

STUDENTS DISCOVER CONSIDERATIONS ON EVALUATING INSTITUTIONAL CHANGE

Overview and Assumptions

This paper provides an overview of possible methods for assessing institutional change in the *Students Discover* Math Science Partnership (MSP) project funded at North Carolina State University (NCSU) by the National Science Foundation. Although several institutions are involved in the project, this paper focuses only on institutional change for the NCSU Department of Biology. While institutional changes are expected in all partners, we expect later papers will address such changes in the other partner institutions.

Framework for Assessing Institutional Change

The questions and methods to evaluate institutional change are organized in this paper using a broad framework that we developed from our review of the literature on institutional change and sustainability. Our framework is based on the literature on institutional change and sustainability of interventions, and specifically on several studies of institutionalization and sustainability of partnerships that have been supported by the MSP program, either within individual projects, in program evaluations, or as part of broader NSF reports.

While not based on an exhaustive review of the literature on institutional change, the framework articulates the areas that have been identified as critical in understanding the success of an MSP project or intervention. The framework here has been tailored to MSP interventions such as *Students Discover*, with primary goals of enhancing educational outcomes; developing educational products and training; and improving awareness, knowledge and working relationships among higher education and K-12 partners.

GrantProse Framework for Measuring Institutional Change

Institutional Area	Description
Cultural Context	MSP projects are intended to increase the participation of higher education institutions in K-12-related activities. This change can expose campus conflicts regarding the institution’s understanding of its mission and key priorities. The culture of many universities emphasizes the goals of increasing research standing and institutional prestige, and MSP priorities of partnerships with K-12 schools, along with STEM teacher recruitment, preparation, and professional development are often regarded less highly.
Roles of Project Leaders	The role of key “change agents” in initiating institutional change has been documented in many industries and workplaces. In MSP projects, faculty leaders with a history of collaboration, both within and across institutions and in some cases with K-12 partners, are often the initiators of MSP projects and cross-institutional collaborations.

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Institutional Area	Description
Administrator Commitment	It is widely accepted that successful and sustainable institutionalization in higher education requires not only active faculty change agents and growing faculty participation but also strong support and resources from top-level administration. Administrators are often critical to shaping essential changes to institutional culture, processes and structures and to securing continued resources that are vital to sustaining project activities.
Uptake by Participating Faculty	Although many MSP projects begin with a small core of highly committed project leaders, successful and sustainable change is usually dependent on increasing the number of participating faculty or staff. The participation of young tenure-track faculty, as well as tenured senior faculty members and non-tenure-track faculty members, is a strong indicator that an MSP project is becoming broadly institutionalized, not just marginally supported. Faculty uptake is often indicated both by changes in teaching and by participation in off-campus MSP partnership activities.
Course and Curricular Changes	Faculty participation in successful MSP projects may be reflected in changes in courses taught and/or curriculum delivered. Several kinds of changes can be observed including the growth of K-12 professional development courses, and the development of curriculum materials specifically for MSP partners. Most of the course changes relate to new curricular content, but venues may also change; for example, faculty may conduct course sessions at K-12 partner campuses.
Policy and Structural Changes	Changes in individual practices, such as teaching and off-campus activities, are important indicators of MSP project success, but they need to be supported by more enduring changes that guide department and institution policies and processes. In successfully sustained MSP projects, these often include changes in hiring, promotion or tenure policies or the creation of new internal centers or institutes, especially ones that link MSP partners.
Resources for Sustainability	NSF supports MSP projects for only a limited number of years, so project leaders need to be looking for sources of continued support well before their grant ends. A key indicator of the sustainability of the project is that top administrators, not just project leaders, are involved in acquiring new funding, either from internal budgets or external sponsors.

Methods for Assessing Institutional Change

This paper represents a set of possibilities that will be refined and narrowed in scope, based on assessments of the costs and benefits of implementing them, and their suitability for the *Students Discover* project. Several kinds of methods can be used to answer key institutionalization questions. Interviews and surveys, as well as focus groups and workplace/classroom observations, are common means of primary data collection. Institutional documents and archival materials, especially those that capture policies and procedures, are also commonly used and we consider all these methods here. We have also included methods that use information about individuals' collaborative behaviors, captured either in static documents such as CVs and publications, or in more dynamic sources such as email or social network interactions.

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Some of these methods are relatively new and their reliability and validity are unclear. Also, some of the methods reviewed here may not yield significant data during the lifetime of this project, since sustainable institutional change often takes many years. To answer the question of institutional change we recommend multiple converging methods, so long as resources permit. Methods described in this paper are specified only broadly. Specific measurement instruments are not presented. Grant*Prose* will produce an Evaluation WorkPlan providing much more information on these topics.

Our consideration of questions and methods for measuring institutional change in the Department of Biology begins with a summary of the goals for institutionalization as described in the *Students Discover* proposal. Following this, possible questions and methods are organized using the areas identified in our framework for institutionalization change.

Institutional Change in the Department of Biology

Students Discover Institutionalization Goals:

- A sustainable institutional capacity and commitment to help in-service scientists and teachers in partnerships to co-create citizen science (CS) projects;
- Strengthened faculty understanding of and interest in partnerships with K-12 education; and
- Improved institution-community partnerships and community-engaged research and scholarship.

Cultural Context	
Questions	Methods
Do faculty have an understanding of the <i>Students Discover</i> project?	Faculty survey and interview
Do faculty view engagement in K-12 education as a personal priority?	Faculty survey and interview

Roles of Project Leaders	
Questions	Methods
Has project leadership stayed stable or improved during the project?	Leader interview
Have leadership duties conflicted with other professional goals and responsibilities?	Leader interview
Have new leaders emerged from additional participating faculty?	Leader interview

Administrator Commitment	
Questions	Methods
Do departmental and/or university administrators express a commitment to implementing or expanding engagement with K-12 educators and institutions?	Administrator survey and interview
Do departmental and/or university administrators develop systems for rewarding faculty engagement with K-12 education?	Departmental and university documents

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Uptake by Departmental Faculty	
Questions	Methods
Do faculty collaborate more with <i>Students Discover</i> partners?	Faculty surveys and interviews [1]; CVs and citation analysis [2];
Have faculty engaged in <i>Students Discover</i> outreach activities?	Email and social network analysis [3]

[1] Survey and interview data will yield qualitative opinion data and can also be aggregated to provide counts. Such counts could provide evidence that the number of faculty engaging in partnership activities is increasing beyond the initial set of project leaders. It will also be interesting to look at aggregate data by faculty position. In other MSP projects, uptake is sometimes limited to post-tenure or non-tenure track faculty, suggesting MSP activities are not valued as key for promotion.

[2] Assuming CVs can be collected, follow a reasonably uniform format, and are kept up to date, they could be a source of K-12 outreach activities, as well as publications, which may provide evidence of changes in scholarly collaboration. It would also be possible to conduct secondary analysis of citations noted in the publications, providing additional information about the scholarly focus. While CVs may evidence change in K-12 outreach activities from year-to-year, publications change slowly and it is unlikely that significant changes in publications will appear during the lifetime of this project (publications under development and/or in press might demonstrate movement in this way).

[3] In contrast to publications, tracking of email or related electronic communications offer much more dynamic sources of data on collaboration changes; however, there are problems here as well:

- Results would only be robust if we could be certain that we were capturing all or much of the communication via these tools;
- The validity of any interpretation could be challenged if only selected communications were analyzed; and
- Change found in email and/or social networks does not necessarily predict long-term sustainability or collaboration. Online communities can vanish very quickly, especially if such a community is organized chiefly for the purpose of a grant project.

Course and Curricular Changes	
Questions	Methods
Have any changes been introduced to course curricula that reflect <i>Students Discover</i> activities and/or engagement in K-12 education? [4]	Faculty survey and interview Course or curriculum documents
Has the department sponsored on-campus or off-campus presentations/events involving K-12 participants? [5]	Event documents Description of participants Participant feedback records

[4] This question reflects course content-related changes that a number of papers on MSP institutional change have discussed. If data on course and content changes are revealed, it may be possible to facilitate comparison across MSP projects.

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[5] Interviews at the administration level should provide broad information on how MSP has been institutionalized at the department level; events will provide evidence of department-level changes.

Policy and Structural Changes	
Questions	Methods
Has the department provided financial, release, or other incentives to encourage K-12 partnership activities?	Administrator interview Policy documents
Has the university changed promotion, tenure or other faculty policies to reward K-12 engagement or related outreach activities? [6]	
Has the university supported the development of new centers or partnership institutes (e.g., to organize all MSP activities under one roof)?	
Have learning networks been developed that link partners and external K-12 practitioners?	Social network analysis
Have hiring policies and criteria been revised to reflect priorities related to broader MSP goals?	Administrator interview Policy documents

[6] At NCSU, structural changes such as the joint Museum/NCSU appointments pre-date the MSP project. These should be noted as a baseline indication of institutional commitment to partnerships and the evaluation should look for indicators of sustainability or growth in this area. In general, documenting the growth of Museum/Higher Education connections is a high priority for NCSU and for the *Students Discover* program. In consideration of how museums typically have K-12 education and outreach as part of their mission, the Grant *Prose* evaluation should reflect this emphasis.

Institutional Commitment and Resources for Sustainability	
Questions	Methods
Have Deans, Chairs and University administrators influenced the reception of MSP on campus?	Administrator interview
Is the University planning to budget internal funds or resources to sustain MSP partnership activities?	Administrator interviews Policy documents

Institutionalization at the Other Higher Education Partners

At a broad level, all NCSU partners in the *Students Discover* project share the MSP goals of their parent institution. However, the partner NCSU institutions (e.g., the Friday Institute, Science House, Kenan Fellows) differ from the Department of Biology in a number of important ways:

- They each have a distinct culture and mission;
- They have differing histories of prior partnerships with the K-12 sector; and
- They have different organizational sizes, structures and authorities. For example, The Science House is relatively small and has no formal teaching faculty; the Kenan staff often act as brokers connecting scientists to K-12 teachers rather than traditional faculty; and, the Friday Institute carries out research on K-12 educators and systems.

While our institutionalization framework may apply to these partnering institutions, the questions and methods of evaluating institutional change may apply somewhat differently to the other three higher-education institutions in the *Students Discover* project.

MSP RESOURCES ON INSTITUTIONAL CHANGE

As noted above, there is a general literature on organizational change while the list here is of documents that we find are especially relevant to the MSP program.

- Frank, J. & Shapiro N. (2010). Institutional Change and Sustainability: Lessons Learned from MSPs http://hub.mspnet.org/media/data/11_-_Frank.pdf?media_000000006600.pdf
- Frechtling, J. (2013). Examination of Factors that Influence Long-term Sustainability of MSP Partnership Projects http://hub.mspnet.org/index.cfm/showcase/list/project_user-17815
- Hora, M. & Millar, S. (2008). A Final Case Study of SCALE Activities at California State University, Northridge: How Institutional Context Influenced a K–20 STEM Education Change Initiative http://hub.mspnet.org/media/data/Final_Master_SCALE_Case_of_CSUN_110708.pdf?media_000000006184.pdf
- Kamau, N., & Parr, R. (2012). Lead Teachers Foster Institutional Changes in Their Schools and School District. http://rusmp.rice.edu/uploadedFiles/Research_and_Presentations/Papers_and_Reports/MLI%20Impact%202012.pdf
- National Impact Report: Math and Science Partnership Program (2010). http://hub.mspnet.org/media/data/MSP_2010_Impact_Report.pdf?media_000000006722.pdf
- Presley, J. & Redd, K. (2012). Final report on: Promoting Institutional Change to Strengthen Science Teacher Preparation. <https://www.aplu.org/document.doc?id=4220>
- Redd, K. (2013). Galvanizing University Leadership for Science Teacher Preparation: The Role of a Higher Education Association. http://hub.mspnet.org/media/data/Session_Redd.pdf?media_000000008002.pdf
- Redd, K. (201?). Promoting institutional change to strengthen Mathematics and Science teachers preparation: An analysis of outcomes for 25 participating institutions. <https://www.aplu.org/document.doc?id=4221>
- Scherer, J. (2007). An Examination of Sustainability and Institutional Change in the NSF-MSP Program. http://msppe.mspnet.org/media/data/Scherer_2007.pdf?media_000000007222.pdf
- Scholl, L., Millar, S. & Owusu-Yeboah, L. (2006). Organizational Change in an Institution of Higher Education: Improving K-20 Math and Science Education through a University-School Partnership http://hub.mspnet.org/media/data/CSUDH_Baseline_Case_Study_Report_Final_040306.pdf?media_000000006142.pdf
- Shapiro, N. & Frank, J. (2010). Institutional Change and Sustainability. 2010 MSP Learning Network Conference. http://hub.mspnet.org/media/data/Shapiro_Paper_Session_2010.pdf?media_000000006678.pdf
- Shapiro, N. & Frank, J. (2010). Change and Sustainability in Higher Education (CASHE). Final Report. http://hub.mspnet.org/media/data/CASHE_Report--FINAL.pdf?media_000000007697.pdf

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Yin, R. (2009). Establishing Long-Term Partnerships between K-12 Districts and Science, Technology, Engineering, and Mathematics (STEM) Faculty.

http://hub.mspnet.org/media/data/Yin_2009a.pdf?media_000000007235.pdf

Yin, R. et. al. (2012). Evaluation of NSF's Math and Science Partnership Program

http://msppe.mspnet.org/media/data/Final_Dissem_Rpt_11-8-11_WEB_VERSION.pdf?media_000000007243.pdf

ADDENDUM

Two studies indicated in our References are especially germane to our discussion in this paper and greater detail is provided on these studies in this Addendum.

Change and Sustainability in Higher Education (CASHÉ)

Key themes and results related to institutional change and sustainability across MSP projects, quoted (in excerpts) from a report authored by Shapiro and Frank, 2010; p. 16-23, are summarized here. Headings are from the report, but align well with our framework:

Theme 1: Backdrop of Institutional Culture/Context

- MSP's requirement for an increased role for higher education in K-12 STEM education surfaced conflicting beliefs regarding fundamental institutional priorities.
- On campus, MSPs catalyzed discussions that focused on shared responsibility for the recruitment, preparation, and professional development of K-12 STEM teachers.
- Higher education's involvement in an MSP raised awareness of education as a "closed loop" system.

Theme 2: Role of MSP Project Leaders

- The emergence and sustainability of MSP projects depended on a few key faculty leaders.
- NSF's decision to limit MSP principal investigator appointments to STEM faculty raised concerns about limiting MSP leadership capacity.
- The MSP project has produced a community of faculty leaders across the nation who are steeped in the knowledge and experience of MSP project work.

Theme 3: Impact of Institutional Leadership and Support

- Both top-down and bottom-up leadership models emerged on MSP campuses.
- Department chairs and school/college deans greatly influenced the acceptance of the MSP on campus.
- Faculty recognition by the institution promoted MSP participation and program sustainability.
- On campus, MSP work was more likely viewed as public service outreach rather than as a core educational mission of the institution.

Theme 4: Investment and Motivation of Participating Faculty

- Many MSP faculty participants had a long-term history with K-12 outreach activities prior to the MSP project.
- Many STEM faculty come to appreciate and rely on work with K-12 as a way of being able to demonstrate "broader impact" (Criterion 2) in their NSF proposals.
- There was a notable absence of tenure-track faculty participation in MSP projects.
- Some MSPs produced outcomes related to teaching and learning on college and university campuses that were rarely addressed in the MSPs' original scope of work.

Theme 5: Structural Changes that Supported and/or Resulted from MSP Work

- On many campuses, MSPs created or expanded an infrastructure for targeted and sustained collaboration on STEM education between higher education, including STEM faculty, and K-12 teachers, schools, and districts.
- Some MSP institutions of higher education established new faculty positions to facilitate and sustain the work of their MSP.

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- MSPs gave rise to a variety of learning networks that linked all P-20 MSP STEM practitioners.
- Cross-campus collaboration on MSP work varied across sites and was directly related to the support of key administrative leaders.

Theme 6: Course and Curricular Changes that Supported and/or Resulted from MSPs

- MSP work drove the review of and, in some instances, significant changes in campus offerings related to the preparation and support of STEM teachers.
- STEM curriculum alignment was an outgrowth of the work of some MSPs.
- MSP work generated unexpected changes in STEM undergraduate courses and curricula.

Theme 7: Question of Sustainability

- It was recognized that MSPs require a long-term investment and commitment by higher education institutions; sustainability plans of most MSPs depended on securing additional external funds.
- Higher education partners identified several categories of MSP initiatives with a high potential for sustainability beyond the initial funding period.
- The key to MSP sustainability was often couched in terms of relationship-building while recognizing the challenges imposed by decreased funding over the long term.
- Some MSPs have been used to leverage broader reform initiatives beyond the original MSP partner institutions.

Evaluation of NSF's Math and Science Partnership Program

The points below summarize results from the MSP program evaluation report (Yin, 2011; p. 3-8). Only results related to institutionalization are quoted; the headings here were not used in the Yin report but reflect the areas of the institutionalization framework outlined above:

Uptake by Participating Faculty

Widespread involvement by science, technology, engineering, and mathematics discipline faculty in partnership activities

- Faculty's work also included offering PD workshops and institutes for existing K–12 teachers and not just courses within university programs.
- STEM faculty participated in a higher proportion of the partnerships' activities than did either the education faculty or the K–12 staff.

Extensive research publications by the partnerships, covering topics in mathematics and science education.

- Instruction and Professional Development
- Curriculum and Assessment

Policy and Structural Changes / Course and Curricular Changes

Early signs that partnerships can sustain their collaborative work beyond their period of formal funding by the MSP Program.

- Offering IHE Courses and Programs for Existing K–12 Teachers
- Changing IHE Tenure and Promotion Rules