meant to be fostered by the course? (Research ability, professional writing, analyzing data trends)

4. As a result of taking the course, what changes in attitude did the students have in the covered topic? (Enthusiasm for the subject for example)

5. As a result of taking the course, what developments were made in the students abilities to consolidate the data together?

The program at UNCC expanded upon these by also recommending surveys to include questions that covered overall experience, academic future, and student self-efficacy. The surveys found in the repository were developed with these questions in mind to evaluate post-course outcomes of the university's Research

Experiences for Undergraduates (REU) program from the perspective of its students and as such, match with the goals of the INSuRE course.

The development of these surveys was done with the support of the NSF which is an independent federal agency that is also the reason for the INSuRE project's existence (INSuRE, 2019; National Science Foundation, 2021). Since the proposed tool's primary goal is to measure the students assessment of INSuRE, it will allow for the replacement of the SOTE. Discovering and focusing on the post-course surveys available was prioritized.

Existing Post-Course Research Assessment Survey Breakdowns

The five institutions were chosen from the repository that had available post-course assessment surveys that were broken down included:

- University of North Carolina, Charlotte (UNCC)
- Humboldt State University (HSU)
- University of Rhode Island (URI)
- Iowa State University (ISU)
- University of Massachusetts, Amherst (UMass)

All five universities have assessment surveys to gather students' perceptions of the research programs held at each university. Each assessment survey was broken into several question styles that would allow for a quick tally of the quantifiable information but allow for students to be descriptive when requesting specific feedback. The Likert scale was the most commonly used style of question on the assessment but multiple-choice, "Check all the apply," and short-

answer were utilized in an effort to gain the answers from students the SALG instrument advised to ask.

While the five questions that the SALG instrument advises to include in the assessment tool were followed by most of the universities, UMass decided to focus specifically on the program itself and less on the development of the students research ability, future plans, or reflection on the project(s) the students worked on. As seen in Table 1, the questions asked in the assessments offer feedback from the students' perspectives that go beyond the research material itself to offer a breadth of information.

Table 1: Categories of Feedback Requested from Students

Post-Course Assessment Questions Devoted to Student's Perception of:	Institution				
	UNCC	HSU	URI	ISU	UMass
Skills prior to program	1	5	0	11	0
Specified field of research covered by project	2	22	0	1	0
Understanding of research process	16	4	0	16	0
Faculty guidance/Interaction	23	5	0	1	2
Academic/Soft skill gains	20	31	0	13	0
Academic goals/future	19	12	2	2	4
Career goals/future	6	6	1	1	0
Student Personality	3	4	1	0	0
Value of research	4	1	1	1	0
Support from other students	19	14	1	1	0
Feedback on course overall	41	12	11	24	23
Demographic questions	3	0	1	4	1
Total Questions asked on assessment	157	116	18	75	30

Shared Practices Among Surveys with High Response Rates

After breaking down several existing post survey questions, tips and techniques utilized that result with a high yield of responses were examined.

Methods of delivery compared when measuring response rate for surveys were

over the internet, mail, and in-person. In-person survey delivery has the highest

response rate and survey completion (Ekhtiari et al., 2017; Szolnoki & Hoffmann,

2013; Yoshiya & Rossi, 2017). Another factor that needs prioritization when

seeking quality results is the timeliness of the survey. What is meant by this is

that there is a greater chance of success of obtaining complete, high quality

feedback the closer the feedback requested is to the item that is in need of being

assessed (Gormally et al., 2014).

CHAPTER FIVE:

DISCUSSION

Building a Student Feedback Assessment Tool for INSuRE at CSUSB

From the results section of Chapter 4, there are many valuable takeaways

that will assist with the creation of a specific assessment tool to help determine if

the Seminar in Information Systems and Technology INSuRE course at CSUSB

is hitting its goals from the perspective of its students. When looking at the

assessment surveys found in the UNCC repository, the main commonality of

them was that they were composed of a mixture of open-ended and short-answer

with Likert scale and multiple-choice questions making up the bulk of the longer

surveys. The SOTE Form A is also a mixture of questions similar to those found

in the UNCC repository but five questions cannot provide the same level of depth

of student feedback as the discovered surveys can.

The main shortcoming of the SOTE when comparing against the

assessment tools is that the questions on the SOTE are focused on having the

student grade the instructor, their interest, and the course with one question

pertaining to each. In contrast, the depth of the surveys created using the

URSSA from the UNCC repository seeks to gauge student ability gains, their

work soft skill development, the next stage of their academic and professional

career, and evaluation of comprehension of the course itself. Being that the

SOTE is so brief, the assessment tool for the INSuRE course at CSUSB will

need to be more in-depth, longer, focusing on the various promises in order to

get more takeaways from the students perspective in an effort to ensure that INSuRE is as effective as it can be (Strayhorn, 2010).

Another takeaway from the survey created with the URSSA tool was noticing the trend that the majority of the surveys broke the questions into subject sections such as "Expectations & Program Quality," "Experience, Knowledge and Ability," and "Familiarity." The SOTE form used for cybersecurity focused students has all of its questions in one section, "Student's Opinion." Should the student wish to evaluate specific aspects/components of the course, it may be more difficult for them to remember them all and fill them in the blank sections. The lack of structure in the students' responses can potentially make it difficult for the instructor to sift through the feedback and identify areas of opportunity by not having the responses focused on the different components of the course. By creating a survey broken into sections that focus on the different promises of the INSuRE course, the instructor will be able to more effectively absorb the students perception of the course's effectiveness in meeting each goal.

The last consideration from the results gathered was looking at the best strategy for the administering of the new assessment survey for the INSuRE course to best capture the students' feedback. Currently, the SOTE form is distributed towards the end of a course sent through email for online courses and in-person for courses that physically meet. Based on the information discovered, these two practices are the one component of the SOTE's strategy that would be recommended for continual use. By having the surveys administered while the

topic is still at the front of the students mind and after passing the majority of the

coursework entailed, this would arguably be the optimal time to gather students

perspectives (Ekhtiari et al., 2017). It is to be considered that this is only the

minimum amount of times that the information shows when the survey needs to

be distributed. The INSuRE project has three distinct milestones, project

selection, midterms, and finals. Therefore, it is advised that smaller versions of

the survey be administered during those earlier periods as well. Utilizing the

survey at these earlier times, even trimmed down versions, will allow the

professor to assess if the students are experiencing specific benefits the

instructor anticipated to have occurred by the time of the assessment. This adds

the ability for the instructor to course correct their lesson plan to focus on the

promises they felt should have already been met. Once the distribution dates are

decided, the survey should be delivered in-person, at the end of a class day, as it

is reported that this will have the largest impact on having optimal yield in terms

of the number of assessment surveys that are filled out (Yoshiya & Rossi, 2017).

CHAPTER SIX:

CONCLUSION

Next Steps for the Student Feedback Assessment Tool

Based on the information discovered in the results section and explained in the discussion section, in light of the other assessment tools used to measure the goals and course objectives, it is fair to determine that the SOTE is not robust enough to capture student perspectives focused on the INSuRE course. The SOTE is a tool that is self-described as being designed to gather the students perception of the teaching effectiveness. As covered in the background section of chapter two, research courses have the potential to change the lives of its students and project-based learning courses bring more to the educational table than academic gains. A course that can offer so many benefits to cybersecurity students needs to be evaluated more closely to help it develop into a more effective program, potentially with every round of new students as they bring unique perspectives. By pulling information from post-course survey assessment tools that evaluated research courses, whose foundation comes from another NSF funded project, a new students' perspective assessment tool has been created for the INSuRE course utilizing Google Forms and can be seen in its entirety in Appendix A.

The questions for the survey are designed to measure if students feel the promises made in the INSuRE syllabus are being met along with the proposed benefits that a high-impact practice course can offer. The chosen survey

questions will measure a CSUSB student's experience of the INSuRE course and have been split into several sections to focus on different promises of INSuRE. These sections are:

1. Yes, I have participated in the INSuRE Project at CSUSB
2. No, I have not participated in the INSuRE Project at CSUSB
3. Research Experiences at CSUSB
4. New Research/Study Habits
5. Career Goals
6. Cybersecurity Career Focus
7. INSuRE's Impact on your Future
8. Employment Since INSuRE
9. Research, Project-based Learning Class Feedback
10. INSuRE General Feedback

Sections 1 and 4 ask specific questions based on the INSuRE course objectives to gauge if the course is meeting them from the students' perspective. They focus on discovering what types of cybersecurity research they performed, their comfort level while performing research, their comfort level with drafting technical documents, and group work behaviors. Sections 5, 6, 7, and 8 ask questions about the other benefits of project-based learning courses were discovered to have by gauging if the experience has benefited the students on a professional level as well. Such as the INSuRE experience having an impact on a student's resume, interview experiences, or job discovery through exposure

with Technical Directors (Shaw et al., 2013). The last section left for questions related to student experience is section 10, which asks for overall feedback on the program which was a constant on the five assessment tools found in the results chapter. This helps students cover anything they may feel was left out of the assessment tool and as Google Forms are easily adjustable, it will allow the instructor the ability to amend the assessment if needed. The remaining sections relate to the possible use of the survey to measure the effectiveness of INSuRE vs. other research classes which is further explained in the third suggestion below.

Since one of the purposes in creating the INSuRE project is to increase the participation of underrepresented demographics in cybersecurity research (National Science Foundation, 2016), demographics that CSUSB largely serves (CSUSB, 2020), it is important to include questions into the assessment survey that measure professional upward mobility. This was addressed by inserting questions about the students job/career prospects and investigating whether or not the INSuRE project course assisted with that upward mobility, as research suggests when students participate in STEM courses (Carpi et al., 2017) and can be seen in sections 5 through 8. As this is the first attempt at creating an assessment tool for the INSuRE program, there are few suggestions where this tool could be utilized.

Suggestion 1 – Use to Assess INSuRE Experience at CSUSB

The simplest and quickest to deploy option is to submit the student feedback assessment tool to the primary instructor for the INSuRE project course. With the creation of the assessment tool focusing on asking questions around the goals of not only the Seminar in Information Systems and Technology INSuRE course but also the benefits seen in those taking research courses, and the use of a project-based curriculum, it is ready for deployment as of the writing of this paper. By creating the survey on Google forms, the instructor will have access to the form and can make adjustments as they see fit should they wish to investigate specific attributes of the course they feel need further exploring or would like to deploy more often. Adjusting the assessment survey in its current form by the removal of the "Feedback Request" questions at the end of each section allows for its immediate deployment. This is not mandatory as the instructor may find value in the feedback on the currently enrolled students assessment of the survey itself.

Suggestion 2 – Refine Further with Feedback from Previous INSuRE Students

The second option would be to continue on this project's research by seeking feedback from past INSuRE project students. While the assessment tool may be effective, it was created without the perspective of a student that has participated in this course. As this assessment tool is being created to measure the success of the INSuRE project course, student feedback on the assessment

itself should help determine if the correct questions are being asked(Seldin, 1997).

At the time of The second option would be to continue on this project's research by seeking feedback from past INSuRE students. While the assessment tool may be effective, it was created without the perspective of a student that has participated in this course. As this assessment tool is being created to measure the success of the INSuRE course according to its students, student feedback on the assessment itself should help determine if the correct questions are being asked (Seldin, 1997).

The CSUSB Institutional Review Board (IRB) application was made to seek feedback from past students on this initial survey and is approved for use through the Spring 2022 term. With this approval (redacted approval confirmation located in Appendix 3), further research could be done by reaching out to the past students of the INSuRE course. They would be able not only take the survey itself but would be asked to evaluate each section. Should they feel that the assessment tool has incomplete sections, they would be able to offer their unique perspectives and suggest changes by answering the "Feedback Request" questions at the end of each section. Upon gathering their input, another instance of this assessment tool can be created and then deployed as described in suggestion 1.

Suggestion 3 – Evaluate Benefits of Research Abilities by Taking INSuRE

While the INSuRE course is the only project-based learning research course for cybersecurity students at CSUSB, there are other disciplines that offer research courses. Another research project application for the assessment tool would be to examine the effectiveness and benefits students gain through the INSuRE course that they would not in another research course at CSUSB. With the INSuRE course having no prerequisites and interdisciplinary collaborative work being part of the benefits of the project-based learning course, students who do not have a cybersecurity concentration may take the course. The assessment tool does ask questions to gauge the students prior and post-research experience and abilities related to the INSuRE course in an effort to discover gained abilities. The assessment tool also has a line of questioning for those who have not taken the INSuRE course which can be built upon to gain answers from a control group of students who participated in a research course that was not INSuRE. This suggestion will require the most effort to implement of the three but it also, arguably, has the greatest potential.

Summary

Based upon the findings of this project, it can be concluded that the use of the SOTE does not adequately address the unique facets of the Seminar in Information Systems and Technology INSuRE course in terms of the student perspective. By looking at the student feedback assessment tools used for other research courses, an updated assessment tool that goes more in-depth is required. While the research performed offers a more encompassing assessment tool of the INSuRE course at CSUSB, it should continue to grow in its knowledge-seeking from term as more feedback is provided. With CSUSB serving a community that is underrepresented in STEM research, strengthening the courses that promote development will strengthen the community at large.

APPENDIX A:

ASSESSMENT TOOL/SURVEY QUESTIONS

Survey Questions and Google Forms Distribution

Google Forms was the chosen medium for this assessment tool for a few reasons. Primarily, Google Forms has benefits for the researcher that include availability, security, data collection, and transferability. As a CSUSB student, the researcher was given additional security over a standard account as there is an additional layer of security when accessing the service through their student account. The data would also be able to be stored in a way that should another CSUSB student wish to utilize the assessment tool for further research, Google Forms allows the surveys to be shared for easy transferability.

The survey questions as shown here were created from the questions pulled from other assessment tools as described in Chapter 4. The survey is a combination of both quantitative and qualitative questions to gather a CSUSB student's experience in the INSuRE project class. Additionally, should further refinement be needed for the survey based on past student experience, as described in Chapter 6, suggestion 2, there are questions at the end of each section that can be included. These questions are labeled "Feedback Request:" and will be seen at the bottom of all sections outside of the first question. This is the full set of questions and answers for the survey in its initial. As not all questions are needed for every participant, the path for the questions is indicated by the italicized grey text which is also used should questions requires instructions to complete:

1. Are you currently or have you previously taken/been enrolled in the INSuRE course at CSUSB IST 5930 (formally IST 590)?
    a. Yes *Skip to question 2*
    b. No *Skip to question 13*

- Yes, I have participated in the INSuRE Project at CSUSB

2. Prior to INSuRE, what type of research projects had you done or been apart of? Please mark all applicable. *Check all that apply.*
    a. Basic Research (Ex: Researching current and emerging cryptographic protocols)
    b. Applied Research (Ex: Researching cryptographic protocols and how well they secure)
    c. Developmental Research (Ex: Researching the next generation of cryptographic protocols)
    d. None
    e. Other:_____
3. Through INSuRE, what type of research project did you participate in? *Check all that apply.*
    a. Basic Research (Ex: Researching current and emerging cryptographic protocols)
    b. Applied Research (Ex: Researching cryptographic protocols and how well they secure)
    c. Developmental Research (Ex: Researching the next generation of cryptographic protocols)
    d. Other: _____
4. Please indicate on the scale below how much you align with the following statement: I am now comfortable drafting a research proposal in part as a result of taking the INSuRE class.
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree
5. Please indicate on the scale below how much you align with the following statement: I am more comfortable presenting research findings to a large audience in part as a result of taking the INSuRE class.
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree

6. Please indicate on the scale below how much you align with the following statement: I am more proficient in discovering relevant research articles in part as a result of taking the INSuRE class.
   a. 1 Strongly Disagree
   b. 2 Disagree
   c. 3 Neither Agree nor Disagree
   d. 4 Agree
   e. 5 Strongly Agree
7. Please indicate on the scale below how much you align with the following statement: I am better at working in a group setting in part as a result of taking the INSuRE class.
   a. 1 Strongly Disagree
   b. 2 Disagree
   c. 3 Neither Agree nor Disagree
   d. 4 Agree
   e. 5 Strongly Agree
8. Please indicate on the scale below how much you align with the following statement: I am more confident working on projects with mentors in the future in part as a result of taking the INSuRE class.
   a. 1 Strongly Disagree
   b. 2 Disagree
   c. 3 Neither Agree nor Disagree
   d. 4 Agree
   e. 5 Strongly Agree
9. Please indicate on the scale below how much you align with the following statement: I am more confident now to work on a research project in part as a result of taking the INSuRE class.
   a. 1 Strongly Disagree
   b. 2 Disagree
   c. 3 Neither Agree nor Disagree
   d. 4 Agree
   e. 5 Strongly Agree
10. Please indicate on the scale below how much you align with the following statement: I learned more about cybersecurity in pa" as a result of taking the INSuRE class.
   a. 1 Strongly Disagree
   b. 2 Disagree
   c. 3 Neither Agree nor Disagree
   d. 4 Agree
   e. 5 Strongly Agree
11. While in the INSuRE class, did you acquire new research/study habits?
   a. Yes *Skip to question 17*
   b. No *Skip to question 20*

12. Feedback Request: What Information modifications, if any, do you think are needed to this section? (Yes, I have participated in the INSuRE Project at CSUSB, Questions 2-11)

    a. _____

- No, I have not participated in the INSuRE Project at CSUSB

13. Did you participate in a research, project-based learning class at CSUSB? (Project-based learning meaning you did not have standardized exams and your grade was based on the work you did on a project, typically in a group)

    a. Yes
    b. No

14. Feedback Request: What Information modifications, if any, do you think are needed to this section? (No, I have not participated in the INSuRE Project at CSUSB, Question 13)

    a. _____*Skip to question 15*

- Research Experience at CSUSB

15. What type of research projects had you done or been apart-of at CSUSB? Please mark all applicable. *Check all that apply.*

    a. Basic Research (Ex: Researching current and emerging cryptographic protocols)
    b. Applied Research (Ex: Researching cryptographic protocols and how well they secure)
    c. Developmental Research (Ex: Researching the next generation of cryptographic protocols)
    d. None
    e. Other:_____

16. Feedback Request: What Information modifications, if any, do you think are needed to this section? (Research Experience at CSUSB, Question 15)

    a. _____*Skip to question 33*

- New Research/Study Habits

17. Please elaborate, in your own words, any type of these new habits or tactics. (More regular meetings, new research tools, etc.)

    a. _____

18. Please indicate on the scale below how much you align with the following statement: The new habits, skills, and/or tools I acquired during the INSuRE project were applicable to my other classes.
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree
19. Feedback Request: What Information modifications, if any, do you think are needed to this section? (New Research/Study Habits, Questions 17-18)
    a. _____ *Skip to question 20*

- Career Goals

20. While you were enrolled in the INSuRE project, did you have a career goal of entering the cybersecurity work force?
    a. Yes *Skip to question 22*
    b. No *Skip to question 25*
21. Feedback Request: What Information modifications, if any, do you think are needed to this section? (Career Goals, Question 20)
    a. _____ *Skip to question 22*

- Career Goals, Yes

22. Please indicate on the scale below how much you align with the following statement: I found that I gained valuable insight into a cybersecurity career by working with a technical director.
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree
23. What aspect, if any, of working on a project supplied by your technical director was most beneficial to you?
    a. _____
24. Feedback Request: What Information modifications, if any, do you think are needed to this section? (Career Goals, Yes, Questions 22-23)
    a. _____ *Skip to question 25*

- INSuRE's Impact on your Future

37

25. Have you incorporated your time and effort while in the INSuRE project into part of your resume?
    a. Yes
    b. No
26. Has your experience in INSuRE project led to discussions during an interview process?
    a. Yes
    b. No
27. Have you graduated from CSUSB?
    a. Yes
    b. No
28. Have you found employment/placement since graduating from CSUSB?
    a. Yes *Skip to question 30*
    b. No *Skip to question 36*
    c. Not Applicable *Skip to question 36*
29. Feedback Request: What Information modifications, if any, do you think are needed to this section? (INSuRE's Impact on your Future, Questions 25-28)
    a. _____

- Employment Since INSuRE

30. Please indicate on the scale below how much you align with the following statement: My experience with the INSuRE program helped with finding employment post-graduation.
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree
31. Please indicate on the scale below how much you align with the following statement: My experience with the INSuRE program has benefited me at my current employer.
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree
32. Feedback Request: What Information modifications, if any, do you think are needed to this section? (Employment Since INSuRE, Questions 30-31)
    a. _____ *Skip to question 36*
33. While enrolled at CSUSB, what was your Major?

a. _____

Research, Project-based Learning Class Feedback

34. Did you graduate from CSUSB?
    a. Yes
    b. No
35. Feedback Request: What Information modifications, if any, do you think
    are needed to this section? (Research, Project-based Learning Class
    Feedback, Questions 34-35)
    a. _____ *End of this*
       path

- INSuRE General Feedback

36. Please indicate on the scale below how much you align with the following
    statement: I would recommend students enroll in a semester of INSuRE
    project, IST 5930 (formally IST 590).
    a. 1 Strongly Disagree
    b. 2 Disagree
    c. 3 Neither Agree nor Disagree
    d. 4 Agree
    e. 5 Strongly Agree
37. What changes/suggestions would you like to see in the INSuRE project,
    IST 5930 (formally IST 590)?
    a. _____
38. Feedback Request: What Information modifications, if any, do you think
    are needed to this section? (INSuRE General Feedback, Questions 36-
    37)
    a. _____ *End of this*
       path

APPENDIX B:

SYLLABUS COVER: SEMINAR FOR INFORMATION SYSTEMS AND

TECHNOLOGY

Info Systems & Technology 590 – INSuRE ██████

A. Course Goals and Outcomes

This course engages students in national cybersecurity/information systems security problems. Students will learn how to apply research techniques, think clearly about these issues, formulate and analyze potential solutions, and communicate their results. Working in small groups under the mentorship of technical clients from government and industry, each student will formulate, carry out, and present original research on current cybersecurity/information security problems of interest to the nation. Support for this course is provided in part by the National Science Foundation and the National Security Agency. As part of the award, this course will be run in a synchronized distance fashion, coordinating some activities with our partner schools and our technical clients.

Course Objectives:

By the end of the course, students will be expected to:

1) be familiar with important current cybersecurity challenges,

2) think clearly about cybersecurity issues,

3) formulate and analyze potential solutions,

4) work cooperatively in groups, and

5) communicate results effectively in a technical report and oral presentation.

Prerequisite:

Students may come from computer science, computer engineering, information technology, related technical field (e.g., electrical engineering, information systems, math), or any related social science field (e.g., national security, political science, publication administration). Each student is expected to bring significant expertise, interest, and experience in at least one relevant technical/social area.

All Assignments are **due by 8 pm** on Thursday of each week. Be prepared to talk about your part every Friday morning.

Instructor/Meeting Info

- California State University, San Bernardino, Department of Information & Decision Sciences
- Instructor: ████████████
- Office: ██████████████
- Phone: ██████████
- E-mail: ███████████
- Office Hours: ███████████████████████
- Class meeting time: ███████████████████

41

APPENDIX C:

INSTITUTIONAL REVIEW BOARD APPROVAL FOR SUGGESTION 2 FROM

CONCLUSION

IRB #: IRB-FY2021-253
Title: California State University, San Bernardino Students Reflection on Participation in the INSuRE Program
Creation Date: 3-10-2021
End Date:
Status: Approved
Principal Investigator: Antony Coulson
Review Board: CSUSB Main IRB
Sponsor:

Study History

Submission Type	Initial	Review Type	Exempt	Decision	Exempt

Key Study Contacts

Member	Bradley Willett	Role	Co-Principal Investigator	Contact	██████████████
Member	Antony Coulson	Role	Principal Investigator	Contact	██████████
Member	Antony Coulson	Role	Primary Contact	Contact	██████████

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