An Evaluation of Focused Outreach and Recruiting Efforts in a Nuclear-Related Workforce Development Program

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I. Abstract

The main objective of this nuclear-related workforce development (NWD) program is to use the scholarships provided by the federal funding agency ($5,000 per semester) in conjunction with Western Carolina University's engineering project-based learning sequence to recruit and retain students who will sustain our existing program for serving nuclear-related industry and academia. Our secondary objective is to increase the quality, quantity, and diversity of students seeking these engineering degrees. The program seeks to recruit engineering students specializing in electric power, mechanical, and electrical disciplines, jointly called EPME. A program requirement is that these students pursue an educational emphasis in nuclear power. This paper summarizes and evaluates the outreach and recruiting efforts for a focused group of students who meet or exceed the selection criteria set forth by the funding agency.

The workforce development program was designed to increase awareness of nuclear power related degrees and employment opportunities in those fields through its recruitment and advertisement campaign. Our recruitment efforts are focused on Western Carolina University's (WCU) junior and senior students who demonstrate commitment to a career supporting the nuclear industry in the near term. These students have already shown promise in scholarship and academic success. Sophomore students are also considered in case the applicant pool from junior and senior students is not satisfactory both quantitatively and qualitatively.

WCU School of Engineering + Technology's enrollment rate has increased by about 15% over the last three years. This enrollment trend is predicted to grow due to the regional demands of industry and the onset of a state-wide initiative of lower tuition rates for WCU students. With this increase of enrollment, the EPME programs will have significant numbers of students who qualify for this scholarship program. The educational pathways for these students to obtain junior and/or senior status is varied. Because of our strong regional partnerships, we are able to recruit students from many different avenues. In addition to in-house students, examples of particular importance are the State Community College system, the State Department of Public Instruction through traditional high schools and Early Colleges, and the State Workforce Development Boards.

A focused outreach and recruiting effort was administered to target and attract students interested in becoming a part of the nuclear related workforce in U.S. First, an email was composed and sent to existing students in the university who meet or exceed the specific criteria (such as academic level and GPA set forth by the funding agency). The effort also included community college visits, participation in university open house events, and internet posting through a website. A total of nine applications were eventually received by the deadline in Fall 2018 semester. As a result of the relatively unsatisfactory applicant pool, a second round of outreach and recruiting efforts primarily focusing on existing students was conducted. This effort yielded another two applications by the deadline in Spring 2019 semester.

Evaluation of the recruitment efforts was analyzed through the data from a recruitment survey that is included in this paper and discussed in detail. The group size for students who completed the surveys included not only scholarship recipients but also other students who were recruited to the engineering programs at WCU.

II. Introduction

The WCU-NWD scholarship program exists to recruit students for serving nuclear-related industry upon graduation and entrance to the workforce. In conjunction with the scholarship program, students perform research through WCU's engineering project-based learning sequence. The intent is to also increase the magnitude of programs and diversity of students seeking engineering degrees specializing in electric power, mechanical, and electrical disciplines, jointly called EPME. With the second round of funding through the Nuclear Regulatory Commission (NRC) workforce development grants, the WCU-NWD program initiated a strategy to re-design recruitment processes and increase student success. In past efforts, the recruitment process included multiple visits to partner institutions around the state [1]. While these visits were helpful, survey results suggested the most effective recruiting effort was one-on-one outreach to individual students. By pairing the survey results on recruitment of the WCU-NWD scholarship program to current literature about recruitment strategies, a best practice was established for WCU.

Literature specific to recruiting scholarship candidates for engineering was limited, but results from interdisciplinary studies showed consistent outcomes. Findings indicated that focusing on a specific audience can help recruiters know who their target population really is and how to reach them [2]. The principal investigators decided to devote more attention to the current undergraduate engineering students at WCU by focusing heavily on internal recruitment. A perceived limitation was the homogeneity of the students in the recruiting pool. Eastman, Christman, Zion, and Yerrick discussed the confines of uniformity in that "engineering education reform documents continue to call for diversifying the ranks of engineers, yet the complexion of the engineering workforce has remained relatively static in its representation." [3] By narrowing the focus to campus applicants, the principal investigators were potentially narrowing the recruit demographics to be representative of the engineering school demographics. However, with the 15% increase of enrollment in the School of Engineering + Technology at WCU, the demographics have steadily become more diverse. Diversity is also representative of the engineering faculty at WCU who are among the most diverse at the university and are above average in comparison to similar institutions across the country.

The WCU-NWD scholarship program did continue outreach to external partners, but the amount of time in visits versus the return on investment with the first round of funding was negatively disproportionate. In reviewing past research, the principal investigators found that similar programs were able to matriculate recruits more successfully through face-to-face interaction. With less external visits as part of the recruitment process, the principal investigators were able to devote individual time to potential candidates. Shadding, Whittington, Wallace, Wandu, and Wilson found that 89% of students who matriculated through their scholarship program were recruited through individual interaction by personal email, referral, and/or face-to-face events [4].

They also found that these strategies were cost effective which was another advantage for the WCU-NWD scholarship program.

Another advantage in recruiting from a concentrated pool was the ability to find a framework that fit the outcomes required by the program, which will help build a pathway for student success. When developing an effective educational program, research suggests that giving scholarship money by itself may not lead to the desired outcome of education reform, especially in areas of engineering. Beddoes, Froyd, and Hall state that scholarship funds have to be distributed as part of a program with strategic outcomes and a focused goal [5]. "These have included, but are not limited to, frameworks of self-efficacy, communities of practice, mentoring, career choice, team functions, and identity formation" [6]. The framework for the WCU-NWD scholarship program is outlined in this paper as well as program outcomes. An analysis of recruitment efforts is included with a discussion of results from the recruitment survey.

This paper contributes to engineering education in the effect that the principal investigators took three significant educational reform strategies into consideration when developing the WCU-NWD scholarship program. The three strategies included diversity and inclusion, individual interaction, and a specialized framework encompassing a broad spectrum of student engagement activities. Although education reform was a research focus, the investigators also maintained a consistent structure to meet the needs of the NRC workforce research and development. The WCU-NWD scholarship program can serve as an example to other scholarship programs specific to demands within engineering education.

III. Program Description

The WCU-NWD program sought to provide six undergraduate scholarships of $5,000 per semester and professional development opportunities to specifically selected WCU engineering students specializing in electric power, mechanical, and electrical disciplines, jointly called EPME. Selected participants were sophomore through senior-level students pursuing an educational emphasis in nuclear power and engaging in nuclear-related projects through WCU's interdisciplinary project-based learning sequence. Each participant agreed to the terms of the scholarship program, which included the requirement to work in a nuclear-related employment for 6 months for every complete or partial year of support awarded. Additionally, participants were provided institutional and program-level opportunities for professional and career development.

Participants of the WCU-NWD program were enrolled in at least three of the College of Engineering and Technology's project-based learning (PBL) courses, starting at the junior level. The PBL sequence includes' the following courses:

> ENGR 350 - Engineering Practices and Principles III - Engineering project-based learning (open-ended) with emphasis on project control and engineering design processes. Special emphasis will be placed on professional, ethical, global, environmental, and contemporary issues. Contact Hours: 2 Lecture, 2 Lab.

ENGR 400 - Engineering Capstone I - Senior engineering project selection, planning, and development. Emphasis will be placed on defining project requirements, developing project work breakdown structure, conceptual designs, and working prototypes. Contact Hours: 1 Lecture, 4 Lab.

ENGR 450 - Engineering Capstone II - Senior engineering project design, development, fabrication, and testing. Emphasis will be placed on iterative design processes, project management and execution, fabrication and testing. Contact Hours: 1 Lecture, 4 Lab.

The PBL sequence of courses provided the participants with an opportunity to learn project management, technical communication, teaming, and problem-solving skills while working on open-ended industry-based projects. The year-long senior capstone experience provided each program participant with opportunities to work on nuclear-related projects with local industries, network, and gain hands-on engineering experience in the field. These efforts were coordinated through WCU's Center for Rapid Product Realization, working with both faculty and industry mentors, and were funded by the supporting industry sponsors.

To provide further opportunities for the participants to increase their technical knowledge, they were required to study our Nuclear Power emphasis, which includes the following courses: 1) ENGR493-01 Special Topics-Distance Course #1, 2) ENGR493-02 Special Topics-Distance Course #2, 3) ENGR 352 Thermodynamics and Heat Transfer, 4) EE 451 Electric Power Systems, and 5) EE 452 Electric Machines and Drives. The courses 3, 4, and 5 above were offered in-classroom by our engineering program. In collaboration with the Nuclear Power Institute at Texas A&M University, courses 1 and 2 were delivered online. With the advising faculty's guidance, students selected from these three courses: 1) Nuclear Power Plant Fundamentals, 2) Nuclear Power Plant Systems (Pressurized Water Reactors), 3) Nuclear Power Plant Systems (Boiling Water Reactors). Mentorship and advisement were provided for course sequencing and selection.

The three WCU-NWD scholarship program directors served as the primary mentors and academic advisors for the participants. Additionally, the directors organized group activities that were used to facilitate interaction between the participants as well as others on and off-campus, such as: career services, tutoring services, guest speakers from the nuclear industry, site-tours, and other professional development activities. Additionally, the program directors reviewed and developed action plans for participants who did not maintain the requisite GPA, usually allowing one semester to improve. During this probationary semester, the directors ensured the student received an extra measure of support and mentorship, including increased tutoring and mentorship through institutional student success offices. In the event a participant's efforts to remediate his/her GPA within the probationary period failed, the student was dropped from the program, and a suitable replacement was sought from the scholarship application pool of applicants.

IV. Outreach and Recruiting Activities

The first round of recruiting and marketing activities was conducted in Fall 2018. Due to the relatively low return of applicants in the first round, a subsequent recruitment effort was conducted in Spring 2019. The scholarship award and the availability of funds, during both

rounds, were announced to existing university students, related university offices, and potential applicants from admission files. Select community colleges were also visited where a description of the scholarship and application materials were distributed. Scholarship information and application assistance workshops were conducted where potential applicants asked further questions, received help completing forms, and received information about the requirements of the scholarship contract. Nine applications in the first round and two applications in the second round were received. Based on the selection process, seven students in Fall 2018 and two students in Spring 2019 were awarded the NRC scholarship. The following lists some of the outreach and recruiting activities for the year-end grant term:

- A world wide web page 'http://nrcscholarship.wcu.edu/' was updated with the new scholarship application opportunity.
- Fall 2018 North Carolina Engineering Pathways meeting at Blue Ridge Community College was attended, informative flyers were distributed.
- WCU Open House (that happens 4 times a year) is a campus preview program, designed especially for prospective undergraduate students to learn about the robust student life of a Catamount. In this program, the students were also introduced to various financial assistance opportunities. NRC scholarship flyers were distributed, and the program was introduced to interested parties.
- Admitted and existing engineering students (sophomore, junior, or senior level) specializing in electric power, mechanical, and electrical disciplines were also informed about the scholarship opportunity through email.
- One-on-one outreach efforts to students, who were potentially interested in the scholarship, was conducted. This effort primarily involved advising day communication of program faculty with student advisees.
- Advising days at WCU are designed to assist students with their course registration and planning needs towards graduation by faculty advisors. Most faculty advisors at WCU's School of Engineering + Technology were provided with scholarship flyers to be distributed to interested students.

A total of nine applications were received by the November 30, 2018 deadline. Since most applicants were junior and senior level students had only a few semesters left before their graduation, total scholarship amounts that were awarded (7) were limited and below our scholarship budget pool. Therefore, another round of recruiting ensued during Spring 2019, which yielded two other highly qualified applicants.

Application assistance workshops were also held on November 2, 2018 and March 26, 2019. Several applicants attended these events, including students majoring in various engineering programs (i.e. electric power, mechanical, and electrical). The workshop activities were:

- A presentation of scholarship details and requirements
- A question and answer session
- One-on-one analysis of application materials such as the application form, letter of intent, and transcripts.

All students who attended these workshops were able to complete their applications by the due

date for both Fall 2018 and Spring 2019 terms.

One-on-one outreach efforts proved to be the most effective method of recruiting during this outreach and recruiting cycle. Seven out of nine students recruited were reached though this effort.

V. Applicant Evaluation and Selection Process

A total of nine application packages were received from the candidates by the November 30, 2018 deadline. By the Spring 2019 deadline of April 9, a total of two application packages were received from the candidates. In terms of demographics for both rounds, there were eleven white non-Hispanic applicants, three being female and nine being male, and all applicants were US citizens. After the completion of applications in both rounds, a scholarship screening and selection committee was formed. The committee included the PI and two Co-PIs as well as the engineering program coordinator and two industry/advisory board representatives. The screening was conducted based on the following five criteria:

1. Application essay and resume quality (0-9 points)
2. Letters of Recommendation (0-9 points)
3. Extracurricular and volunteer activities (0-9 points)
4. Academic strength (0-9 points)
5. Professional discretion (-2,-1,0,1 or 2 points)
    a. From underrepresented groups
    b. Higher academic levels (i.e. senior, junior)
    c. With financial need
    d. Ability to meet scholarship criteria, potential for success.

For professional discretion criterion, for example, if the applicant is qualified for all 4 categories then he/she gets 2, if the student is qualified for just 1, then he/she gets -1.

A total of 36 points could be assigned and the professional discretion criterion could be used as a tie breaker. The committee had several meetings to review and discuss the applications. The six committee members participated in ranking each applicant using the five criteria mentioned above.

Once the rankings were completed, ten students (due to the availability in our budget) were selected and notified by the Co-PI and PI through email, with scholarship acceptance and agreement packages attached, and they were given two weeks to respond. Nine students accepted the scholarship and one student declined. Some statistical characteristics with the final scholarship recipients are provided in Table 1, below. The recipients were not ethnically diverse. This may be attributed to the limited ethnic diversity at WCU. The recipients #8 and #9, found in Table 1, were awarded scholarships in Spring 2019. The recipients #2 and #3 were senior students majoring in Electrical Engineering during the time of application. In order to help fulfill the scholarship requirements associated with the Nuclear Power emphasis, and to enhance their educational experience, recipients #2 and #3 declared a second major in Engineering with an Electric Power concentration.

Table 1. Characteristics of Recruited Scholarship Recipients

Student	Gender	Race/Ethnicity	Major	Class
1	Female	White Non-Hispanic	Engineering, Mechanical	Junior
2	Male	White Non-Hispanic	Engineering, Electric Power and Electrical Engineering	Senior
3	Male	White Non-Hispanic	Engineering, Electric Power and Electrical Engineering	Senior
4	Male	White Non-Hispanic	Engineering, Mechanical	Junior
5	Male	White Non-Hispanic	Electrical Engineering	Sophomore
6	Male	White Non-Hispanic	Electrical Engineering	Sophomore
7	Male	White Non-Hispanic	Engineering, Electric Power	Junior
8	Female	White Non-Hispanic	Engineering, Electric Power	Sophomore
9	Male	White Non-Hispanic	Electrical Engineering	Junior

VI. End of First Semester Evaluation Results

The first evaluation activity made use of surveys distributed to both award recipients and a sampling of other students recruited into the electrical engineering (EE) and the engineering program with electric power (EPE) concentrations at WCU. These surveys were distributed in two different classrooms and had a total 31 respondents including five scholarship recipients. Although full analysis of the surveys is not complete, the results indicated that all NRC scholars agree that funding provided by NRC scholarship was important in their ability to pursue their degree. However, not all of them agree the scholarship has provided enough support to pursue their degree. The survey questions formed to help evaluate outreach and recruiting efforts were:

1. The application process for NRC was easy for me to complete.
2. The expectation for NRC scholars to maintain at least a 3.0 GPA overall within major is reasonable.
3. The funding provided by my NRC scholarship is important to my being able to pursue my degree.
4. I believe it is important for me to participate in NRC activities focused on recruitment of new students.
5. How did you learn about the NRC scholarship project?
6. How could the recruitment and application process for new NRC scholars be improved?
7. How could the NRC scholarship project be improved?

Likert-type options were used in the first four questions above. An open-ended answer approach was used in the remaining three questions. The survey results for these questions are provided below for a senior level (EE472) and a sophomore level (EE212) course (with or without NRC scholarship recipients).

> **Course 1:** EE472 – Advanced Power Electronics and Drives: Design and Analysis; n = 3; Number of NRC scholarship recipients = 2.

Course 2: EE212 – Instrumentation and Networks Laboratory; n = 28; Number of NRC scholarship recipients = 3.

Question #1: For Course 1, 2 out of 3 students strongly agreed or agreed that the application process for the NRC scholarships was easy to complete. One (1) student did not provide an answer to this question suggesting he did not apply for the NRC scholarships. For Course 2, 10 out of 28 students strongly agreed or agreed that the application process for the NRC scholarships was easy to complete. 8 students stated, 'not applicable', 6 remained 'neutral,' and 4 students did not answer this question, perhaps indicating that these students did not apply for the NRC scholarships. Figure 1 shows the details of the survey results for both courses combined excluding 'not applicable' responses.

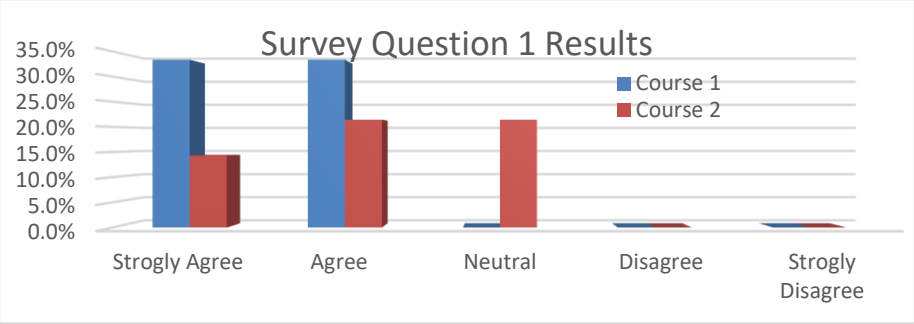

Figure 1. Responses to Survey Question 1. "The application process for NRC was easy for me to complete"

Question #2: In both courses, over 85% of students strongly agreed or agreed that maintaining a GPA of 3.0 overall within the major was reasonable in order to keep the scholarship. The detailed distribution of responses to this survey question in both courses are shown in Figure 2. The survey response "not applicable" was not an option in this question.

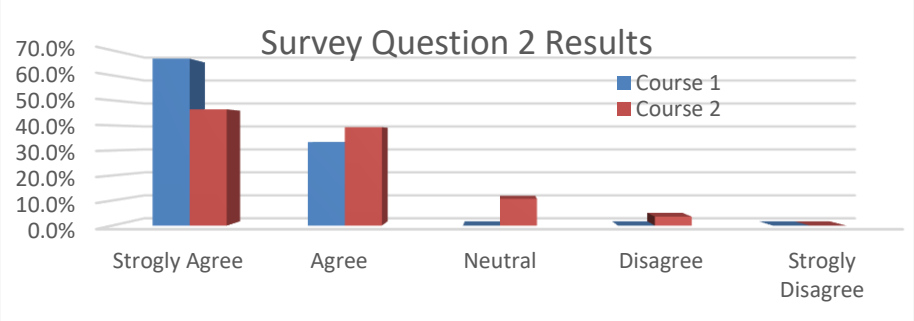

Figure 2. Responses to Survey Question 2. "The expectation for NRC scholars to maintain at least a 3.0 GPA overall within major is reasonable"

Question #3: In Course 1, there were 2 students receiving the NRC scholarship. Both students strongly agreed that the funding provided by NRC is important for pursuing their degree. The

remaining student responded that this did not apply, since he was not a scholarship recipient. In Course 2, there were 3 students receiving the NRC scholarship. However, 13 out of 28 students, including the scholarship recipients, either strongly agreed or agreed. The agreement indicated by these 10 students, who are not scholarship recipients, is possibly a hypothetical answer under the assumption of being a scholarship recipient. 8 students remained, 'neutral,' and 6 stated, 'not applicable,' suggesting that these students are neither NRC scholarship recipients nor informed about NRC scholarships. One (1) student, who is not an NRC scholarship recipient, disagreed that funding provided by NRC is important for pursuing his/her degree. This can be another hypothetical answer by a well-informed student about the scholarship.

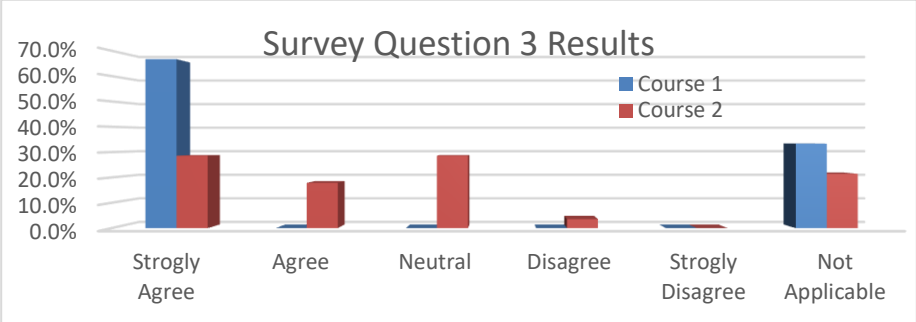

Figure 3. Responses to Survey Question 3. "The funding provided by my NRC scholarship is important to my being able to pursue my degree"

Question #4: In this question, the respondents were asked about the importance of participating in NRC activities focused on recruitment of new students. In Course 1, 2 students who are the scholarship recipients strongly agreed that it was important for them to participate in activities focused on recruitment of new students. One (1) student stated, 'not applicable' indicating this question did not apply to him, since he was neither NRC scholarship recipients nor was he really interested. The results in Course 2 had a broad spectrum of answers. 2 students strongly agreed, 12 students agreed, and 1 student disagreed with the statement in Question 4. All 3 scholarship recipients interestingly responded with the same "agree" answer. While 9 of the students remained neutral, 4 indicated that this question did not apply to them. It was quite surprising to see that 11 out of 28 students in Course 2, who were not NRC scholarship recipients, strongly agreed (2) and agreed (9) with the statement. The students' interest in the nuclear field and/or their spirit of volunteerism can be contributing factors to these responses. The details of the survey results to this question for both courses are shown in Figure 4.

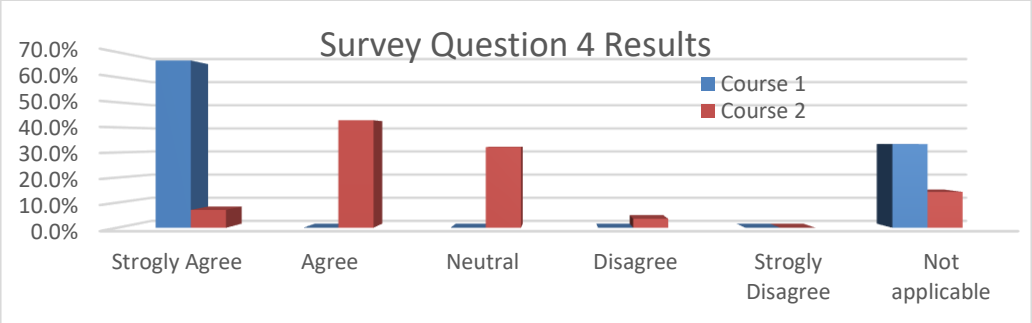

Figure 4. Responses to Survey Question 4. "I believe it is important for me to participate in NRC activities focused on recruitment of new students"

Question #5: In Course 1, when students were asked about how they learned about the NRC Scholarship project, 2 responses (scholarship recipients), indicated their 'faculty adviser/mentor' and 1 other response was 'email' and/or 'flyer'. In Course 2, the answers from NRC scholarship recipients included 'email' (1) and 'faculty adviser/mentor' (2). The responses from other students in Course 2 include 'email' (11), 'faculty adviser/mentor,' (3) and 'flyer' (1). Few students had dual responses including 'peers' and 'faculty adviser/mentor' (1), 'flyer' and 'email' (1), 'faculty adviser/mentor' and 'flyer' (1), and 'email' and 'peers' (1). Some students did not respond (2) or just learned at the time of survey (4) as they have never heard of this scholarship program before.

Among 31 respondents in both courses, 'email' was indicated as the best way of getting the word out, 'faculty adviser/mentor' was the second, 'flyer' and 'peers' was the least popular methods of reaching out. However, it is interesting to note that 4 out of 5 NRC scholarship recipients were reached through their 'faculty adviser/mentor,' which seems to be the most productive method of recruiting.

Question #6: Two specific and somewhat identical suggestions to improve the recruitment and application process for new NRC scholars in Course 1 were as follows:

1. Students need to be introduced to the scholarship program early in their college careers rather than later.
2. Reaching out to freshmen and high school seniors who are scheduled to attend WCU.

As mentioned before, NRC scholarships are only available to sophomore through senior level students. However, students in their early college career or earlier can be informed about the scholarship opportunity as a method of "long-term investing" in the scholarship program.

In Course 2, students' suggested methods of improvement which have not been previously explored were as follows:

1. More awareness
2. More aggressive advertisement
3. Posters
4. Making it available to international students
5. Clarifying the number of available scholarships
6. Through professors' announcements in classes

7. Word of mouth
8. Social media
9. Better description of the scholarship program

The 5th and 9th suggestions from Course 2 participants were related to application process improvements. The rest of the suggestions were related to the recruitment process. Only suggestions 2 and 6 were repeated by a few other participants. The other suggestions were specific to individual participants. Suggestion 4 would be unachievable since NRC scholarships are only available to U.S. citizens and permanent residents. The methods of improvements suggested in the 1st and 2nd items are somewhat similar but can be different as well dependent upon implementation. More aggressive advertisement may lead to more awareness, but the opposite may not always be true.

Question #7: In this question, overall suggestions to improve the NRC scholarship project were requested from the participants. Only a few applicable suggestions were noticed in both courses:

1. More knowledge needs to be known about the scholarship program before accepting the scholarship agreement.
2. Project PI needs and can use a helping hand.

Both suggestions came from the scholarship recipients. In terms of addressing the concern in the first suggestion, the project team specifically designed application assistance workshops to clarify all the specific concerns from the applicants in both recruiting cycles. Most likely, this recipient did not participate in the corresponding workshop of his/her recruiting cycle. The second suggestion is a valid concern that can be addressed by more organized recruiting efforts. One potential solution to address this concern can be to use some voluntary help from students as revealed by the responses of Question 4.

The number of scholarship applicants, as indicated in section IV, was somewhat low considering the size of scholarship provided. There are several factors that can be worth mentioning. First, the scholarship recipient, upon graduation, had a service requirement in a specific industry or academia. Secondly, an aversion among a majority of the students to nuclear-related employment was noticed after several interviews during the recruiting cycle. With this, the survey question number 6 revealed that students needed a better introduction and awareness of nuclear-related employment, which in turn would improve the recruiting process.

The project PI also serves in another college-wide scholarship committee as well. This college level scholarship program offers several scholarship opportunities with no specific requirements (such as no academic level or major restrictions) and provides only a small fraction of the resources available through the NRC scholarship. However, these scholarships tend to receive hundreds of applicants. On the other hand, larger-resource scholarships in the same program with specific major and/or discipline requirements, but no service requirement, tend to receive only a few applicants. These observations align well with NRC scholarship applicant trends. In addition, the NRC scholarship has more eligibility requirements than the larger-resource scholarships, however, it still recruits more students. One final factor for the small applicant pool is that there is a relatively low-level of financial need among the student body due to the low cost

of tuition at WCU. The applicant statistics shows that only less than half of the applicants were with financial need.

VII. Conclusions

A focused outreach and recruiting effort in the nuclear-related workforce development program WCU-NWD is described in this paper. In this study, the efforts of recruiting and outreach were concentrated to specific areas based on the results revealed by the previous recruiting efforts conducted by the project investigators[1]. Accordingly, more attention was given to existing students at WCU. According to the survey results in Question 5, the most effective recruiting effort was one-on-one outreach to individual students who were potentially interested in the scholarship program. Advising days at WCU were especially good mediums to reach out to potential applicants by the faculty. Although email announcements were effective tools for reaching out to potential applicants, the yield of return was somewhat limited. Another important conclusion from this study was the potential of using help from students in outreach and recruiting efforts. It was quite surprising to see in Question 4 that a good fraction of students, who are not NRC scholarship recipients, showed strong interest and enthusiasm in helping with recruiting efforts. This can be a valuable resource to be explored in the next recruiting cycles to expand the efforts of recruiting by the project faculty.

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