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THE ASSESSING WOMEN IN ENGINEERING PROJECT: A MODEL FOR SUSTAINABLE AND PROFITABLE COLLABORATION

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Women in engineering (WIE) programs work to recruit and retain women in undergraduate engineering programs and are a crucial part of the nation's effort to attract more women into engineering professions. For WIE programs to be maximally effective, they must have access to validated assessment instruments for measuring the effectiveness of their recruitment and retention activities. The Assessing Women in Engineering (AWE) project, sponsored by the National Science Foundation, aims to develop such instruments. This article describes the AWE project's unique collaboration between a WIE director and an assessment professional to develop exportable assessment instruments and models for WIE programs nationwide, thus allowing them to assess their programs' activities and ultimately provide data for making well-informed evaluation decisions.

INTRODUCTION

We know from the literature that effective collaborative relationships can have significant positive effects on all participants, including (a) higher achievement and greater productivity; (b) more caring, supportive, and committed relationships; and (c) greater psychological health, social competence, and self-esteem (e.g., Johnson & Johnson, 2002). This same literature tells us that the reasons for these positive results are based in working relationships in which participants are able to synergistically supplement one another's strengths as well as weaknesses or gaps in knowledge and skills. They are then able to combine knowledge and experience to create a new understanding of problems to help one another achieve desired goals. This article describes a relatively unusual collaboration in the women in engineering (WIE) and engineering education community: a collaborative partnership between a WIE program director and an educational assessment professional (AP), who are creating validated assessment tools for WIE directors. Although such partnerships have existed before, this one offers the unique attributes of an ongoing, in-depth relationship between the two professionals that is resulting in more carefully crafted assessment tools and implementation processes. These deliverables have the potential to promote systemic change in WIE programming and practice. This in-progress partnership, realized through the Assessing Women in Engineering (AWE) grant from the National Science Foundation (NSF; Marra & Bogue, 2001), is responding to the need for validated and easy-to-use

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assessment tools for WIE directors and is providing educational APs with in-depth insights into the culture of the assessment discipline.

In this article, we examine the characteristics of each partner's contributions in the context of the AWE project, the benefits of such a partnership, what this partnership is accomplishing, and how other such partnerships can be developed at other institutions. We begin by describing the national problem situation that brought us together in this partnership.

THE PROBLEM TO ADDRESS: ASSESSMENT IN WIE

Many sources and historical data have shown the consistently low representation of women in undergraduate engineering curricula and in the engineering workforce. Specifically, women constitute approximately only 20% of undergraduate engineering school enrollment nationwide and only about 8.5% of America's engineers (Goodman et al., 2002).

Establishing WIE programs at approximately 50 colleges and universities around the United States has been one response to this situation (Marra & Bogue, 2001). WIE programs serve to both widen the pipeline for K-12 women and girls and then become reservoirs and pumping stations for many of the undergraduate, graduate, and sometimes female faculty members in colleges and universities. Anecdotal and research results on specific programs show that WIE programs do have an impact on the goal expressed by the NSF and other engineering and science industrial and academic leaders to broaden the participation of girls and young women in engineering and technology (Cunningham, Thompson, Lachapelle, Goodman, & Bittinger, 2000; Heller & Martin, 1994; Mannix, 2001; National Science Foundation, 2001; Thompson, Cunningham, Lachappell, Bittinger, & Goodman, 2001). Nonetheless, the development of effective assessment and evaluation of WIE programs' activities (e.g., their recruitment and retention activities) and the overall programs themselves is still in its infancy.

Certainly, there are significant externally funded assessment activities that have focused on longitudinal studies of some of the larger WIE programs at Purdue University, Dartmouth University, and the University of Washington (Brainard & Carlin, 1997; Muller & Pavone, 1997). However, these are the exception, not the rule, in terms of both funding and effort level and the types of analysis used. Furthermore, these efforts do not address vital assessment questions such as these: Is a particular activity meeting its recruitment or retention objectives? What impact is it having on student enrollment or persistence? Should we continue this activity or use limited resources to fund another, more effective activity? What would be more effective?

We recognize that there are good reasons for the state of assessment activities in WIE programs. The Women's Experiences in College Engineering Project's interviews with 28 WIE directors from 26 institutions provide valuable insights into WIE programs and directors that reflect on assessment and evaluation (Goodman et al., 2002; Thompson et al., 2001). Several findings from this report are pertinent. First, not surprisingly, time is of the essence. The WIE directors described their time as generally being divided between four major activities: recruiting, retention, fundraising, and advising students. Second, at most institutions, the WIE staff is very small and fragmented. In their sample, Thompson et al. (2001) found that only 9 of the 28 directors interviewed indicated that they had full-time staff members, and it was not reported whether these were financed via "hard" or "soft" funding. Additionally, not all directors worked full-time on WIE.

Data from our own survey of WIE directors support and expand on Thompson et al.'s (2001) findings (Bogue & Marra, 2001). Not only do few directors work full-time, their support staff members generally do not work full-time, and often, there are multiple support staff members, each working in some unique part-time arrangement, typically on "soft" funding. The result is that WIE staffing is fragmented, making continuity and comprehensiveness in activity execution and follow-up difficult, if not impossible. Regarding assessment in particular, there is little time to devote to developing valid and reliable assessment instruments; even if data are collected, there may not be adequate time or expertise to usefully analyze or even compare the results longitudinally. Thus, the state of WIE programs (e.g., funding and staffing levels, lack of time, staff expertise) makes partnership with APs potentially beneficial.

Our partnership developed in the context of a project for an NSF (2001) grant from the Program for Gender Equity to accomplish the following goals:

- Develop exportable, valid, and reliable quantitative[1] assessment tools for WIE activities (e.g., mentoring or orientation activities as opposed to an entire WIE program).
- Educate WIE directors on the benefits of assessment and means of accomplishing it.

To accomplish these goals, we are working over a 3-year period with programs at five universities: the Georgia Institute of Technology, Rensselaer Polytechnic Institute, the University of Texas at Austin, the University of Louisville, and the University of Arizona. With these programs, which collectively represent a variety of private and public institutions, years of experience for WIE directors, and student body characteristics, we are developing, piloting, revising, implementing, conducting preliminary data analysis on, and disseminating easy-to-access, reliable, and valid assessment instruments. Ultimately, all participating institutions will use the same set of instruments, thus allowing them to have access to powerful benchmarking data in addition to the data from each of their respective institutions.[2] At this writing, we have conducted in-depth literature reviews on WIE and assessment as the basis for instrument development, are conducting longitudinal needs assessment and benchmarking activities with our participating programs, have developed and completed the pilot testing of five separate instruments, are conducting longitudinal data collection and analysis to track the overall effects of participating in WIE activities, and are documenting our instruments and developing a Web site for dissemination.

A SOLUTION APPROACH: EFFECTIVE COLLABORATION

An effective partnership or collaboration must offer synergistic advantages to all parties involved. This section provides an overview of the two types of positions represented in this

[1]Although we realize and appreciate the benefits of using qualitative methods for assessment, we felt that the time-intensive nature of qualitative methods would be prohibitive to WIE directors, who are already short on time and will struggle to implement any sort of meaningful assessment. Therefore, our project focuses strictly on developing quantitative instruments.

[2]Further, during project dissemination, the instruments will be made more broadly available to WIE programs in North America. Refer to the AWE project's Web site (http://www.aweonline.org) for details.

partnership: WIE directors, identified here as subject matter experts (SMEs) and APs; the problems both of these positions face in performing their jobs; and an introduction to how this partnership can address these problems and provide mutually advantageous working arrangements for both.

The WIE SME

In the AWE partnership, the WIE program director serves as an SME for the AP in the discipline of WIE. To describe how the partnership affects WIE programs, we first provide some background on how WIE programs operate. WIE programs serve many functions, but their primary responsibilities focus on the recruitment of women into engineering undergraduate programs and then the retention and development of those same women within their programs of study. Initially, this may sound well defined, but the ways in which WIE programs work to accomplish these outcomes vary tremendously.

Recruitment happens at multiple phases and levels. In the community of scholars and practitioners who address WIE, there exists a high level of awareness and research showing the importance of starting recruitment efforts at an early age. WIE programs with Girl Scouts, for example, are designed to help maintain interest in math and science and raise awareness of engineering as a career path for these girls (Lucena, 2000; Women in Engineering Programs & Advocates Network, 2001). Recruitment efforts for older students include "open houses" held on college and university campuses and summer engineering camps where successful activities result in participants electing to apply to the sponsoring WIE programs' engineering programs.

Once the students arrive, WIE program retention efforts work to counteract the trend of significantly larger percentages of women dropping out of engineering undergraduate programs relative to their male counterparts (National Science Foundation, 1996, 2000; Seymour & Hewitt, 1994). Undergraduate retention activities are aimed at supporting students, helping them develop the skills they will need to succeed in their engineering studies; less frequently, they are aimed at changing the climates in which students are immersed. Student activities include 1st-year student orientations, skills development programs (e.g., using tools to tear apart and rebuild an engine), peer and professional mentoring, residence hall programs that cluster engineering students together for ongoing peer support, female-clustered math and science courses, academic advising and career counseling, resume development, and others. Broader climate activities include faculty development programs and revamping curricula.

In summary, the WIE director SME engages in the following tasks:

1. developing targeted recruitment and retention programming, working with a variety of paid and unpaid employees;
2. meeting with students individually to advise and/or counsel on career planning and academics;
3. developing funding streams to support programming; and
4. working with college and university constituencies to develop awareness of women's issues and to justify the continuation of the WIE program.

All of these activities can be strengthened by access to better assessment methods and instruments.

The AP

The other member of this partnership is an instructional designer, the AP, who focuses her efforts on assessment activities while the WIE director SME focuses on the development and implementation of programming to recruit and retain girls and women in engineering. Just as SMEs experience difficulties in attempting to develop and implement assessment tools that would provide them with data critical to the improvement and success of their program goals, APs experience similar problems. Gaining in-depth access to discipline area knowledge necessary to create high-quality assessment instruments and conducting complete assessment instrument implementation and follow-through to achieve lasting change from the assessment activities can be very challenging.

The terms *assessment* and *evaluation* are often confused or used interchangeably. *Assessment* refers to gathering data and/or information that measures the impact of a certain activity relative to its objectives (Scriven, 1991). In contrast, *evaluation* refers to the judgment of a program or activity based in part on assessment data. Assessment tools are specifically designed to gather data associated with the goals and/or objectives of an activity. For example, a WIE peer mentoring activity may aim to (a) reduce feelings of isolation for younger female engineering students and (b) increase retention in key 1st-year and sophomore engineering core courses such as calculus and introductory physics. Assessment instruments for this activity would be designed to measure its effectiveness in terms of those two objectives. Instruments might include a pre- and postintervention student surveys to examine students' sense of isolation and tracking of grades and retention figures in key courses. After assessment data are gathered, descriptive statements can be made about the results.

The purposes of assessment are varied and depend on one's perspective (Dietel, Herman, & Knuth, 1991; Linn, 1993; Nitko, 2001; Scriven, 1991). For instance, educational policy makers use assessment to set standards, monitor the quality of education, or formulate policies, whereas teachers may use assessment to perform the individual diagnosis of performance problems, monitor overall student progress, and plan and improve curricula and teaching. As such, an educational AP engages in the following tasks:

1. working with an SME in the area targeted for assessment to determine the goals, objectives, and outcomes of the intervention that is to be assessed;
2. developing valid assessment tools to measure desired outcomes;
3. alternatively, helping choose existing assessment instruments that are relevant to the intervention's intended outcomes;
4. implementing finalized instruments;
5. reporting assessment data; and
6. helping interpret assessment data to affect organizational or systemic change with resulting data.

Next, we briefly elaborate on Items 1 and 2 from the above list, examining the impact on both partners.

Partnership Activities: Working With SMEs to Determine Intervention Goals, Objectives, and Outcomes

APs cannot operate effectively in a vacuum. Even though an AP may have the skills needed to develop and implement valid and reliable (see below) assessment instruments, he

or she must do this design and development for a specific program, course, or other intervention within a discipline or content area. No AP can be an expert regarding the desired behavioral or learning outcomes in every discipline area, and thus he or she, must work with an SME to effectively define and operationalize these outcomes or objectives and subsequently determine how to measure them.

An SME is an individual who can provide expert knowledge on the targeted content area (Clark, 1999; Rossett, 1987). In the case of WIE programs and interventions, SMEs may be WIE directors or staff members, academics who have studied factors that affect the success of WIE, or potentially other members of the engineering administration or faculty. An SME should be able to work with an AP to define the intended outcomes or objectives of the activity that needs to be assessed. As described, these objectives may be behavioral, attitudinal, or directed at learning performances.

An objective or a learning outcome is a statement of what a learner or program participant will be able to do or how she will feel or behave after having participated in an activity. For a more formal learning experience, such as a college course, one would expect to have a whole list of course objectives focused on skills and knowledge a learner should attain. For example, "When the learner completes this course, she will be able to (a) identify the parts of an internal combustion engine, (b) disassemble a simple internal combustion engine, and (c) reassemble a simple internal combustion engine."

Objectives may also be attitudinal or behavioral. For instance, after participating in a WIE activity, a WIE director may wish for a participant to choose to hold certain beliefs (e.g., "I believe that women can be successful as engineers") or attitudes (e.g., "I have a positive attitude about participating in an undergraduate engineering program") or to behave in certain ways (e.g., "after participating in the WIE high school information session, a participant will choose to apply to the undergraduate engineering program at Penn State").

One may think that determining these objectives would be relatively easy for an SME, but in fact, many SMEs are so closely involved with the details of implementing their activities that they may not have taken the time to explicitly define the activities' objectives or may be unaware of the value of setting objectives as part of program development. For instance, a WIE director may hear about a "successful" mentoring program at another institution and decide to implement her own. Although this WIE director SME may have an idea of what she hopes to accomplish with this program, she may not have explicitly identified the intended behavioral, attitudinal, or learning outcomes intended for the program. An AP works with the SME to make these objectives explicit. Only when the AP knows exactly what the intended objectives for a program or intervention are can he or she develop assessment instruments that measure for them. Figure 1 shows two sets of "objectives" for an undergraduate WIE student mentoring program. The first set is somewhat vague, general, and ill defined, whereas the second set is measurable, stated in very explicit terms describing changes one wishes to see as a result of this program in student behaviors, attitudes, and learning performances.

Partnership Activities: Develop Valid Assessment Tools to Measure Desired Outcomes

A major part of developing assessment instruments (even survey instruments) is to ensure that they are both valid and reliable. An instrument that is reliable produces the same results consistently. Tanner (2001) describes instrument reliability as the "degree to which

Sample Mentoring Activity Objectives

Imprecise objectives:	Precise objectives:
• Improve participant performance in engineering classes.	• Reduce participants' feelings of isolation within the college of engineering. • Increase grades of participants in engineering classes.
• Improve participant attitudes.	• Increase participants' feelings of inclusion within the college of engineering. • Increase participants' feelings of self-efficacy in engineering. • Provide positive role models for participants. • Increase participant access to information and skills necessary to be successful in an undergraduate engineering curriculum.

Figure 1. Sample objectives for a mentoring activity.

measurement data are stable" (p. 361). In other words, if one were to administer the same test or survey to the same set of learners under similar conditions, would it produce the same results? An underlying assumption of the concept of reliability is that the relevant conditions must remain stable to attain consistent and reliable measurements. These relevant conditions might include learners' understanding of and experience with the domain being assessed and the environmental conditions of the assessment activity.

Validity, on the other hand, is concerned with whether assessments are actually measuring what they are intended to measure. For instance, one can create a set of objective test items designed to measure an individual's ability to solve force problems in physics. To ask whether an assessment instrument is valid is to ask whether the score that a learner received for his or her performance on a multiple-choice physics exam is really a valid representation of what he or she knows about force problems in physics. Validity issues also apply to developing survey instruments. An SME may wish to develop a survey to assess the degree to which a peer mentoring program affected female students' feelings of isolation in an undergraduate engineering curriculum. It is the job of an AP to ensure that the survey in fact does contain a set of items that will measure that objective.

AP Challenges

Just as a WIE SME may not have the time or expertise to build high-quality assessment instruments for his or her activities, an AP often has difficulties effectively performing tasks necessary for producing high-quality assessment instruments. Typical problems include

- a lack of time with an SME, which is critical in establishing objectives and content for assessment instruments and a commonly documented problem for instructional design personnel (Rossett, 1987);
- a lack of access to pilot subjects for instrument reliability testing;

- a lack of access to stakeholders and other key personnel in a discipline area, critical for instruments and processes to be adopted (Matter, 1999); and
- convincing and educating WIE SMEs about the expertise that APs bring to working relationships.

In WIE, too often, activities are measured with instruments developed on the fly or borrowed, with little understanding of the expertise required to develop effective assessment. For a collaboration to be effective, an AP must build the SME's understanding of the AP's skill set so that the SME will be an effective, critical, and worthwhile collaborators.

PARTNERSHIP RESULTS AND EXAMPLES

The partnership just described has resulted in products and processes that exceed the capabilities of what would have been possible had either member worked alone. We present one example each for the AP and the WIE director SME.

Example From the Perspective of the AP

In addition to addressing all of the "AP challenges" listed above, the in-depth contact between the WIE SMEs and the AP has helped the AP gain in-depth insight into the culture in which final instruments would be implemented, thus allowing the AP to fine-tune the instruments in ways to promote adoption in the discipline area. The example that follows shows the value of this partnership and further addresses one of the AP's challenges: that of gaining a sufficient understanding of the discipline and its stakeholders to develop relevant and effective instruments and to encourage instrument adoption.

The situation described occurred as we worked on the postprogram instrument for mentored students. To appreciate the significance of this example, one must understand that these instruments are designed to measure specific factors related to the success of women in undergraduate engineering curricula that a mentor program might affect. These factors include networking skills, feelings of isolation or inclusion, the presence or absence of role models, and whether students feel part of a community in their engineering programs. For instance, Items 1 to 4 in Figure 2 are designed to assess feelings of isolation or inclusion.

There are two things that make this instrument different from what WIE directors may be used to seeing in assessment instruments. First, the items are designed to measure the underlying factors that mentoring programs should affect (e.g., feeling isolated), yet these items do not refer directly to the mentoring program or activities. These items are designed to be administered in a pre- and posttest fashion and thus will measure any change in participants' responses. We then use statistical analysis methods to correlate the responses on items relevant to each factor with data on individuals' participation levels in the mentoring activity (gathered elsewhere in the posttest instrument). This type of assessment is in contrast to beliefs-based surveys, in which we ask participants to "self-report" on how a particular activity such as mentoring may have affected them (e.g., "The mentoring program made me feel more connected to the college of engineering: agree, disagree"). Although such data have their place in some assessment activities, it is generally an unreliable method for ascertaining if a participant's actual behaviors or feelings have been altered. The second way this instrument differs is in its overall absence of student satisfaction items (e.g., "Overall, how satisfied were you with the mentoring program?").

Directions: Items 1 through 4 are statements about studying engineering. To the **left** of each statement indicate whether you **Strongly Disagree, Disagree, Neither Disagree** nor **Agree, Agree,** or **Strongly Agree** by circling the appropriate number. To the **right** of each statement circle the appropriate number to indicate whether the statement is **Very Unimportant, Unimportant, Neither Important** nor **Unimportant, Important,** or **Very Important** to you in terms of completing your engineering degree. Please circle one response per item in both the **Agree** and **Important** columns.

To what extent do you AGREE?	How IMPORTANT is this?
0 = Strongly Disagree	0 = Very Unimportant
1= Disagree	1 = Not at all important
2= Neither Disagree nor Agree	2 = Neutral
3 = Agree	3 = Important
4 = Strongly Agree	4 = Very Important

1. 0 1 2 3 4..... I feel I can relate to the people around me in my classes..... → 0 1 2 3 4
2. 0 1 2 3 4..... I feel I can relate to the people around me in my extra-curricular activities.. → 0 1 2 3 4
3. 0 1 2 3 4..... I have positive role models of practicing female engineers..... → 0 1 2 3 4
4. 0 1 2 3 4..... I feel that I have a lot in common with the other students in my classes..... → 0 1 2 3 4

Figure 2. Sample items from postactivity survey of mentored students.

Operating alone as an AP, these differences did not appear problematic; in fact, the AP had considered them the main strengths of the instrument. However, the SME (Bogue) pointed out that, taken together, these differences potentially make this instrument appear unfamiliar to WIE directors and nonresponsive to their need to gather formative feedback on an activity, and ultimately may be seen as not worth the time it takes to administer to participants. Bogue indicated that if we wished for our WIE participants to use the instrument, we not only needed to measure the impact of the program on the factors mentoring programs should affect but also provide some formative evaluation items[3] that would more directly help WIE directors improve their mentoring programs. This conversation resulted in adding student satisfaction and formative feedback items to the instrument (see Figure 3).

[3]Formative evaluation is conducted to provide information that can improve an activity that is still under development or subject to revisions.

Directions: The items below are statements about different aspects of the mentoring program. To the **left** of each statement indicate whether you are **Not at all Satisfied, Somewhat Dissatisfied, Neither Satisfied** nor **Dissatisfied (neutral), Satisfied,** or **Very Satisfied** by circling the appropriate number. To the **right** of each statement circle the appropriate number to indicate whether the statement is **Very Unimportant, Unimportant, Neither Important** nor **Unimportant, Important,** or **Very Important** to you in terms of completing your engineering degree.

Your mentor's ability to answer your questions about the engineering curriculum.

The quality of the match between you and your mentor.

Your overall satisfaction with your assigned mentor.

Your overall satisfaction level with all aspects of the mentor program.

Figure 3. Sample of student satisfaction and formative feedback items added to the survey of mentored students.

This was an "a-ha" moment for the AP (Marra). With the AP's focus on designing a valid assessment instrument for mentoring programs, and thus an instrument that was very tightly based on the objectives of the program, she had totally overlooked the existing culture within which WIE directors generally operate. For Bogue, as the WIE SME, the instrument absolutely required formative items in addition to the objectives-based items designed by Marra. We both recognized that the instrument may still seem unfamiliar to WIE directors, even with the addition of the formative items. However, by raising the AP's awareness of this issue and adding the formative items, we addressed directors' real needs and laid the groundwork for addressing the unfamiliar items via conversation and training to help promote the adoption of this and other such instruments.

This example illustrates another advantage of the partnership. Although the different sets of expertise and backgrounds that each partner brings to the relationship sometimes result in our operating with different assumptions or using a common label in disparate ways, it is exactly when we recognize these disconnects that we make significant progress toward the complementary goals of creating both valid and usable assessment instruments.

Example From the Perspective of the WIE SME

As a WIE director, the everyday demands of recruitment, retention, advising, and fundraising typically leave little time for effective assessment, although such assessment is integral to successfully carrying out those activities. Even administrators with the ability to develop assessment tools simply lack the time. Having the opportunity to develop long-term assessment tools that effectively address the objectives of WIE programming with an AP meets a universal and foundational need. From the WIE director's point of view, the AP-SME partnership offers

- a heightened awareness and understanding of assessment as an effective program development and planning tool and a valid, directed way to assess the value of programming, which in turn increases motivation to undertake and follow through on effective objective-based assessment;
- assessment results that provide a sound basis for improving programming and the accessing and deployment of scarce resources; and
- active participation in the development of assessment instruments through sustained interaction with an AP who is engaged in the outcomes and who has developed an in-depth understanding of the literature and contemporary issues in my field and of the culture in which programming is delivered, including the opportunity for the SME to actively influence the shape and delivery of assessment instruments as the assessment expert develops them.

A high school camp for girls provides an example of how an effective SME-AP partnership can specifically affect the day-to-day decisions of a WIE director. In 2001, Penn State introduced a weeklong residential camp for junior and senior high school girls designed to introduce them to engineering and to recruit them to Penn State. The camp objectives were to

- introduce girls not identifying engineering as a potential major to engineering, with the expected outcome of a high percentage of uncommitted girls becoming interested;

- recruit girls to Penn State, with the expected outcome of girls applying to Penn State; and
- provide leadership experience for upper-level women, with the expected outcomes of women being retained at higher levels and increased commitments to engineering.

By all typical measures, the camp was a success. In the precamp survey, 5% of participants indicated that they wanted to become engineers, compared with 100% in the postcamp survey. The postcamp survey also showed that 13 of 15 senior participants (87%) indicated their intent to study engineering at Penn State. In postcamp survey items that gathered formative and student satisfaction data, participants also reported high approval ratings of the camp's organization, hands-on activities, and mentors.

The postcamp survey was designed prior to the SME's partnership with the AP. After their partnership began, the SME and the AP reviewed the postcamp survey and the results. With the AP's expertise together with the SME's increased understanding of assessment resulting from the partnership, the SME realized that the data collected on the postcamp survey provided a report of participants' overall satisfaction levels (e.g., they liked the activities and the camp overall) but did not provide information on whether the camp's objectives were met. Even results that showed that most of the senior participants planned to apply to study engineering at Penn State were not convincing, because data gathered immediately after an event at which the participants had fun are inevitably skewed. A participant's newly found commitment to go into engineering may well be a function of her enjoyment of the camp experience, not a reliable predictor of her future behavior (i.e., will they actually apply to Penn State?); unfortunately, most commonly used assessments fail to address this. To measure the true impact of the experience on a participant's commitment to studying engineering, one must administer a survey and track behavior a few months after the event, when the initial excitement has worn off. However, this is often not economically feasible, as was the case with this camp.

Although the postcamp survey results were ultimately not very useful, the AP and the SME located other data that reflected on the success of the camp relative to its objectives. By tracking camp participants, we were able to ascertain that of the 13 senior campers who reported their intention to attend Penn State, only 2 applied. Of those, only 1 was accepted. The SME also did a time analysis of camp activities, only to discover that campers spent most of their time eating and moving from the dorm to the various locations for the hands-on activities and only 10% on engineering and engineering-related activities. Just as significantly, the analysis indicated that most of the staff members' time was equally misdirected. These results pointed to outcomes that were radically different than the postcamp survey data; the campers may have been having a lot of fun, but the camp's core objectives were not being met. Nor was the camp cost effective in terms of yielding viable applicants to Penn State.

With this more accurate picture of the camp's outcomes relative to its objectives, the WIE director SME was able to change the camp from a weeklong residential camp to a day camp offered in modules that would allow girls to attend the camp for anywhere from 1 to 5 days. Specific revisions included eliminating as many of the peripheral activities as possible and focusing camp time on delivering hands-on engineering experiences that directly addressed camp objectives. This example illustrates how the WIE director SME's partnership with the AP resulted in realizing the weaknesses in the existing assessment data, finding actual behavioral data to describe the impact of the camp, and, on the basis of valid

assessment data, making revisions to the camp that allowed it to meet is objectives while expending fewer WIE program resources.

CONCLUSIONS

This article describes a collaborative partnership between a WIE director and an educational AP. To date, the collaboration has resulted in outcomes, the instruments and career development tools described above, that would not have been possible had either professional been working alone. Less visible are the intangibles: the increased efficacy of assessment instrument and plans based on a foundation with equal parts of AP and SME input that result in valid and usable data for strategic decision making and the deployment of scarce resources.

The benefits of collaborations between APs and SMEs are clear. When WIE directors operate without the input of APs, the disconnect between the apparent success of an activity and its inability to meet objectives can go undetected, as can the opportunity to enhance the activity, make more informed programmatic decisions, and attract and sustain funding. When APs develop instruments without an in-depth understanding of an alternate discipline or the context in which instruments will be implemented, the resulting tools and/or data can be useless. Working as a team can ensure the development of well thought out assessment instruments that are integrated into an activity from the beginning planning stages and the ultimate desired result for WIE programs: enhanced programming. As important for environments in which soft funding is the norm, this type of collaboration creates a team with the potential to attract more external funding. Funding organizations are often looking for evidence of a project team that can bring to bear a larger set of skills and resources than individuals from a single discipline can garner.

The benefits to both partnership members have been significant, and all have been derived from a heightened level of the combined expertise created by the partnership. In our case, the AP brings critical analysis, design, and assessment expertise to WIE, and the WIE director brings essential subject matter expertise to the project, cultural insights that support the development and adoption of more effective instruments, and a meaningful context for the designer to practice his or her trade. Additionally, by bringing these two academic discipline areas together, we expand our joint understanding of the issues, challenges, and desired outcomes; create significantly more opportunities for dissemination of our results; and provide wider exposure for WIE issues to individuals who previously may not have been aware of such issues.

The AWE project has provided an opportunity for a productive AP-SME partnership, resulting in outcomes that are more than the sum of their parts. In addition to the development and anticipated dissemination of tested and validated assessment instruments, AWE is yielding valuable career development tools that will help WIE professionals improve the efficacy and productivity of their programs and activities. Further, we hope these professionals can take advantage of what we are learning from this model to implement their own partnerships with the overall goal of providing more effective educational experiences for our students.

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