

AWE: A Model for Sustainable and Profitable Collaboration

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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-esteem¹. This same literature tells us that the reasons for these positive results are based in working relationships where the participants are able to synergistically supplement each other's weaknesses or gaps in knowledge and skills. They are then able to combine knowledge and experience to create a new understanding of problems in order to help each other achieve desired goals. This paper describes a relatively unusual collaboration in the Women in Engineering / Engineering Education community – a collaborative partnership between a Women in Engineering (WIE) program director and an educational assessment specialist. 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 that can promote systemic change in WIE. This in-progress partnership which is being realized through the NSF-funded “Assessing Women in Engineering” (AWE) grant² has allowed the WIE director (and other WIE directors nationwide) access to validated and reliable WIE activity assessment instruments and also providing educational assessment professional with in depth insights into the culture of the assessment discipline.

In this paper we examine the characteristics of each partner's contributions, the benefits of such a partnership, what this partnership is accomplishing, and how other such partnerships can be developed at other institutions.

Overview / Related Literature

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 partnership – WIE directors and assessment experts; 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.

Women in Engineering Directors

Many sources and historical data have shown the consistently low representation of women in undergraduate engineering curricula and in the engineering workforce. Specifically, women comprise approximately only 20% of undergraduate engineering school enrollment nationwide and only about 8.5 % of the United State's engineers³.

Women in engineering (WIE) programs located at approximately 50 colleges and universities around the country have been one response to this situation³. WIE programs serve a "gate keeping" function for young women as they begin their educational preparation to become practicing engineers. WIE programs serve many functions, but their primary responsibilities focus on recruitment of women into engineering undergraduate programs and then 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 that address women in engineering, there exists a high level of awareness and research that shows the importance of starting recruitment efforts at an early age. WIE programs with Girl Scouts, for example, are designed to help maintain an interest in math and science and raise awareness of engineering as a career path for these girls^{4,5}. Recruitment efforts for older students include "open house" days held on college and university campuses and summer engineering camps. Such programs involve significant follow-up with participants as directors work to recruit these students into their engineering programs.

Once the students arrive, WIE program retention efforts work to counteract the trend we see of significantly larger percentages of women dropping out of engineering undergraduate programs relative to their male counterparts^{6,7,8}. Retention activities are aimed at supporting students as well as changing the climate in which students are immersed. Student activities range from first-year student orientations, skills development programs (e.g. using power 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, and career counseling and resume development. Broader climate activities include faculty development programs, revamping curricula, and overall retention tracking that tracks exposure to specific programs.

WIE programs serve to both widen the pipeline for K-12 women and girls and then become a reservoir and pumping station for many of the undergraduate, graduate and sometimes women faculty in the colleges or university. Anecdotally and through research on specific program activities, we know that WIE programs have a tremendous impact on the goal expressed by the National Science Foundation (NSF) and other engineering and science industrial and academic leaders to broaden participation of girls and young women in engineering and technology^{9,10,11,12,13}. Nonetheless, the current development of assessment and evaluation of WIE program's activities (e.g. the recruitment and retention activities) and the overall programs themselves is still in its

infancy. .

Certainly there have been significant externally funded assessment activities that have focused on longitudinal studies of some of the larger WIE programs at Purdue, Dartmouth and the University of Washington ^{14,15}. However, these are the exception and not the rule both in terms of funding and effort level, and the types of analysis used. Further, these efforts do not address vital assessment questions such as these: Is this activity meeting its objectives? What impact is it having on students? Should we continue this activity or use limited resources to fund another, more effective activity? What would be more effective?

We also recognize there are good reasons for the results we found in our literature review. The Women's Experiences in College Engineering Project's (WECE) interviews with 28 WIE directors from 26 institutions provide valuable insights into WIE programs and directors that reflect on assessment and evaluation ^{3,13}. 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. Secondly, at most institutions the WIE staff is very small and fragmented. In their sample, Thompson, et al found that only 9 of the 28 directors interviewed indicated they had full time staff and it was not reported whether these were financed via "hard" or "soft" funding. Additionally, not all directors were full time on WIE but rather divided their time between WIE and other activities ¹³. Data from our own informal survey of WIE directors supports and expands upon Thompson's findings ¹⁶. Not only are few directors full time, their support staffs are generally not full time and often there are multiple support staff each working in some unique part-time arrangement. The result is that WIE staffing is fragmented, making continuity and comprehensiveness in activity execution and follow-up difficult if not impossible. All of this would imply that directors spend their time mostly in the four areas reported by WECE and much of that is spent on recruiting and retention activities. This together with low staffing levels would indicate there is little time to devote to developing valid and reliable assessment instruments, and even if data is collected, there may not be adequate time or expertise to usefully analyze it.

Assessment Specialists

The other member of this partnership is an instructional designer who focuses her efforts on assessment activities – we'll refer to her as an “assessment specialist” (AS) in this paper. Just as WIE directors 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, ASs 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 in order 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 measure the impact of a certain activity relative to its objectives¹⁷. In contrast evaluation refers to a 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 the activity in question. For example, a WIE program that has a peer

mentoring program includes objectives to a) reduce feelings of isolation for younger women engineering students, and b) increase retention in key first-year and sophomore engineering core courses such as Calculus I and II and Introductory Physics. Assessment instruments for this program would be designed to measure the program's effectiveness in terms of those two objectives. Instruments might include a pre- and post-student survey to examine students' sense of isolation and tracking of retention figures in key courses. After assessment data is gathered, descriptive statements can be made about the results.

The purposes of assessment are varied and depend on one's perspective¹⁷⁻²⁰. For instance educational policymakers use assessment to set standards, monitor the quality of education, or formulate policies, while teachers may use assessment to perform individual diagnosis of performance problems, monitor overall student progress and to plan and improve curriculum and teaching. As such, an educational assessment professional engages in the following tasks:

1. Working with subject matter experts in the area targeted for assessment to determine the goals, objectives and outcomes of the intervention that is to be assessed;
2. Develop valid assessment tools (whether traditional or rubrics) to measure desired outcomes;
3. Alternatively, helping to choose already-existing assessment instruments that are relevant to the intervention's intended outcomes;
4. Implement finalized instruments for the desired program or intervention;
5. Report assessment data; and
6. Help to interpret assessment data in order to affect organizational or systemic change with resulting data.

For purposes of brevity, we elaborate on only a subset of these.

Working with subject matter experts in the area targeted for assessment to determine the goals, objectives and outcomes of the intervention that is to be assessed.

Assessment professionals cannot operate effectively in a vacuum. Even though an assessment professional 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 assessment professional can be an expert regarding the desired behavioral or learning outcomes in every discipline area and thus he or she must work with subject matter experts in order to define and operationalize these outcomes or objectives.

A subject matter expert (SME) can be any individual who can provide expert knowledge on the targeted content area^{21,22}. In the case of WIE programs and interventions, SMEs may be WIE directors or staff members, or potentially other members of the engineering administration or engineering faculty. The SME should be able to work with the assessment professional in order 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 the learner or program participant can do, or how she will feel or behave after having participated in some instructional activity or in the case of WIE programs, after having participated in WIE activity. For a more formal learning experience, such as a college course, one would expect to have a whole list of learning outcomes for that course. They are usually stated in the form of “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; c) reassemble a simple internal combustion engine.”

These objectives are skills or knowledge that the learner should have when he or she completes this course, however objectives may also be attitudinal or behavioral. For instance, after participating in a WIE activity, the WIE director may wish for the participant to choose to hold certain beliefs (e.g. “I believe that women can be successful as engineers”), attitudes (e.g. “I have a positive attitude about participating in an undergraduate engineering program”), or behave in certain ways (e.g. after participating in the WIE high school information session, the participant will choose to apply to the undergraduate engineering program at Penn State University).

It is essential that the assessment expert have access to a complete list of the desired outcomes or objectives for the program or course for which she is designing assessment. These objectives or outcomes tell the assessment expert what her instruments should be designed to measure. One may think that determining these objectives would be relatively easy for any SME, but the fact is many SMEs are so closely involved with the details of implementing their program or activity that he or she may not have taken the time to explicitly define its objectives or, in fact, 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 SME / WIE director may have a vague 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. It is the job of the assessment professional to work with the SME to make these objectives explicit. Only when the assessment professional knows exactly what the intended outcomes for a program or intervention are, can she or he develop assessment instruments that measure for these outcomes. Figure 1 shows two sets of “outcomes” for a mentoring program for undergraduate engineering students. The first set is somewhat vague, general and ill defined, while the second set is stated in very explicit terms of what sorts of changes we wish to see as a result of this program in students behaviors, attitudes and learning performances.

Sample Mentoring Activity Objectives	
Imprecise objectives:	Precise objectives:
<ul style="list-style-type: none">• Improve participant performance in engineering classes.	<ul style="list-style-type: none">• Reduce participants’ feelings of isolation within the college of engineering.

- 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 Mentoring Activity Objectives

Once an explicit set of objectives or outcomes is determined for the activity, the assessment professional and the SME can begin to develop assessment tools to measure these objectives.

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. Reliability asks the question of whether the assessment produces the same results consistently. Tanner²³ describes it as the “degree to which 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, does the test or assessment activity *reliably* measure the learner’s behavior? An underlying assumption of the concept of reliability is that the relevant conditions must remain stable in order to attain consistent and reliable measurements. These relevant conditions might include the learner’s understanding of and experience with the domain being tested, 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 Jamie received for her performance on the multiple-choice physics exam is really a valid representation of what Jamie knows about force problems in physics. The same issues apply to developing valid survey instruments. An AS may wish to develop a survey to assess the degree to which a peer mentoring program impacted women students’ feelings of isolation in an undergraduate engineering curriculum. It is the job of the AS to ensure that the survey in fact does contain a set of items that will measure that intended outcomes.

Developing assessment instruments that are both valid and reliable is one of the things that makes the job of the AS somewhat difficult. Although it may seem deceptively easy to develop a survey instrument, the job of creating both reliable and valid survey items is not simple. There are many known processes for both the initial development of an assessment instrument and for the processes of checking the reliability and validity of a developing instrument. At a high level the

process is as follows.

1. Develop an initial assessment instrument that is tied directed to the outcomes one wishes to measure. For specifics on item development see Fowler²⁴.
2. Find a set of qualified internal reviewers to review the items for clarity (an important part of reliability) and content (for validity). Reviewers should also be instructed to look for anything that is misleading or could be interpreted in multiple ways. Revise instrument.
3. Find a set of individuals from the target audience for the instrument to complete the instrument and provide feedback. This generally entails finding a set of learners, or in the case of WIE programs, activity participants who will agree to complete the instrument and answer questions about its clarity of content, format, and any other aspects of the instrument they wish to comment on. Once again, this feedback will be used to revise the instrument. This step is called “pilot testing” the instrument.
4. Find a set of qualified external reviewers to review the instrument for whether its content validly represents the outcomes it is intended to measure. So, in our example, we may identify mentoring experts and ask them if the instrument items actually do measure student’s feelings of isolation or inclusion.
5. Continue to gather more instrument data from your intended audience and conduct statistical processes for testing validity and reliability (see²⁰ for details).
6. Make further adjustments to instrument.
7. Create final instrument version complete with instrument administrator instructions.

Just as the WIE director may not have the time or expertise to build high-quality assessment instruments for her activities, assessment professionals often have difficulties effectively performing the tasks just described. Typical problems encountered are briefly described.

- Lack of time spent with an SME. One can see that access to SMEs is critical to developing high quality assessment instruments. SMEs work with assessment professionals to translate their discipline and discipline culture and to establish a set of concise and measurable objectives for the intervention or activity to be assessed. Without this access, assessment professionals would have to rely on other, less direct, sources for establishing objectives. Lack of SME time is a commonly documented problem both for assessment and instructional design personnel²².
- Lack of time in the work schedule to adequately get to know the new discipline area in depth. In addition to SME time, assessment personnel need to conduct literature reviews in order to more fully understand a discipline area and also to determine what, if any, existing assessment tools are available for potential modification and application towards the current project. In spite of the importance of this activity, it is often overlooked or minimalized due to time constraints.
- Lack of time to and availability of stakeholders and other key personnel in a discipline area. While SMEs are critical to determining outcomes and objectives – which are in turn critical to developing assessment instruments, the larger community of stakeholders in a discipline area may not be critical to actual instrument development, but they are critical for having these instruments ultimately adopted and used to their fullest potential. Matter²⁵ discussed the criticality of involving key stakeholders in public schools when conducting educational assessment in public schools. This involvement of stakeholders allows an assessment professional to work to promote understanding of the assessment process, and

adoption of the instruments being developed. Often assessment professionals do not have the time or resources to seek out and work with these individuals.

- Access to pilot subjects. From the assessment personnel task description above, we see that having access to subjects who can participate in pilot testing of developing instruments is also a crucial part of the assessment instrument development process. Problems in attaining the cooperation of pilot subjects usually stem from perceived lack of time for this “extra” activity in already-busy class and activity schedules.
- Lack of ability to see assessment process through to its implementation, data reporting and potential to affect meaningful change. Basically, we often don’t have the time or resources to do anything beyond the instrument development.

Our Partnership

This section describes the full context for the collaborative partnership and explores the specific synergistic benefits to both parties with a particular focus on how this collaborative relationship helps to solve difficulties encountered by both professions. The partnership developed in the context of a proposal for an NSF grant from the Program for Gender Equity⁹. The authors had established a prior working relationship at Penn State where author Marra worked as an educational consultant to the College of Engineering and thus began working with WIE director Bogue. The authors proposed and were granted funding for the Assessing Women in Engineering (AWE) project that is designed to accomplish the following goals.

- Develop exportable, valid and reliable quantitative¹ 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 this goal, the authors and PIs are working over a three-year period with their institutions’ WIE programs and four cooperating programs at the Georgia Institute of Technology, Rensselaer Polytechnic Institute, University of Texas – Austin, and the University of Louisville. With these five programs that collectively represent a variety of private and public institutions, years of experience for WIE directors and student body characteristics, we are piloting, revising, implementing, conducting preliminary data analysis and disseminating easy-to-access, reliable and valid assessment instruments. All 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.

At this writing, we are at the beginning of year 2 of our three-year project. Our accomplishments include the following.

- In-depth needs assessment of all participating WIE programs to determine their current program characteristics, program offerings and assessment needs.

¹ Although the authors 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.

- In-depth literature review of WIE literature with a focus on identifying prior assessment activities.
- In-depth literature review of related fields including psychology and education in order to identify related assessment instruments and measurement areas (e.g. self-efficacy) that can inform the development of our WIE instruments.
- Documentation (and eventual publication) of the above literature reviews in a form designed to inform WIE directors on the theoretical and educational constructs that impact WIE program development.
- Development of preliminary engineering self-efficacy assessment instrument designed to be implemented longitudinally with women engineering students (both those who participate and do not participate in WIE activities).
- Development of preliminary pre and post mentoring activity instruments designed to be implemented with “mentee” participants prior to and following their mentor program participation.
- Pilot testing of these instruments with WIE students.
- Expert review for validity of these instruments by project WIE directors as well as other designated experts in related fields.
- Development of a preliminary AWE web site for project participant data exchange and for future dissemination efforts.
- Preliminary development of pre and post mentor assessment instruments.

All of the accomplishments listed have been achieved through the efforts of the collaborative partnership between the WIE director and the assessment expert. Next, we describe specific examples of how our working partnership has resulted in products and processes that exceed the capabilities of what would have been possible had either member worked alone. We present one set of examples each for the assessment professional and the WIE director.

Examples from the perspective of the assessment professional

The in-depth contact and access I have had with WIE subject matter experts, and in particular to my co-PI has been a unique and incredibly profitable and productive experience. In general I have been the recipient of the following benefits that I would not have experienced otherwise.

- Opportunity to interact with variety of stakeholders in the discipline area (e.g. directors, personnel from professional organizations, relevant experts).
- Opportunity to have ongoing and substantial contact with a WIE director SME during all phases of the assessment process.
- Opportunity to do extensive pilot testing with student groups who represent the overall intended population for the developing instruments.
- Fine –tuning of assessment items to fit appropriate language for the discipline area. For instance,
- Fine tuning of assessment instruments to promote adoption by target audience – see example below.
- Via ongoing contact with WIE director SME, conduct improved identification of expert reviewers to ensure content validity of instruments.

Examples of how the collaboration enhances the process and outcomes

As in illustration, we offer the following example of the “Fine tuning of assessment instruments to promote adoption by target audience”. This situation occurred as we worked on the post mentor program participation instrument for mentees. To appreciate the significance of this example, one must understand that these instruments are designed to measure specific constructs related to the success of women in undergraduate engineering curricula that a mentor program might impact. These constructs include networking, feelings of isolation/inclusion, role models, how students spend their time, and whether students feel part of a community in their engineering programs. For instance, items 1-5 shown in Figure 2 are designed to assess feelings of isolation/inclusion. The instrument also contains items, such as item 6 in Figure2, to collect descriptive data on how the mentee actually participated in the mentor program.

Figure 2. Sample Post Mentor Activity Items

<p>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.</p>	
<p>To what extent do you AGREE? this? 0 = Strongly Disagree 1 = Disagree 2 = Neither Disagree nor Agree 3 = Agree 4 = Strongly Agree</p>	<p>How IMPORTANT is 0 = Very Unimportant 1 = Not at all important 2 = Neutral 3 = Important 4 = Very Important</p>
<p>1. 0 1 2 3 4..... I feel I can relate to the people around me in my classes. → 0 1 2 3 4</p> <p>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</p> <p>3. 0 1 2 3 4..... I have positive role models of practicing <u>female</u> engineers..... → 0 1 2 3 4</p> <p>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</p> <p>5. How would you describe your level of participation this academic year in the mentoring program (choose one)?</p> <p><input type="radio"/> Very active – participated in almost all of the mentor program activities</p> <p><input type="radio"/> Active – participated in most of the mentor program activities</p> <p><input type="radio"/> Somewhat active - participated in about half of the mentoring program activities</p> <p><input type="radio"/> Minimally active – only attended a few mentoring program activity</p> <p><input type="radio"/> No participation –did not participate in any mentoring program activities this academic year.</p>	

There are two things that make this instrument quite different from what WIE directors may be used to seeing as an assessment tools. First, items 1 – 4 are designed to measure the underlying constructs that mentoring programs should impact yet these items do not refer directly to the mentoring program or activities. These items are designed to be administered in a pre / post test fashion and thus will measure any change in the participant’s responses. We then use statistical analysis methods to correlate the responses on items relevant to each construct with the individual’s participation level in the mentoring activity. This type of assessment is in contrast to

one where we ask participants to “self report” on how a particular activity such as mentoring may have impacted them relative to the relevant constructs. Although self-report data has its 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?”).

Operating alone as an AS none of these things seemed to be a problem to me –in fact I had considered them the main strengths of the instrument. However my WIE director partner pointed out that, taken together, these differences makes this instrument appear as potentially unfamiliar, and perhaps not helpful to WIE directors. Ultimately, such an instrument might be considered to be off target, not able to gather helpful feedback for directors, and thus not worth the time it takes to administer to participants. Specifically, my WIE director partner pointed out that if we wished for our WIE director participants to actually adopt and use the instrument we not only needed to measure the constructs and objectives but also provide some formative evaluation items that would help WIE directors improve their mentor programs. This conversation resulted in adding student satisfaction and formative feedback items such as those shown in Figure 3 to the instrument

Directions: Items xx through yy 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. Please circle one response per item in both the **Agree** and **Important** columns.

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

The frequency of contact with your mentor.

Your frequency of contact with other protégées in the program.

The level of interest your mentor showed in you.

The quality of the formal program activities conducted as part of the mentor program.

The overall quality of your contact with your mentor.

The quality of the match between you and your mentor.

The communication methods used to run the mentor program.

Your overall satisfaction with your assigned mentor.

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

Figure 3. Student Satisfaction and Formative Feedback Items Added to the Mentor Instrument

Reflecting back on this, I have to say this was really one of those “aha” moments for me. My

focus on designing a valid assessment instrument for mentoring programs – and thus an instrument that was very tightly based upon the objectives of the program, I had totally overlooked the existing culture that WIE directors generally operate within. And although the instrument may still seem unfamiliar to WIE directors even after we had added formative feedback items, by raising my awareness of this issue, we can address the unfamiliarities via conversation and training in order to help promote adoption of this, and other such instruments.

Examples from the perspective of the WIE director, aka Subject Matter Expert

As a WIE director, the everyday demands of recruitment, retention, advising and fundraising 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 assessment expert meets a universal and critical need. The partnership has created opportunities for me as a WIE director that are not normally available.

- Development of tailor-made instruments that specifically address the objectives of WIE programming and the culture in which that programming is realized.
- Access to assessment expertise that is founded in an in-depth understanding of the literature and contemporary issues of the field and an expert.
- Develop effective WIE programming by integrating assessment and assessable objectives from the beginning planning stages.
- Active participation in the development of assessment instruments through sustained interaction with an AS who is engaged in the outcomes.
- Opportunity to work with AS from the beginning of a project will create instruments and data that will serve multiple purposes (e.g., activity development and funding justification). See example below.
- Ability to influence throughout the shape and delivery of assessment instruments as they are developed by the assessment expert.

As an example of how this partnership has created opportunities to create instruments and resulting data that can serve multiple purposes, we describe the responses to a survey of AWE collaborators about their concepts of assessment. Not surprising, given the restrictions of resources and personnel explored earlier in this paper, the directors relied on quickly manufactured instruments to supply formative results for assessment; they also did not typically leverage the data to justify or expand programming. This provides a good example of how WIE programming is ripe for the benefits of effective SME/AS collaborations and how a change in awareness can support the development of assessment tools that will serve multiple purposes.

Typically project development is driven by director instinct, expertise and experience, a method that is often successful but can be misleading. Without valid data there is no way to sift out the difference between "happy face formative evaluations" that indicate a fun activity and those that substantiate an effective one (i.e. an activity that forwards the goals of the WIE programs and supporters). Too often, event assessments are developed as quick surveys, pulled together just before the event and representing a smorgasbord of other instruments. Without the input of an

AS, such assessment efforts may be meaningless. For example, the questions are often leading rather than open-ended. (e.g. "Did you enjoy the session on biomechanics (y/n) rather than "The biomechanics session laid out career opportunities: t/f)). Just as important, and another "aha" moment for both PIs was the fact that assessment data was not being used to improve programming, it was also not seen as a way to attract and continue funding for that programming. The collaboration has been effective in raising the awareness of participating WIE directors on both points as indicated by a Year 1 survey.

Going back to the high school camp assessment example above, formative assessment data was combined with time and resource analysis and retention/recruitment data to judge the success of the event. In fact, we combined typical formative evaluations with traditional project management methods to come up with an assessment of the project that directed change. This assessment provided the basis for an effective revamp of the camp, based upon meeting the objectives. This example resulted in effective programmatic changes as well as results that justified the change to financial supporters.

Largely supported with soft money directors are understandably reluctant to go back to funders to tell them they are overhauling an activity that was presented as effective in a proposal not too long ago. Effective assessment and data analysis can mandate program change; it can also provide the rationale for sustaining and changing programming. In the case study provided, we used the data analysis to justify the changes and achieved buy in from supporters for the experimental approach that led to a camp that better reaches our mutual goals.

The benefits of collaborations with ASs are clear: when WIE directors operate without the input of ASs, their 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 and to attract and sustain funding. Working with AS can insure development of well thought out assessment plans that are integrated into an activity from the beginning planning stages and enhanced programming.

Benefits

Even at this relatively early stage in the project, 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 assessment person brings design and assessment expertise to WIE and the WIE director brings essential subject matter expertise to the project 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.

When we look beyond the specifics of the AWE project, this type of collaboration creates a team with the potential to attract more external funding as such organizations are often looking for evidence of a project team who can bring to bear a larger set of skills and resources than individuals from a single discipline can garner.

Conclusions

This paper has described an effective collaborative partnership between a WIE director and an educational assessment specialist. This collaboration was developed in the context of an NSF grant from the Program for Gender Equity designed to create reliable, valid and exportable assessment instruments for WIE program activities nationwide. To date the collaboration has resulted in the above-described outcomes that would not have been possible had either professional been working alone. Benefits include development and pilot testing of WIE assessment instruments for self-efficacy and mentoring; creating a broad foundation for the development of assessment instruments based on the joint exploration of practice, theory and literature; and the resulting in-depth literature reviews that will be published and serve to educate WIE directors on the theoretical and educational constructs that impact WIE program development.

Although the specific outcomes are highly valuable in and of themselves, the larger messages of this project are:

1. Such partnerships between WIE directors and other professionals are not limited to working with assessment specialists but could also be implemented with educational technologists, instructional designers, and engineering faculty members.
2. WIE directors, or the SME, have much expertise to offer these professionals in these relationships that will improve the quality and outcomes of the assessment plan.
3. WIE directors have access to a student population that can aid in pilot testing and other data analysis activities. These activities not only benefit the WIE director's collaborative partner, but also provide the WIE director with valuable data concerning her activities and overall program effectiveness.
4. The extra time it takes to create such an effective partnership can be worth the investment for the benefits reaped from these relationships and enhanced quality of the end product.

The Assessing Women in Engineering (AWE) project has provided an opportunity for one such effective partnership. WIE directors and other educational professionals can take advantage of what we are learning from this model in order to implement their own partnerships with the overall goal of providing more effective educational experiences for our students.

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