Integrating Evaluation into Program Development: Benefits of Baselining a NSF-BPC Alliance

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ABSTRACT
The Commonwealth Alliance for Information Technology Education (CAITE) is one of 11 National Science Foundation Broadening Participation in Computing (BPC) alliances aimed at increasing the participation and success of underrepresented groups in information technology (IT). From the beginning, CAITE partners worked to integrate a detailed and comprehensive evaluation strategy to provide a quantitative assessment of the effectiveness of CAITE action plans on its main objectives. We collected large institutional data sets for the seven academic years prior to the project inception from each of the nine original partners, the six additional partners and several other institutions. These data serve as a baseline for assessing the efficacy of CAITE interventions and make it possible to examine trends in student participation and success across each CAITE partner and the alliance as a whole. Importantly, these data provide valuable insight into each of the institutions that has allowed CAITE to tailor its inventions to reflect local conditions at each institution and within each region. From the evaluation data, it became clear that we needed to adjust action plans to better meet CAITE objectives. We describe specific aspects that warranted data-driven adjustments, and highlight lessons learned from these revelations.

Categories and Subject Descriptors
K.3.2 [Computing Milieux] Computer and Information Science Education

General Terms
Management, Measurement, Human Factors

Keywords
Broadening participation, community colleges, information technology education and workforce

1. INTRODUCTION
The Commonwealth Alliance for Information Technology Education (CAITE) [1-2] is an initiative funded by the National Science Foundation’s (NSF) Broadening Participation in Computing (BPC) program [3-5]. CAITE (pronounced “Kate”) hopes to increase the participation and success of underrepresented groups in information technology (IT) through a regional strategy that includes all four, non-medical campuses of the University of Massachusetts (UMass), two state colleges (Bridgewater and Worcester) and nine community colleges (Bristol, Bunker Hill, Cape Cod, Greenfield, Holyoke, Middlesex, Northern Essex, Roxbury and Springfield Technical). CAITE takes a broad view of IT, that ranges from “IT across the curriculum” [6] to traditional computer science, computer engineering, information systems, and information technology.

The CAITE program was originally developed out of growing concern over the declining numbers of women and underrepresented minorities majoring in IT while, concurrently, there was and continues to be a demand for IT professionals throughout the spectrum of industry. Since community colleges serve as a gateway for students in economically underserved regions and attract large numbers of students to career and technical (CTE) IT programs, CAITE places a special emphasis on community-college-4-year-college pathways and hopes to reach out to community college students and to support their transfer and retention in 4-year programs. Our objectives and plans of action were based on the available literature and best practices [7-9] that suggest reasons for the low percentage of underrepresented ethnic minorities and women enrolled in IT programs and interventions that we might try in Massachusetts two- and four-year institutions.

From the beginning, the CAITE partners and its evaluators, SageFox Associates, worked to integrate a detailed and comprehensive evaluation strategy to the CAITE initiative. The primary goal of the evaluation process is to provide a quantitative assessment of the effectiveness of CAITE interventions. To establish a baseline, we needed to address two main questions: who are the students currently participating in IT programs and interventions that we might try in Massachusetts two- and four-year institutions.

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Data requests included enrollment information, demographics, test scores, transfer information, course performance and other academic outcomes (degrees, GPA, etc.). Data were collected for all students enrolled in an IT major or taking at least one IT course. Our evaluation plans also include surveys of CAITE event attendees, interviews with partner institutions, and a continuing assessment of the project management and the alliance as a whole.

Once the first evaluation reports detailing baseline information of student demographics, program offerings, event expectations and feedback were processed, it became clear that there were opportunities to adjust CAITE plans of actions to better meet the project objectives. We also identified a number of difficulties in collecting, validating and analyzing data from 15 CAITE institutions and several other “control” (from the CAITE perspective) institutions. These led to some revisions in the data collection rubrics and methods that have been corrected in our current second phase.

Integrating evaluation and baselining can be used to continually reassess and revise project plans. We will share examples of baselining, describe specific aspects of our plans that warrant data-driven adjustments, and highlight lessons learned. We will also highlight the importance of community colleges in the efforts to impact diversity in IT fields. The ongoing assessments indicate that increasing the diversity of students enrolling and completing 4-year degrees may be achieved through better understanding the diversity of the programs and students at community colleges.

2. CAITE PROGRAM DESCRIPTION

Now in its third year and recently in receipt of an extension award from NSF that will carry the project at least through five years, the CAITE alliance expanded from three to four University of Massachusetts campuses, added two state colleges, and grew from six to nine community colleges. The CAITE mission is multi-dimensional: reaching out not only to community college, and four-year college/university students, but also to middle school and high school students, parents, teachers and counselors. CAITE seeks to facilitate pathways that provide multiple points of entry and a variety of opportunities for IT degrees and careers.

2.1 Action Plan

The CAITE approach to accomplishing its core goals (Figure 1) is bifocal: focusing on outreach and creating and supporting novel and existing pathways to degree completion. The outreach component includes a variety of career fairs, seminars, workshops and contests aimed at invigorating student (and their parents’, teachers’ and counselors’) interest in and knowledge of IT fields. Institutions have an opportunity to showcase their diverse IT programs and associated career opportunities. Often these efforts are coordinated among community colleges and 4-year campuses within a region. In one region, for example, the university hosted a “Mind the Gap! – A Career Summit for Women & Technology” where fifty percent of the participants were university students and the rest were from three community colleges within the region. Events are often co-sponsored with other initiatives such as the Boston Area Technical Connections (BATEC), the Urban Massachusetts and New England Louis Stokes Alliances for Minority Participation, and various CAITE partnerships (Empowering Leadership, the CRAW/CDC Alliance, Georgia Computes!, AccessComputing, etc.). In addition to events, CAITE also has an extensive media program including websites (project reporting, collaboration and student recruiting), printed materials in Spanish and English, newsletters and so on.

The second component of the plan of action is the implementation and support of novel and existing pathways towards degree completion. Two core goals drive this plan: facilitating recruiting for, enrollment in and transfer to degree programs and supporting and retaining students through successful program completion.

The CAITE plan for achieving these goals include:

- “Transfer pathways” to facilitate student enrollment in IT degree programs – both traditional articulated programs and transfer from Career and Technical Education (CTE) programs;
• Mentoring structures including supplemental peer-mentoring and facilitated study groups;
• Professional development efforts across the alliance with special focus on community college and high school faculty, advisors and guidance counselors;
• Collaboration with TechPrep and others to use assessment tools and other methods (e.g., Accuplacer) for assessing college readiness early enough for appropriate intervention;
• “Dual enrollment” programs on site (HS and CC), on-line and/or with technology support; and
• Formal and informal middle and high school programs.

Working in tandem with the state’s “Mass Transfer” program, our pathways effort focuses on both student-centered and institution-centered reform. Student-centered initiatives aim to provide students with access to a wealth of education resources. A website (Figure 2) connects interested middle school, high school, and college students with information regarding IT careers, education opportunities, and networking events. The website includes sections that address frequent misconceptions and gaps of knowledge that are known to deter interest in IT. In addition, the website includes links to IT programs and events by geographic region. We are adding information on course equivalency and transfer credit information that reflect standing academic policies shared by participating institutions.

Institution-centered initiatives include: development of articulation agreements between community colleges and universities and professional development. CAITE sponsored several articulation “summits” to gather course information, create a map of course equivalents between institutions, identify common links to program and degree requirements, and to determine potential common courses and curricula.

Improving student retention and degree completion involves an integrative approach between mentoring and academic advising. CAITE, with assistance from Mt. Holyoke College Professor Becky Packard (a national leader in peer mentoring research), is piloting a peer-mentoring strategy in six institutions each semester over the next few years. Typically, three 4-year schools and three community colleges participate. The primary mechanism of the peer-mentoring program is a supplemental instruction style intervention where step-ahead peers provide students with guidance on course materials in selected “gateway” courses. Once evaluations are completed, best practices will be disseminated to remaining campuses. Articulation agreements, which involve university and community college faculty and admissions office staff, improve academic advising by providing clearer understanding of program offerings and course requirements.

3. EVALUATION STRATEGY

CAITE evaluation provides constant feedback to event and outreach coordinators, and also provides the means by which to determine the overall efficacy of both outreach and pathway interventions in quantitative terms. Baseline data that describe the target-points prior to a proposed intervention is a fundamental component of successful longitudinal assessment. It is precisely the effort of analyzing baseline data that has led to very important adjustments to the CAITE initiative and strategy.

CAITE evaluators gather extensive data on outreach activities using surveys, questionnaires, interviews and focus groups. This allows us to identify participant demographics, attitudes and awareness of IT careers. Resources and human subject constraints do not allow us to “track” individuals from outreach events through enrollment in a program, however analysis of institutional data will allow us to identify any changes in the number, makeup and origin of the students enrolling, succeeding and/or transferring on a yearly basis. These data allow us to infer a relation between events or activities given at student origins and changes in enrollment, retention, etc.

Baseline evaluation provides large amounts of institutional data. Institutional research offices at participating institutions provide us with baseline data on cohorts of students beginning or switching into IT majors (CS, CIS, CE, SE, M/IS, IT, etc.) as well as those who take IT courses without eventually becoming IT majors. We collected data for consecutive years dating back to the 2000 – 2001 academic year.

Figure 3 displays trends in enrollment of students matriculating as computer science majors at 4 university campuses and an average over the community colleges for each of the seven years prior to beginning of CAITE. These data are compared with national data, such as the CRA Taulbee data (“X” marker in Figure 3). Our pre-CAITE data tracks rather closely with the Taulbee data, which should allow us to see if our interventions

1 Institution names are not used to avoid unnecessary “comparisons.”
result in outcomes that differ from national trends at the next round of data collection.

The institutional data allows us to determine trends in the participation of women and minorities (Figure 4) and compare it with national data sources when available. Again, our data is consistent with the Taulbee data on women entering degree programs. These two charts do highlight some real differences between institutions. The percentage of URM at community colleges is much higher than at the university campuses with one clear exception, the urban university campus. For women, the enrollment at the predominately research campuses is somewhat lower than for the primarily undergraduate campuses. While our most recent data shows significant increases for both women and URM across CAITE, these data aid us in designing interventions.

A particularly useful tool is the ability to identify the proportion of students transferring from other schools. Given that the alliance is organized by geographic region, where community colleges work together with the neighboring university and 4-year college campuses, we track student enrollment from “feeder” schools (Table 1). Clearly “Univ. B” draws significant numbers of transfers from many sources, a characteristic of the mission of the school. The strategy for this campus has to be different than for the other two. Similar data on high schools helps aid outreach targeting, where we can focus on schools that send significant numbers of graduates to a specific college.

<table>
<thead>
<tr>
<th>4 Year Partner</th>
<th>Univ A</th>
<th>Univ B</th>
<th>Univ C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Transfers</td>
<td>73</td>
<td>468</td>
<td>75</td>
</tr>
<tr>
<td>Feeder School</td>
<td>CC 1</td>
<td>CC 2</td>
<td>CC 3</td>
</tr>
<tr>
<td>Feeder Transfers</td>
<td>2</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>% From Feeder CC</td>
<td>25%</td>
<td>3%</td>
<td>30%</td>
</tr>
</tbody>
</table>

3.1 Data-driven Adjustments

3.1.1 “Outreach” Adjustments

The various surveys and questionnaires used for outreach events provide insight into the barriers and positive impacts of these efforts. The data indicate that while there is excellent attendance at inaugural events, attendance often drops when the event is repeated but not when it is replicated elsewhere. Except for urban College Fairs, large events are not very successful in attracting student participation. College Fairs tend to be more successful if they are targeted and encourage student interaction with panelists and leaders in workshops and seminars; students prefer learning about funding, application processes, college selection and career paths rather than the more traditional booth-style format with admissions officers. Demographic data indicate that all day events are a poor match with student schedules and time commitments. As a result, CAITE has focused on shorter durations, more targeted events, events held locally, and replication. Moreover, we identified a need to survey incoming students in order to link outreach interventions with enrollment and are beginning that process with the AY09-10 cohorts.

3.1.2 “Pathways” Adjustments

Our baseline evaluation for the pathway interventions produces striking student age distribution data. We find, as we would expect, that student populations skew younger at university campuses than at feeder community colleges. In the three regions of Table 2, there are more community college students in the 24+ age groups than university students, reflecting that community colleges attract older students (often holding degrees) to technical and career programs in response to career changes and market skill demands. Recognizing the breadth of community college IT offerings allows for more appropriate interventions. The articulation summits have provided a clearer picture of just how complex this task will be.
programs and, particularly CTE programs, align poorly with traditional computer science programs. While CTE students transfer to 4-year programs in numbers similar to articulated-transfer-program students, it may take 3 or more years for a transferring CTE student to make up for the lack of transferable coursework applying to degree programs. In response, CAITE is developing new degree programs that allow transfer students to complete the requirements for a bachelor’s degree more quickly.

Understanding the diversity of program offerings and student populations at community colleges alerts administrators and program developers to the reality that, in a variety of aspects, universities and 4-year colleges often do not have the infrastructure to support incoming community college students, who may be older, have family responsibilities and must hold down full- or part-time jobs. In Region B, the age distribution of the university and community college students are similar, which may suggest that this university campus is more “friendly” to older student populations.

Table 2. Age Distribution of Paired Institutions in Regions

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Region A</th>
<th>Region B</th>
<th>Region C</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 19 yrs.</td>
<td>82%</td>
<td>49%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>27%</td>
<td>37%</td>
<td>36%</td>
</tr>
<tr>
<td>20-23 yrs.</td>
<td>15%</td>
<td>22%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>18%</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>24-39 yrs.</td>
<td>3%</td>
<td>22%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>≥ 40 yrs.</td>
<td>0%</td>
<td>8%</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>1%</td>
<td>1%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Recently, community colleges have seen a dramatic rise in enrollment, particularly in developmental courses. With more students entering college without necessary mathematics and language skills, CAITE increased emphasis on early identification (at the middle school and high school level) of college preparation deficiencies. We are piloting “IT academies” for high school students to provide support through the HS-CC-4-year-college pathway. CAITE also is working with school officials to expand high school dual enrollment courses offered by community colleges and 4-year institutions at high schools, on college campuses and through blended and distance education.

Our advising and mentoring strategy was also modified. CAITE began with university advisors offering services at community colleges. Evaluation demonstrated that coordinating time for student advising, inherent differences in program offerings, and institutional cultures made it difficult to offer effective academic advising at the community college level. To address this, CAITE is piloting peer-mentoring programs and strengthening the emphasis on student-driven information resources.

4. Conclusions

CAITE, working with its evaluators and institutional research offices, collected baseline data covering 15 institutions and seven entering cohorts of IT majors, students who entered or left IT majors after initial matriculation, and students who enrolled in IT courses but did not become majors. A biennial series of collection and analyses will allow us to provide quantitative evidence of the efficacy of CAITE interventions. We will reference our analysis against national and local data, and we have a strategy for linking quantitative analysis with the qualitative evaluation.

The important lesson here, however, is in how integrated evaluation and assessment has allowed us to better understand the similarities and differences among institutions in our alliance and the characteristics of the students who enroll in them. As a result, we have already tailored our interventions to address the issues revealed by our baseline analysis and introduced new interventions where gaps were identified. This baseline data collection is critical for planning, implementation, evaluation and the success of the project — a process we strongly encourage other programs adapt.

5. ACKNOWLEDGMENTS

The authors thank the NSF CISE Broadening Participation in Computing Program for support under awards CNS-0634412 and CNS-0837739. All opinions reflected in this paper are those of the authors and not necessarily those of the National Science Foundation.

6. REFERENCES


