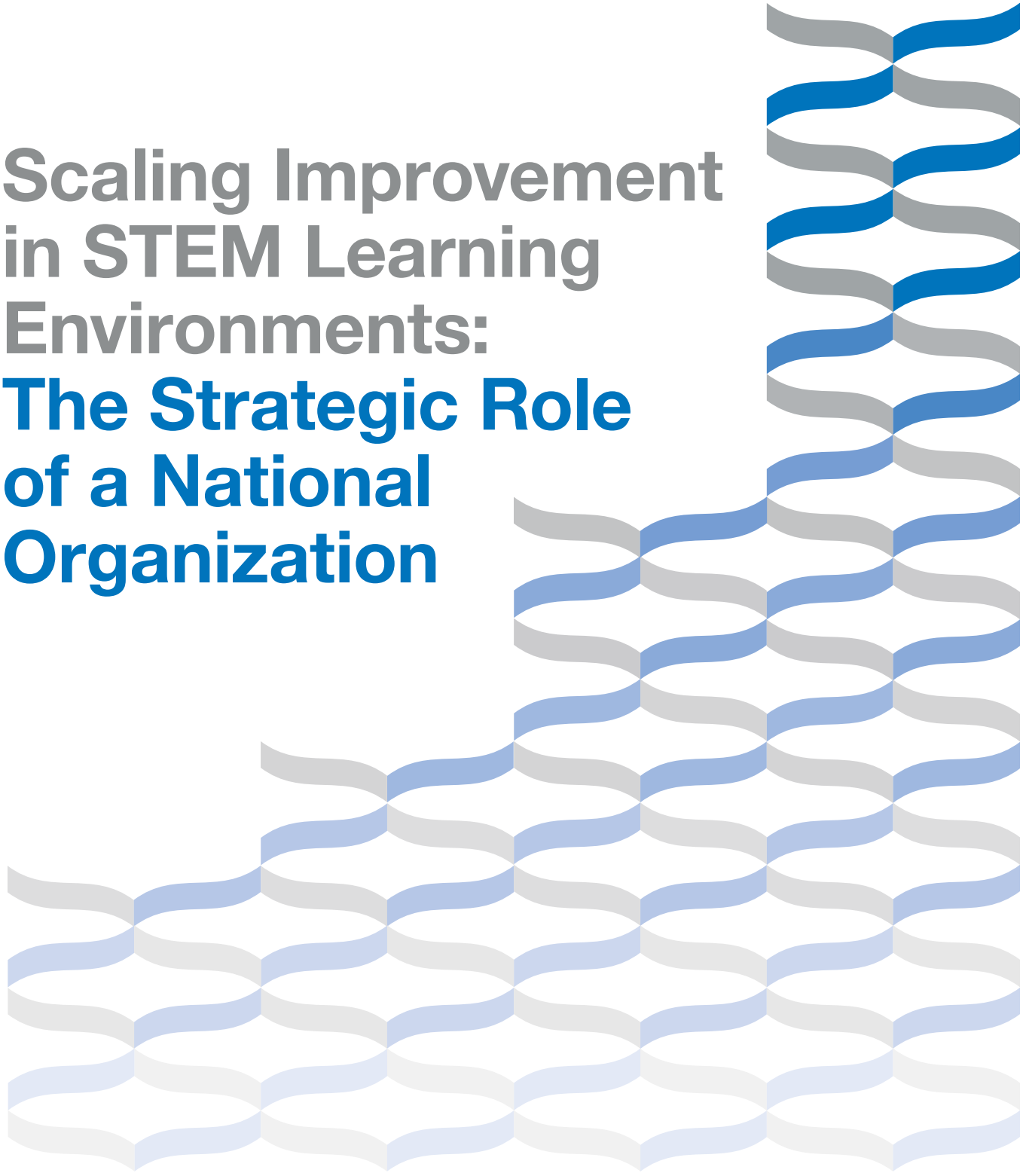
# Scaling Improvement in STEM Learning Environments: The Strategic Role of a National Organization



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## About the author

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# Contents

# **Foreword** by Mary Sue Coleman

When the Association of American Universities (AAU) launched its initiative to improve undergraduate STEM education in the fall of 2011, it set out to influence the culture of STEM departments at AAU universities in ways that would encourage their faculty members to use teaching practices proven by research to be effective in engaging students and helping them learn. AAU aimed to address the institutional and cultural barriers impeding improvements to large introductory STEM courses – often referred to as "weed out courses."

The overarching goal of the Undergraduate STEM Education Initiative was very ambitious. Trying to achieve large-scale systemic change at our institutions was not a typical project for the AAU. It was not at all clear that the association could positively affect the quality and effectiveness of undergraduate STEM teaching and learning at member universities.

AAU sought an outside evaluation to assist it in understanding the association's role in improving undergraduate STEM education at its member institutions. Such an evaluation focused on helping the association reflect on the Initiative's achievements, shortcomings, and what AAU might do in the future to continue to make progress toward achieving the widespread improvement in the quality and effectiveness of undergraduate STEM teaching. AAU also hoped that an independent analysis might inform other higher education associations and scientific societies about effective strategies for national associations seeking to help individual institutions achieve broad-based systemic and cultural changes.

With support from the National Science Foundation, Dr. Adrianna Kezar, a noted expert in higher education change, governance, and leadership from the University of Southern California, and her colleagues observed and assessed the initial years of AAU's Undergraduate STEM Education Initiative. This report summarizes the key findings by Dr. Kezar and her research team.

The report's findings will be carefully reviewed by the AAU staff, the board of directors, and the full AAU membership to identify lessons to strengthen efforts to improve the quality and effectiveness of undergraduate education at AAU universities. The findings also will assist AAU when it embarks on future efforts in partnership with member campuses.

The analysis demonstrates that AAU had a substantial positive effect on educational reforms on its campuses both for the eight project sites and for the larger network of AAU institutions. The prestige and status of AAU; the *Framework for Systemic Change in Undergraduate STEM Teaching and Learning* providing a conceptual model for how individual institutions might proceed with implementing and institutionalizing educational reforms; and the *Essential Questions and Data Sources* report that helps campuses track the progress of their reform efforts were noteworthy. The report also identifies areas in which AAU had less effect than desired, along with recommendations for how to improve those areas. Finally, AAU expects that the research findings can assist other national higher education and disciplinary societies as they seek to foster improvements in the educational performance of their constituencies.

# Executive Summary

## Key lessons for national organizations for scaling improvements in STEM learning environments

- Assess strengths and assets as well as limitations as an organization.
- Use a systems approach and networks to scale change.
- Develop a multi-theory strategy for maximum impact.
- Understand and intentionally plan influence strategies.
- Carefully evaluate the framing and language used to communicate the change.
- Apply strategies to facilitate learning and adoption, and examine barriers to learning in change processes.
- Consider culture change at multiple levels – the culture at the national organization as well as the culture at the member organizations.
- Create distributed leadership to improve STEM education.

For organizations engaged in scaling change, we have developed a practitioner guide with tools to help in this process.

This study explored an undergraduate education initiative developed by the Association of American Universities (AAU) to improve the quality of undergraduate teaching and learning in science, technology, engineering, and mathematics (STEM) fields at its member institutions. The study relied on interviews, documents, and observations to examine strategies that have been successful in scaling and sustaining changes arising from the AAU STEM Initiative.

**The project explored two major questions:**

1. How does the AAU Initiative achieve scale in reform of undergraduate STEM teaching and learning?
2. What is the role of a national association in undergraduate STEM reform and what approaches are perceived to have the most impact in achieving scale?

Following are the key findings related to these questions:

**AAU used a systems approach to promote long-lasting large-scale change in STEM teaching.** The systems approach used by AAU included three primary levels: the institutional level, consisting of the Initiative's eight campus-based project sites; the AAU network level, across the 62 AAU member-universities as a group; and the national level, composed of various national agencies and groups interested in STEM teaching reform. As intended, AAU's strategic focus on these primary organizational levels, as well as the various subsystems within them, helped foster large-scale commitment to reforming STEM education by its member institutions.

AAU was most effective when it used strategies that leveraged the prestige of the "AAU identity," i.e., the most prestigious research university collective in the United States. The three most efficacious strategies were:

- strategies aimed at utilizing the prestige and influence of AAU
- strategies that built on the historic strengths of AAU
- strategies that utilized a unique niche of AAU

When interviewees commented about missed opportunities to improve undergraduate STEM education, they often meant AAU not leveraging its prestige and influence, not working with its historic strengths (such as mobilizing presidents or issuing national reports), and not utilizing its unique niche (e.g. its ability to convene key stakeholders).

These findings demonstrate that AAU appears best-positioned to impact change at the network and national levels, although its influence clearly was felt by the individual project sites. In particular, interview data revealed AAU's particular perceived strengths in working with national groups; helping shape national priorities and funding; helping garner media attention; and influencing administrators' perspectives and priorities. Placing more emphasis on these may advance future AAU efforts.

**AAU's most effective roles in improving STEM undergraduate teaching are based on leveraging its influence.** The data in this report demonstrates the importance of maximizing AAU's organizational prestige and reputation to garner support for change at institutional and network levels. As an organization representing leading U.S. graduate-level universities, AAU can influence the values and priorities operating across the higher education enterprise. By itself, AAU's launch of the Undergraduate STEM Education Initiative helped increase the attention paid to undergraduate teaching at its member institutions and arguably at other research institutions. The strategies that leveraged AAU's influence in this manner included: name dropping AAU institutions to influence colleagues; branding the project as an AAU effort; creating competition among peer institutions; creation of a peer or comparison group (i.e., project sites and an AAU Network); media attention; rewards and recognition; site visits; and partnering with external groups.

**AAU used framing and messaging strategies to help increase the value or at least the attention paid to teaching in higher education.** Institutional logics are socially constructed patterns of practices, assumptions, values, and beliefs through which people attribute meaning to their social world. Logics govern individual and organizational action by dictating sources of legitimacy within an organizational field. For the last century at least, the logics governing work in research universities emphasize the importance of research and graduate education, encouraging the faculty to pay more attention to research and scholarship than teaching, especially undergraduate teaching.

Logics are often deeply embedded in organizations and the individuals within them, which can lead to unquestioned acceptance of norms. However, new or emergent logics can be introduced and legitimated through language and discourse by developing frames that resonate with their target audiences. For example, AAU developed language to enhance the prestige of teaching by, e.g., making its members "as excellent in teaching as they are in research." This frame aligned with the existing values and priorities ("excellence" as a desirable standard in research universities) of its target audience. Because of AAU's expansive network and influence, the frame has been widely adopted, prompting the beginning of a shift in institutional logics. In addition, AAU was very successful in establishing a contradiction that helps people engage new logics. In particular, AAU set up a major contradiction using the idea that "great institutions cannot be poor at teaching." Variations of this phrase were used (research universities as the epitome of excellence for research should reflect this excellence in teaching, etc.) but all emphasized the same logic: As the epitomes of excellence, AAU institutions should not tolerate having a major portion of their work—undergraduate teaching—be considered poor.

AAU used a variety of strategies to disseminate and embed the recreated logics. These included the various networks that AAU had created as part of the Initiative as well as the points of contact at most member institutions as part of the AAU STEM Network. Additionally, the AAU president described the focus of the Initiative at each meeting. The new logic was listed on the AAU website, noted in listserv messages to the campus points of contact and project site leaders, and included in newsletters and other outreach. The *Framework for Systemic Change to Undergraduate STEM Teaching and Learning* document describing the rationale for change and the strategies employed made clear that AAU was an important mechanism for disseminating the new logic by having a concrete image and reference point for the logic in the change process.

Because of the academic and research excellence of its members, AAU is one of a few actors in American higher education that can shape institutional logics, establish contradictions, and impact areas such as reward structures in the long run through changes in logics/values. For these reasons, AAU is an essential player in achieving systemic change in undergraduate STEM education.

**Rather than limiting its efforts to the original eight project sites, AAU focused from the start on building a network of its members to support undergraduate STEM reform.** Research suggests that evidence of improved practices is a necessary but not sufficient condition to create and sustain change. Institutional and interpersonal networks, and peer interactions are crucial in changing ideas and practices. AAU leveraged networks to scale change at all three levels of the system, its campuses, subgroups on campuses, coalitions focused on STEM education, and external groups. These groups serve different purposes, including influence, learning, funding and resources, dissemination, and emotional support. This report describes promising networking practices including identifying peer networks, providing opportunities for networking, and identifying network subgroups. This report also demonstrates the importance of connecting multiple networks, providing support for networks, and developing leadership to maintain networks. The multiple network functions within the AAU Initiative would not have flourished without the planning and attention of AAU staff. AAU was effective at creating and leveraging networks to scale change because networking builds on AAU's image as representing prestigious institutions and effectively advancing important policy initiatives.

The study also identified ways that networking could be improved. The recommendations include: identifying the right network members; empowering the AAU STEM community to lead; creating network leadership by tapping existing president, provost, and dean networks; broadening on-campus teams; networking department chairs; and distributing ownership and leadership for networks.

**AAU focused on information sharing and learning in the STEM Initiative.** Networks facilitate information sharing and the circulation of new ideas. Although important to promote change, information sharing is only a precursor to learning and does not guarantee adoption of changes. Study data reflects that information sharing was prevalent through AAU networks, but learning was mentioned much less often than other strategies such as influence and framing. Key areas where adoption of teaching-related innovations occurred across campuses included data analytics, curriculum, facilities to support active teaching, pedagogy and the like.

AAU initially supported organizational learning by considering how to structure the project site work plans, including the use of data, working collectively in teams, and working across departments. More direct AAU influences on organizational learning took place through site visits and AAU STEM Initiative meetings. Finally, the request for proposal (RFP) process and entities such as Faculty Learning Communities promoted local organizational learning.

Several factors appear to have shaped the degree of learning and adoption of practices across AAU campuses. On the positive side, AAU helped establish new norms (i.e., to improve undergraduate STEM teaching), which had to take hold before the adoption of new practices and learning occurred. Potentially negative factors affecting organizational learning included perceptions that practices were not applicable unless invented at the specific campus (the "not invented "here" syndrome), competition among campuses, and the need for data from the local context to support any change.

**AAU used multiple strategies and theories of change simultaneously to help accelerate change.** Among other strategies, AAU used a combination of influence, systems approaches, organizational learning, institutionalization, cultural approaches, and shifting norms. Multiple theories of change can help motivate and persuade campuses to change, offer them rationales to do so, make changes to infrastructure, and facilitate adoption of new ideas and practices.

This study first identified the *value of using several theories of action* to create synergy to amplify the change. Second, this study also illustrated how national organizations can reflect on their *organizational identity, assets and niche in determining which theories of action to use*. Third, *intentional deployment of theories* can assist in maximizing the effect of the theory by fully planning its use. In a project of this complexity, a single approach would have limited the impact, scale and opportunity for change. Synergy can be achieved between approaches; often one approach helped support another change strategy. As a respected voice in higher education, AAU was able to leverage its influence (a tactic deriving from institutional theory) toward change and create new institutional logics that reshape values. Through its national prestige and influence, AAU was also able to leverage the open systems approach, and to impact groups such as the National Science Foundation and the National Academies of Science to create support for improving teaching. AAU is one of the few groups with the prestige to align many different players/organizations within the higher education system to create a powerful and aligned network of action. Using these various approaches together resulted in AAU's success in scaling change to date, but relying on any one strategy would have been limiting.

**AAU's most effective role in fostering change was perceived differently by various participants.** In developing strategies for complex change processes, it is important to consider the backgrounds and experiences of various stakeholders. The *Framework* attempted to distinguish stakeholders in part by identifying distinct levels of internal and external effects on STEM teaching as well as distinct stakeholder groups. Even so, the *Framework* is insufficiently detailed to provide specific strategies for member institutions. Instead a local needs assessment to identify stakeholders and their needs must complement the more general AAU *Framework* to promote effective change on local campuses, and to identify strategies for distinct stakeholder groups to make the most of their connection with AAU.

For example, administrators were much more aware of AAU's prestige than were faculty members. Administrators were also more knowledgeable about the role of AAU in shaping the overall landscape of higher education. As one consequence, faculty members and administrators of various types often differed in how they perceived AAU's role in fostering the use of evidence-based teaching in STEM on their campuses.

It seems unlikely that AAU as an organization is in the best position to address various group needs on individual campuses. One option to meet the needs of multiple constituent groups is to conduct a needs assessment and determine which needs are best met by AAU and which are best met by other actors. AAU could consider partnerships or brokering with other organizations that might be better able to meet these needs.

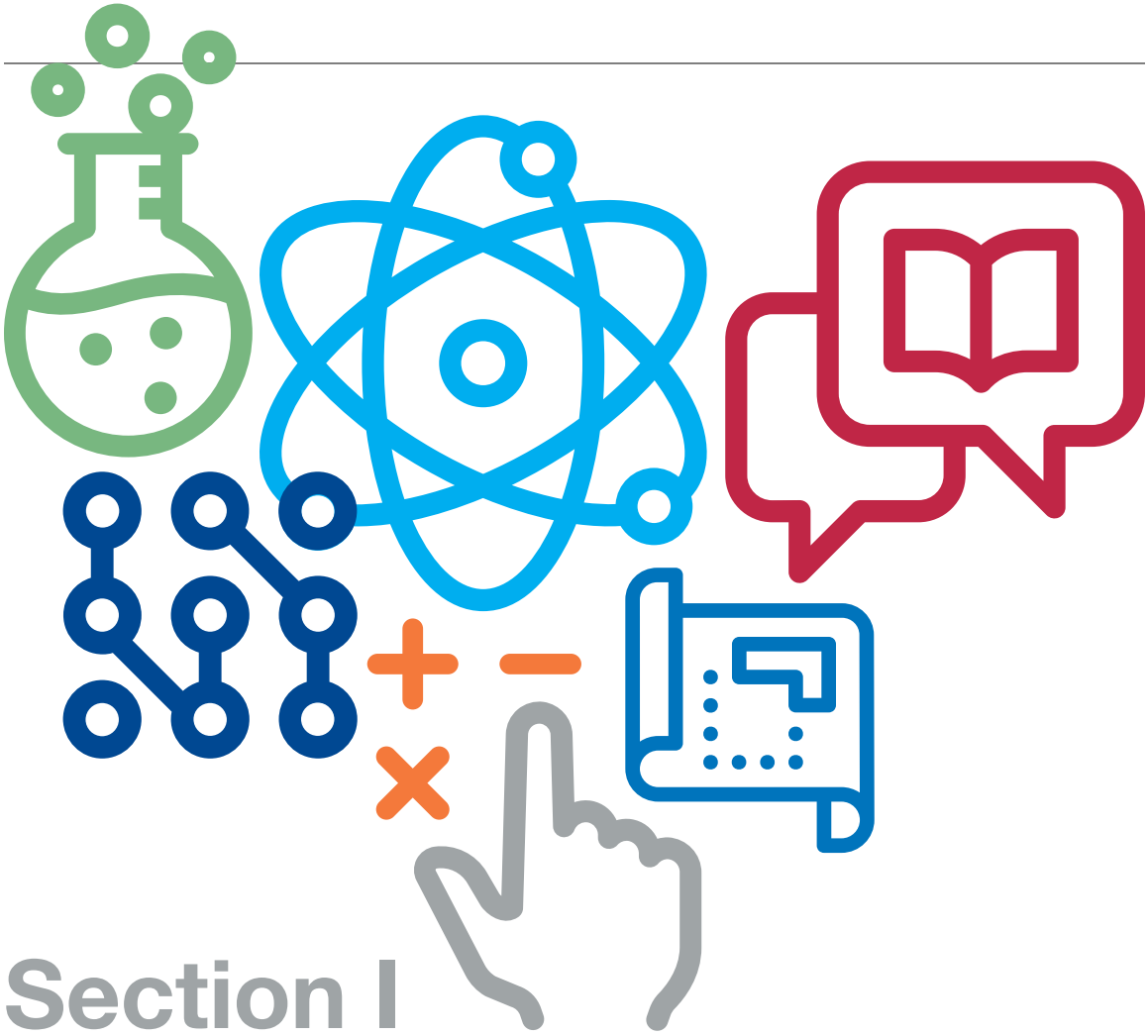
**AAU's work was similar to, but also departed from, traditional theories of university reform.** There are three key aspects to traditional theories of scaling reform examined in this study: *deliberation, networks, and external supports*. Opportunities for deliberation and dialogue among professionals – such as convenings, conferences, and meetings – develop motivation, interest, and ownership. Through dialogue, norms and values are explored and changed as people accept new ways of doing things. Networks connect people to others with similar ideas and also provide change agents with the information, incentives, and social capital that facilitates the change process. Networks also reduce risk-taking by having groups of people experiment together. External mechanisms of support can take many forms ranging from concept papers and frameworks to funding, awards, and recognition necessary to help sustain change agents in the face of entropy and even negative dynamics. These strategies acknowledge that individuals (or even individual campuses) cannot successfully act alone to scale changes and that their environments must be reshaped to support the changes themselves. An individual campus is unlikely to act outside the norms, messages and incentives developed within the broader enterprise of higher education. Disciplinary societies, national organizations, and regional groups all shape and influence campus behaviors, including individual faculty behaviors. Aligning messages among groups provides motivation for change.

To some extent, AAU utilized all three components of theories of scale – deliberation, networks, and external supports. AAU created a network of networks that scaled changes across many departments, campuses, and organizations. The AAU STEM Initiative also provided important external supports. AAU was not as successful in creating deliberation as it was with the other two strategies. AAU's most effective strategy for scaling reform involved its status as a prestige organization with the power to reshape the higher education enterprise – a significant departure from traditional theories of scaling reform.

**AAU can maximize its impact on STEM education reform by finding ways to incorporate the quality of teaching into its overall mission.** Data suggest that AAU can be a stronger force for improving the quality of instruction in higher education by leading the charge. The AAU STEM Initiative is certainly one part of that message, as is making clear that AAU is committed to maintaining its effort in improving education for the long run. More complex are steps to add a teaching component to membership criteria. Interviewees tended to support a modification in AAU membership. Many member institutions look to AAU for clues about institutional performance. Finding additional ways to make clear that undergraduate teaching quality and effectiveness is a fundamental expectation for AAU members is an important step in this process.

### Lessons for National Organizations

Although the study provides important feedback for AAU to hone its strategy, larger lessons about the role of national organizations in reforming undergraduate education also emerged. The concepts of mapping strengths and capabilities, having concrete plans about influence, optimizing networks, and practices for maximizing learning are likely transferable to these other settings. Furthermore, many of the principles that emerged could also be utilized in regional or local organizations. The report ends with key recommendations for other external organizations and stakeholders interested in scaling changes. A practitioner's guide is available online.



# Section I
## Background, Literature and Methodology

**From 2014-2017 The Pullias Center at the University of Southern California, generously funded by the National Science Foundation (NSF), studied the roles and influences of the Association of American Universities (AAU) in scaling teaching innovations in introductory science, technology, engineering, and mathematics (STEM) courses at its member institutions.**

AAU's principal mechanism in this effort was its Undergraduate STEM Education Initiative (AAU STEM Initiative or Initiative) funded by The Leona M. and Harry B. Helmsley Charitable Trust, the NSF, Northrop Grumman Foundation, the Burroughs Wellcome Fund, Elsevier, and Research Corporation for Science Advancement.

Before presenting findings, we review the AAU STEM Initiative, the national context in which it operates, and how it differs from past efforts to improve undergraduate STEM education. Next we discuss the relevant literature and its use in the study design and interpretation of results. We present the findings of the study in Section II.

# Chapter 1 Background and Overview of Study

The need for teaching improvement in undergraduate STEM disciplines and potential ways to redress instructional inadequacies have received increased attention and taken on new urgency in recent years (see e.g., President's Council of Advisors on Science and Technology). We have begun to see a shift to a much more coordinated vision about needed reforms and how to achieve them (see e.g., American Association for Advancement of Science, 2011; Howard Hughes Medical Institute, 2009; National Academies, 2010; National Science Foundation, 2010). This shift has been driven in part by new scholarship demonstrating the effectiveness of evidence-based active learning techniques in comparison to the *sage on the stage*, or expert lecturer who transmits knowledge (National Research Council, 2012) as well as widely disseminated recommendations for improving STEM instructional practices (President's Council of Advisors on Science and Technology).

Despite abundant demonstrations of effectiveness, student-centered, evidence-based teaching practices have not been widely adopted in introductory undergraduate STEM courses. The reasons are complex, including deep-seated customs, faculty rewards structures, the competitive pressures to stay productive in research, as well as the need to prepare and persuade faculty to use these new approaches and for students to engage with them. Most efforts to engage faculty in using evidence-based active learning teaching practices have focused on attempting to change individual faculty members' instructional behaviors in isolation. Much less attention has been paid to organizational culture and faculty rewards. Fairweather (2008), in his report to the National Academies Research Council Board of Science Education, noted that teaching reforms focused solely on individual instructors rarely lead to widespread reform. Instead, "the instructional role [cannot] be addressed independently from other aspects of the faculty position, particularly research, and from the larger institutional context" (p.3, 2008). Fairweather (2008) and Austin (2011) recommend that reforming STEM instructional practice requires engaging institutional leaders such as department chairs, deans, and presidents in rethinking institutional structures and culture. Austin (2011) also suggests that external groups such as disciplinary societies, national associations, government agencies, and employers will be necessary to help support and leverage change within institutions.

**The overall objective of AAU's Undergraduate STEM Education Initiative is to influence the culture of STEM departments at AAU universities to encourage and support the faculty to use teaching practices proven by research to be more effective in engaging students in STEM education and in helping students learn.**

In 2011, AAU launched a five-year initiative in partnership with member institutions to improve undergraduate STEM teaching and learning. In contrast to traditional reforms that focused primarily on reforming the teaching of individual faculty members, the AAU Initiative focused on reforming the primary academic unit in the institution, the department, and incorporating both curricular and cultural elements in the improvement of STEM undergraduate education. The overall objective of AAU's Undergraduate STEM Education Initiative[1] is to influence the culture of STEM departments at

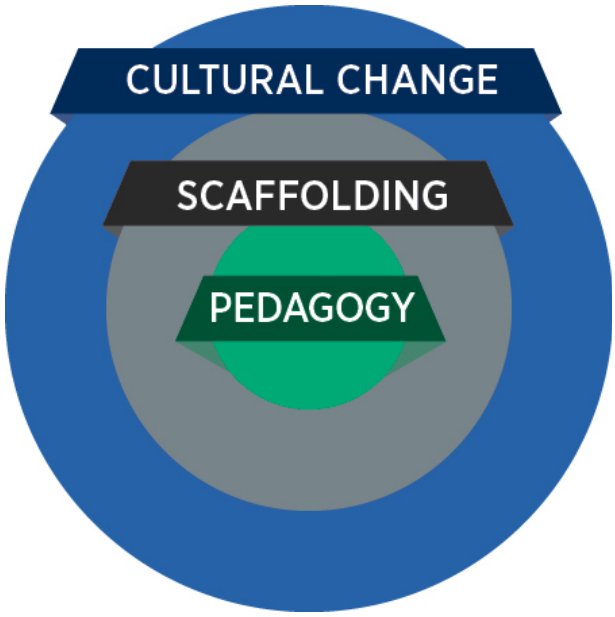
1 AAU published a *Progress Toward Achieving Systemic Change,* a five-year status report on the AAU Undergraduate STEM Education Initiative in October 2017. The report documents the results of the AAU STEM Initiative to date. AAU is committed to expend the initial effort indefinitely by integrating continued support for undergraduate STEM education improvement into its ongoing portfolio of work.

AAU universities to encourage and support the faculty to use teaching practices proven by research to be more effective in engaging students in STEM education and in helping students learn. The goals of AAU's STEM Initiative are to:

1. develop an effective analytical framework for assessing and improving the quality of STEM teaching and learning;
2. support project sites at a subset of AAU-member institutions to implement the framework;
3. explore mechanisms that institutions and departments can use to train, recognize, and reward faculty members who want to improve the quality of their STEM teaching;
4. work with federal research agencies to develop mechanisms for recognizing, rewarding, and promoting efforts to improve undergraduate learning; and
5. develop effective means for sharing information about promising and effective undergraduate STEM education programs, approaches, methods, and pedagogies.

In collaboration with its member universities, AAU developed a Framework for Systemic Change in Undergraduate STEM Teaching and Learning (Framework) to guide institutions in their commitment to facilitate change in undergraduate STEM education. This required identifying key levels of change, the agents of change, and the mechanisms of change, as well as the models for scaling and sustaining it, drawing from literature on institutionalization. The core of AAU's Framework is pedagogy: the practices used by faculty members to engage students and guide and support their learning. To successfully enact and sustain the use of evidence-based teaching techniques, two additional elements are necessary; scaffolding, or support, for both faculty and students; and larger cultural change to facilitate changing teaching practices. Ultimately, the Framework is intended help the various individuals and organizations (faculty members, department chairs, college and university administrators, and institutions) who work together to improve undergraduate STEM teaching and learning. See Figure 1 – The Framework:

**Figure 1**
The Framework



From among 31 AAU universities that submitted concept papers, AAU selected eight member campuses to serve as project sites[2]. Several criteria were considered when choosing sites, such as the degree of departmental and faculty engagement, institutional commitment, likelihood of sustained organizational change, and commitment to evaluation and assessment. As a collective, the eight project sites represented the diversity of the AAU membership (e.g., public and private universities, large and small enrollments) and proposed projects that addressed the full range of elements outlined in the Framework. Over a three-year period, AAU STEM Project Sites served as laboratories to implement STEM education reforms. Project sites are the first phase of a larger AAU commitment to encourage broad-based reform of undergraduate teaching practices at AAU universities and beyond.

A crucial step in disseminating STEM educational reforms beyond project sites was AAU's formation of an AAU STEM Network. AAU envisioned a collaborative network to link member institutions grappling with similar challenges in improving STEM teaching and learning for undergraduate students. The network met annually during the initial five years of the AAU STEM Initiative with plans to continue meeting into the future. Research by Fairweather (2008), Eckel and Kezar (2003), and Kezar (2001) endorses the importance of relationships and networks in changing faculty and administrative behavior especially when the collaboration is among peers as well as high prestige individuals and organizations. Austin (2011) and Kezar (2001) in particular identify networks as an important alternative to (often ineffective) strategies based solely on empirical evidence as a motivator for changing faculty behavior. Social relationships and networks are among the strongest motivators for changing ideas and practices (Valente, 1995; Rogers, 2003).

Complementing these implementation efforts is AAU's work on metrics. With support from a two-year grant from the NSF "Widening Implementation & Demonstration of Evidence-Based Reforms" (WIDER) program, AAU developed a set of baseline measures that project sites, and other institutions, could use to document the current status of undergraduate teaching and learning and monitor the effects of reforms (see *Essential Questions and Data Sources* released in 2017).

At the national level AAU works closely with other key organizations involved with undergraduate STEM reform including the Association for the Advancement of Science (AAAS), Association of American Colleges and Universities (AAC&U) Project Kaleidoscope (PKAL), and the Association of Public and Land-grant Universities (APLU). By attempting to align important national norm-driving groups, AAU learned from the success, for example, of the Accreditation Board for Engineering and Technology (ABET) in encouraging more attention on undergraduate programs by shifting accreditation criteria to focus on student learning outcomes (Lattuca et al., 2006).

**Finding ways to align norms across peer institutions, and linking with disciplinary societies and other key national groups is important to reinforce norms that value improved STEM undergraduate education.**

In addition to aligning norm-driving groups within an institution—programs, departments, and colleges or schools—and finding ways to align norms across peer institutions, linking with disciplinary societies and other key national groups is important to reinforce norms that value improved STEM undergraduate education.

2 Brown University; Michigan State University; The University of Arizona; University of California, Davis; University of Colorado Boulder; University of North Carolina at Chapel Hill; University of Pennsylvania; and Washington University in St. Louis

A crucial cultural barrier to STEM reform *within* research universities is faculty members' perceptions of the relative importance of teaching. This challenge is especially true for Introductory STEM courses which often enroll students outside the major; i.e., the relevant norm here is not only the value of teaching but the value of teaching introductory students outside of one's major. Fairweather notes "that resistance to adopting more effective teaching strategies in large part derives from the perception of STEM faculty that the teaching process is at odds with the research process, and that research is more interesting and more valued at their institutions" (p. 5, 2008). As Austin (2011) identified, norms for faculty behavior are shaped at multiple levels – department, institution, discipline and through other key external groups such as the AAU. By adopting its Framework, the AAU Initiative attempts to incentivize its member institutions to address the ways that faculty norms about teaching are developed and reinforced by various agencies within and outside the institution.

AAU is uniquely positioned, both within the context of its own initiative and in the wider higher education community, to reshape faculty norms and work with other external agencies and disciplinary societies to align those norms. Furthermore, AAU can achieve disproportionately significant influence on U.S. academic institutions in part because of the long-term prestige and status market in which academic institutions operate (Fairweather, 1996). In reviewing the history and sociological trends of higher education, Riesman (2001) famously quipped that the top 80-100 institutions in the country have consistently shaped the norms and behaviors of all other colleges and universities in the previous 200 years. In this context, a commitment by prestigious research universities to improve undergraduate STEM education provides a highly influential role model example for other institutions to follow.

This research project sought to use the AAU STEM Initiative as a real-time, field-based innovation to examine the role that AAU can play in achieving scale of evidence-based teaching practices in undergraduate education. The main objective is to understand *how* the AAU STEM Initiative achieves scale of improving undergraduate STEM teaching and learning. The research questions are:

- How does the AAU Initiative achieve scale in reform of undergraduate STEM teaching and learning?
- What is the role of a national association in undergraduate STEM reform and what approaches are perceived to have the greatest impact to achieve scale?

In the next section the literature used to frame the study is described, followed by our methodology.

# Chapter 2 Literature Review

This study was framed initially by literature on scaling up innovations in higher education (Kezar, 2001; Kezar, 2011). The study was both deductive and inductive. As we conducted our initial review of the documents and began observing the Initiative, we examined additional theories that might help explain observed phenomena including institutional theory, organizational learning, and systems theory. We iteratively tested concepts until we found those most clearly reflected in the data.

Since very little is known empirically about bringing innovations to scale within higher education, this study of the AAU Initiative can potentially add considerably to the literature. Most studies have focused on individual or institutional change rather than on macro changes scaled across an institution or institutions (Kezar, 2011). Most research about scaling-up innovations (programs/interventions) comes from policy research and applied subfields such as international or community development (Dede, 2006). This study draws on knowledge about scaling reforms from these fields as well as the limited literature in K-12 schools, which is the closest literature base on educational institutions available (Adelman & Taylor, 1997; Dede, 2006).

**Since very little is known empirically about bringing innovations to scale within higher education, this study of the AAU Initiative can potentially add considerably to the literature.**

**Defining Scale.** Scale (sometimes referred to as scale-up) typically has been *defined* as broader reach of a practice being used by more individuals over time (Elmore, 1996). Effective scaling involves depth, sustainability, spread., and shift in the ownership of the reform (Coburn, 2003). Depth is achieved when innovations reach consequential change in classroom and school practice, impacting the beliefs of teachers and underlying assumptions about the nature of teaching and learning. Spread refers to the dissemination of the innovation in its complex forms (e.g., affecting teacher consciousness and group interactions). Shift in reform ownership is evident when the innovation moves from an external push for reform to its acceptance and ownership by local educators and their institutional leaders. Depth, spread, and shift in reform ownership combine to lead to sustainability.

**Characteristics of Scale.** The AAU STEM Initiative is consistent with research associated with scaling change in education, including a focus on campus systems such as faculty rewards and work priorities, promoting new logics or values about teaching, and developing a network of peers to reinforce campus reforms (McLaughlin & Mitra, 2002). Two primary characteristics of widespread use or scale of an innovation are conditions that *motivate* and *sustain*. Crucial components of motivation are incentives, ownership, and being context based/organically created (Healey and Destafano, 1997; McLaughlin & Mitra, 2002; Samoff et al., 2003). For professional employees such as faculty members *incentives* can range from seed funding, reward structures, merit pay, and course releases (Kezar, 2001). For the AAU Initiative how universities deal with the incentives in favor of research and scholarship in reward structures is crucial to effective scaling of reforms in undergraduate STEM education (Fairweather, 2008; Kezar, 2001). *Internal ownership* of reforms (in contrast to viewing the reform as externally imposed) is another element of successful scaling of reforms (Coburn, 2003; Datnow, et al, 1998; Elmore, 1996; McLaughlin & Mitra, 2002l; Palmer, 1992; Samoff, Sebante & Dembele, 2003). Samoff, Sebante, and Dembele (2003) noted that reforms are inherently *context- based*, particularly in education. Innovations in one setting are not easily transferred to another setting unless they can be modified or adapted to that setting (Datnow, et al., 1998). Scaling of a reform is most effective when the reform is developed *organically* within a school or setting rather than imposed from the outside (Datnow, et al., 1998; Healy, & DeStefano, 1997; Lee, & Luykx, 2005).

Two key conditions are important for sustainability: *implementation context* and *norms* (Coburn, 2003; Elmore, 1996; McLaughlin & Mitra, 2002). Ignoring the implementation context is a barrier to scaling of reforms (Datnow, et al., 1998; Dede, 2006; Lee, & Luykx, 2005). For example, Elmore's (1996) evaluation of 20 years of NSF-funded school reforms found that school incentive structures worked against scaling change in core activities. Relevant examples for the AAU Initiative include misaligned reward structures, lack of incentives, and curricular policies. Reform strategies that do not take into account local *norms* often fail to scale (Coburn, 2003; Elmore, 1996; Samoff, Sebante & Dembele, 2003). Good practices should be openly and publicly debated more regularly – becoming part of the value system (Dede, 2006; Elmore, 1996).

In this study, we examine the ways that the AAU STEM Initiative is perceived as successfully addressing *motivation* and *sustainability* as well as the subconstructs of incentives, ownership, context based/organically created, implementation context and norms. In this context overcoming resistance is as important as creating incentives for reforms (McLaughlin & Mitra, 2002).

**Strategies for Achieving Scale.** Kezar's (2011) review of research on scaling educational reforms identified three key levers for success: deliberation and discussion, networks, and external support and incentives. These strategies help overcome barriers to scaling reforms. Table 1 demonstrates the relationship between the strategy and the successful characteristics of scale up.

**Table 1: How each strategy addresses the characteristics of successful scale-up**

| Areas of successful scale up | Deliberation | Networks | External support |
|---|---|---|---|
| **Motivation** | **X** | | **X** |
| Incentives | | X | X |
| Implementation context/flexibility | X | X | |
| Ownership | X | | |
| **Sustainability** | | **X** | **X** |
| Implementation context/flexibility | X | X | |
| Underlying norms | X | | |

***Deliberation and discussion:*** One strategy is creating opportunities for deliberation and dialogue among peers – convenings, conferences, seminars, and meetings. Faculty members are more likely to adopt a new pedagogy when they engage in a process to help them understand the necessity of the change (Elmore, 1996; Kezar, 2011). Norms and values can be influenced by dialogue with peer professionals, which helps participants make sense of the change (Senge, 1990). Deliberation can increase commitment to reforms by engaging participants more deeply in the learning process about the reforms (Kezar, 2011). Deliberation helps scaling because it allows for adaptation that accounts for cultural and structural differences within institutions (Samoff, Sebante & Dembele, 2003).

***Networks:*** Networks connect people to others with similar ideas as well as providing change agents with information to help them promote the change process locally (Datnow, et al., 1998; Dede, 2006; Lee, & Luykx, 2005). Research has shown that people interacting with others in networks become more open to adopting new approaches to solve problems (Tenasi & Chesmore, 2003). Networks also can provide external motivation for innovation when local

incentives are weak (Kezar, 2011). By connecting participants with other innovators, networks help overcome the challenges of scale confronted by isolated individuals or organizations (Rogers, 2003). Networks help participants feel part of a collective strategy rather than being an isolated innovator (Rogers, 2003; Valente, 1995). Networks also can provide information about using *social capital* to overcome barriers to reform (Burt, 2000). Social capital is the set of resources (e.g., knowledge, influence that people possess, finances) embedded within social relations/structures which can be mobilized by an actor to increase the likelihood of success in purposive action (Daly & Finnigan, 2009).

***External supports:*** External organizations can provide individual campuses resources and other forms of support (e.g., concept papers, frameworks, funding, awards and recognition) to encourage change in the face of entropy or negative dynamics, and can also enhance the sustainability of change (Datnow, et al., 1998; Dede, 2006, Kezar, 2011). Individuals (or even individual campuses) often cannot successfully act alone to scale changes. External environments play key roles in supporting the reforms because an individual campus is unlikely to act outside the norms and incentives held by peer institutions and the broader enterprise of higher education. Disciplinary societies, national organizations, and regional groups (e.g., accreditation agencies) all influence the behaviors of administrators and instructional faculty members (Austin, 2011; Kezar, 2001). These supports increase the likelihood of scaling of instructional reforms.

Distributive rather than top down forms of *leadership* are the most effective in scale-up strategies (Palmer, 1992; Senge, 1990). Distributed leadership is enacted by groups of people rather than depending solely on a particular position or authority. It draws on leadership across and sometimes beyond the institution. Distributed leadership includes faculty, professional association employees, staff at AAU, and those in formal positions of authority such as administrators or policymakers.

In addition to the theories of scaling discussed above, we found additional theoretical perspectives useful in analyzing the effects of the AAU Initiative – institutional theory, organizational learning, systems theory, and institutionalization.

**Institutional Theory.** Institutional theory, which fit much of our emerging data, describes why change occurs as a complex interplay of strong normative internal cultural dynamics with varying external logics that push for new ways of doing things. Institutional theory suggests that individual change agents and institutional leaders are strongly influenced by internal forces of inertia, but when external norms change – in this case from peer institutions and relevant academic disciplines – this impacts internal cultural dynamics (Powell & DiMaggio, 1991). Institutional theory also suggests that colleges and universities – as institutions with long-standing missions tied to societal goals – will change more slowly and less often than other types of organizations. Our research demonstrates that AAU leveraged external logics related to valuing teaching at research universities to help promote institutional change.

In addition to the nation-state, market factors, and other societal factors, various actors within the higher education universe also affect institutional decision-making (Powell & DiMaggio 1991). These actors include accreditation, disciplinary societies, and policy groups such as the State Higher Education Executive Officers. Especially important for AAU institutions is the prestige market in which U.S. higher education operates. This prestige market places greater value on faculty research productivity and to a somewhat lesser degree on student selectivity. These values are reinforced by disciplinary societies and by faculty rewards within academic

institutions (Boyce 2003). Institutional theory assisted us in developing a comprehensive perspective of change that integrates important external factors with key internal dynamics to explain the impact of the AAU Initiative on its membership. It also demonstrates how practices become embedded, or institutionalized, in the structures and processes of organizations, which makes it difficult to change values and systems once they become embedded.

As an important external actor, AAU's strategy in the STEM Initiative was to align the various internal and external players to emphasize and reinforce excellence in undergraduate teaching as a highly visible and desirable goal for its member institutions. Beyond its membership, AAU also hoped to leverage the isomorphic power of research universities to shift and make the norms within higher education more balanced between teaching and research, and to institutionalize the notion that faculty should be as excellent in teaching as they are in research.

**AAU's strategy in the STEM Initiative was to align the various internal and external players to emphasize and reinforce excellence in undergraduate teaching as a highly visible and desirable goal for its member institutions.**

**Organizational Learning.** Organizational learning is the study of whether, how, and under what conditions organizations can be said to have learned. Organizations are seen to change when individuals learn and collectively reorient the way that they approach conducting work. From the beginning of the Initiative the AAU leadership viewed the 8 project sites as laboratories to try out new practices. AAU sought to expand sharing of these reforms across the project sites and more broadly across AAU member institutions by forming the AAU Network. Four of the five main objectives of the AAU STEM Initiative relate in some way to organizational learning, including developing meetings for information sharing about best practices in STEM reform, working with institutions and departments to train their faculty in evidence-based teaching, and supporting project sites to implement the framework (which also could be seen as a learning tool). Data collection and sharing the information across member institutions was also part of encouraging organizational learning. A major goal of the project was to develop measures to help institutions assess the use of evidence-based instruction and monitor the effects of reforms on these instructional practices.

**Systems, Open Systems and Institutionalization Approaches to Scale.** The AAU also articulated a systems approach to change. Systems theories examine the inter-relationship of various subsystems within an organization and how organizations are interconnected. From this perspective, professional development alone is insufficient to encourage evidence-based instruction because classroom practices are also tied to incentive systems, departmental norms, facilities, campus priorities, and student expectations.

AAU also incorporated an open-system theory of change that connected internal educational reforms with various external actors. Although several studies of change in higher education consider the effects of internal systems like reward structures (Kezar, 2013), few studies incorporate open systems theory, especially in studies of teaching and learning (Kezar, 2013; Zemsky, 2013).

The systems approach is present in the five objectives for the AAU STEM Initiative that operate at multiple levels – project demonstration sites, the AAU STEM Network, work with federal agencies, and the broader higher education system. The most well-articulated level within the systems approach is the institutional system, where AAU's Framework required project sites to identify key levels of change, the agents of change, the mechanisms of change, and models for scaling and sustaining change.

Additionally, the project was informed by theories of institutionalization, which examine the ways that institutional structure and culture shape and frame implicit or tacit activities. Change requires reshaping the underlying structures and culture. Institutionalization theory suggests that the alignment of leadership and institutional infrastructure – including tenure and promotion requirements, professional development and classroom assessment – with educational reforms are required to sustain the reforms.

# Chapter 3 Methods

**Overall Methodology.** Consistent with previous research on scaling innovations (e.g., Coburn, 2003; Elmore, 1996; Samoff, Sebante & Dembele, 2003), this study used a qualitative design based on interviews and observations to examine perceptions of motivation, sustainability, and strategies meant to achieve scale. Studies of scaling innovations are best done during the innovation while memories and events are fresh in the minds of study participants (Dede, 2006; McLaughlin & Mitra, 2002).

**Document Analysis.** The first year of the research project focused on document analysis (while simultaneously conducting observations) to better understand the Initiative – how it was framed and communicated, what strategies were used, how implementation was occurring, and the like. We reviewed many documents from several years of the AAU STEM Initiative including annual reports; correspondence about the Initiative; key documents such as the project framework, site visit notes, survey data about teaching practices; webinars captured through video hosted by AAU; and multiple meeting notes from AAU STEM Network, AAU STEM Project Site, Advisory Committee, and AAU project team meetings. In total, we reviewed more than 10,000 pages of documents to situate more comprehensive analyses of subsequent interview and observational data. We continued to review documents developed in the final two years of this study.

**Observations.** The study began with 1 ½ years of observation across the AAU Initiative by project research staff prior to interviewing participants in the Initiative. The observations were used to validate and extend interview data and documentation. Observations also provided context information to help interpret interview data. Additional observations were conducted for one year concurrent with the interview data.

Extensive field notes were taken at the following events:

- Bimonthly meetings by the AAU STEM Initiative project team over 2 ½ years – 28 meetings in total
- Annual workshops for the AAU STEM Project Site leadership teams
- Annual AAU STEM Network conference
- Annual in-person and conference call meetings of the AAU STEM Advisory Committee
- Larger convenings focusing on special topics or themes such as the development of metrics to evaluate teaching
- Site visits to the eight AAU STEM Project Sites during year three (only a select number were conducted)
- National workshops/meetings when the AAU STEM Initiative was involved

Observations focused on the strategies used (particularly networking, convenings, and leadership) to scale-up educational reforms achieved through the three key principles noted in the literature: introduction of new ideas, social capital, and risk-taking. Through observation, we documented instances of new ideas circulated at meetings, the ways that solutions to problems were shared, and the ways that individuals expressed willingness to confront the status quo on their campus. These observational data were crucial to validate claims made by respondents during interviews as well as documentation. Observation of the convenings and meetings also shed light on whether discussion and deliberation (e.g., network meetings, local faculty learning communities) can help change norms and cultures on campuses. Observations were also uniquely situated to help us judge how networking among campus leaders (central administration, deans, department chairs) enabled them (or did not enable them) to interact with colleagues, align messages, describe values, and think about incentives.

**Interviews and Sample.** We interviewed four groups of individuals to understand the characteristics (e.g. address underlying norms) and strategies (e.g., convenings, relationship/network) that best support scale: (1) AAU STEM Initiative leaders (AAU staff responsible for the Initiative and the Advisory Committee for the Initiative); (2) selected faculty and administrators from the STEM Initiative project sites; (3) a comparable sample of faculty and administrators from non-project sites who are part of the AAU STEM Network; and (4) collaborators from outside organizations assisting AAU in the Initiative. In total, the study included 104 interviews (48 from AAU STEM Project Site teams, 26 AAU STEM Network members from non-project sites, 13 key AAU staff, and 17 individuals from collaborating organizations). We discuss the rationale for this sample below.

We interviewed *all key personnel* directing the Initiative, including the two co-project leaders of the AAU STEM Initiative, three AAU staff members, the planning team, and advisory committee members who were integral to advancing the AAU STEM Initiative. Key personnel described their observations about creating and implementing the Initiative as well as their perceptions about what seemed to be leading to scale.

For each of the *eight AAU STEM Project Site* campuses we interviewed between 6 and 10 individuals. These interviews included the co-project site leadership, at least one department chair of a participating department, and two or three faculty members engaged in reforming an introductory STEM course. The project site leadership were best situated and knowledgeable about project activities and about tracking implementation and scale-up. The project site leaders also were in a position to judge the effects of external forces (including the AAU) on local project activities. To obtain additional perspective, we also spoke with two or three faculty members on each campus who have been involved with the Initiative but not with the planning team.

The *AAU STEM Network* included all 62 AAU institutions. Each AAU campus has a *point of contact* who is regularly informed about the AAU STEM Initiative and invited to participate in the AAU STEM Network convenings. We interviewed 26 points of contact, some who regularly engaged in the AAU STEM Network activities and some who were less active. These individuals spoke directly to the influence of those events on their ideas for pedagogical innovation, support for pedagogical innovation, and leadership strategies for creating broader scale implementation on their campuses. These interviews allowed the research team to better understand the mechanisms of scale affected by the AAU STEM Network.

Lastly, we identified and interviewed *collaborators*. These individuals came from other national associations, disciplinary societies, and federal agencies engaged in national efforts to reform undergraduate STEM education. Collaborators provided an outside perspective on how the AAU Initiative has (or has not) reshaped norms about undergraduate teaching in colleges and universities.

Interview protocols were customized for each group, but each protocol contained shared or core themes. These themes took into account the key constructs reviewed in the literature, including participants' involvement with the Initiative, challenges and facilitators of scale, evidence of scale, perceptions of the Initiative, what has worked and not worked, and what is in the process of being sustained. Unique questions for each group included: (1) AAU key personnel: What was the history and development of the Initiative. (2) Collaborators, Network members, and Points of Contact: Awareness about the Initiative and its details. Prior to field testing the draft interview protocol was reviewed by a Project Advisory Board consisting of relevant higher education scholars and practitioners.

Interviews were approximately one hour in length and conducted via telephone. Some interviews with project teams took up to two hours. All interviews were recorded and transcribed.

**Data Analysis.** The qualitative data (both interviews and observation) was analyzed using HyperResearch; a qualitative software program that helps manage and analyze large amounts of qualitative data. We used the Kincheloe and Berry (2004) process of bricolage to analyze qualitative data. This approach involves utilizing multiple theoretical perspectives to best understand a complex phenomenon. It avoids reductionism by not taking single theoretical or narrow approaches to interpretation. Instead, various theories are overlaid to interpret data both separately and then simultaneously. This approach acknowledges the complexities of social life and the need to bring in many different interpretive frameworks to best understand complex social processes. Bricolage is a useful approach to analyzing complex processes such as educational reforms that do not fit neatly into a single psychological, sociological, or organizational disciplinary box. We overlaid ideas from institutional theory, systems theory, theories of scaling change, organizational learning, institutionalization, and cultural theories, all addressing change from different vantage points, to explore the Initiative from various perspectives.

We employed the Boyatzis (1998) deductive and inductive thematic coding strategy. Inductive themes were developed by reviewing the data in the first two years before formal coding started in the third year of the research study. Institutional theory, for example, was added to our coding scheme early on because its importance was evident during observation of events. We began with a list of codes informed from the initial literature review on scaling changes in higher education (e.g., incentives, networks, deliberation). We then added literature on institutional theory and organizational learning as it emerged in our informal analysis. Our final code list used for analyses was developed over a two-year period and included 98 codes drawn from both the literature and from data collection.

**Trustworthiness and Limitations.** This study design draws on systematic approaches to studying scale proven valid in other research. It emphasizes interviews and observations to help to explain the underlying mechanisms related to motivation, ownership, norms, and sustainability (Dede, 2006). We used several methods to address trustworthiness. First, observations were carried out for 1 ½ years prior to conducting interviews to ensure that the researchers were familiar with the Initiative and the contexts in which it took place. This step is an essential component of interview validity. Second, observation and interview data were compared to provide multiple data points for assessing results (triangulation). Third, coding reliability was addressed by having several researchers code the same data and making sure that the results agreed. Fourth, we received feedback from our advisory board on the design, observation and interview protocols, sample, and data interpretations. The study was limited by little exposure to project sites for impromptu conversations with campus participants and a sample for each project site skewed toward project participants.

# Section II Findings

**Introduction** **We begin the findings section (Chapters 4 and 5) with a review of AAU's systems approach to facilitate scaling change. We examine three primary organizational levels: 1) institutional or campus-based level, 2) AAU STEM Network level, and 3) macro level including national agencies with a stake in improving undergraduate STEM education. We also examined sub-systems with each level such as departments within an institution.**

Chapter 6 highlights one of our main findings – that AAU's role in scaling improved teaching can best be supported through influence strategies. In this section, we review data that supports the importance of maximizing AAU's prestige to motivate for change. Following influence, Chapter 7 highlights AAU's work to frame and "message" the work of improving undergraduate teaching. Framing the work and developing a compelling rationale for the change were important processes for changing underlying values about the importance of undergraduate teaching at AAU institutions.

Chapter 8 reviews AAU's role in leveraging networks to scale reforms. The data strongly suggested that AAU's most effective strategies for reforming STEM education focused on systems change, influence, networks, and framing/logics. Chapter 9 describes findings related to the final major factor for scaling reforms – learning – including challenges that emerged for AAU while acting as a learning facilitator. Chapter 10 examines how AAU used multiple approaches/strategies to scaling change simultaneously and some of the benefits to doing so. These benefits included helping motivate and persuade campuses to change, offering them a rationale to do so, encouraging improvements in infrastructure, and helping campuses facilitate adoption of teaching reforms. We review synergies that can be created through multiple theories as well as some conflicts that can occur when deploying multiple theories.

Chapter 11 examines stakeholders' views of AAU in the complex process of improving undergraduate STEM education. Chapter 12 begins to compare findings in earlier chapters to theories of scale, demonstrating how AAU's work was similar to but also departed from the existing theories of scale. Chapter 13 reviews an area noted throughout our study as an important possible factor in scaling change – AAU changing its own culture to help foster changes in the campuses.

Section III, the last section, offers conclusions and recommendations which distill lessons and ideas across the various chapters.

# Chapter 4 Systems Approach to Change

The Initiative worked at three major levels to encourage undergraduate STEM reform: the eight AAU STEM Project Sites, the AAU STEM Network, and national organizations in higher education. This three-level strategy demonstrates a systems approach in action. The Initiative leveraged the interaction among the three levels to try to generate greater synergy among them, which is consistent with research about effective change strategies (Kezar, 2013).

**Individual AAU STEM Project Sites.** The *eight project sites* were the major focus of the initiative. As one respondent stated: "You need some action site where people can see the ideas are happening that you're trying to proliferate. So, these sites can become what people are talking about and help them to see and understand the AAU Initiative." Unlike many prior efforts in higher education, the AAU Initiative emphasized institutional-level reform from the beginning. The Initiative based its framework and implementation strategies on the premise that scaling and sustainability required institutional as well as departmental and individual buy-in from the beginning, an atypical perspective in this type of reform.[3] Most of the individuals interviewed perceived the AAU focus on institutional reform as unique and compelling.

AAU used a variety of approaches to shape the commitment and direction of the individual campuses. AAU *distributed the funding* it received from the Helmsley Charitable Trust using a *request for proposal* (RFP) that required campuses to match funds, demonstrate commitment from their senior leadership, commit to a joint faculty and administrative planning and implementation team, and to designate work that spanned the three levels of the Framework (pedagogy, scaffolding, and cultural change). This approach to funding allowed AAU to retain leverage over the change process after the monies were distributed because the expectations delineated in the RFP created a common vision for action and reinforced an institutional approach to change. This approach also created the opportunity for shaping the broader AAU STEM Network. AAU institutions that submitted unsuccessful applications still were influenced by the expectations set out in the RFP. This funding approach created synergies between the project sites and the AAU STEM Network.

To help project sites develop projects in line with eventual institutionalization, AAU created a *Framework* (AAU *Framework for Systemic Change in Undergraduate STEM Teaching and Learning*) that described the three levels of change that applicants for the eight project sites had to address in their proposals: 1. *Pedagogy* – including assisting faculty in creating learning goals, assessments, and other practices that support new evidence-based teaching practices; 2. *Scaffolding* – including infrastructure, reform across curricula, and linking academic departments with support services that support new evidence-based teaching practices; and 3. *Cultural change* – commitment among senior leaders to the use of evidence-based teaching practices including revisions to the promotion and tenure process as needed. The Framework became a tool that could work across various levels of the higher education system, one that any campus across the country (including other AAU universities) could use to guide their change process. AAU reinforced the importance of an institutional and systems-wide approach to reforming teaching by using the Framework as a guide for interviews at project sites and for meetings of both project sites and of the AAU Network (e.g., concurrent conference sessions were organized in terms of pedagogy, scaffolding and culture change).

3 There are other initiatives that have taken an institutional approach, particularly Project Kaleidoscope (PKAL) which has been focusing on the institution as the unit of change for over two decades.

The AAU STEM Initiative project team (also referred to as project leaders and PIs) also created and collected *survey and metric data* to help both AAU and project sites monitor progress in implementing evidence-based teaching in introductory STEM courses. As part of its larger dissemination plan, the AAU Initiative project team wrote and disseminated *Essential Questions and Data Sources* including a list of survey questions and related data to help other institutions assess their progress in implementing undergraduate education reforms. For more information see Essential Questions. The metric data reinforced the synergy between the institutional, network, and national actors in the change process. The metric data provides an example of how a tool developed within one part of a system – the institution in this case – can have implications for the larger system.

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Project sites submitted *annual reports* to assist both institutional PIs and the AAU project team in monitoring progress. The AAU project team reviewed the reports and provided feedback to each of the eight project sites. The AAU project team led webinars for all project sites (and later for the AAU Network) to address key problems and strategies identified in the annual reports.

AAU leaders created a variety of opportunities for the project sites to share information and learn from each other – *annual meetings, webinars, grants for travel to other campuses, social networking sites* to support communication and sharing of best practices (e.g. Hubzero/Trellis), a website with curated resources, listservs for the project teams, and workshops targeted for particular groups such as department chairs. Many of these strategies focused on the project sites but a few of them addressed the larger AAU Network. For example, the *AAU website* collected examples of successful innovations in teaching from all AAU Network members, not just from project sites. AAU also developed a *communications plan* that sent regular messages to AAU campuses about STEM education including grant opportunities, information resources, workshops and professional development, and state and federal policy updates.

*Site visits* were conducted both at the beginning and end of the project. These site visits were meant to encourage and document implementation and scaling of educational reforms, not to act as an external evaluation of project work. AAU project leaders visited each project site to discuss its progress and meet with various stakeholders to re-energize the reform effort on that campus. AAU staff also offered to link campus PIs with individuals at other institutions doing similar reform work and to make presentations to campus constituents if requested by the teams at the project sites.

**AAU STEM Network.** The AAU STEM Network focused on encouraging all AAU institutions to be "as excellent in teaching as research." The RFP process showed a significant demand for a network: half of the 62 AAU members submitted proposals to become a project site. AAU worked with member campuses to appoint a *point of contact* at each campus. AAU sent information about the Initiative to each point of contact and invited them to attend *annual network meetings* where the eight project sites could interact with other AAU campuses. Information flowed both ways: many points of contact were successful reformers in STEM education and could help project sites refine their reform strategies.

Another mechanism to support the broader AAU Network was communication with *key constituent groups* in AAU, including presidents, provosts, and deans. The AAU project team, for example, periodically updated chief academic officers about the progress of the Initiative at their annual or semiannual meetings. The chief academic officers also were interviewed as part of each site visit by the AAU project team.

AAU STEM Network sites also submitted examples of work on undergraduate STEM reform for AAU's *sourcebook* on the *website,* which helped further communication between network members. AAU staff encouraged collaboration between network members by mapping the activities happening on each campus and sharing the information across institutions. In addition, leaders in undergraduate STEM reform at non-project AAU campuses often served as *expert speakers* in AAU-sponsored meetings to inform the broader network.

AAU staff forwarded information about potential grant funding for STEM undergraduate reform to all member institutions. AAU staff also helped non-project member institutions submit *their proposals to other funding agencies*.

AAU also worked with the *public affairs officers* at each AAU STEM Network campus to discuss ways to publicize the efforts to improve undergraduate STEM education at each campus. For example, the *New York Times* published an article on the implementation of evidence-based teaching practices at the University of California, Davis. The University of North Carolina and Michigan State University were showcased in an *Inside Higher Education* article featuring the AAU STEM Initiative. Non-project sites also garnered media attention. For example, the University of Michigan's Center for Research on Learning and Teaching and California Institute of Technology's Center for Teaching, Learning & Outreach were profiled in a *New York Times* article on STEM reform efforts. AAU used media attention to help foster friendly competition, noting "some campuses are getting really good press for their work to improve teaching, do you want to be left behind?"

**AAU used media attention to help foster friendly competition, noting "some campuses are getting really good press for their work to improve teaching, do you want to be left behind?"**

**Broader, National STEM Reform.** At the national level AAU worked to shape the dialogue and activities about undergraduate STEM education. The *Framework document* and the *Essential Questions and Data Source document* were important means to spread the word about STEM educational reform on AAU campuses. Interviewees were familiar with these activities and generally supportive of them.

AAU also helped to support a *coalition of national organizations* aimed at improving undergraduate STEM education, named Coalition for Reform of Undergraduate STEM Education (Coalition or CRUSE). Coalition members include the American Association for the Advancement of Science, the Association of American Colleges and Universities, the Association of Public and Land-Grant Universities, Association of American Community Colleges, and the National Research Council. Linda Slakey, senior advisor to AAU, was the creator and now convener of the Coalition.

AAU worked with the Coalition to map national-level STEM reform activities in STEM undergraduate education across associations and disciplinary societies. The goals of mapping were to coordinate work across national organizations and to institutionalize existing reforms. In the first

year of the Initiative AAU hosted a meeting of funding agencies and foundations to increase visibility of reforms and potentially lead to future funding of STEM undergraduate reforms. The Coalition convened the second meeting of funders and foundations, which led to a report called *Achieving Systemic Change – A source book for advancing and funding undergraduate STEM education*. Members of the Coalition were involved with AAU STEM Initiative meetings and webinars and worked with project sites as well as the AAU STEM Network. The Coalition also participates in the National Undergraduate STEM partnership established by the President's Council of Advisors on Science and Technology (PCAST). The Coalition represents a successful leveraging of AAU's social and political capital with outside groups.

**AAU mapped national-level STEM reform activities to coordinate work across national organizations and to institutionalize existing reforms.**

Beyond the Washington D.C. area, AAU reached out to teaching and learning entities such as the Bayview Alliance (BVA); Cottrell Scholars; Howard Hughes Medical Institute (HHMI) Professors; Center for Integration of Research, Teaching and Learning (CIRTL), and Professional Organizational Development (POD). AAU invited these partners to attend meetings of the project teams and AAU STEM Network, which resulted in substantial information sharing between these organizations and project sites. AAU regularly communicated with the National Academy of Sciences (NAS) as well as STEM disciplinary societies, industry associations, and universities involved in STEM undergraduate education. AAU staff also took on leadership roles, sat on boards, and assumed positions on steering committees for the National Alliance for Broader Impacts, Business-Higher Education Forum, Accelerating Systemic Change Network (ASCN), as well as many related NSF project advisory boards.

These partnerships successfully supported change at the national level. For example, following the AAU Initiative the Cottrell Scholars, a program devoted to improving undergraduate teaching in STEM, sponsored a collaborative research project to increase awareness among the STEM academic community about appropriate metrics to measure the effectiveness of teaching and to promote using these metrics in promotion and tenure decisions. These efforts have the potential to help reshape evaluation of college teaching nationally.

The *advisory committee* for the AAU STEM Initiative, which brought together esteemed individuals in the sciences as well as past and present presidents of AAU institutions, also helped promote a national dialogue about STEM undergraduate reforms. The advisory committee influenced the strategies used by project sites and the messages communicated to the AAU STEM Network, providing yet another example of synergistic strategy across the multiple levels of the project.

AAU is helping develop a *national award* to recognize college and university departments that have demonstrably improved undergraduate STEM education. Leaders at AAU spent years developing the concept, working with potential funders and managing organizations to propose a process for offering and securing the award. Although the award would not be managed by AAU (or awarded only to AAU campuses) it is cast as part of the national effort to improve undergraduate STEM reform.

AAU has historically been involved with *advocating* at the federal level for AAU institutions. Since the AAU STEM Initiative began, this advocacy has included seeking money from Congress to improve STEM education. AAU leaders also attended White House summits and the

working groups of the Committee on STEM Education (CoSTEM) to help coordinate federal investment in STEM education. They also worked with major foundations to develop a workshop focused on increasing the funding for undergraduate STEM reform efforts from foundations. In this manner AAU influenced the shape of national policy and funding priorities as well as indirectly affecting AAU campuses that typically pursue such funding opportunities.

AAU also had a robust *public relations and media plan*. AAU project leaders created media attention through news articles about STEM reform efforts, by placing articles in major journals such as *Science* and *Nature*, and by attending national STEM reform conferences to promote the AAU STEM Initiative. AAU regularly issued press releases about the progress of the Initiative. These media efforts brought attention to STEM reform work in general and especially to the eight project sites. This media attention created a buzz among the broader AAU STEM Network. As an example, several interviewees cited the August 2015 *Inside Higher Education* article highlighting the AAU STEM Initiative's efforts as well as snapshots of two project sites, the University of North Carolina, Chapel Hill and Michigan State University. Finally, AAU project staff presented at research conferences sponsored by the Association for the Study of Higher Education, and AAAS, and at the Transforming Institutions conference sponsored by Purdue University.

In sum, AAU has had a substantial effect on the national policy dialogue about undergraduate STEM education. Many of AAU's actions at the national level filtered down to its member institutions. Even so, interviewees from individual campuses were much less familiar with AAU's role at the national level than they were with AAU's work with individual campuses and with the AAU STEM Network. Perhaps more communication about AAU's national work might create more synergy between its work at the national level with its influence on project sites and with the AAU STEM Network.

**Synergizing the Levels of the System.** The Initiative leveraged the interactions among the three levels to try to create and strengthen synergy. The evidence suggests that AAU achieved such synergy in part by engaging organizations at the national level in a manner that assisted and/or influenced work within the STEM network and at the project sites. See Chapter 8 for more detail about this process based on networking. In this chapter we presented many examples of such synergy resulting from the use of the Framework document, metrics, RFP funding model, points of contact, networks, partnerships, and the measures of teaching excellence.

**Working across multiple system levels helped AAU leverage its impact on STEM reforms.**

The AAU STEM Initiative worked across and among the three levels – institution, AAU STEM Network, and national higher education environment. As predicted by institutional and systems theories, working across the various systems/levels helped AAU leverage its impact on STEM reforms. It was clear AAU took into account the differences among these three levels/systems and did achieve synergies across them. Yet AAU did not intentionally plan for synergies across levels/systems which potentially reduced the amount of synergy achieved in promoting reforms in STEM undergraduate education. We conclude that national organizations trying to maximize their effects on STEM undergraduate reforms should map and evaluate the different ways that the organizations are working across and among different systems. We highlight below other ways AAU could foster synergies among multiple organizational/systems levels:

1. AAU might have communicated its work at the national level, particularly its important partnerships, more effectively with individual campuses and the AAU STEM Network. Intentionally linking its national work (e.g., media attention, national partners like the Cottrell Scholars) with member institutions could provide synergistic support for on-campus work.

2. AAU might have used the members of the Advisory Committee to the AAU Initiative more directly in project work. Although the Advisory Committee reviewed project work and made general recommendations, it might also have played a more active role in advocating for change nationally.
3. Although AAU offered several ways for project sites to share information, not as much effort went into sharing information between project and non-project sites. Providing mini grants for project sites to visit non-project sites is another way to leverage knowledge and communicate innovative ideas between organizations.[4]
4. Interviewees often stated that they were unaware of the work occurring at these three levels, especially work in the broader national environment. Greater communication and articulation of AAU's full strategy might have created more opportunities for synergy across AAU, its project sites, and the AAU STEM Network.

**Conclusion.** This chapter examined how the AAU worked at three major levels – eight individual project sites; the AAU STEM Network that involved all 62 AAU campuses; and the national level among higher education associations, national agencies focused on STEM education, business and industry partners, and philanthropic groups.

4 AAU's current funding from Northrop Grumman includes funds for mini-grants for more campuses to take advantage of learning from each other.

# Chapter 5 Working the System

This chapter explores how AAU can best position itself to influence its member institutions and the AAU Network in reforming undergraduate STEM education. Interviewees perceived that AAU was most effective in promoting STEM undergraduate reforms at project sites and across the AAU Network when it used three distinct strategies:

- Strategies aimed at utilizing the prestige and influence of AAU
- Strategies that built on the historic strengths of AAU
- Strategies that emphasized AAU as a unique niche within U.S. higher education.

According to interviewees, AAU was least effective when missing opportunities to leverage its identity with member institutions. Throughout this document, we will return to the importance of AAU's unique position in the U.S. higher education milieu as a primary factor in its ability to influence member institutions and higher education writ large in the effort to improve undergraduate STEM education. In this context, networking is an especially powerful mechanism for AAU to take advantage of its position to influence institutions of higher education.

We start with the national level of the higher education enterprise. Highlighted in this chapter are examples of where AAU has been successful in influencing the national conversation about STEM undergraduate education, as well as opportunities for increasing AAU's effectiveness. Before proceeding, we note that the distinctions between the levels of the "system" are somewhat artificial and not fully bounded. In describing its work, AAU staff did not separately define or discuss their activities in reforming STEM undergraduate education by level (institution, STEM Network, national organizations). For the most part, AAU staff viewed their work in the Initiative quite fluidly without distinctions by level or system. For analytical purposes, however, levels are important to help us understand the impact of AAU on local and Network reforms as an organization that typically works primarily at the national level.

Institutional theory suggests that innovations in organizations are strongly influenced by larger forces – beyond individual institutions – within an ecosystem. Several interviewees acknowledge that AAU's multilevel or systems approach embedded in the Initiative helped foster change. As a director of a center for teaching and learning stated:

> "I think they [AAU] definitely play a prestigious role within the ecosystem that I'm embedded in. When they announced this initiative's program, what I thought was interesting is how it motivated and enticed many of my colleagues at other institutions. Everybody was having this conversation. Hey, is your school putting one in? That wouldn't have happened if just any other organization said, 'Hey, we're interested in doing reform.' It was because it was the AAU. There's a certain level of 'this will be something of importance to our university and to the landscape of the nation's STEM teaching.' There were messages coming over the POD network about this. So only a group like AAU can make that kind of national conversation happen."

This sentiment was common among interviewees: AAU was uniquely capable of shaping the system at these multiple levels. We explore the perceptions of respondents in greater detail below.

**Broader National Level.** In this section, we describe respondent beliefs about where AAU could have the most impact at the national level. A few interviewees recommended additional activities in which AAU might participate.

***National documents, resources and publications:*** AAU created several documents with a national audience in mind, including the *Framework* and the *Essential Questions and Data Sources documents*. Collaborators in particular described the importance of these documents: "The framework will generate both conversation and provide directions for campuses interested in improving teaching in STEM courses, and this presents a very different perspective on how to go about this work[5]. This might be challenging to some but will definitely generate conversation because it comes from the AAU." This comment (and many similar ones) reinforces the view of AAU as an information source with a built-in audience of interested local and national consumers of such information. One interviewee summarized this important role: "Any time something like this [*Achieving Systemic Change* document] comes out that has a lot of power. It can inspire people. They can give people ideas about how to do things they may not have thought about doing before. I think that's a really good way to reach a broader audience and they could do that even more." As an example of the type of influential literature envisioned in this quotation, in 2017 (after this research study was conducted) AAU published *Improving Undergraduate STEM Education at Research Universities: A Collection of Case Studies*. In general, respondents believed that resources and publications from AAU would be noticed by campus leaders across the country. AAU can reach audiences of institutional decision makers such as presidents and provosts that STEM reformers typically cannot reach. In sum, by publishing and distributing national documents AAU took advantage of its unique national niche and organizational identity.

***Partnerships, networks, and convenings:*** AAU is uniquely placed to develop partnerships with a variety of organizations including the more elite, such as the National Academies of Science and National Institute of Health. AAU can also convene groups, such as funding agencies and foundations, that might not otherwise participate if invited by a less prestigious organization. Interviewees appreciated the partnership and connections formed by AAU in support for reforming undergraduate STEM education: "I think there's been some really important work [by AAU] with other organizations interested in advancing STEM, and it's hard to work across organizations, I know that, but I think even more can and should be done to shape the national efforts and bring them together." Several respondents asked even more of this activity: "I can imagine bringing together a group to talk about rewards systems at AAU institutions, or perhaps the value of professional development, or developing leaders within their STEM departments or colleges, ways to evaluate teaching, or showcase major redesigned curriculum, or to discuss assessment of teaching excellence in STEM. Maybe convening some of the disciplinary societies, accreditors and industry to discuss curriculum, I can imagine this being a larger role in [AAU's] work."

Interviewees noted the importance of AAU's role as a convener and suggested that it could expand that role. While AAU had done important work to convene the project sites and the AAU STEM Network, many interviewees suggested future convenings be focused on specific problems. Such topics might include changing tenure and promotion criteria or measuring teaching excellence. More focused meetings would allow for deeper deliberation about improving the undergraduate learning environment.

***Media and public relations:*** Many interviewees appreciated the high visibility of the Initiative in the media. As one administrator noted: "Media attention really helps shift priorities on our campus. AAU sending a press release or noting how a piece was picked up by a media outlet

5 While it is too early to know the impact of the Framework and Essential Questions and Data Sources on the broader higher education landscape, it is likely that these documents will be utilized by a variety of campuses to help shape their STEM reform efforts. For other work, such as the national award, which has yet to be put in place, or work with the National Science Foundation, it may be too early to see its impact across the system.

– that supported our efforts to innovate." Many interviewees noted that AAU participation resulted in more media coverage for their campus (or other organization) than would otherwise have occurred. A collaborator commented: "Well, they are AAU – they can just draw more attention than others, they can open more doors at the media." Respondents noted that their public affairs and relations staff cooperated with AAU's public relations operation to increase media coverage of local efforts.

***National award or recognition for excellence in teaching:*** Early on, AAU recognized that a national award to recognize teaching excellence in STEM, particularly at the departmental level, might attract academic leaders' attention and influence campus priorities. Respondents from various constituencies agreed with this assessment. As one example: "There just isn't the same national awards or prestige for teaching. There are some awards, but one associated with the AAU will garner more attention." Respondents believed that AAU was one of very few organizations whose sponsorship of a national teaching excellence award could achieve the visibility required to motivate large-scale change in STEM instruction.

***Advocacy:*** The AAU STEM Initiative is meant in part to help shape policy to improve undergraduate teaching and learning by interacting with federal entities such as Congress, the White House Office of Science Technology and Policy, and the National Science Foundation. Collaborators in particular felt that AAU's track record with advocacy uniquely positioned AAU to leverage reform in STEM undergraduate education: "AAU needs to be at the table for the national conversations about STEM, about teaching, to make this a priority because them being there makes it a priority."

**"AAU needs to be at the table for the national conversations about STEM, about teaching, to make this a priority because them being there makes it a priority."**

***Teaching standards and measures of good teaching:*** Although respondents believed that AAU was not well positioned to alter reward systems on individual campuses, most believed that AAU could play an important role in defining standards or measures of teaching excellence at AAU institutions. One interviewee commented on the importance of AAU's work with the Cottrell Scholars and related efforts in shaping the discussion about teaching excellence: "Given AAU is the standard bearer, they literally develop the metrics for defining excellence at AAU institutions. Creating those types of metrics around teaching would seem natural and legitimate and could really drive and scale change." Although AAU has little history in defining metrics for effective teaching, for many years it has developed and reported metrics of research and scholarly productivity about its member institutions.

***Creating national level leadership with Advisory Committee and Coalition of Presidents:*** Many interviewees spoke about the importance of AAU's national leadership in influencing local efforts to improve STEM undergraduate education. The AAU Initiative Advisory Committee and AAU member presidents are two groups capable of filling this national-level role. As noted by one respondent: "You look who's on their advisory committee and those are people that can get the attention of national organizations, government agencies, disciplinary societies, business and industry – all sorts of key players. They could be leveraged more to get more media attention, to push various strategic initiatives." Few other national organizations have the same influence in this regard as AAU.

**AAU STEM Network.** Interviewees also perceived AAU to have an important influence with various networks at the national level. They mentioned several ways to expand AAU's influence in this regard: networks, influence, resource development, media, and convenings.

***Create and sustain networks aimed at STEM reform:*** Interviewees felt that AAU's work with various networks and network development was among its most valuable contributions to reform: "AAU is well positioned to connect, convene, and has the cache to get people to show up for events." We discuss these networking effects in more detail in Chapter 8.

***Work with Presidents and Provosts:*** Many respondents felt that AAU might involve its member presidents more directly in reforming undergraduate STEM education. As one example: "I'm not sure why there isn't, or we aren't developing some kind of coalition of the AAU presidents who'd really get out there and are supporting excellence in teaching. We need a group of them to be champions and that would really help the efforts to scale change." Said another respondent: "I believe that those parties [presidents and provosts] should have been engaged with the AAU Initiative from the beginning and much more directly. In other words, I mean, this initiative is on the one side and discussions among presidents and provosts taking place in the other. We are told they hear about the Initiative, but I think there needs to be more of a continuous relationship taking place and feedback between the project sites and AAU president and provosts. And we need to tap the whole set of AAU institutions which can happen through those presidents and provost meetings." AAU already regularly works with its member presidents and provosts so additional engagement in the STEM Initiative can be explored. We note, however, that AAU's primary role is to represent its membership; it does not have the authority (nor does it wish to) instruct its member presidents and provosts how to participate in the Initiative.

***Points of contact:*** Respondents largely viewed the campus points of contact as underutilized in local STEM educational reforms. One faculty member comments: "I am not sure exactly our role – I think that has been evolving, but we could definitely be better involved, engaged. Many campuses that are doing some of the most forward-thinking work were not funded as project sites. And even since the funding occurred I have seen some other non-AAU campuses doing interesting [work] but it is not, there is not a good way to connect on that." [6]

***Hold convenings:*** Interviewees consistently found the AAU national convenings useful to campus reform efforts. They encouraged AAU to continue bringing together AAU campuses to discuss ways to improve teaching practices. Some recommended convenings focused on issues related to the improvement of undergraduate teaching: faculty professional development, rewards structures, teaching and learning infrastructure, and finding ways to make teaching excellence a campus priority. As one interviewee stated: "AAU can bring together all the various constituents that are needed to create and scale change. Unless provosts and deans across the AAU are working together to address rewards it is not likely to happen one campus at a time. So, some things need to be tackled together through convenience. And scale can just be achieved better if professional development is discussed by staff working on that across AAU

6 In fact, some of the AAU network sites that were not funded ended up making changes that were as large-scale and ambitious as the demonstration sites. These campuses that made changes were often striving AAU campuses that were interested in improving their reputation within the overall AAU and garnering more visibility. So rather than being motivated by the strategies of AAU, they were influenced by their own campus leader's prestige-seeking within the network. The operative motivations that appear to be at play at the project sites and among the network focus more on prestige and leveraging prestige than other mechanisms that AAU leaders hoped would be in place such as learning from one another and planning processes to institutionalize change. In Chapter 6 on influence, we describe in more detail why AAU's role may be more successful in scaling change when it leverages its influence and prestige rather than working closely at the project sites.

institutions, or deans having a group discussion about improving classrooms, the physical spaces, or curriculum models." In sum, the ability to harness the power of networks to foster improvement in STEM undergraduate education was seen as a major strength of AAU.

***Media and competition among AAU campuses:*** In addition to spreading the word about campus reforms, media coverage also fostered "friendly competition" to reform STEM undergraduate education. According to respondents, this type of peer pressure is a significant lever for reform. As one example: "When I saw activity happening on their campus it was a result of leaders having heard about the work on another campus and feeling they needed to create some more activity on their own." Faculty and administrators both agreed that media attention and competition were strong sources of motivation for change on their campus.

***Resources:*** Interviewees viewed AAU as an important source of funding for project sites and for the AAU STEM Network, although the primary sources of funding for the Initiative were external organizations. AAU was also helpful in pointing member institutions to potential funding sources for STEM Initiative-related work. In addition, AAU provided relevant resources such as metrics for teaching excellence. Respondents felt that resources should first be targeted to AAU institutions, but also noted how resources created through the Initiative could benefit the larger national higher education enterprise.

***Award or recognition among the AAU institutions:*** Although most respondents were not aware of AAU's work to establish a departmental award for excellence in teaching, several respondents who were aware of the award enthusiastically supported the concept. For example: "there might be some kind of AAU award for innovation that they could provide, and it comes with a really powerful letter to the university's administration when it's given. You can imagine that [at] each of the reform locations they could identify an individual who did, X, Y Z and made significant contributions to A, B, C. That's the thing that I think needs to happen."

**Individual Campus Level.** Evidence suggests that AAU was more effective in promoting reform in undergraduate STEM education by working at the national and network levels to influence local reforms than by intervening at the campus level, at least in part because AAU did not have the resources to carry out extensive on-site work. Working at the micro level to interact with individual campuses is not the most productive use of AAU's time and resources. Since its beginning, AAU's primary relationship has been with university presidents and chancellors. It also has long-established working relationships with vice presidents for research, graduate deans, and university public/government affairs officers. AAU's relationships with individuals working on STEM education reform at each campus is more recent. AAU typically has not had the same type of working relationships with department chairs or faculty and staff directly involved with reforming STEM teaching on their campuses. In this context, AAU is limited in its direct influence on achieving institutional change. To increase its direct influence on the faculty and staff and department chairs implementing STEM reforms AAU would require additional resources and tools for working with local actors.

**The primary difficulties for AAU in working with educational reforms at the campus level is minimal ongoing contact with individual faculty, instructional staff, and department chairs, as well as the local idiosyncrasies of how each campus makes decisions and promotes (or does not promote) the use of evidence-based teaching.**

The evolution of the STEM Initiative demonstrates the complexities of working directly with individual campuses on STEM education reform. At the beginning of the STEM Initiative, AAU project leaders found local personnel confused about the role of AAU in the initial site visits. Personnel at project sites often assumed the visit was meant to evaluate project progress or rate each project. Instead, the purpose was to assist projects in their implementation. This lack of understanding was in part a function of the newness of this local role for the AAU. It took AAU project leaders much longer than they anticipated to develop rapport with members of the campus teams. For example, the campuses were uncomfortable at first with collecting baseline data about teaching, including examining aggregate data across the eight project site universities. Developing trust between the AAU and the eight project sites required considerable work, although relationships between personnel at individual campuses and AAU project staff improved considerably over time.

Interviewees' comments acknowledged the limitations of AAU's direct role in local reforms. As one example: "I'm not sure what they can actually do – for campuses. They are not set up that way or have those connections." As another example: "I think it is mostly just who they are – who they can influence, not anything they can do working with campuses."

Our data show that AAU, as is true of many national organizations for higher education, is not set up to work on an ongoing basis directly with individual campuses as they attempt to reform undergraduate STEM education. AAU has much closer ties with senior administrators on tis member campuses than it does with individual faculty and staff working in STEM education. As we discuss throughout the remainder of this report, the primary difficulties for AAU in working with educational reforms at the campus level is minimal ongoing contact with individual faculty, instructional staff, and department chairs, as well as the local idiosyncrasies of how each campus makes decisions and promotes (or does not promote) the use of evidence-based teaching.

These findings demonstrate that AAU appears better-positioned to impact change at the network and national levels than at the individual campus level. Placing even more emphasis on the network and national levels may advance its efforts going forward. AAU appears most effective when focusing on coordinating with national groups, helping shape national priorities and funding, garnering media attention and influencing campus administrators' perspectives and priorities. Chapter 6 elaborates on the nature of AAU as a prestige organization and the consequences of its actions for scaling change in STEM undergraduate education.

**Leadership for Scaled Systems Change.** Interviewees suggested that the Initiative so far had not spent many resources on leadership development, which they saw as a missed opportunity. Below we examine interviewees comments about leadership.

> ***Individual project sites:*** Almost everybody interviewed described the importance of strong leadership to institutionalization. Faculty leadership was necessary to champion new pedagogical approaches in departments and academic leaders' (chairs, deans, provosts) support was needed to develop policies and structures to support teaching quality. According to respondents, most project sites lacked meaningful leadership at one or both levels for some time. Administrative turnover adversely affected reforms at some campuses. At some campuses no mechanism existed to continue institutional resources for STEM reforms after the project funding ended. Some respondents sought to identify roles for leadership at different levels to support STEM teaching reforms: "I don't think we really know what senior administrative support and commitment really looks like. We talk about it but, I saw this in this effort, and I have seen it in others. We just do not hold administrators to a particular set of activities or tasks, and I

saw this as a gap in this initiative as well." At the two campuses where the Initiative was institutionalized, senior administrator commitment and support was present. For example, at one campus, interviewees noted how the chancellor and provost were extremely knowledgeable and committed to the Initiative; they have created a new role of vice president of instruction, built new active-learning classrooms, identified funding to support the reforms in the future, and connected the Initiative to their broader institutional processes such as accreditation and strategic planning. Both faculty and administrators on campus identified these as signs of institutional commitment and senior administrative support.

***Ensuring Multi-level Leadership:*** The development and connection between leadership at multiple levels (e.g., bottom up from faculty, in the middle with deans, and fro the top with the president and provost) is important to scaling STEM undergraduate reforms. On some campuses even when one or more leadership levels supported the reforms the linkage between them was not evident. On one campus, the Initiative was too top-down; the provost submitted the proposal with limited faculty and departmental involvement. At another, key faculty members and top administrators were supportive but the buy-in from some department chairs and other faculty members was less. AAU emphasized the importance of leadership at multiple levels in its RFP but probably needed to help project sites develop and monitor the roles of leadership in the reform process. Perhaps developing a "check box" matrix with involvement by different forms and levels of leadership would help local campuses monitor involvement by leaders in STEM undergraduate reform.

***Articulating Senior Level Leadership:*** AAU potentially has more direct influence on its primary constituencies, presidents and provosts. AAU might explore options for encouraging participation by these leaders in STEM undergraduate reform. One campus provided an example of what this type of senior leadership might look like:

> "To give an example of what I think AAU could provide, at a recent meeting of the faculty, the dean of the College of natural science came to talk to the faculty about Gateway course reform. In fact, one of his associate deans gave a presentation, and the associate dean mentioned up front and center – and he put a picture of the university president up on the screen – and says this is a priority for the entire university. There's a list of the key projects the university is committed to with the AAU listed front and center. Part of the whole point of the presentation was to say to the faculty, the president and this national organization that the university is involved with think this is really an important topic. The dean thinks it's so important that he's right here in the room with you wanting to talk to you about this. What are you as a department going to be doing to further Gateway reform? There was some discussion of particular modifications of courses and so on that proceeded. And the dean, all the way down to the faculty and the room was really engaged. There was mention of outside resources from these grants and then there's money that the provost and the dean who provided, just showing that this is all flowing in the same direction. You should get with this direction because it's really important to all these individuals and groups."

This interviewee felt that AAU Initiative project staff could offer more tangible examples to guide actions by senior administrators in reforming undergraduate STEM teaching and learning. AAU might provide information to help local project leaders—the "champions" on each campus—to find ways to build both top-down and bottom-up support for reforms, including identifying appropriate roles of different types of leaders in those processes.

***Build leadership skills of AAU STEM Network champions:*** Based on the success of early convenings of individual campus project staff by AAU, many respondents recommended that AAU expand its role to offer a Leadership Institute for champions of STEM education reform. The Leadership Institute could allow AAU campuses to engage deeply with the Framework, discuss leadership development on their campuses, and find ways to institutionalize successful reforms.

***National level leadership: Finding the right leadership niche within the Coalition for Reform of Undergraduate STEM Education.*** AAU can also play a larger role in creating collective impact in working with the Coalition for Reform of Undergraduate STEM Education. Even though AAU is relatively new to undergraduate teaching reform, unlike many other coalition members it can garner attention from such key organizations as the National Research Council, the National Science Foundation, the White House, Congress, and the National Academies of Science more effectively than most members of the coalition. In general, interviewees felt that AAU involvement at the national level was important to further the reform of undergraduate STEM education.

**Conclusion.** This chapter highlights interviewee perceptions about the best roles for AAU in scaling changes to undergraduate STEM education. Especially important, according to interviewees, was AAU's influence at the national level where its history and prestige were most effective in supporting reforms.

# Chapter 6 Leveraging Influence for Change

Chapter 4 described how the AAU STEM Initiative has shaped systems change at various levels. Chapter 5 reviewed what participants said was AAU's strongest role in that system, its prestige and influence. In this chapter, we examine in-depth how AAU leveraged its prestige and influence to encourage change. We also discuss missed opportunities that might inform AAU as it continues with its work on the AAU STEM Initiative.

Interviewees said that AAU's leveraging of its influence *was the most important role* it played in creating change. Elite campuses as a collective, i.e., AAU, and individually strongly institutions influence the broader system of higher education including its values and ways of doing work. For example:

> "When Harvard changed its medical education – then all the others followed."

> "I think one thing that was striking was, on a positive side, just having the name of AAU associated with it, which is a very prestigious organization. Seeing a prestigious organization that had not previously been a giant player in this arena, shall we say, choose to step in, that was really important."

As noted by a plenary speaker at an AAU conference on cultural change: "culture eats strategy for lunch." This statement is consistent with the findings of this study and others: when seeking to reform instructional practices the values and norms of universities are more influential than change strategies. Focusing on shifting culture, especially in departments and academic programs, vis-a-vis reinforcing particular values and priorities is fundamental to implementing and especially institutionalizing reforms in undergraduate STEM education. This chapter examines ways that the Initiative fostered attempts to influence values and priorities, alter norms, create institutional logics, and leverage networks. Influence, in particular, is an important contribution to the literature which typically has emphasized technocratic strategies such as planning, data, and communication.

**Interviewees said that AAU's leveraging of its influence was the most important role it played in creating change.**

The AAU Initiative gave less overt or intentional attention to influence strategies, creation of new norms/values, and networking and more attention to strategies such as data collection, information sharing, or resource identification. AAU did consider how influence needed to be balanced with ownership of the Initiative, which is important to effective use of influence strategies. Even if somewhat unintended, AAU's technocratic strategies such as resource identification were ultimately in service of influence, resetting norms, or improving networking.

**Utilizing Influence to Push for Change in Values and Priorities.** By establishing the Initiative AAU took advantage of its most important role in reforming undergraduate STEM education, indicating to member institutions the importance that AAU placed on enhancing the value and practice of undergraduate teaching. AAU serves as the "gold standard and standard bearer for the entire system." Almost all interviewees found the Initiative alone an important factor in change:

> "The simple existence of this initiative and the fact that AAU is really an organization of the top leadership, of the presidents and the provosts. They [other campuses] seem to be getting the message. As I talk with universities, they're very much aware that this

initiative is going on. Even if I'm talking at a research university that's not specifically an AAU university, AAU is — I mean that's the gold standard in terms of a research university so that many of the other universities, especially the large publics that aspire to become AAU members, look at this effort and decide [that] trying to promote improved STEM education at the undergraduate level is something that's worth pursuing."

Interviewees found the general message of the Initiative more important than specific strategies or change approaches: "It's more of a general awareness than specific project activities that they're [other campuses] trying to emulate."

At nearly every meeting we attended, we heard similar sentiments: AAU was able to capture the attention of institutional leaders and was therefore capable of influencing campus behaviors. At a department chair workshop that we attended, the first comment made by a faculty member to the AAU was: "You have my institution's attention – they want to be an AAU institution and care about that. So that is what can convince our campuses. You are influential."

In addition to leveraging its prestige, many respondents noted the power of AAU as a high-stakes organization. AAU can eject member-universities if they do not align with AAU values, which enhances AAU's ability to influence its members.

***Influencing whom?*** Interviewees described a variety of groups and organizations with which AAU holds sway, and discussed the degree to which the Initiative was successful in influencing those groups to date.[7]

*Prestigious, national higher education players.* First, interviewees noted AAU's influence on the other prestige groups that shape higher education, including the National Academy of Sciences, National Science Foundation, the National Research Council, Howard Hughes Medical Institute, and Congress. These organizations shape the environment for STEM – its funding, policies and priorities. One interviewee describes this impact: "There are few organizations that are prestigious enough that they can make Congress listen. They can make the National Science Foundation listen. That means they [AAU] can make things happen." AAU was described as one of the few groups that could get the attention of organizations that set national priorities, funding, and direction. One interviewee commented: "Imagine if the National Academies made teaching a priority, a real priority, that could change things. AAU can work with them [National Academies] and others – setting each in this direction to improving teaching."

*AAU campus leaders.* Many Interviewees also noted AAU's influence on senior campus administrators – presidents, chancellors, and provosts – at their institutions, particularly in setting priorities for the campus: "AAU has the presidents' and provosts' ears. Our initiative was mentioned at a meeting of presidents and the next day I got a call asking about our initiative. And I know that is just one example, but I have other examples of when AAU has made an issue a priority and then it comes down the pike at our campus."

*Leaders at other campuses.* Interviewees found AAU's influence on senior administrators to extend beyond AAU institutions. One administrator described the influence that AAU has on presidents and provosts across the country: "AAU is an organization that's known by all

7 Some faculty admitted that they had never heard of the AAU before the Initiative, but have since learned that it is an important organization. They said, however, that their faculty colleagues are largely unaware of what the AAU is and its influence. Thus, AAU did not have as much influence on some individual faculty members at AAU campuses. This issue is detailed in Chapter 11.

presidents and provosts across the country, so certainly it can impact presidents of AAU institutions, but it's also shaping the perspective of leadership on all sorts of campuses across the country." AAU influenced the broader array of colleges and universities in two ways: (1) shaping institutions that want to become members of AAU and (2) peer pressure by emphasizing reforms in institutions that define excellence in U.S. higher education. As one administrator described: "There're a lot of wannabes out there. And this sort of initiative not only impacts the AAU campuses but those that are striving to become an AAU campus. They're always looking for what's happening at AAU campuses. So, there's the potential there to impact all of these campuses as well." Others described peer pressure: "If AAU campuses start to teach STEM quite differently, this will create pressure for other institutions to teach in new ways – they will not want to be perceived as too far from the standard." AAU can leverage its status as a standard bearer to create pressure for change throughout the system – an important component of scaling change.

*STEM reform community.* Several organizations and initiatives focus on STEM reform – Bayview Alliance, CIRTL, PKAL, disciplinary societies, grant funded projects from NSF, and the like. These groups help shape the dialogue about future directions for STEM. Interviewees described opportunities for AAU to influence and benefit from working relationships with these other organizations: "There are these other initiatives but many of them are not centered in research universities and those that are could still use the support and influence of AAU. So, there can be a lot more done to leverage AAU's influence to forward the efforts of CIRTL, for example." In particular, AAU can push the boundaries of excellence in teaching and promote the work of these other organizations to advance STEM reform in general.

***More influence needed:*** Respondents felt that AAU should collaborate more systematically with the groups that shape the national dialogue about reforming STEM undergraduate education: "I have to admit I don't know the work they may be doing with these groups, but the fact that I don't know a lot about activities they're engaged in suggests they could be doing more or making the work better known." Another expressed a similar sentiment: "I don't get the sense they are doing enough to make campus leaders – whether it be AAU presidents or leaders at other campuses – to make this a priority. Leaders across the country should really be questioning how good we are at teaching when there are these indictments coming out in national studies and reports."

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Often, we found that respondents were unaware of the existing collaborative work between AAU and other important organizations. We observed many of these collaborative efforts. So, part of the problem may be communication as much as action. Even so, respondents were quite unified in their belief that AAU's ability to influence these important organizations was among the most efficacious strategies for creating change in STEM undergraduate education. We also encourage AAU to consider alternative ways to hone its influence on external groups. As one example, Hunter Rawlings, then president of AAU, helped spread the word about educational reforms when he asked campus presidents if they knew how their institution was responding to the AAU STEM Initiative. Turning unofficial events such as this one into more formal strategies might expand AAU's impact on STEM reforms.

Consistent with institutional theory, the more AAU works with and influences a variety of groups to form a single dominant logic about STEM undergraduate reforms, the more likely change is to occur on college campuses. We explore the relationship between influence and institutional logics in more detail in the next chapter.

**Approaches for Influence and Leveraging Prestige.** This section discusses the approaches for AAU to leverage influence most often mentioned by interviewees and observed by the research team.

***Name-dropping:*** Many interviewees (project sites and points of contact) talked about using the name of AAU or its member institutions to persuade individuals on their campuses to consider new instructional practices. Here is how one faculty member described this connection: "When you're making the case to faculty who are very focused on their own research agendas, the ability to name drop other institutions is very helpful. To be able to say, 'I know from the AAU STEM Network that Duke or Brown is doing this.' The ability to have a little bit 'of our peers are doing this, we ought to be doing this' – that has been enormously helpful." One point of contact described the way she used the AAU name with senior campus administrators "Having the Initiative just exist has helped me in recruiting more support for new classrooms and money for professional development. I mention the Initiative and what I learned at a recent meeting and resources flowed." In sum, using the names of AAU and/or its member institutions was a useful strategy for generating buy-in among faculty and administrators for undergraduate STEM reforms.

***Branding as an AAU Project Site:*** Project sites that actively leveraged the AAU name on campus seemed more likely to be the most successful projects. Some of the project teams called themselves an "AAU" project and used the AAU name on all of their communications. Interviewees found that this branding increased visibility on campus and generated greater administrative support.

***Competition:*** Competition among AAU institutions is a core part of being a member. Leveraging the competition assisted some project sites in their work. As one administrator noted: "There's just this built-in competition between AAU institutions. They'll want to be in the top tier and are competing constantly to improve. So that competition was built into this initiative – we competed to be project sites, as project sites we compete to contribute to the initiative, and we want to be perceived as leaders in this work." During interviews, the points of contact described how they positioned themselves for future competition in the AAU STEM Initiative. As one faculty member noted: "I know our campus leaders are very interested in competing for funding if it were to become available from AAU. There's also a perception they don't want to be too far behind in terms of changes. So that has helped get support for the work we're doing on our campus." Another quipped: "The proposals in the creation of those centers had impact because in a way, everyone wanted to be the one doing the best thing. I guess this friendly competition is the catalyst of any changes." This competition between sites would likely not arise in a less influential organization.

***AAU peer group affect or comparison:*** Many interviewees noted that AAU also leveraged change by emphasizing the similarities between member institutions. Having peer institutions advocating and demonstrating instructional reforms is quite effective. As noted by one campus leader: "We really are driven by meaningful comparison groups – ones that are similar, that seem to have similar goals and environments … so if your peers are doing something and you're not, that brings some pressure to bear on you especially if it's something

that you believe is important. And so, I think the involvement of the AAU provides motivation to our universities and to all universities who want to be an AAU institution." Whether described as a "comparison group" or "peer group," interviewees found their faculty and administrators much more likely to engage in change processes when working with peers. Interviewees provided counter examples where working with other types of institutions was less effective: "Our campus has been involved with a lot of other STEM reform efforts but none of them have had the kind of traction this initiative has had. From everything I can observe, it's clear that is because this involves institutions that are research-oriented, everyone is much more interested and there are more changes going on that I've seen as a result of other initiatives."

Interviewees found that the legitimacy of AAU makes its advocacy for the use of evidence-based teaching in STEM more effective in gathering support from faculty and administrators than is research demonstrating the benefits of active teaching and learning. One administrator described this phenomenon: "On my campus, other AAU campuses are much more influential than anything else – studies or evidence from NRC [National Research Council], NAS, disciplinary groups or others that relate or reach out to non-AAU type institutions. Unless the message is customized to our peer group, it isn't received."

***External recognition and reward:*** Several individuals favored AAU or an equally prominent organization supporting formal recognition to campuses (or departments) with demonstrated high quality undergraduate teaching. Departments or institutions vying to be recognized for their teaching is a useful form of competition in scaling STEM education reforms. One interviewee commented "In terms of influence, an award would also help. It builds on our inherent sense of competition." As noted earlier, AAU has been working to develop a national award to be given to departments demonstrating excellence in teaching.

***Media and press:*** Interviewees also mentioned AAU's work with the media and press as influential on their campuses. One administrator stated: "My president said to his cabinet – 'I need to know more about this initiative on my campus, because there's been a recent article about it in the press.' Everyone then was contacting me and that got a lot of attention and support and furthered my work on campus." Interviewees noted how media coverage is especially important in influencing presidents and provosts.

***Site visits:*** Site visits by AAU project staff helped campus project teams gain credibility on their campuses. During site visits the AAU staff met with deans, provosts and often presidents, which enhanced project visibility at senior leadership levels. A faculty member commented: "Those site visits. They really get the attention of our provost and deans. You can see changes taking off after the AAU team has come to campus." Site visits also helped promote communication of local project activities both across project participants – which helped within-project communication – and to faculty and administrators not currently involved with project activities. Interviewees found the site visits especially helpful in gaining support from the latter group which often were influenced by the presence of AAU. In sum, the AAU project team site visits supported reforms on campus both because they helped cement the support of senior leaders and because they helped extend the reach of local campus projects to individuals who otherwise might not have become engaged in or aware of the campus reform efforts.

***Partnering with other influential organizations:*** Interviewees noted that AAU was most effective when it partnered with other prominent national groups to promote effective undergraduate teaching in STEM. Various respondents indicated the importance of having these national groups – including funding agencies, National Research Council, NSF, among others – in attendance at AAU STEM Initiative meetings. One collaborator describes this impact: "I have talked a lot with leaders at the AAU campus sites and I can tell that having HHMI or Helmsley [Charitable Trust] here at the meetings, that makes people pay attention more and I think they have more confidence that in five years they're still going to be people talking about improving teaching in STEM."

**"I have talked a lot with leaders at the AAU campus sites and I can tell that having HHMI or Helmsley here at the meetings, that makes people pay attention more..."**

***Balancing influence and being a trusted partner:*** The AAU project team recognized that playing up AAU's power with its member institutions – evident during the initial contacts with member campuses – could adversely affect reform efforts. From the beginning, the project team believed that long-lasting reforms of STEM education were more likely when local faculty members and administrators "owned" the reforms. If project sites viewed the AAU Initiative as a top-down directive instead of as a partnership with AAU the likelihood of participation, effectiveness, and scaling at project campuses would be reduced. As a consequence, the AAU project team sought to become trusted partners in the reform process rather than acting as an outside agency trying to impose policy change. The AAU project staff carefully monitored the campuses' suggestions and reactions to their work. Project campuses, as one example, reviewed AAU survey documents and made regular suggestions about the Initiative as it unfolded. As another example, the AAU project team specified the types of individuals it wanted to interview during site visits but ultimately left the choice up to project sites. We will return to the concepts of balancing and negotiating different theories of action in Chapter 10.

For the most part, interviewees uniformly found AAU to be a collaborative partner, one that did not overstep or abuse its power. Interviewees described AAU's influence in the Initiative in a positive way; even critics of the Initiative noted that AAU used its influence effectively without imposing, dictating, or forcing actions. Interestingly, most of the critics wanted AAU to be more aggressive in asserting its influence on individual campuses.

**Additional Areas for Influence.** Although most interviewees felt that AAU's most effective role in fostering STEM reforms was influence, they were often uninformed about the degree to which AAU was or was not active in seeking to influence STEM reforms. In some cases, interviewees recommended that AAU expand its influence in ways that we knew AAU had already adopted. It may be that AAU requires a bit less additional effort in influencing STEM reforms and more communication about what it already is doing. Below we describe recommendations by respondents and our assessment of them.

***Even more partnering work with influential organizations and groups:*** Although interviewees recognized AAU's efforts to influence what are termed "field actors" in institutional theory – groups that can frame the landscape or system – many felt that AAU might give more attention to this task. Organizations mentioned by respondents as missed opportunities for partnerships included accrediting agencies, textbook companies, leaders in the assessment movement, individuals involved with the MCAT revisions, and the National Science Foundation. One interviewee mentioned how the National Academy of Sciences has no award or recognition for teaching. They went on to indicate that if the NAS changed their criteria to include excellence

in teaching it would create an elite teaching society and create a sustained effort to take seriously teaching reforms.

It is important to note that AAU already was working with the American Council on Education on federal education policy, as well as with the Association of Public and Land-grant Universities, regional and national institutional accrediting agencies, disciplinary societies, the National Academies of Sciences, various private foundations and funding organizations, the National Science Foundation and White House Office of Science and Technology Policy. Many of these working relationships were not communicated by AAU to its member institutions or at least to many of the faculty and administrators working in them.

***Leveraging their prestige and influence for change within the national or macro system:*** Interviewees noted how change efforts seem focused primarily on the AAU project sites. The STEM Network was an effort by AAU to expand the Initiative to all member institutions and implicitly to leverage AAU's prestige to effect the larger national higher education environment. Some respondents recommended making the national implications of the Initiative more visible: "I think it's that idea, the very fact that AAU represents these highly select research institutions and we are interested in STEM education. It's saying to not just our institution but to higher education as a whole that this is really important, and that we need to make changes. We, the AAU, believe this is important enough that they're going to spend their capital and their time and effort on thinking about STEM education and getting these research institutions to think about STEM education and make changes in STEM education."

***Expanding membership criteria:*** Several respondents advocated for AAU including teaching excellence as a criterion for membership. As one example: "Campus leaders are really focused on the AAU criteria and those are all focused on research. I am just not sure how much progress will actually be made if the criteria are not changed and I'm very convinced that campus leaders will take note if teaching is a part of the AAU criteria." As we discuss in more detail in Chapter 13, this sentiment expresses the importance of AAU's endorsement of quality teaching. The sentiment, however, masks the complexity of both the way that AAU sets its criteria for membership and the metrics available for measuring teaching excellence. The criteria for AAU membership is not a decision made solely by AAU staff. It is an expression of the general membership as represented by the presidents of AAU institutions. Equally complex and perhaps more problematic is the lack of available metrics to easily measure teaching excellence especially for institutions as a whole. Although expanding membership criteria to include teaching quality seems a straightforward way to encourage the improvement of teaching at AAU institutions, enacting such a change to membership criteria is much more complicated than implied by some interviewees. It is an area worth further investigation though.

**"Campus leaders are really focused on the AAU criteria and those are all focused on research. I am just not sure how much progress will actually be made if the criteria are not changed and I'm very convinced that campus leaders will take note if teaching is a part of the AAU criteria."**

***Setting standards around teaching and evaluation of teaching:*** Many interviewees recommended that AAU endorse a set of standards for teaching quality. Interviewees acknowledge that AAU could not act alone. AAU might partner with groups such as the Cottrell Scholars to develop some national benchmarks that might help shape institutional efforts in evaluating teaching. As one collaborator noted: "As a national organization you [AAU] can call attention to issues or problems like the PCAST report did, but you [AAU] can also outline new ways for people to think about work. I think AAU has a real opportunity to define for research universities what quality teaching is in that environment and I think they need to extend themselves even more in this area." We note that some resources already are available. AAU's *Essential Questions and Data Sources* is one of them. The recently published (2017) *Indicators for Monitoring Undergraduate STEM Education* by the National Academies of Sciences is another one.

**Challenges to an Influence Strategy.**

***Maintaining priority from afar:*** Respondents raised questions about how to sustain AAU influence over time. Some interviewees emphasized the episodic nature of AAU influence. AAU's presence was elevated when it announced the Initiative, during the awarding of project sites, and (for grant recipients) during the site visits. In between these times the influence tended to fade. Other interviewees suggested that episodic engagement by national organizations such as AAU is natural. AAU has many tasks to perform and limited resources to perform them. To these interviewees episodic engagement need not adversely affect the success of the Initiative. One interviewee described the issue in this fashion: "I guess the AAU recommendations end up—and even if not directly influencing the process, I guess they lurk in the background." She was noting that AAU is most influential not directly on an ongoing basis, but indirectly, as a value system lurking in the background. Feedback about the efficacy of episodic and distant influence was perceived differently by stakeholders. Some stakeholders felt a national organization could create mechanisms for change (e.g., adding teaching quality to AAU membership criteria) while others felt that AAU could not monitor reforms on an ongoing basis. For these respondents, AAU's primary contribution was to leverage its influence to encourage member institutions to work toward improving undergraduate STEM education.

***Interest alignment:*** Institutional theory hypothesizes that change occurs when influential groups within the sector align their messages and policies. Such alignment is challenging in the AAU Initiative because so many initiatives with their own imperatives are underway at the same time. These include the Center for the Integration of Research, Teaching and Learning (CIRTL), Network of STEM Education Centers (NSEC), PULSE Vision & Change, and Bayview Alliance (BVA). Each initiative, including AAU's, relies on different leverage points and approaches to creating change. They even have different priorities in the change process. CIRTL, for example, emphasizes the training of prospective faculty members to use active learning strategies, whereas AAU is trying to influence current instructors and their academic departments. These initiatives also vary by level of focus with, for example, some centering their efforts on the department and others on institutional consortia. Interviewees noted the complexity of the collection of STEM reform initiatives and the relative lack of coordination between them. As one interviewee noted: "These various efforts – sometimes they just seem to have different methodologies. Their work is not at odds with each other, but rarely is work connected meaningfully."

**Conclusion.** The consensus among interviewees is that AAU's most effective approach to change is leveraging its own influence and prestige. Successful influence strategies included competition, setting up comparison and peer groups, public relations and press, and national awards and recognition. AAU project and network sites leveraged the prestige and status of AAU to foster reform on their campuses. Interviewees had some specific recommendations for improvement but for the most part, interviewees struggled to detail these alternatives.

The research team makes the following recommendations: 1. Identify and map the groups/organizations on which AAU is likely to have the most influence including but not limited to the list of groups discussed in this chapter; 2. Consider strategies for working with the groups that build off of AAU's capacities, unique strengths, and assets; and, 3. Communicate its influence work with various groups when such communication would not jeopardize the very influence AAU is trying to exert.

Finally, we note that in some situations communicating or making visible efforts to influence other groups and organizations would be counterproductive. It is quite possible that AAU could not always be forthright in describing influence efforts as the process of influencing could be compromised by such communication. Even though influence is a complex change strategy, designing an effective influence strategy is a key to AAU's success in its Initiative to improve undergraduate STEM education.

# Chapter 7 Recreating Institutional Logics/Norms to Frame and Message the Change

After influence, respondents mentioned AAU's role in reshaping norms and values most often. According to institutional theory, norms and values can be altered by changing institutional logics (Scott, 2008). Institutional logics are the "socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules" through which people attribute "meaning to their social reality" (Thornton & Ocasio, 2008, p. 804). Logics are embedded in structures, practices, and the cultures of institutions. Logics indirectly govern the behavior of actors and groups of actors within organizations by dictating the "sources of legitimacy" of particular ideas (Thornton, Ocasio, & Lounsbury, 2012, p. 56). Behaviors among individuals in organizations are thought to be "a consequence of taken for granted beliefs, schemas, and ideas that originate in larger institutional contexts" (Leicht & Fennell, 2008, p. 2).

Institutional logics are identified through values and rationales described in the language and discourse of important entities (e.g., associations, accreditors, legislative bodies, National Research Council) within the organizational field (Thornton & Ocasio, 2008). A field can be guided by a single logic, or multiple and/or contradictory logics. For the last hundred years, the predominant institutional logics driving research universities, particularly elite ones, have been the prioritization of research over teaching (Scott, 2001).

Institutional change happens when influential organizations in the field adopt and discuss new institutional logics or reframe existing logics. New or emergent logics are best identified through the language and discourse of groups because they have not become instantiated into institutional practices. Institutional logics gain greater legitimacy when multiple stakeholders adopt the logic (Bastedo, 2009). One of the critical roles for AAU is to have multiple field players – groups involved with STEM reform – adopt similar language or logics.

Institutional logics are typically studied at four levels that help understand their dominance in shaping the field: *content*, *penetration*, *compatibility*, and *exclusiveness* (Scott, 2008). Content refers to the actual beliefs and assumptions and how compelling they are, which affects how they will guide/shape behavior and gain legitimacy. Penetration refers to their vertical depth and horizontal breadth. An institutional logic has penetration if it resonates with most people throughout an organization (although not necessarily everyone) and is widely found across institutions within the field. Compatibility has to do with whether the logic is related to institutional arrangements. In other words, a particular logic needs to fit with other belief systems and activities that guide the organization. Finally, exclusivity refers to whether other logics exist and the extent to which the logic is contested within the field. Logics that *lack* solid content, penetration, compatibility, and exclusiveness are likely to have minimal dominance within the field (Scott, 2008).

**We document how AAU successfully established a contradiction among existing logics to motivate change and worked to revise the current institutional logic defining prestige.**

We examined the emergent institutional logics in the AAU Initiative and the extent to which the Initiative appeared to shape changes. To the extent possible we explored the content, penetration, compatibility, and exclusiveness of those logics. In this chapter we document how AAU successfully established a contradiction among existing logics to motivate change and worked to revise the current institutional logic defining prestige. Establishing the AAU Initiative was an important way to

establish credibility in promoting logics designed to enhance the quality of undergraduate STEM teaching. Some respondents believed that further change in AAU's culture, particularly by making teaching excellence a criterion for membership, was needed to reduce the exclusiveness attached to the logic favoring research. We discuss this issue in more detail in Chapter 13, including the challenges for AAU in attempting to change its membership criteria.

We note that respondents typically used the words "framing" and "messaging" when referring to institutional logics. This chapter explains the importance of how the Initiative was framed and messaged to create motivation for change, garner ownership, and supplant existing values that guide day-to-day actions.

**Establishing Crisis or Contradiction.** According to institutional theory, identifying a contradiction or crisis is a precursor to motivating institutional actors to change. The data indicated that AAU was very successful in establishing contradiction. First, AAU pushed the concept "great institutions cannot be poor at teaching." For elite institutions, all with a superior reputation for research, to have a central function, teaching, known as or even suspected to be mediocre is a major contradiction. Second, AAU asked its member institutions the following question: How can research universities which pride themselves on research not use evidence to assess and inform their teaching? Both contradictions were compelling to all groups interviewed.

Some stakeholders felt that identifying a sense of crisis could contribute to the STEM reform effort. The outsized failure rate of racial/ethnic minorities in STEM was cast by some respondents as a crisis. They recommended that AAU emphasize the outsized gains by racial/ethnic minorities from active learning strategies, in part as a response to the crisis with these student populations. Another set of interviewees noted how the Initiative could be improved if it was connected to larger existing issues that are the priorities for presidents.

In any case, respondents widely supported AAU's success in identifying poor undergraduate instruction as a contradiction among its member institutions.

**Recreated Logic – AAU Elevating Teaching to the Level of Research.** AAU developed framing for a new institutional logic[8] based on some version of the phrase: "AAU institutions will be as excellent in teaching as they are in research." This broad institutional logic resonated strongly with most groups of interviewees. In a recent Inside Higher Education article (Oct 2, 2017) and in the introduction to the AAU report on the Initiative, AAU President Mary Sue Coleman described making excellence in teaching a priority "the new normal" for member institutions.

When it came to *compatibility* and *exclusiveness*, various interviewees raised concerns about feasibility of or actual commitment to this logic. As one collaborator noted: "I think it's admirable what they're trying to do in terms of focusing on excellence in teaching, but I have my reservations about whether AAU presidents will really get behind this and I really doubt there will be changes to the reward system. So, there's lots of issues that I think will get in the way of this commitment." We collected dozens of statements from interviewees concerned about the compatibility of the logic about excellence in teaching, most of it centered on skepticism about AAU's willingness to modify membership criteria.

The AAU STEM Initiative focused on redesigning undergraduate STEM introductory classrooms. The rationale for this choice is that most reform efforts focus on co-curricular activities when it

8 Institutional theory would this change a shift or reframing of a current logic, i.e., expanding the definition of prestige to include teaching and research.

relates to student success in STEM. Very little has been done to alter classroom teaching practices in introductory STEM courses, even though their enrollments at all institutions are among the largest. Undergraduate education at research universities has long been criticized. Many respondents mentioned Ernest Boyer's critique of the teaching at the research university in his book *College*. About 75 percent of respondents agreed with this framing of the problem.

Although in general agreement with the emphasis on teaching excellence, about 25 percent of respondents found the focus on introductory courses in STEM limiting. Most common was the objection to the lack of focus on diversity in the framing of the Initiative. One faculty member describes why diversity is an important issue in the STEM teaching context: "I still can't understand why we are not focused on the success of students of color and women in STEM when this has so clearly been a problem for a long time and is getting a great deal of national attention." AAU's response emphasized that supporting undergraduate reforms would also benefit students from diverse backgrounds. This perspective seemed inadequate to several respondents who argued for a more targeted strategy for students of color.

The other primary issue was whether the Initiative was a one-time reform, or if it was meant to be a continuous ongoing innovation. Respondents understood that AAU's intent was for the reforms to be long-lasting, including the Framework's emphasis on cultural change. The question is whether or not project sites viewed the Initiative in the same manner: "as institutions going through a one-time redesign of courses and then the AAU teaching issue will be done and addressed." The primary concern here is that a one-time project is less likely to impact the local culture. As one administrator described: "I think it's unfortunate – the language that they've [AAU] used. Reform is the word that's often brought up, and I think if we talked about this as teaching innovation and something that's ongoing and that institutions need to continuously learn from their data about how to make a strong teaching and learning environment, that would be much more aligned with what I think we're really trying to achieve." In our assessment many efforts by AAU are aligned with institutionalization and long-lasting reform. For some participants, perhaps reframing the Initiative as an "ongoing innovation" might better support the notion of cultural change.

Additional challenges included perceptions that graduate education would have been a better focus, that active learning pedagogy was too narrow a focus, that the focus should be on student learning over teaching, and that all disciplines, not only STEM, should be included.

All of the interviewees were attentive to the role of language in shaping actions of people on their campuses. We recommend that in future initiatives AAU and other national organizations ensure that to the extent possible the language represents a consensus of meaning among stakeholders.

**Framing the Approach to Change.** In terms of the framing of the change process, interview data indicated strong consensus about targeting work at the institutional, departmental, and systems levels; among both faculty and administrators; and, adopting a cultural approach. All groups interviewed described similar language for the process of change. Stakeholders agreed that the focus on institutional or cultural change was the right direction. As an example, one collaborator stated: "As I understand it, they [AAU] are taking an institutional approach. Past efforts have focused a lot on changing individual courses and that just hasn't had much impact. So, I think they really, we are really on to something." There was also consensus on the importance of focusing on departmental changes. As one faculty member stated: "The departments are the lifeblood of research university; this is where curriculums are created, where promotion and tenure decisions are vetted, and where values are established. AAU made the right choice in focusing on the importance of departments."

All groups interviewed emphasized the importance of faculty leadership. Interviewees said that engaging faculty as leaders in the change process was critical to its success. Respondents also acknowledged that support from presidents and provosts also was needed for successful implementation and scaling. According to one faculty member: "We've had faculty champions in the past but if they aren't supported by changes in the classroom, professional development, and a sense of priority on campus among administrators then these initiatives get very little traction."

There was also substantial support for aligning changes in instructional practices with the culture and context of research universities. As an example, one administrator stated: "If we were to march out a set of ideas from other projects at a community college or liberal arts college – in fact this kind of thing has been done before – they just don't get picked up by the research universities. It's not as if there aren't other teaching and learning efforts going on in STEM, but this one is led by peer institutions." Lastly, collaborators and AAU leadership viewed positively the emphasis on making changes systemically – working with the project sites, across the AAU Network, and partnering with other external groups including the National Science Foundation focused on improving teaching in undergraduate STEM courses. Although individuals at project sites generally lacked experience with efforts to partner with external groups, there was general consensus on the importance of working with these groups to effect local change.

The AAU Framework codified many aspects of the change process. Although we found significant agreement about the overall framing of the change process among stakeholders, there was less understanding among faculty and administrators of how to translate the Framework into change strategies. The faculty, in particular, found the Framework difficult to comprehend. They also had difficulty conceptualizing all components of the Framework simultaneously.

Although there was consensus around the framing of the change process, there was often a lack of understanding about how to implement this direction.[9] Faculty members might describe the importance of institutional or cultural change but did not fully understand what that meant. Respondents found it difficult to implement a change process they did not understand well. Similarly, collaborators, project site leaders, and AAU network points of contact reiterated the importance of top-down leadership support but were less certain how to operationalize such support. The positionality of different individuals within the system appeared to shape their ability to understand the approach or strategy to change. Although interviewees typically did not describe the Framework as instrumental in supporting change on their campuses, their perspective likely was a result of their lack of understanding of the implications of the Framework for project implementation. We make recommendations for how to deal with this disconnect in Chapter 11.

**The positionality of different individuals within the system appeared to shape their ability to understand the approach or strategy to change.**

**Disseminating and Supporting Recreated Logics.** AAU used a variety of strategies to *disseminate* and embed the recreated logics. The primary strategy was the dissemination of the logics through various networks that AAU had created as part of the Initiative. The points of contact of the AAU STEM Network served to disseminate the new logics as well. Networks were the most scalable avenue for disseminating the logic on an on-going basis.

9 We explore the intersection of perspectives about change by different groups in Chapter 11.

AAU also used a variety of communication strategies. The AAU president described the focus of the Initiative at each meeting of the AAU presidents and provosts. The new logic was also listed on the AAU website, noted in listserv messages to the campus points of contact and project site leaders, and included in newsletters and other outreach. The Framework document was a frame of reference at project meetings. Its visualization served as an avenue for disseminating the new logic and a reference point for the logic in the change process.

Networks and communication were the primary dissemination mechanisms, complemented by other activities in the Initiative. AAU also structured all of its meetings and events around the logic of the Framework. For example, breakout sessions at all of their events were organized around pedagogy, scaffolding, and cultural change. The project sites were a means for disseminating these new logics into practice. Site visits and grants that supported campuses to visit one another also disseminated logics. Several interviewees stated that "conversations about teaching excellence were occurring now on their campuses after an AAU staff visit" and that "having faculty or administrators involved with AAU STEM Initiative come to their campus" helped them think about ways to improve teaching approaches in STEM.

Interviewees talked about mechanisms to support this new norm for improved undergraduate teaching—in institutional theory the recreated logic—over time. Respondents found that having peer institutions involved in similar change processes gave them some political protection with their faculties and administrators. As one faculty member stated: "I don't think our campus would move in this direction unless there were a whole set of campuses doing this work together. There is safety in numbers." Respondents also indicated the potential usefulness of common standards and assessment tools across peer institutions, although agreement on such metrics is not widespread at this time. Local norms and traditions for measuring teaching also can work against the use of common standards.

**Conclusion**. One of the most difficult parts of the change process is developing compelling logics that can motivate long-term cultural change and shift entire symbolic and language subsystems. The study of the AAU STEM Initiative provides a helpful articulation of the way logics can be developed, disseminated, and supported. Although logics have been created and disseminated, little support exists for them at the current time. The compelling logic that they created provides the motivation and buy-in to begin the change process. The chapters on influence, networks and learning articulate ways logics are being disseminated and supported.

# Chapter 8 Creating and Leveraging Networks for Change

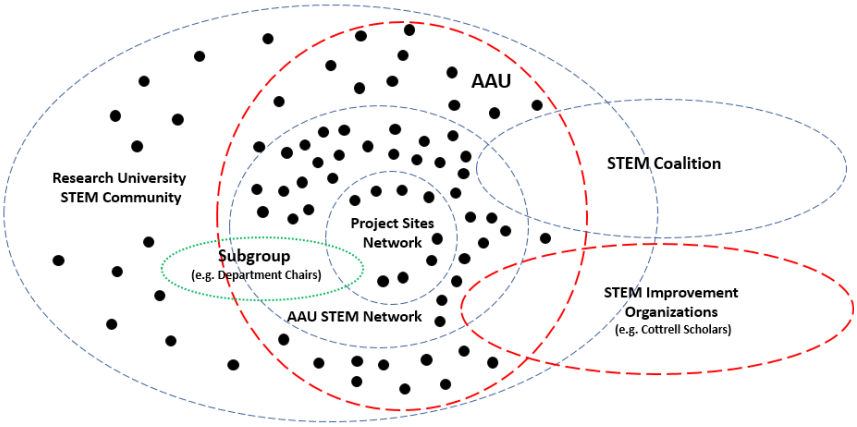
Evidence strongly suggests that AAU was effective in creating and leveraging networks, a fundamental role in supporting undergraduate STEM reform. Consistent with the literature on organizational change, these peer relationships and institutional/interpersonal networks are crucial factors in changing ideas and practices (Eckel and Kezar, 2003; Fairweather, 2008; Rogers, 2003; Valente, 1995). As one respondent indicated: "If you think about it, there's a massive amount of networks set up around research. Disciplinary societies support and focus on research. There's a gigantic research infrastructure within every AAU institution. What we need are networks, prestigious ones, around teaching. That would change everything."

In this chapter, we review how AAU serves as a "network of networks." We first describe the types of networks leveraged to implement change. Next, we describe effective practices used by AAU to leverage the networks for change. Lastly, we highlight a few missed opportunities for leveraging networks.

**Types of Networks.** Interviewees described various networks potentially relevant to improving undergraduate STEM education at AAU institutions. Part of the effectiveness of the AAU Initiative was its ability to navigate and work with so many networks varying in composition, size, and levels of work. For example, AAU worked with constituent groups including individual AAU campuses, STEM reformers, national groups such as POD and CRUSE, and funding agencies. Figure 2 visualizes these networks:

**Figure 2**

Diagram Key


***AAU Project Sites:*** The AAU engaged the eight project sites regularly through meetings and other forms of communication (e.g., teleconferences, webinars, listservs), essentially forming a network of project sites. As one consequence, over time the project site teams became familiar with one another's work. A participant described the project site network as follows: "so the various campuses that receive the money they don't just go off and do their own work. AAU is bringing them together regularly. This is really important that the sites interact regularly and share information. This means that there is much greater likelihood for a bigger impact across the campuses, they're not just isolated sites."

***AAU STEM Network:*** All 62 AAU member institutions were invited to participate in the AAU STEM Network. Invitations were directed to the point of contact on each campus. During the evolution of the Initiative the Network meeting became an annual event. Many interviewees agreed with AAU's decision to invite all member institutions to the Network instead of limiting it to the 31 institutions submitting a proposal to become a project site. As one example: "Our campus already had a lot of energy around innovation in teaching, so this allows us an opportunity to connect with others and get ideas. We have a really active biology department, but our math department is interested in getting involved but doesn't have a lot of direction. So, we're able to get ideas for [the] math department from our involvement."

***AAU STEM Community:*** During the Initiative an AAU STEM "community" emerged from various networks – project sites, AAU STEM Network, and other external stakeholders. Several individuals echoed the sentiment that: "One of the best outcomes of the initiative was a larger community of AAU peers that care about STEM innovation." Interviewees described this community as larger than the AAU STEM Network – a community encompassing a diverse set of individuals deeply committed to STEM reform at research universities. One faculty member described this community as follows: "The real value for me out of the initiative has been the development of the community of peers dedicated to STEM innovation. There are many people now I can call on and I just didn't have that in the past." This community was especially important for individuals working on campuses without significant ongoing STEM educational reforms. This community developed organically out of the other networks. Many respondents believed the AAU STEM community was among the most important achievements of the Initiative. In the future this community seems well positioned to support institutional and cultural change.

***Subgroups:*** Subgroups within AAU institutions also formed informal networks. These subgroups included directors of Centers for Teaching and Learning, faculty in particular disciplines such as biology or physics, and department chairs. AAU convened a special meeting for the interested to take advantage of the momentum in the Initiative. One faculty member described the value of these subgroups: "I now talk to biology professors across a number of AAU research universities. We're exchanging ideas about curricular reforms and assessment, and mostly we're just supporting each other." The evolution of subgroups was an important outgrowth of the Initiative, one because of its organic nature that will likely be sustained as the Initiative ends.

Additionally, AAU also involved external networks. Interviewees found substantial value in networking with important external organizations such as the National Science Foundation and the National Academy of Sciences. According to one respondent:

> "The AAU project connects to people that are outside. The ability to connect people from different realms, so let me put it that way. The AAU project brought us to talk to the provost of all the AAU institutions. They have brought us to interact with the Cottrell scholars. They have connected us to HHMI, HHMI scholars, HHMI professors. The other projects don't do that. The other projects are more insular to themselves. I think the AAU in this work has been more broadly connected and they have connected the Bayview Alliance and they have connected just across a lot of different networks. You start to see who overlaps and you start to see some new things. That's been useful for our own development here on our campus. That's been useful."

In this next section, we elaborate on these valuable external connections.

***Coalition:*** One of the major Washington D.C.-based groups focused on improving undergraduate education is CRUSE (noted in Chapter 4). AAU joined and supported CRUSE. One of the AAU STEM Initiative senior scholars, Linda Slakey, was the convener and facilitator of this group. CRUSE has worked to align and advance work across multiple national projects aimed at improving the effectiveness of undergraduate STEM education.

***Networking with external groups:*** AAU also connected to existing networks to expand the expertise available to the Initiative. Examples of this type of external networking include connecting with POD – a national organization dedicated to improving teaching and learning in higher education. AAU also linked with other STEM reform projects like the BVA, CIRTL, APLU's NSEC project, and AAC&U's PKAL and TIDES projects. An administrator found these linkages important: "There are no other opportunities for me to be in a room with national higher education organizations, experts in STEM teaching like the Bayview Alliance or lobbyists from the AAU. All of these different perspectives have been helpful in thinking about innovation on our own campus – how to get people's attention, how to frame things."

The AAU's STEM Initiative Advisory Committee also connected the Initiative with important external groups. As one interviewee describes: "The advisory board is a real asset to the overall initiative. We can call on them to invite speakers, to connect us with other STEM reform projects, to let us know about new publications coming out or policies that will affect our work, to call up and put pressure on leaders on campuses' project sites, to tell us about examples of good work happening on an AAU campus."

AAU was less successful in engaging disciplinary societies in part because it had "little history in working with these groups and little visibility among them." As a prestigious organization, interviewees felt that AAU could link with disciplinary societies in the future to expand the reach of the Initiative.

**Functions of Networks that Facilitate Change.** Different types of networks within the Initiative serve different purposes. For example, interviewees participating in the AAU STEM Network and project site networks particularly benefited from their focus on knowledge, learning, and emotional support. Below we describe important network functions, including influence; knowledge, learning and brainstorming; funding and resources; dissemination; emotional support and encouragement of risk taking.

***Influence:*** The most frequent benefit cited by respondents was their role in influencing others. Many interviewees described the influence of having prominent speakers and participants in networking events. For example: "AAU is able to get the most prestigious and well-known speakers. Because of that, they have had really high attendance at meetings. I was surprised by that, especially given the focus of the initiative." AAU can attract major speakers such as Carl Wieman or organizations such as the Howard Hughes Medical Institute in part because of AAU's connections to other STEM reform activities and work, which implies the visibility of the AAU Initiative.

***Knowledge and information:*** Interviewees also spoke of the knowledge they gained from participating in networks – such as models of good teaching, ways to evaluate teaching, and data analytics. A faculty member commented: "To have a group of people that you can call on if you have a challenge and that they can help you think it through. That's what this network is – a group that is a source of information." Networks were crucial to promoting the

use of evidence-based teaching methods and data analytics in large part because of AAU involvement. Interviewees acknowledged that the same information disseminated through less prestigious networks would have had less impact on their campuses. Ultimately the prestige of AAU was as important as the type of information disseminated by the various networks. Information sharing was important to stimulate STEM reforms on individual campuses. A crucial element was sharing information with peer institutions: "It's true that having connections to other schools is an incubator for ideas, and it's [change] more likely to happen, the more I hear what the other AAU schools are doing than if we weren't."

***Brainstorming and learning:*** Respondents found networking useful to rethink their teaching and brainstorm about new practices. Equally important was finding ways to prioritize teaching, especially through modifying reward structures. Consider the following statement as an example of these effects: "We have this aha moment, when several of us [department chairs], we're talking about how to get more buy in for student learning outcomes and assessment. Sure, you can hear about different approaches to doing this work, but we're really struggling with getting buy in among the faculty to use them – the insights that we came to and wrestling with this problem together was valuable." Although many respondents could see the potential of AAU-related networks to enhance their own learning, this potential was not always realized. Finding ways to make sure that the potential for learning through networks is more effectively realized is a crucial endeavor for the AAU moving forward.

***Emotional support for change agents:*** Faculty and administrators found attempting to prioritize or at least enhance the value of teaching in a research university time consuming and emotionally draining. Many interviewees found the AAU-related networks important sources of emotional support. As one example: "I really appreciate coming to the event and talking to people because then I don't feel so alone in this work and it really provides motivation and energy to continue to do this work on my campus." Another respondent stated: "You can always be in a bubble a lot, right, and you think, sometimes, that the unique challenges that you're having in your institutions are yours alone. It's sometimes good to hear that your peer institutions are having the same challenges. What I took away from that was (a) we're not alone, and (b) there are some schools doing some stuff that we just needed to keep an eye on." Emotional support is a less tangible but important benefit of networks, one that AAU should continue to emphasize in its future work.

**"I definitely think that there has been this safety in numbers mentality, that knowing there are many different AAU institutions involved in improving teaching, that has made a difference for faculty being willing to try and administrators to giving us a sense of priority, of support."**

***Safety in numbers and reducing innovation risk:*** Having peer institutions involved in the improvement of undergraduate STEM education made it safer for individual faculty members and administrators to support change on their own campuses. As one interviewee noted: "I definitely think that there has been this safety in numbers mentality, that knowing there are many different AAU institutions involved in improving teaching, that has made a difference for faculty being willing to try and administrators to giving us a sense of priority, of support."

***Resources and funding:*** Many respondents cited the importance of AAU's links with organizations that fund STEM education such as The Helmsley Charitable Trust, NSF, HHMI,

Research Corporation for Science Advancement (RCSA), the Alfred P. Sloan Foundation and the W. M. Keck Foundation. As one administrator noted: "I can get faculty and administrators to go to meetings when I can tell them there will be funders there. It's also helpful to hear how funders are considering changes in direction, so I find it interesting as well. So, the funders provide real motivation for participation."

***Dissemination:*** As described in the previous chapter, AAU employed networks to help disseminate best practices and shape values and norms about teaching on its member campuses and in the broader higher education community. For example, the connection with the UC System and BVA was an effort to further disseminate logics and best practices of the Initiative.

The AAU Initiative also used on-campus networks to help scaling by encouraging links between teaching innovators in STEM and non-STEM departments. Consider the following example from one faculty member: "I have talked with people from English and philosophy. I actually was giving a workshop and talk yesterday to a group of faculty. My co-faculty workshop presenter was from the philosophy department. We were talking about many of the things that we have in common, how we might use some of the same design and online tools to help students write and draw, and they need to write and draw in philosophy, just as much as you are doing chemistry." One administrator summarized the cumulative effect of networks in the AAU Initiative: "Now, I can say – I know some people across the country who are working on such things. I can pay attention to what they are doing. I know if I see an article in *Science* or a position piece in some other magazine, I recognize the name from one of those conferences. I read that much more closely. I know I can trust it. I like that."[10]

**Effective Network Practices.** Interviewees described several key factors in the effective use of networks in STEM education reform. These included identifying peer networks, providing opportunities for networking, and identifying network subgroups.

***Identifying peer networks:*** Interviewees strongly emphasized the importance of engaging peers in change efforts. By peers, interviewees meant both peer institutions and peer professionals. "Peer professionals" referred primarily to the faculty and administrators in other AAU institutions, especially those from the same discipline. As one administrator described: "So why are we able to create changes on our campus? A main factor has been being able to say that we're part of this broader AAU STEM Network and our peers are making these changes and if we don't want to get left behind we need to start doing this work as well. That really motivated a lot of changes in terms of getting resources, space, and even some faculty buy in." As another stated: "I am the only one in an administrative role my campus dedicated to improving teaching. So, meeting with others who have a similar role on another campus has been so helpful to share advice and feel less isolated and provide emotional support."

***Providing opportunities for networking at meetings and through activities:*** Allowing time for participants to interact in unstructured formats during AAU STEM Network meetings increased the impact of networking. As on interviewee stated: "AAU creates great networking potential at these meetings. First, they invite the right people, influential people. And there's time in between the talks for participants just to mingle. I've followed up with a few people that I met at meetings." AAU staff also used the site visits to encourage networking by putting local faculty and administrators in touch with relevant faculty, staff, and administrators at other locations.

10 It should be noted interviewees did not state that AAU helped support the development of on-campus networks, but this might be an area for future consideration.

***Identifying subgroups:*** Breaking into subgroups – by discipline, role, or area of work – was a successful tactic at AAU STEM Network meetings. According to respondents, the use of these subgroups was especially important because the context of changing teaching practices typically is most strongly influenced by the academic unit and by peers: "It hasn't happened very often, but when we've broken up into disciplinary or role groups we've been able to tackle some meaty problems that lots of us are facing on campus, but individually are having troubles addressing."

***Technology-based networking:*** In addition to face-to-face strategies, AAU used various technologies in networking including electronic platforms, listservs and emails, websites, and curated resources. Interviewees found these strategies less successful than in-person communication. One faculty member described the difficulty in using social media to network:

> "I'd say all of them [organizations] struggle with having ongoing communication happen. All of them struggle with 'How do you keep people connected and working together when they are not meeting? If you are going to meet twice a year, what happens the rest of the year?' All of them struggle with having effective means of doing that. The AAU has tried. First, there was the products on Purdue, and now they are using Trellis and it's kinda hard to have any of those things work. I mean, I haven't seen anybody do that well and we struggle with the same issue with some of our projects, how to really keep a community going virtually is very difficult."

**Future Directions for Networking.** Interviewees also identified needs for improvement in networking activities including identifying the right network members; empowering the AAU STEM community to lead; creating network leadership; tapping existing president, provost, and dean networks; broadening on-campus teams; networking department chairs[11]; and altering the network to expand its reach.

***Identifying the right points of contact/network members:*** The point of contact at each AAU campus was an important link to help AAU establish and operate the AAU STEM Network. In many cases the individual appointed had the necessary contacts and sway to operate effectively and encourage the use of evidence-based teaching in STEM. In a few cases, the point of contact was not sufficiently well positioned or experienced to carry out networking responsibilities and foster change on campus. When the point of contact was unable to further the AAU Initiative on campus, in a few cases the university changed the point of contact which increased the viability of STEM reforms on their campuses. As one point of contact stated: "So I'm the new point of contact on the campus. The last person, she stepped down, as she had no background in STEM education. She just didn't know who to communicate with on-campus and she wasn't interested in attending the events of the AAU Initiative, but she was in the role for three years. So now, I'm just attending my first event and I started to communicate across campus and there's a lot of excitement. So, when I go back to campus I am going to be giving a talk about what I heard at the meeting. But before, nothing was communicated." Identifying a potentially effective point of contact on each campus is an important part of the success of the AAU Initiative.

***Empowering the AAU STEM community to lead:*** Continuous support of some form is needed to sustain AAU-related networks for undergraduate STEM reform. As one faculty member described: "You have this passionate group of individuals committed to change, and

11 Based on the success of the first department chairs workshop, AAU will convene AAU STEM Department Chairs biannually starting in 2018.

now they're connected across all these different campuses, all these different influential campuses. But I don't hear anyone fostering this group. A network needs resources, a platform or some infrastructure, and it can also help if there is ordaining of its legitimacy by AAU. So, it exists but it's not supported at this point or truly empowered to play the role it can." The future success of the AAU Initiative depends in part on AAU's ability to find ways to continue supporting the networks working to improve undergraduate STEM education.

***Network leadership:*** To continue to be successful the complex "network of networks" requires continuity of leadership of both individuals and groups. As one administrator described: "With other networks that I'm a part of, there's a real passionate leader that embodies the community. I'm not sure who that would be with the AAU STEM Initiative or AAU STEM Network that is emerging. And I worry because the leader provides the emotional energy and motivation for people to continue as well as a sense of direction." Most individuals interviewed felt that the AAU STEM community was the most efficacious network – the network of champions who want to improve STEM teaching and learning at AAU institutions. AAU could help in this effort by recommending individuals or groups for leadership roles in the network or by helping create an executive committee to oversee these activities.

***Utilizing existing president, provost, and dean networks:*** Interviewees differed in their views about how well AAU used its internal connections – especially those with presidents and provosts – to promote local change. Documents suggested that AAU did have significant contact with these important constituencies about the Initiative. Yet many campus participants did not know about these efforts. Consider the following example: "When I think of AAU, I don't think of STEM reform. I think of presidents. And from what I can tell, there isn't a great deal of knowledge among presidents about this Initiative. This seems an untapped resource. Why are presidents and provosts not talking about improving teaching." Despite the sentiments expressed by this (and other) respondents, site visit interviews showed that presidents and provosts typically were aware of the Initiative. Many of them helped spread the word and provide resources. Yet respondents were looking for more from campus leaders especially in the form of public support for quality teaching in faculty rewards.

It may be that some individuals look more to outside groups such as AAU than to internal dynamics when attempting to make teaching more of a priority on their own campus. From this perspective the external push for change is given as much or greater weight than within-campus dynamics. Consider the following example. One dean who attended a meeting of AAU deans[12] said he was supporting the promotion of a faculty member based primarily on good teaching. None of his colleagues said they would have supported such a case on their campuses. The dean's view was that AAU's connection with presidents and provosts did not result in sufficient encouragement to deans to promote instructional improvement.

These examples show the complexity and tension within the broader movement to improve undergraduate teaching at research universities. On one side—reflected in the above examples—is the need for direct external peer pressure to assist local campuses in leveraging peer actions to make needed changes. An alternative perspective views changing attitudes about the importance of teaching as primarily a function of local cultures (department, college, institution). From this latter perspective the AAU is an indirect source of influence in the change of local cultures. The literature clearly indicates that outside pressure alone is

12 During the Initiative AAU held its first-ever meeting for deans from AAU campuses. AAU plans to continue such meetings.

not determinative in enacting local change. In our literature review, as reflected in the AAU Framework, both internal and external networking are crucial to organizational change. Among AAU's most important contributions is bringing external peer pressures to bear on local reforms. AAU is still learning how best to leverage these networks in the service of local improvements.

One problem is the lack of communication between AAU and individual faculty and administrators about its regular convenings of presidents and provosts. Our review of documents and observations found that the Initiative *was* a regular topic of discussion at AAU spring and fall meetings of the presidents and chancellors. Yet, because AAU meetings are closed to outsiders, these proceedings typically were not disseminated broadly. It may be presidents and chancellors of AAU members find it easier to talk about improving teaching than to increase its value in promotion and tenure decisions.

In the future, it is critical that there be a way to clearly communicate about the importance of undergraduate teaching by the presidents and provosts, perhaps through public statements. Additionally, venues where presidents and chancellors can engage directly with department chairs and faculty members to discuss the value of teaching on the campus is symbolically significant. As one respondent stated:

> "I think one of the problems is that we don't really fully understand or talk about what senior leadership support means. I think that we need to call out and activate the kinds of support we need from senior leaders to make these changes real. It might be a list of suggested actions for presidents and provosts, like establish a task force to examine better ways to measure teaching on your campus; set aside a certain amount of the budget for infrastructure for better teaching; hold departments accountable for quality teaching. So, we need to actually help administrators understand what they can or should be doing quite specifically – that, to my understanding, has not happened yet."

AAU might also work to provide additional concrete examples in case studies and disseminate potential strategies to engage senior leadership in the change process on campuses and across the AAU network. One example of such work was the case study publication developed by AAU for deans. More of this type of work will be important to continued cultural change.

**"I think one of the problems is that we don't really fully understand or talk about what senior leadership support means. I think that we need to call out and activate the kinds of support we need from senior leaders to make these changes real."**

***Broadening on-campus teams into institution-wide networks:*** Interview data showed that most project teams were not connected with a larger campus network or community. Most teams did not even consider how they might create an on-campus network or expand and scale their efforts. Interviewees did not feel that AAU encouraged them to form a local network or connect with other STEM reform projects. Only one project site team described how they had expanded into (what could be considered) a network that connected faculty, administrators, and academic units across campus in an effort to improve teaching. This network was a local effort:

> "We have the CIRCLE fellows. This is a two-year fellowship that was aimed at helping faculty implement active learning and creating a network. They get paid and they work with us for two years, which allows them to implement some sort of intervention the first year with our help. We get to evaluate it and then help them refine it to do it the second year. What we did was we picked the introductory courses. We picked the courses that have co-teachers. We worked with biology, chemistry, physics we're now working with, and chemical engineering. Over time this is expanding and connecting more faculty."

Observational data showed more signs of emergent on-campus networks. Some project sites formed faculty learning communities to create a type of network of those interested in improving STEM instruction. At another site, the AAU project was housed in a center coordinating various STEM initiatives on campus.

AAU recognized the need to encourage greater development of on-campus networks in STEM reform. AAU received a grant in 2017 from the Northrop Grumman Foundation to help campuses link various STEM improvement projects, and to create greater synergy across projects. In addition AAU received an NSF IUSE grant in 2016 to study the within-campus dynamics of implementing and scaling STEM educational reforms.

***Networking department chairs:*** Project participants agreed with AAU about the centrality of departments in improving undergraduate STEM teaching. Some suggested that AAU move beyond its nascent efforts to convene department chairs to establish a formal network of chairs with a focus on STEM reforms. Although supporting the concept, others were not sure that AAU was best positioned to sponsor such an effort. In either case, finding a way to create a network of department chairs seems potentially an important part of future STEM reforms.

***Networking too focused on the core:*** A few individuals suggested finding a longer-term solution to the management of AAU-related networks. As one example: "The initiative builds networks, but they are all dependent on the AAU staff and initiative to connect. There needs to be more work to build up the connections that exist outside the core so that the network is more distributed and therefore more sustainable over time, and also scaling and disseminating information more." AAU leaders recognized that individuals in member institutions eventually needed to take greater ownership for managing AAU-related networks. AAU took a step in this direction by asking several project sites to host future meetings of the AAU STEM Network. Balance is key here: AAU must maintain sufficient control for the Initiative to succeed while at the same time moving to distribute leadership across network participants.

**Conclusion.** Networking was central to scaling innovation in STEM at AAU campuses and beyond. Networking builds on AAU's historic strengths and capabilities, which made AAU well positioned to support networking. The AAU-related networks served many functions to support the scaling of innovation. Recommendations for enhancing this already strong networking effort included encouraging the development of on-campus networks, identifying the right individuals to participate in the network, and better leveraging the existing senior leadership networks in local change efforts.

# Chapter 9 Information Sharing and Learning

This chapter examines how networks facilitated information sharing and encouraged the use of best practices in undergraduate teaching. As the chart below illustrates, information sharing is an important but not sufficient contributor to learning and adoption of change. Nor is learning the only route to adoption of change. As we examine in this chapter, in this study we found more evidence of information sharing than learning.

Learning is a complex phenomenon that includes unearthing underlying assumptions, challenging existing assumptions, data and information systems and sharing, turning information into knowledge, inquiry processes, and brainstorming and group processes. Most of what interviewees described was information sharing and, in a few instances, brainstorming, which are necessary precursors of learning and consequently adoption of innovations. Yet learning is not the only way to achieve adoption. In this study, adoption seems to occur more often as a result of influence and new norms than as a result of individual and institutional learning. Some interviewees thought the lack of learning was a function of timing; learning would become more evident over time. Evidence also suggests that influence can facilitate learning (see Chapters 6 and 10).

Most interviewees did not believe that learning was a principal component of the AAU Initiative strategy nor was it necessary. They indicated limited evidence of learning (or adoption vis-a-vis learning) as a result of the Initiative. Influence and networking were much more influential strategies than learning in the Initiative. Interviewees were less confident in AAU's ability to promote educational change by learning processes than by influence and networking.

**Table 2: Definitions**

| Information sharing | Learning | Adoption thru learning |
|---|---|---|
| **Involves the distribution or dissemination of information, ideas and practices aimed at learning and adopting a new practice or policy** | **Involves a deeper engagement with information, comparing it to underlying assumptions, challenging existing assumptions, turning information into knowledge, inquiry processes, and brainstorming and group processes** | **Involves implementation of an idea/practice by considering barriers, obstacles, facilitators and more thoroughly brainstorming how to make the adoption successful** |

In this chapter, we review examples of adoption that seemed the result of learning, how AAU facilitated learning, and challenges to AAU's use of learning as an adoption strategy. Most of the learning described by interviewees related to cross-campus experiences (e.g., hearing about a practice on another campus and working to understand it) rather than to internal learning processes where faculty members on a campus help their colleagues understand the use of innovative curricula or instructional practices.

**Evidence of Adoption of New Practices through Learning.** Respondents spoke less about specific learning experiences affecting STEM instructional practices and more about a general awareness or shift in perspective: "It's more a general awareness than specific project initiatives that we've been trying to emulate. So yes, I can't point to specific practices we've adopted or learning that occurred, but yet I feel some kind of learning has been gained." These data may be limited because interviewees were not always aware of instructional improvements on their campuses so could not relate specific learning experiences to them.

Also, interviewees sometimes could not distinguish between the effect of learning on STEM innovations from that of, for example, influence. In a few cases we found evidence of the effects of learning on STEM instructional reform. We describe the impacts of these learning processes next.

***Data analytics:*** The AAU Initiative successfully exposed participants to the use of data analytics in portraying student retention and student learning outcomes. During the Initiative several campuses (both AAU Project Sites and members of the AAU STEM Network) adopted or considered adopting data analytics to improve STEM student success and to learn how instructional practices affected student learning and degree progression. As one point of contact described: "We're really excited about the data analytics and not only how we collect a lot of information. We also have them [AAU leaders] come out to our campus to help people understand and adopt this practice." The AAU helped campuses view data on students and faculty as more than statistics to be reported; they became sources of identifying where instructional reforms were most needed and potentially most impactful. One administrator describes this learning: "Our team went to several sessions – across different meetings – having to do with data on student learning, pathways, outcomes. All of that helped us to explore and think through our data systems and start to brainstorm ways we can improve."

**The AAU helped campuses view data on students and faculty as more than statistics to be reported; they became sources of identifying where instructional reforms were most needed and potentially most impactful.**

***Curriculum:*** Participating in the Initiative led some AAU institutions to modify or consider modifying STEM curricula, including adopting innovative STEM curricula from other AAU campuses. One administrator stated: "For example, our chemistry department is collaborating with a department from the University of Arizona in adopting an entirely new Intro Chem series. That was a direct result of participation in the initiative." During the Initiative several respondents gained knowledge about assessing student learning, which helped them identify shortcomings in their curricula and led them to consider alternative curricula and forms of assessment. The AAU survey data also stimulated participant discussions about the effects of curricula on student learning outcomes and retention, which led to proposed improvements in curricula and instructional practices and identification of needed improvement in infrastructure and policy.

***Discipline-based education researchers/faculty:*** Some AAU institutions hired or considered hiring faculty members who conduct research on teaching within their discipline – discipline-based education researchers (DBERs) – as one way to improve teaching in STEM disciplines. As one administrator stated: "Our campus is now considering hiring DBER faculty – we currently do not have any. To have educators embedded within each department. We proposed this to the incoming president." The challenge at AAU (and other) institutions is

where to place these faculty members – in STEM departments or in education? – and how to review their work for promotion and tenure. Particularly challenging are DBER faculty in STEM departments where the nature of research in the field is quite different than DBER research. Among the key questions were whom to use as external references and how to educate other faculty in the department to view DBER faculty members' contributions to the department. Some respondents credited the AAU Initiative for helping them see the benefits of DBER-related hires and for assisting them in identifying the challenges of these types of hires in the promotion and tenure process.

***Active learning classrooms/facilities:*** Another element of scaling STEM innovations was the modification of classroom spaces to support active learning. The Initiative helped institutions considering such modifications learn from others who already had modified some classrooms. As one administrator explained: "An area we're really interested in is better classrooms, and the initiative has allowed me to learn about and visit some novel learning spaces."

***Pedagogical practices:*** Some interviewees cited the importance of discussing or even observing active pedagogical practices prior to implementing them on their own campuses. One faculty member described observation tools that they considered adopting: "At Davis they have tools for evidence-based action, I think that's it. I think that would really resonate on our campus. So, there are active discussions happening about that." Another administrator noted the teaching practices inventory: "I think the one thing that comes to mind that we're thinking about adopting is Carl Wieman's teaching practices inventory and trying to think about how do we incorporate that into what we do. Is that something that we mandate? Is it something we suggest that the faculty use as a tool for themselves? So that's an example of how I hear something at a meeting and I try to work with others to incorporate and brainstorm the ways it would work with our own particular culture here." The AAU Initiative annual meetings were a primary source of information about active pedagogical strategies for those considering adoption on their campuses.

An obvious source for modeling active learning strategies is other departments or programs on the same campus. Here the evidence of institutional learning was mixed. Several campus teams reported some adoption by new departments and new colleagues within departments. Others found spreading the use of active pedagogies beyond the initial adopters problematic.

***Learning that change can be institutional:*** Some respondents learned to consider pedagogical change from an institutional as well as a classroom perspective. The Initiative in its Framework helped some participants consider how institutional context influenced what otherwise seemed to be departmental or program-level matters. As one example: "Something that came out of this initiative for me was an appreciation that good teaching – to make that happen – it will require institutional support and commitment."

***Learning about the change process:*** Some individuals reported learning about the change process. As one faculty member noted: "Noah Finkelstein as an example. These are individuals who were very much in tune to organizational change theories that, in my mind, had always been under the purview of higher education. It makes the task of trying to approach social transformation much less daunting because there are these people out there doing that and helping you to understand how to do it. I think AAU does a good job highlighting where those best practices about change are happening."

Although it was not always clear whether respondents had adopted pedagogical reforms, interviews indicated that they learned about adopting practices, becoming familiar with new practices/ideas, bringing them to their campuses, and brainstorming ways they might be implemented.

***Reflecting on minimal learning or adoption of new practices:*** Some respondents found the pace and spread of learning and adoption of new practices from peer institutions on their campus slow. As an example: "I think one thing that AAU would have hoped, and it hasn't really happened so much, is that there would be more cross-university collaborations and dissemination of ideas. We've just been so busy just taking care of our own initiative, we haven't really collaborated much or borrowed from other campuses." Some interviewees attributed the lack of institutional learning or its spread to the short time frame of the grant.

Other individuals disagreed. These respondents emphasized the importance of increased awareness by faculty members and administrators about the use of evidence-based teaching practices at other AAU campuses as the crucial first step. These respondents believed that such awareness is crucial to making active teaching and learning an expectation or norm. In their view, over time the new norm would lead to improved instructional practices. These interviewees focused more on AAU's influence and norm setting than on monitoring the extent of reforms on campus at this point in time.

**Practices that Supported Learning.** The initial RFP contained ideas about how to structure the projects sites, including the use of data, working collectively in teams, and working across departments. These ideas ultimately were instrumental in supporting learning. AAU site visits and Network meetings also fostered participant learning. Some internal campus practices such as working on project teams also promoted learning about effective reform strategies.

***Request for proposal:*** The RFP required institutions to develop an institution-wide project, to use data, to work across multiple departments, to engage senior institutional leadership in some way, and to make use of a cross-campus team with faculty members, administrators and staff. Several interviewees described the RFP as a tool for learning. As one respondent noted: "I just really think it's the integration of the idea that we had to have curriculum development, faculty development, evaluation, and cultural change together. The way we had to write our grant, we had to integrate it all together. We had never worked like that before." Respondents consistently described the RFP as carefully crafted and influential in the approach they adopted to improve undergraduate STEM education. The RFP became a pivotal reference document for learning.

***Use and collection of data and metrics:*** The use of data and metrics also contributed to learning. Interviewees described as influential several data sources, including the data analytics work by Marco Molinaro at UC Davis, the survey data collected by AAU about teaching, and the emphasis by projects on student learning outcomes. One faculty member noted the importance of data in encouraging adoption of innovations: "Well, one of the things that really brings people out is that we have data, but it's not just the data, its data collected as part of AAU. People who are using whatever sort of active learning, we have data about their classes compared to non-active learning, we bring them together every once in a while. They don't have to set anything up, but they do come. We bring them together, and they talk about the data. And that has led to insights into the value of active

learning and more adoption."[13] An administrator described how data were used to support learning on their campus: "We could truly measure and see what was going on now, how are things changing and/or through a big data approach could we, once all this data got together and it was integrated, could we find areas that needed improvement. That's been really exciting."

***Working across departments:*** Respondents found two key components of the RFP – working across departments and developing a team with representatives from across the campus – instrumental in fostering learning. Requiring departments to work together resulted in shared ideas about teaching, assessment, and evaluation, all topics not typically shared across departments. This arrangement helped spread the use of evidence-based pedagogies by exposing potential adopters to those with extensive expertise and experience in such strategies. A faculty member describes the importance of working across departments for learning: "Physics has always been way ahead of other departments at our institution. Now, what they're doing is spreading to other departments because, through this initiative, we had to begin to work across departments, and share information and learn from each other."

***Working as teams:*** Campus project teams typically included faculty across multiple departments along with administrators and staff from academic affairs. By connecting individuals and groups that typically do not interact – central administrators with individual teachers for example – project teams sometimes led to insights about implementing, supporting, and scaling effective teaching on campus. One administrator described the learning that occurred from these interactions: "What it meant was anybody who was involved in the AAU [Initiative] really can't be isolated. They're not allowed to be isolated. They have to talk to the teaching center. They have to talk to the teaching center for the evaluation. In these discussions, particularly about their evaluations, they rethink their teaching." This same person goes on to say: "I really think it's the integration and working together. If you integrate these things together, the person cannot be solitary. They can't be isolated. Once they're not isolated, they start talking to other people. It's just, 'Oh, I had that same issue.' Or, 'Oh, is this how you solved that? Look what happened in my class. Did that same thing happen for you and your class?'" Most of the respondents acknowledged that working across units or departments to foster improved undergraduate education was not typical before the AAU Initiative.

**Most of the respondents acknowledged that working across units or departments to foster improved undergraduate education was not typical before the AAU Initiative.**

***Site visits:*** Site visits were important sources of both influence and learning. In addition to gathering data, AAU staff brainstormed with project teams about solutions to local challenges. AAU staff also shared information about instructional reforms on other AAU campuses. The activities were instrumental to learning at the project sites. An administrator commented on the value of the site visits: "One thing I want to highlight is, the site visits, I think that was an opportunity for us to get out of our bubble, just doing things and implementing. I feel like we really engaged ideas differently when the AAU came here."

13 Respondents portrayal of change as a combination of learning with strategies such as networks, systems, and influence was quite common as discussed in the next section of the report.

***Visiting another site:*** Very few campuses took advantage of the opportunity – provided by AAU funds as part of the Initiative – to visit another project site. Those that did found the experience helpful in adopting a new curriculum, changing pedagogical practices, and using data analytics. One faculty member talked about visiting another site: "We got a whole new perspective when we went to MSU. I'm really interested in their center for scientific teaching. It really helped expand our thinking around assessment. I'm coming back to our campus and saying, 'We got these ideas at another AAU campus.' That opened up faculty to considering the ideas we brought back."

***AAU STEM Network meetings:*** Points of contact (POC) and project site team members learned from one another at AAU-related network meetings. Sometimes the focus was on local reform, other times on becoming better prepared for future competitions for funding. One POC described the learning resulting from network meetings: "Having heard from the project sites at the meeting, we've adopted improving teaching as a part of our strategic plan and it's a major priority. We are starting an initiative to bring in discipline-based education researchers. And we have adopted some of the teaching practices such as assessment and clickers." Another POC stated: "We're doing a lot with student data now that we borrowed from UC Davis. We're really focused on analyzing student pathways. We also adopted some evidence-based teaching practices, particularly, active learning." And yet another POC: "We're working on a lot of different fronts right now. We started the process to hire more discipline-based education researchers. We began expanding our data analytics, we were already doing that but using more of the ideas from UC Davis. We're also enhancing more of our classroom spaces – using more technology – using some of the ideas from UPenn. And we are doing a lot of new curricular work." These findings suggest that adoption of new practices may be driven by influence and competition as much as by learning.

***Peer learning:*** Interviewees universally appreciated the opportunity to learn from peer institutions. The faculty and staff at peer AAU institutions understood key components of instructional reform: the tenure and promotion system, departmental cultures, value systems around teaching, and infrastructure. Some believe that the continued conversations among faculty and staff at research universities are creating change and perhaps learning: "I think by repeatedly bringing together some R1s that are really thinking about this, thinking about data, thinking about instructional change, what has happened are collaborations and exchanges."

***Norms that reinforce examination of teaching practices:*** Individuals reported that changing cultural norms – such as having high expectations for quality teaching – was key to scaling and sustaining of excellence in teaching. For example, one interviewee suggested that, "We need ongoing cultures that support teaching excellence." Another stated that, "Everyone should feel like they need to innovate their teaching." Interviewees found AAU's Initiative helpful in altering logics and norms, which were important to support individual and campus learning. Changing the conversation to frame change as "ongoing" and "continuous" would increase the effectiveness of the Initiative.

***Feedback from annual reports:*** AAU required annual reports from project sites and provided feedback to campuses based on those reports. Some interviewees found this feedback helpful. For example, one project team member responded: "They were really helpful at meetings, site visits, and even with the annual reports. We got questions about ways we could engage leadership more and how we were going to sustain the efforts after AAU funding went away and information about another campus that was engaged with a similar pedagogical effort."

**Framework: Vision and Learning Guide.** AAU developed the *Framework* document to provide a vision for the AAU campuses – a sense of what excellence in teaching at AAU institutions might look like. It also presented STEM improvement as an institutionally situated challenge that required support and attention at all levels of the institution. AAU developed the concept of Framework in part by reviewing the APLU Rubric for teacher education, although AAU's Framework was more conceptual and less detailed.

AAU sought substantial feedback on the initial Framework (as well as with many other aspects of the Initiative). The initial draft Framework was refined based on feedback (a strong practice for obtaining input) provided principally by POCs at 42 AAU member campuses. The final version of the Framework reflected a change from a detailed and proscriptive set of instructions to a more conceptual document about implementation and scaling change.

AAU expressed the Framework in both diagram and text formats and made it available as an online resource. AAU aligned its RFP for project sites with the Framework. AAU also used the Framework to organize meetings, reports, and most project deliverables. It became the foundation for all communications materials related to the AAU STEM Initiative (included in the AAU website). The Framework was, in many ways, omnipresent. Yet many interviewees did not describe the Framework as a helpful tool for implementing and scaling STEM instructional reforms. Even some members of the AAU STEM Advisory Committee were unable to enumerate the elements of the Framework.

The Framework was rarely brought up in discussions about effective practices or strategies by project sites. When probed, respondents indicated only a vague understanding of the Framework: "I know probably about the framework. It has circles. And I know probably the big goals. I don't really know all the details as well as I should, but I know the framework is about different ways that you can affect change in teaching."

One group that consistently found the Framework useful: campus champions (including the PIs of project sites). At each project site – and in the Network as a whole – one or two individuals were passionate about and champions of innovation in STEM teaching. Many of these individuals were familiar with the literature on STEM reform strategies. They were the most likely to note value in the Framework. One participant explained:

> "I actually think that having worked with and thought through the Framework, it was really helpful. I think it was really important because lots of times when faculty think about making changes, they think about curriculum development. Then I as a faculty developer will go and say, 'Okay, I'll work with you, faculty member, to make your curricular development.' I'll be honest, at the time they gave it to us I was like 'Oh man!' But now I see how helpful it is. We're doing curriculum development and people go off into their own little courses, right? Because we have the faculty development in the cultural change it's really making a big change across university."

The results suggest that the Framework was most influential for project team leaders, less so for other participants.

The Framework seemed best understood by project leaders and campus champions; it seemed less successful as a general tool for learning about change for other participants on project sites. Several possible explanations for this disparity exist. First, each campus was asked to submit a project proposal focused on one aspect of the Framework while at least acknowledging all

levels of the Framework. Campus participants may only have become familiar with the component of the Framework included in their project site proposal; campus participants seemed quite knowledgeable about their own projects. AAU did not ask proposals to address the entire Framework because it might deter campus teams from applying. Using the Framework as a broad educational tool might require additional communication mechanisms.

Second, the Framework incorporated elements of both improving teaching and cultural change (at the department, college, and institution). The blending of a vision for improving teaching with a process for creating and scaling change might have confused some participants. As a potential learning tool AAU might have been better served by separating discussions of pedagogical reform from the process of change. As one respondent stated: "I find the framework overly complicated. It's working at all these different levels, it talks about culture change, and then it talks about specific practices. I just tend to get lost in it."

Third, when analyzing data based on role differences – faculty member vs. administrator for example – there was a clear trend for faculty members to have difficulty understanding the role of the Framework's third circle – cultural change – in reforming pedagogical practices. Even a few administrators had difficulty linking the components of the Framework into a coherent vision for local reform.

The challenge for AAU is to distinguish the Framework as a tool to promote change by influencing campus champions and project leaders (e.g., project leaders used the Framework in shaping project activities) from the Framework as a tool to educate a variety of participants on member campuses about the reform process (which was much less successful). The latter function likely requires a different dissemination strategy, one based on careful delineation of the roles of AAU (e.g., influence vs. learning) in campus reform.

**Why Learning was Challenging.** The Initiative was less successful in its role in fostering individual and institutional learning than in, for example, influence for several reasons. Some interviewees believed that AAU through its Initiative first had to help establish new norms about undergraduate teaching, after which improved instructional practices would emerge. In addition, some factors emerged from study data as potential barriers to individual and institutional learning: perceiving practices from other institutions (or even other departments at the same institution) not being applicable, competition between campuses, the need for local data for claims of effectiveness to be accepted, AAU's limited history in directly engaging in institutional change (especially for teaching), and lack of meaningful venues for deep discussion.

> ***"Not invented here" – unique institutional culture:*** The AAU STEM Initiative faced a paradox. AAU acknowledged the importance of institutional context in reforming undergraduate STEM education while at the same time encouraging institutions to learn from each other and from research on teaching and learning. Respondents sometimes found that the local culture inhibited reforming undergraduate teaching, and that challenging local norms rather than honoring them was crucial to change. AAU support of local context as a driver of change often left change agents in a bind trying to navigate local pressures. The phenomenon showed most clearly when opponents of reform argued that changes created in other units on their campus or at other universities would be inappropriate for the local environment.

Most interviewees described AAU's "sensitivity to research university culture" and unique institutional mission as positive aspects of the Initiative. One administrator noted: "Yeah, I think they recognized early on – They know all these institutions are different. They seem to honor in a way that I really like, the fact that the people that are at those institutions and the ones that are

in the department are the ones who can see the greatest opportunities and make them fit their context. I really like that." As one faculty member described: "No, we really haven't adopted any specific ideas or practices from other campuses. Our campus is quite different from the others. But I enjoy hearing what's happening on other campuses." Or "I know that these are AAU institutions, but we're quite unique. We're smaller, our curriculum is more fluid and interdisciplinary, our faculty are different, so I just don't see a lot of similarity."

In contrast, some interviewees found an overemphasis on institutional context and culture could be used to deflect change:

> "There is a lot going on in the liberal arts colleges in terms of defining excellence in teaching in STEM. The fact that our institutions won't even look at this work because they don't think it's important for research universities or that research universities are so different is not helpful. This good work in other institutions [liberal arts colleges] are not highlighted within the Initiative, and in fact the idea that research universities are unique is constantly repeated."

Another administrator suggested how the focus on institutional context might prevent adoption of good ideas:

> "Maybe, in a tiny bit of irony, the HHMI thing that we're involved in is really trying to understand whether the specific initiative that was introduced at University of Maryland Baltimore County, UMBC, can be successful at other campuses. Whether that can be taken from a blue collar regional school, where they've been just extraordinarily, extravagantly successful with preparing students for careers in science, especially minority students, to other places. But there is this feeling we have to prove it. So, we are trying to translate that [improved teaching practices] into AAU type schools. There's some irony about that as well. That on the one hand, we're happy for our association with AAU and learning from other schools. Then, in a related project, we're talking about a school that wouldn't, in a million years, be in the AAU."

These findings suggest that paying attention to institutional type and unique context must be balanced by emphasizing the value of and transferability of ideas from other contexts.

***Competition:*** We noted previously that competition served in some cases to stimulate local teaching reforms – for example, implementing reforms because peer competitors were doing it. However, adopting approaches from other institutions became problematic because borrowing from other sites implied an equal or higher value to external norms than to local ones. One faculty member described how competition could adversely affect the sharing of ideas to improve undergraduate teaching: "I think we all just came in strongly believing in our ideas and maybe we felt borrowing ideas from the other campuses would somehow support them and we are competitive with each other."

**Adopting approaches from other institutions became problematic because borrowing from other sites implied an equal or higher value to external norms than to local ones.**

Competition also affected sharing data across institutions. Early on campus teams were reluctant to share data about their teaching practices with peer institutions. AAU project staff were concerned early on about campus competition preventing participants at annual

gatherings from problem solving together, learning and sharing, and might lead them to miss out on opportunities within the broader network.[14] It is possible that a fear of losing a competitive edge adversely affected sharing information across project sites. This concern seemed especially true of student retention rates and learning outcomes. At the curricular level, however, competition did not prevent some sites from seeking solutions implemented elsewhere. As one example, the University of California at Davis considered adopting the Chemical Thinking curriculum developed at the University of Arizona.

***Distrusting research and evidence from other contexts:*** A particularly onerous form of "not invented here syndrome" centered on distrust of research results about pedagogical reforms. This distrust was as evident between departments in the same institution as between institutions. Some project participants wanted to collect their own data, even if that was time consuming and resource intensive, because they believed their instructional environment was unique. As one example: "We would have to conduct a study before considering ideas from other campuses. So that has made us leery of considering the ideas – the time it takes to conduct a study."

***AAU not known for leadership in teaching and learning:*** AAU (and many of its member institutions) have a limited track record in supporting improvements in undergraduate education. Although mentioned by only a few interviewees, it may be that its "newcomer" status to undergraduate reforms affected AAU's ability to shape learning. One respondent exemplified this belief: "There are so many great examples of phenomenal teaching in STEM at liberal arts colleges and even community colleges. This just hasn't been a strength area for AAU, so you wouldn't imagine that this is an area – I guess I can see they would have some struggles here." We note that this perception is held by only a few interviewees and is not necessarily reflected in the literature on DBER, which contains many examples from research universities. Perhaps this perception is in part a function of AAU's recent entry into the undergraduate education policy arena.

**Conclusion.** AAU's role in learning was seen by respondents as less important than other roles the organization played. Evidence showed some examples of adoption through learning including data analytics, curriculum and learning spaces. We note that the Initiative, in part by design, has paid more attention to the roles of influence and prestige on promoting educational reform. It has had less success in achieving reform through individual and institutional learning.

14 Over time this concern by AAU project staff dissipated.

# Chapter 10 Value of Multiple Theories/ Strategies of Change

AAU's approach in the Initiative drew from multiple theories to inform a complex change strategy. This approach is consistent with a growing body of literature showing that systemic change efforts are enhanced when actors use several change approaches consistent with their assets (Boyce, 2003; Kezar, 2013; Sporn, 1999). In this section, we summarize the interplay of these theories and examine how certain strategies can embed multiple theories of change/action.

**Harnessing Multiple Theories.** As noted in the literature review, AAU's initial conceptualization of the Initiative reflected several different theories of change. Most prominent were theories of institutionalization and, to a lesser degree, broader systems theory (examining the interplay of various parts of the higher education system to create and influence change), networking, and organizational learning. Although not described in Initiative documents, the Initiative also drew from institutional theory, particularly in viewing AAU through the lens of influence and prestige. Employing multiple theories of change is important because theories might vary in their relevance depending on the type of change, context for change, challenges related to the change, or the actors involved.

***Institutional theory:*** AAU's prestige, success in using influence strategies, and reframing institutional logics all suggest the importance of institutional theories (IT) of change. IT emphasizes change as a result of external forces and the reshaping of cultural norms and logics. Interviewees confirmed that AAU's most important role in scaling change came from helping to reshape cultural norms through its prestige and influence.

***Network theory:*** Because networks can influence scale and foster change, networking is a key concept in institutional theory. Yet networking is its own theory of action as well. Respondents found AAU's role as a network creator and supporter to be an extremely successful strategy that built on AAU's strengths and assets. Evidence throughout this report supports AAU's role as a network developer, and the functions these networks served in helping to scale changes.

***Organizational learning:*** Theories of organizational learning suggest that learning is the key driver for change. From this perspective, challenging existing assumptions, reviewing new information, and undergoing an inquiry process is required to promote new norms and ways of working. AAU facilitated learning, in some instances, particularly through networks, which demonstrates a kind of synergy between strategies. Despite some evidence of success, AAU was less successful in employing learning strategies than in networking and other prestige-based strategies.

***Systems theory and institutionalization:*** Interviewees noted the importance of scaling reforms at multiple levels, which is consistent with systems theory. In particular, interviewees discussed the efficacy of strategies within different parts of the system, as well as an energizing process across strategies at different organizational levels.

Institutionalization theory emphasizes the importance of leadership and infrastructure in implementing and scaling change. Institutionalization can also be seen as a facet of systems theory in that the institution is a system of various parts which must be coordinated to achieve long-lasting change. Systems theory focuses on the interrelationship of various institutional

behaviors and policies – tenure and promotion requirements, professional development, institutional commitment, and classroom assessment – in fostering reform.

Our study identified three important findings related to multiple theories of change. First, we identified the *value of using several theories of action* to create synergy to amplify the change. Second, we illustrate how national organizations can make use of their *organizational identity, assets and niche in determining which theories of action to use*. Third, *intentional deployment of theories* can assist in achieving policy reforms. As a prestige organization, AAU was able to leverage its influence (a tactic deriving from institutional theory) toward change and create new institutional logics that helped reshape values. AAU also employed an open systems approach by leveraging its prestige and influence to gain support from such prestigious organizations as the National Science Foundation and the National Academies of Sciences to create support for improving teaching. AAU is one of the few groups with the prestige to align many different players/organizations within the higher education system and to create a powerful and aligned network of action. In general, AAU has the prestige to convene and organize networks. People want to attend its meetings. Using these various approaches together helped AAU's success in scaling change to date; relying on a single theory of change would have been too limiting.

Evidence suggests that AAU's reliance on multiple theories was important to the success of the Initiative. No single theoretical model was sufficient to guide such a complex reform effort. Overall, institutional theory and its focus on influence seemed a better fit for the AAU Initiative than theories of action related to institutionalization of changes, especially at the institutional level. Theories of organizational and individual learning seemed least well suited for the AAU Initiative.

**No single theoretical model was sufficient to guide such a complex reform effort. Overall, institutional theory and its focus on influence seemed a better fit for the AAU Initiative.**

Had AAU made its reliance on institutional theory more explicit it might have made for more effective implementation at local institutions. Given the lack of explicit external articulation, planning, and strategizing related to influence strategies or institutional logics, AAU's use of influence was not as robust as it could have been. This study points to the importance of making theories of action explicit so they can be used for planning purposes.

**Strategies that Reflect Multiple Theories.** In this section, we review four strategies that reflect multiple theories of change. It may be important for organizations trying to scale change to align implementation strategies with the various change models implicit in their overall approach. In the Initiative these strategies could include influence, learning, challenging assumptions, networking, resetting norms, exploring values, developing leadership, or mapping priorities onto practices and policies.

***Site visits:*** The AAU site visits exemplified an activity reflecting multiple theories of change. Interviewees said site visits helped facilitate change in various ways.

*Influence.* Respondents described site visits as instrumental in influencing change because the AAU staff met with presidents and provosts and other key leaders, which brought attention to the Initiative. An administrator described the value of the site visits: "Each

time we have a site visit we've really been invigorated. After our last site visit for example, I was able to get administrators' attention on using data analytics - something I was unable to do in the past - and to think again about setting up some kind working group around promotion and tenure." Another respondent said:

> "Emily as well as the folks at AAU have been part of pushing the conversation about how to create a climate supportive of teaching with the leadership at my school. It's not as if we're ignored by the leadership, but it really helps when they come and create more awareness for the programs we are trying to create. They talk to our deans and provosts. And it's not been without notice. I hear things like 'Wow, it's really interesting what you guys are doing.' I just had this conversation with those folks from AAU. So, they're very impressed. So, when they come and visit and talk to our chairs or talk to the deans or talk to the provost, that really matters. That's the thing to keep things moving."

Project teams were able to use the AAU brand name to get resistant faculty and administrators to attend meetings. The site visits also seemed to help project teams make headway in their work.

*Sharing practices and learning.* AAU also used site visits to create learning among project teams, sharing best practices from other campuses to get them to explore or consider new approaches and brainstorm implementation strategies. Additionally, AAU staff encouraged sharing ideas across departments by describing a change in one department (e.g., biology) to influence faculty and staff in another department (e.g., physics). Site visits also provided the opportunity for learning by allowing teams to brainstorm difficult challenges: "We wanted to use the model of apprenticeship from North Carolina, but we're really worried about the tenured faculties' reaction. But in talking with AAU, we were able to think that through." Further, AAU staff challenged values and priorities – asking, for example, have you reconsidered your hiring criteria? The researchers observed AAU staff repeatedly asking questions that were aimed at prompting learning.

*Networking.* AAU staff used site visits to expand project site networks, connecting teams to faculty and administrators on other campuses. A faculty member noted: "Each time they visit, we have been able to identify [through AAU staff] another campus or person working on a similar challenge that we could contact." These respondents also found that the presence of AAU representatives on their campus helped persuade otherwise reluctant faculty and staff to attend events. This example shows the synergy of connected strategies where AAU's "influence" strategy leads to a broader campus network.

*System theory.* Lastly, AAU generated systems thinking by asking individuals on a campus to reflect on their progress in relation to the Framework. Throughout a site visit, AAU staff prompted questions from administrators that focused on institutional commitment and infrastructure. Similarly, they asked faculty and department chairs about the role of infrastructure in helping or impeding their work. AAU staff sometimes communicated perspectives about work across the system. For example, telling administrators how their improvements in infrastructure helped support the campus project team in improving undergraduate STEM instruction.

***RFP and design of the project sites:*** The RFP is another example of a strategy reflecting multiple theories of action. The RFP was noted by various interviewees as well-structured and strategic.

*Influence.* First, the RFP reflected an influence strategy that succeeded in getting key administrators across many AAU campuses to think about improving undergraduate teaching in STEM courses. Many of the campuses that did not receive funding for a project site talked about the usefulness of the proposal process in initiating campus action: "So, we didn't even get the funding, but we still have several efforts that I think are to create an institution-wide change. Normally, we would've had separate initiatives, but the RFP pushed us to start thinking about our work in teaching reform differently and to consider more institutional infrastructure that's needed. Without the AAU Initiative, that just wouldn't happen." In sum, the RFP and AAU's general influence alone helped spur several AAU campuses to pursue reforms in undergraduate STEM education.

*Organizational learning.* Many interviewees said the AAU RFP made their campuses (faculty and administrators) think about STEM reform in new ways, noting how it promoted learning and systems thinking. For example, faculty and administrators started thinking about overall institutional support for educational reforms instead of relying mostly on individual faculty members in departments. One faculty member described the learning that resulted from the RFP and proposal process: "I think it really goes back to the Initial request – its design. We had to shift our thinking from individual pockets of work spread around to an institutional effort."

*Systems theory and institutionalization/networking.* The RFP asked campus leaders to commit resources to the proposed local project and asked for a letter of support from the president or chancellor. The RFP also challenged institutions to create teams of individuals across faculty, staff, and administrators to implement the proposed project. In this way the RFP required both top-down and bottom-up commitment and support. By fostering leadership across the institution, AAU was enabling (or in some cases reinforcing) systems change to take hold. By encouraging senior leadership involvement along with key faculty and staff, AAU set the stage for an effective internal network to work toward change.

***Annual meetings:*** The annual meetings and workshops were highly regarded by respondents. Participants enjoyed the opportunity to get together in person, network, share and learn information, and consider the various strategies needed to support sustained change.

*Networks.* As noted in Chapter 8, annual meetings were essential to develop a larger network for undergraduate STEM reform. Annual meetings helped develop and later enhance connections across campuses between faculty in particular disciplines, many types of administrators, and champions who were passionate about STEM reform.

*Organizational learning.* Many interviewees also said the annual meetings were important opportunities for learning. As one faculty member described: "I think the most successful aspect were the meetings. They provided us a chance to reflect on our work, to learn about what other people were doing, to hear about what's happening at the national level, and recommit to the work." Some interviewees described specific outcomes from the meetings, including adoption of practices from other campuses such as data analytics developed at UC Davis.

*Influence.* Holding annual meetings at the AAU national offices or at another location in Washington, D.C., as well as bringing in prominent speakers to talk with attendees also influenced participants. According to one respondent: "It's hard to exactly pinpoint, but there was something about being in Washington, D.C., and mixing with people I would never get a chance to interact with and feeling like this is so different from other meetings I might go to."

*Systems theory and institutionalization.* Because AAU used the Framework to organize meeting activities, the annual meetings also reinforced key elements of a systems theory of change and institutionalization. For example, meeting sessions focused on promotion and tenure, improving professional development, and assessing learning outcomes. AAU also brought in influential speakers from prestigious organizations and national leaders in STEM reform.

***Media attention to the Initiative:*** The media and press coverage of the AAU Initiative, particularly of specific campus activities, reflected multiple theories of action.

*Influence.* Bringing media attention to campuses was an influence strategy. It helped reprioritize the Initiative on some campuses. In a few instances media attention brought in additional resources and infrastructure. One faculty member stated: "I think having the administrator see the story in a major press was part of the reason we got additional resources for the effort, and so something that seems basic can have a much bigger impact." Media also stimulated reform by leveraging the inherent competition between institutions. When some campus leaders saw their peers gaining media attention for STEM reforms, they wanted to respond by developing or publicizing their own reforms.

*Learning.* Campus leaders often engaged in learning when they developed stories for the media. Journalists asked pointed questions that helped campus project participants and senior leaders think about their reforms in more detail. Many interviewees suggested that working on a press release or working with AAU public relations staff allowed them to reflect on their overall work and bring insights back to the project team. One administrator stated: "This might seem like a small issue, but in having to talk to people off campus, in the media who are not in STEM, it makes me push my thinking about what we are doing. I need to be more explicit in how I describe it. I find myself having insights into our work."

*Networking.* A few interviewees talked about reaching out to personnel at another campus after seeing a news article about STEM reforms. In such cases, faculty members reached out to peers at the other campus. Administrators also talked with their peers at other institutions.

**Conclusion.** AAU's STEM Initiative was a complex change process. It leveraged several approaches to scale change across different stakeholders, campuses, networks and organizations. Strategies designed to share best practices were most effective with faculty and campus points of contact. Influence was more effective with provosts and deans. Networking was especially helpful to local champions for STEM innovation in teaching. Reform strategies can increase impact by embedding as many approaches to change as possible, as demonstrated by the various theories of action embedded in the RFP/ project design, annual meetings, site visits, and media/public relations.

# Chapter 11 Differing Group Perceptions of AAU's Role in Improving STEM Learning Environments

Although there was agreement among interviewees about the most effective roles of AAU in scaling change (influence, networking, and resetting institutional logics/norms), group differences were also apparent among collaborators, administrators at the project sites, faculty at the project sites, and points of contact (faculty or administrator). These differences raise the question of how to serve different groups simultaneously or even whether it is possible to serve multiple groups if their needs differ substantially. One option is to focus primarily on the constituent groups for which an organization has maximum impact. The findings also suggest the importance of AAU framing issues differently for constituent groups with quite different needs and expectations. Being aware of differences when working with multiple groups is critical to scaling change. Furthermore, understanding different group perspectives is important to identify where an organization such as AAU can most meaningfully engage with its constituents.

In the sections below, we review some of the key differences by groups interviewed.[15]

**AAU as Prestige Organization.** Senior administrators were much more aware of AAU as a prestige organization than were faculty members. These administrators were also knowledgeable about the role of AAU in shaping the overall landscape of higher education and its history of shaping the overall sector. As an example, one administrator stated: "Well, the AAU gets a lot of respect as an organization. It's the top research universities and the fact that the AAU is actually doing a project in STEM signals to a lot of people something is different. I think it adds a lot of weight to the initiative and to the attention that's being paid to it among the top research universities in the country." Some faculty members admitted that they had never heard of the AAU before that the Initiative but have since learned it is important to their institution. These faculty members thought their colleagues remain largely unaware of the AAU and its influence. One faculty member stated: "I know this [AAU] is a big thing among administrators, well I have become aware of that. But for faculty, they might have heard something about being an AAU institution, you know that is prestigious, but they do not know an AAU organization even exists." Department chairs, initially generally unfamiliar with the AAU, sometimes found out about AAU through discussions with senior administrators. Said one chair: "I've had the opportunity to learn more about the AAU, but most of the faculty I interact with – they just don't know what it is."

The Initiative often worked with teams comprised largely of faculty and department chairs, groups often not sufficiently informed about AAU to leverage the AAU brand to improve STEM instruction. A few project sites and points of contact did develop strategies to take advantage of AAU's status in promoting local STEM reforms. From this perspective AAU might increase its impact on STEM reforms by engaging in a communication plan to raise awareness of AAU as an organization among individual faculty and administrators. Such an initiative, though, seems a questionable investment by AAU of time and resources.

**Understanding of Framework.** As discussed in Chapter 9, collaborators and senior administrators were more familiar with AAU's Framework than the faculty. The faculty and some

15 There may be additional differences, as we interviewed a selective set of groups.

administrators, including department chairs, often struggled to translate the element of cultural change in the Framework into strategies to better align infrastructure with undergraduate instruction. These differences in perspective suggest that AAU (and other organizations that engage faculty and mid-level staff and administrators) may need to find ways to help STEM reformers position their work in the broader institutional environment.

**Differences in Defining Impact or Scale of Initiative.** Participants varied substantially in how they defined key outcomes such as impact and scale. Collaborators were much more likely to refer to impact as actions affecting all AAU institutions as well as the national dialogue about undergraduate STEM reform. Senior administrators described scale in terms of institutional change; they were unlikely to consider other AAU institutions in their definition. Department chairs often limited their definition of scale to a few faculty members in a department or sometimes across departments. Faculty members typically viewed scale as reform across a department especially by engaging more members of the department in the reform effort. Even members of the AAU leadership team differed in their understanding of impact or scale. Some believed that scale was about individual institutions changing their culture. For others scale referred to all AAU institutions altering their culture. Others considered scale as both impacting the national discourse on STEM reform and reforming AAU institutions. In this context, when AAU spoke about scaling change each constituent group heard that statement in different ways. These differences in perspective sometimes adversely affected the use of a systems approach for reform (see Chapters 4 and 5). In particular these different perspectives about scale reduced the potential synergy of local actions because the participants were not always moving toward the same objectives (noted in Chapter 4). For example, departments on the same campus sometimes differed in their views about the need for STEM reform and about the strategies required to achieve it.

**When AAU spoke about scaling change each constituent group heard that statement in different ways.**

**Beliefs About Who Should Lead Change Efforts.** The faculty differed with senior administrators when describing leadership in undergraduate STEM reform efforts. Faculty members tended to emphasize a bottom-up view with leadership roles for influential faculty, department chairs, and the department as an entity. From this perspective faculty and departmental leadership is required for eventual institutionalization of reforms. Senior administrators emphasized the need for shared leadership between the faculty and middle-level administrators such as chairs and deans. Many senior administrators did not assert the importance of their own role in leading change. Many faculty respondents cited a lack of senior administrator involvement in the change process as a potential barrier. Yet the faculty did not envision a primary role for these administrators in their own "change model." The apparent lack of leadership at multiple levels could be a barrier to institutionalizing reforms. It is also possible that the form of support from senior leadership, such as providing funds and renovating classrooms, was less apparent to project participants than the involvement by faculty and staff implementing the reforms.

**Role of AAU.** Respondents differed in their views of the role of AAU in the Initiative based on the role, their work on the project, and their understanding of scale. Interviewees tended to view AAU through the lens of their own needs and challenges. Faculty members described ways that AAU could help them develop tools for course and curriculum reform and find ways to help modify reward structures. One faculty member commented: "I'd really like the AAU to create an extensive curated website with examples of new pedagogies and curriculum, by discipline, nationally. Nothing like this really exists. NSF tried to do this, but it is not up to date and includes a lot of non-AAU institutions." Another noted: "It might really helpful if they sponsored some

professional development or workshops across AAU institutions that focused on teaching and improving teaching." Faculty tended to view AAU as a potential provider of services needed to meet on-the-ground challenges. Administrators of all types were more likely to emphasize AAU's role in helping garner additional resources for projects similar to the Initiative; including funds to improve teaching facilities, support for data analytics, assessment tools to measure teaching effectiveness, and providing examples of other successful reforms. As one administrator stated: "I have appreciated their work on uses of data. We have had a few presentations. And I think they are working on measures of teaching. These efforts are both really useful."

A realistic view of AAU demonstrates that it cannot respond to all of these individualized group and campus needs; it lacks the organizational capacity to do so. Even if it had the capacity, it is unclear that focusing heavily on local needs is an effective role for AAU. One way to determine the best match between campus needs and AAU capacity and strengths is to conduct a needs assessment to identify unmet needs, and then identify where AAU might be the appropriate organization to help and where it is not the appropriate organization. AAU could also use the needs assessment to identify possible partnerships or broker with other organizations that might be better suited to helping campuses meet local needs. For example, connecting faculty at project sites to professional development organizations such as POD might help faculty obtain support for pedagogical reforms. As another example, AAU has strongly supported data analytics work, but other organizations are better suited to helping member institutions use data analytics on their own campuses.

**Conclusion.** This chapter discusses the importance of comparing AAU strengths and capacities with local campus needs. We recommend using a needs assessment to help AAU and its member campuses determine the most strategically effective roles for AAU and its member institutions. In addition, making clear the boundaries of AAU's reach – whether by describing the limits of its resources or clearly stating its range of responsibilities – will help clarify AAU's role as the Initiative goes forward. Also important is developing strategies that take into account differences in role group perceptions about the change process.

# Chapter 12 Scaling Reform

One of the goals of this report was to understand AAU's ability to implement strategies shown to be effective in scaling reforms, including creating forms for deliberation, developing external supports (often provided by an intermediary organization), and creating and supporting networks. This chapter summarizes the evidence about the use of well-established factors in scale in AAU's Initiative.

Previously, we outlined three key aspects of theories of scale: *deliberation, networks, and external supports*. Opportunities for deliberation and dialogue among professionals – such as convenings, conferences, and meetings – develop motivation, interest, and ownership (Elmore, 1996; Kezar, 2011). Through dialogue, norms and values are explored and changed as people accept new ways of behaving. Networks connect people to others with similar ideas and also provide change agents with information, incentives, and social capital. These assets facilitate the change process by providing knowledge about how to overcome barriers or foster working relationships. Networks also reduce risk-taking by having groups of people experiment together. External mechanisms of support can take many forms ranging from concept papers and frameworks to funding, awards, and recognition, which often are necessary to help sustain change agents in the face of entropy or negative social dynamics. These strategies acknowledge that individuals (or even individual campuses) cannot successfully act alone to scale changes, and that their environments must be reshaped to support ongoing change. An individual campus is unlikely to act outside the norms, messages and incentives developed within the broader enterprise of higher education, which may be especially true for the major universities in AAU. Disciplinary societies, national organizations, and regional groups all shape and influence campus behaviors, including individual faculty behaviors. Aligning messages among groups provides motivation for change.

**Deliberation.** The AAU's work to create the deliberation necessary for change was incomplete. AAU worked to recreate institutional logics and language that are often part of deliberation processes (see Chapter 7). However, AAU needed more input from various stakeholders to create more consensus about the focus of the Initiative. Most interviewees did not feel that this was accomplished through the Initiative. We found little evidence from the observations of deep deliberation.

In our observations and interviews on campuses and at network meetings we found the focus of project sites mostly on implementation of project activities, and to a lesser degree on institutionalization. Much less attention was given to deliberation about the meaning of the reform process and especially changing local cultures. As one project site interviewee noted: "Most of the project sites just focused on implementing the work, and very little discussion is happening across campuses about improving teaching." Most of the project sites involved small groups of faculty and a few administrators, which often seemed unable to generate broader discussion of teaching across campus.

A few interviewees from AAU STEM Network campuses mentioned some new conversations that occurred as a result of being part of the AAU Initiative: "Before the initiative we had very little work on evidence-based teaching and now we're having discussions about active learning and need for space to experiment with to do this work."

Some interviewees also commented that the primary focus in annual meetings was on information sharing and implementation strategies, less on deliberation about the reform process: "I like hearing what's happening on other campuses, and at the national level, it's interesting but

not leading to deep conversations." Another point of contact commented: "The meetings lack the kind of depth that have you really chew on issues – I am not sure what people walk away with beyond hearing about work on other campuses." These comments indicated that AAU meetings focused more on local project activities, best practices, and implementation strategies, and less on delving deeply into professional debates about values and norms. In a few instances at AAU meetings we did observe groups based on academic discipline where participants discussed their teaching. In these sessions participants sometimes got into heated philosophical discussions about the best ways to improve undergraduate STEM education.

The few project sites that devoted more attention to deliberation about values and norms had been engaging in STEM reforms for many years. The AAU Initiative allowed these sites to continue already existing conversations. These sites viewed the AAU Initiative as enhancing (but not originating) conversations about values and norms.

Most project sites and campuses within the broader AAU STEM Network had not yet deeply explored existing values or the adoption of a new value system. While the AAU Initiative helped foster a new value system through new institutional logics, STEM reform projects, and dissemination via networking, the deliberation of changing values often necessary to ensure long-lasting reform was seldom evident. The Initiative is still in its early stages and has time to make sure that space is provided in future meetings (as well as in feedback to project sites) to encourage deeper deliberation about cultural norms and values related to teaching.

**Networks.** AAU successfully created and leveraged networks that shared best practices, provided emotional support, enhanced resource development, shaped campus priorities, influenced leadership, and disseminated institutional logics. The networks created as part of the Initiative served many important functions related to scaling change.

**AAU successfully created and leveraged networks that shared best practices, provided emotional support, enhanced resource development, shaped campus priorities, influenced leadership, and disseminated institutional logics.**

The success of AAU with networking was manifest in the development of new networks with distinct groups including the AAU STEM reform community, the project sites, and the points of contact. AAU also encouraged and assisted many of its member institutions in participating in various networks that supported scaling STEM reform. For example, UC Davis interacted with BVA, CIRTL, The Helmsley Charitable Trust, the Keck Foundation and the Gates Foundation.

Other interviews spoke about the value of AAU's creation of a network of networks. AAU accomplished this by combining its networking and systems approaches. Rather than viewing networking in a limited way, AAU created and connected networks across the entire higher education system – from departments, to institutions, to the AAU network, to networks across the sector of higher education. One faculty member explained:

> "There were a couple of examples where I've seen this multiple network effect. For example, at the AAC&U STEM Education meeting I've seen groups from those eight sites presenting there and sort of vice versa where the participants of national organizations attend the AAU network meeting in Washington. The presenters are definitely a part of the larger community that I've seen either presenting or engaging in different ways in other networks. There's clearly this cross network happening. There's clearly—there's so

many different networks around the country and AAU is intersecting with all of them. You just see these faces and influential people who are making changes. What really strikes me in those, I think, are the connections and the networking capacity that's really kind of being stimulated by AAU."

In addition, AAU leveraged change through its relationship with the Coalition for Reform of Undergraduate STEM education (CRUSE), which is a rich resource for expanding and making available ideas for future reforms in STEM education.

In addition to information sharing, networks played a valuable role in the AAU Initiative by helping project participants find emotional and political support as they pursue this complex task of changing undergraduate STEM education: "There is a sense of community that says we're not alone in trying to do this, that we're part of a bigger thing which is really nice. It does have the potential for sharing ideas back and forth, and we have done some of that."

**External Supports/Intermediary Organization.** AAU was partially successful in creating external supports. One of its key support mechanisms – the Framework – was very useful to project site PIs but not well understood by most other project participants. This result is not particularly surprising because AAU is not typically engaged with the day-to-day work of the faculty, staff, and chairs of its member institutions. It is too soon to tell if other AAU support mechanisms, such as the *Essential Questions and Data Sources,* will be well received by faculty and staff at member institutions.

AAU's use of external support was often successful, including providing media coverage and public relations for the AAU campuses involved in reforming STEM education. Working with the Cottrell Scholars helped disseminate new ways of measuring excellence in teaching as well as stimulating discussions about the role of teaching in faculty rewards.

**Motivation and Sustainability.** Theories of scale also speak to motivation through the development of incentives, ownership, and organic creation as well as sustainability through contextual supports and alteration of norms. Deliberation, networks, and external supports are the vehicles that typically create motivation and sustainability, the underlying mechanisms that support scale. In terms of motivation, the Initiative was perceived as organic in part because campuses provided input on the Framework, metrics to be collected, the RFP, and other core documents in the Initiative. As for ownership, evidence of which in this case we take to mean individuals feeling committed to engaging in or supporting innovative teaching in STEM, the Initiative achieved partial success. Ownership primarily was demonstrated by faculty champions and department chairs with less ownership by individual faculty and staff. Most campuses were unable to spread and obtain ownership by a large number of faculty. Signs of ownership by some senior leaders were evident at AAU meetings for presidents and provosts as well as in interviews with project PIs. Yet most individual faculty members and staff, including those significantly engaged in project work, were not aware of this commitment. One visible sign of institutional-level ownership was changes to physical spaces used for instruction. At some campuses, such as the University of Arizona, newly modified spaces have become prized locations for faculty members using active learning strategies. The most challenging task in modifying cultural norms at AAU institutions, not surprisingly, remains changing the faculty reward system, particularly by increasing the value of teaching. Although there were some signs of institutional ownership in changes made to faculty rewards, such as the requirement at some campuses to include additional materials about teaching in promotion and tenure dossiers, these changes were not widely noted by respondents and few of those commenting said that teaching had become more valued in promotion and

tenure decisions. Changing faculty rewards is undoubtedly the most important and contested aspect of long-lasting cultural reform on AAU campuses. Finding ways to institutionalize changes in incentive structures is a crucial part of the long-term success of the AAU Initiative.

Sustainability of the Initiative is very much a work in progress. Respondents at many campuses reported initial signs of supports including professional development, technology, altered classrooms, institutional commitment and other infrastructure. Successful completion of these supports is an important factor in whether or not STEM reforms become institutionalized. Substantial evidence exists of support for teaching excellence, as evidenced by alternative metrics to measure teaching and learning as well as improved standards for professional development. The underlying values that shape norms about the importance of undergraduate teaching are still a work in progress. Development and widespread acceptance of these teaching-related norms is fundamental to achieving the long-term goals of the AAU Initiative. AAU also demonstrated sustainability in several ways: the new AAU president continued support for the Initiative started by her predecessor, AAU changed the status of the director of the Initiative from soft money to hard money and added an additional 1 ½ full-time equivalent of staff support, and AAU continued to support some Initiative dissemination activities beyond the life of the original grant.

**Summary of Scale.** Organizations working to scale reforms must assess their strengths and identify strategies that best fit their ability to encourage deliberation, networks, and external supports (if at all). This assessment must also identify activities for which the organization is ill-suited, and where possible identify alternative organizations or strategies to foster scaling. A good example of identifying a partner organization and negotiating its involvement with the reform effort is AAU's work with the Cottrell Scholars. AAU supported the work of the Cottrell Scholars to develop measures of teaching excellence – a crucial part of reforming undergraduate STEM teaching – which was a task for which Cottrell Scholars were better suited than AAU. Forming collaborative relationships with other organizations better positioned than AAU to achieve some aspects of scaling STEM reform is potentially an effective way to promote deliberation and implementation of STEM reforms on AAU campuses.

**Conclusion.** The AAU STEM Initiative successfully employed two key mechanisms for scaling: networks and establishing a set of external supports. To date, AAU has been less successful in finding ways to enhance deliberation of cultural norms on member campuses.

AAU's strength in scaling change is its unique position as a prestigious organization that can influence the field of higher education. In sum, although many of the models for scaling reviewed in this report have proven useful in other situations, AAU seems best positioned to use its influence to scale changes in undergraduate STEM education.

The findings from this study also suggest that trying to adopt all the scale strategies may not be a strong or meaningful approach. Instead, assessing an organization's strengths and capabilities is the important first step to determining a scaling approach. If an organization is not well positioned to create deliberation, networks, or external supports, then forming partnerships with other organizations to implement scaling strategies is important. Organizational assesments can help to identify approaches to change that best fit an organization's strategic strengths and capabilities.

# Chapter 13 Maximizing AAU's Role as a Change Agent to Achieve Cultural Change

In this chapter, we review interviewees' perceptions about the potential role(s) for AAU in encouraging greater attention to teaching among its members. Respondents recommended that AAU first change its own culture to indicate its commitment to better teaching. The assumption by these respondents was that member institutions would fall in line if AAU as an organization made clear its preference for better teaching. These respondents also believed the clearest way to exhibit commitment to teaching was by making it a criterion for membership in AAU.

Before proceeding to examine respondent recommendations, we note that most respondents were not well informed about AAU or its operations. To better understand the feasibility of their recommendations we start by clarifying how AAU operates. AAU is not an independent organization dictating policies to its members. Rather it represents its members. General policies and funding are approved by a board consisting of presidents of AAU institutions. The AAU staff propose a budget and priorities; it is the board that authorizes them. If AAU were to expand its criteria for membership to include metrics for teaching, the presidents of member institutions would have to initiate the process. Such a process may be possible; however, it is not a decision made solely by AAU staff. In addition, the metrics currently available to measure teaching quality are not widely agreed upon nor widely available, making it difficult to compare instructional quality at the institutional level. AAU can work (and in some ways has already) toward the development of such metrics. Without the necessary metrics it is difficult to make a proposal to the board to expand membership criteria. Finally, as described in the previous chapter, AAU made a real as well as symbolic commitment to undergraduate education by establishing the Initiative. This commitment included finding funding for the Initiative, convincing member presidents to support it, making the director of the Initiative a full-time staff member, and adding staff to assist her. Even though AAU had made some efforts that demonstrate work toward culture change, interviewees recommended further steps to institutionalize culture change in the long term.

**AAU's Membership Criteria.** The most often mentioned proposal for AAU to maximize its role in creating change was to expand its membership criteria, currently primarily based on research, to include teaching. One administrator described how the membership criteria could be a lever for change: "I think the meetings are good, the focus is good, but they need to really address the AAU membership criteria. It's the elephant in the room. You can have this initiative and activities and conversations but if the membership criteria remain the same I just don't see this having traction long-term." A faculty member emphasized the importance of changing criteria for scalable change: "As I said before, I think in order for there to be sustained global change, the AAU has to have some metrics around teaching and learning that are meaningful that their institutions strive to achieve. I mean it is like the metrics they use for deciding who gets in. The research dollars and other sorts of things that they use to decide who is an AAU institution. If there is nothing there around teaching and learning, then I don't think it is going to be sustained and I don't think it is going to have as broad of an impact as it could." Several interviewees spoke about the membership criteria as a barrier to change itself. For example: "Well, they can host meetings and write reports, but if they do not change the membership criteria, which say what they think is important, nothing is really going to change. It will be lots of talk and some action and little impact." In sum, the membership criteria were seen as both a barrier to change and a major lever in maximizing AAU's role as a change agent.

**AAU's Organizational Identity.** AAU has evolved into an organization focused primarily on supporting research. AAU's identity is heavily focused on supporting academic research at its member institutions. It has a long history of policymaking around research and advocating for research funding. Respondents found two aspects of AAU's identity potential barriers to increasing the influence of the Initiative on undergraduate education. First, interviewees described the priority given by AAU to research as a potential cultural barrier to the improved undergraduate education envisioned in the Initiative. As one interviewee described: "I think they really need to reposition what the research university is. Right now, the organization defines it[self] as being excellent in research based on its criterion and priorities, but they could redefine that and say that a great research university is excellent in teaching and research. So, until they change their own definition of what a great research university is, I think efforts like this will struggle. So, if they want research universities to change, they need to change first." We note that these respondents seem to consider AAU as an independent organization that drives the modern definition of the research university primarily through its control of membership criteria.

**Interviewees described the priority given by AAU to research as a potential cultural barrier to the improved undergraduate education envisioned in the Initiative.**

The second major aspect centers on AAU's role as a policy organization. In the past, this meant AAU focused primarily on policy issues and advocacy; little effort was spent on projects. The AAU Initiative was an initial step toward project management. Although at the beginning of the Initiative the former president, Hunter Rawlings, indicated that "AAU does not do projects," over time the staffing and activities have expanded to allow more project-related work. According to some respondents, incorporating a project-based component to promote institutional change is an important step toward continuing the momentum developed by the Initiative. Others worry that this expanded focus might be detrimental to AAU: "I wonder if work with project sites is using their assets. It seems like they should focus on the existing infrastructure that they have – what about getting a group of presidents to champion STEM reform, have a convening of AAU institutions to redefine excellence in university teaching, or get a network of provosts working on setting standards for excellence in teaching? They can work within what they're already doing and amplify it. Setting up some separate initiative also sets it up for just going away once the funds are over." Interviewees questioned whether AAU was well-positioned to run programs and work on institutional change efforts, and whether it would need to rethink its position on programs if it wants to continue this type of work. Recent structural changes at AAU, such as making the director of the Initiative a permanent position, adding staff to assist in project-related work, and seeking additional funds for the project indicate that AAU is taking steps to expand its capacity in this regard.

AAU is well-positioned to use its influence because it has a history and tradition of working with advocacy. AAU's work with presidents and provosts has focused on institutional priorities and networking. Work to shape institutional norms and leverage networks builds off AAU's historic strengths. AAU has begun to add programmatic and project work to its policy and advocacy functions in part to play a more active leadership in higher education reforms. Going forward, the challenge for AAU is to determine if the addition of project-related activities comes at a cost to its historical ability to leverage influence or if the two are complementary. Especially important is judging the AAU's capacity and resources relative to its various tasks. In the cases of the Initiative and a national survey on sexual assault on college campuses AAU decided it had both the resources and the appropriate stature in the academic community to do the work.

In contrast, in deciding whether to help develop a national departmental award for teaching excellence AAU decided it did not have the capacity to manage and fund such an award. Instead, AAU partnered with organizations that agreed to monitor and administer the departmental award. AAU took a similar approach to developing measures of teaching excellence with the Cottrell Scholars.

One of the most frequently identified missed opportunities for scaling change was AAU's lack of reflection on its own organizational identity. Interviewees asked AAU to consider how it historically has supported excellence in research (actual programs and infrastructure at AAU) and what the organization might do to promote excellence in teaching. Rather than an externally-focused initiative, many commented that changes are more likely to occur and be sustained if the Initiative was aimed at both cultural changes at AAU in what the organization values, recognizes and rewards in conjunction with the external changes desired at AAU campuses. One interviewee summarized this point: "It's my belief that AAU will eventually develop a ranking for teaching accomplishments. Once that's established and can be measured, I think that's the point in time where transformation will really take hold."

**Interviewees asked AAU to consider how it historically has supported excellence in research (actual programs and infrastructure at AAU) and what the organization might do to promote excellence in teaching.**

**President and Provost Networks.** Many respondents said that AAU could, in its regular convenings of member presidents and provosts, encourage them to give greater priority to teaching excellence on their campuses. Many individuals commented that communication with these groups about the Initiative was too infrequent and that they were not charged with any responsibility to ensure changes were happening on their campuses. Second, interviewees noted how a group of presidential champions might be tapped to push for an expansion of AAU membership criteria, development of a report about a 21st century research university, or other avenues that would signal changes within AAU values.

Other interviewees recognized that finding ways to encourage senior leadership to add another task to their already full agenda was challenging. Some interviewees also recognized the difficulty for AAU staff in trying to work with presidents and provosts. For example: "The provosts really don't need to see another talk about how all the stuff works [good teaching practices]. We know it works. We know what works and we're frustrated that we don't have enough direct influence to just get everybody to change all at once. Doesn't really help to show the data again. And we've got all our own data [institutional based data]. It's been measured so many times. We know that stereotype threat is real. We know lectures don't work. We know all these things are the right way to do it and I just worry that if the AAU– If we get to Laguna Beach and there's another talk about this, I just think it would be, it might be, counterproductive." Some respondents suggested that actionable work and examples might be more effective with senior leaders than conversations about valuing teaching. As a whole, interviewees believed that passively informing presidents and provosts of the AAU STEM Initiative is not as effective as actively engaging them in fostering change on their campuses. Perhaps AAU could develop a small group of presidential champions to reinforce the work done in the Initiative. A group of champions, for example, might support a competition to encourage AAU campuses to enhance their commitment to teaching.

**Downsides of Exclusivity among AAU Universities.** One challenge for the Initiative is to balance appreciation for context, taking into account institutional and departmental differences in implementation strategies, with the very real barrier resulting from this focus on exclusivity. In some cases, AAU institutions would not adopt successful reforms from other campuses because such reforms could not fit into the local context. Our data suggest that this attitude slowed change even when the external reforms might have been folded into institutional practice. We noted in previous chapters how models for teaching excellence from liberal arts colleges, as one example, sometimes were rejected out of hand because of the difference in institutional type.[16]

One key to enhancing the quality of undergraduate teaching at AAU institutions is to find a way to balance "respect for the research university identity and culture" and "unique campus context/ cultures" with being open to potentially transferable teaching practices from other types of institutions. Data analytics, for example, has proved transferable across institutional types. Professional development practices are also likely transferable across different contexts or institutional types. Although more complex, even some aspects of teaching standards might be transferable (in this example most likely across institutions of the same type). AAU could do more to emphasize transferable practices, policies, and ideas – even those that come from outside the sector – and the value of learning from examples such as University of Maryland, Baltimore County, which was an institution brought up repeatedly as an important example of excellent STEM education. As one respondent noted:

> "There's over 40 years of research and work on how to teach better. These institutions are going to make really slow progress if they feel they have to start all over again learning what we've already learned. Why can't they learn from others? We know Uri Triesman's collaborative learning model can work within any institution. Why aren't these institutions [AAU campuses] using all of these existing strong models rather than just reinventing them themselves."

The Initiative would likely advance and scale changes more quickly if it builds off of existing research on pedagogy and curriculum, borrows models from campuses such as UMBC, and legitimates the expertise of centers for teaching and learning. Especially harmful is the impression that no reforms are valid unless developed at an AAU campus, which is constraining innovation and adoption of best practices. The elitism of AAU campuses can make them less prone to adoption, learning, and culture change from other campuses.

**Conclusion.** This section highlighted key areas where AAU can increase its impact and potentially increase its ability to scale and sustain changes. The areas highlighted in this section build on the already-identified strengths of AAU – especially strategies that extend their influence and further tap key prestige groups. The recommendations amplify and build on existing networks of presidents and provosts, encouraging them to be more active agents of change or to form a network of peers among presidents and provosts to support improvement of teaching on their campuses. The recommendations also continue to expand AAU's important work in defining new institutional logics – challenging existing hierarchies that discount the value of teaching. The most commonly described and perhaps most meaningful in terms of altering the cultural-symbolic system is AAU altering its own cultural values in support of teaching.

16 While interviewees did not as often directly describe attention to institutional context or culture as a barrier to culture change, researchers identified this trend in looking across comments of interviewees during questioning about adoption of new practices or learning from other sites or examples. We recognize that AAU was being attentive to institutional context in order to engage research universities by honoring that they have a distinctive environment which should be taken into account when thinking about STEM reform.

# Section III
# Recommendations

**In this final chapter, we summarize and provide recommendations for other organizations attempting to scale practices, particularly initiatives related to improving the teaching and learning environment. For organizations engaged in scaling change, we have developed a practitioner guide with tools to help in this process.**

**1. Assess your strengths and assets as well as limitations as an organization**

One of the most important lessons of this study is that organizations engaged in change processes should first assess their strengths and devise strategies accordingly. This lesson is especially true when dealing with complex phenomena involving several organizations. Capitalizing on an organization's strengths is crucial to effective change strategies. For AAU, these strengths included its ability: (a) to influence leaders such as presidents and provosts as well as other prestige and influence organizations; (b) to create and leverage networks; (c) to define overarching logics or value systems for the Initiative; and (d) to work across the higher education system, ranging from the National Science Foundation, to partners in STEM reform such as the Bayview Alliance.

The converse is also true: organizations need to identify their limitations and not take on strategies for which they maybe are less well-suited. For example, AAU was ill-suited to work directly with project sites because of its lack of resources and limited influence with local faculty and staff. Instead, site visits, which focused more on influence and information sharing, were a more effective way for AAU to work with individual project sites.

**2. Using a systems approach is promising to scaling change**

Every organization will have capacity to create change at some levels of the higher education system; few can work across the entire system. Some associations and organizations might be very well-prepared to work with individual faculty on professional development or curriculum reform efforts; other groups might be well-positioned to assist mid-level leaders such as deans and department chairs; other associations have regular workshops to help campuses institutionalize changes. AAU is one of the few organizations that can work across multiple parts of the higher education system and took advantage of that capability in its Initiative. Organizations should establish where they can work best within the overall system and strategically apply their efforts accordingly.

Research has shown that the more levels of a system that are impacted, the more likely changes are to scale and be sustained. One of the beneficial outcomes of the AAU Initiative was better alignment among various reform efforts in undergraduate STEM education. Alignment of various parties involved in the same general policy arena (CRUSE is one example) – in this case undergraduate teaching in STEM – increases the odds of the scaling of the reforms. The efforts to align organizations begun under the AAU Initiative were promising. They will require ongoing resources to keep the alignment in place.

**3. Develop a multi-theory strategy for maximum impact**

Using multiple theories of action to scale change can be very valuable in projects with multiple stakeholders and complex motivations. AAU project leaders adopted a multi-theory approach to the change process, which supported the trajectory and efficacy of its reform strategies. Systems change, learning, influence, institutionalization, cultural change, and networks are complex approaches to change. It is all too common for change efforts to adopt a simplistic approach to change. AAU's deployment of various theories of action increased the impact of the Initiative. As the AAU example shows, embedding strategies which can be used in multi-faceted ways is also an efficient way to use time and resources. Using multi-faceted strategies is a very effective way to incorporate multiple theories of action into a change process.

**4. Understand and intentionally plan influence strategies**

Few examples exist in the literature on change about the articulation, definition, and use of influence strategies. This study provided concrete examples of what an influence strategy might look like in higher education settings. The AAU influence-based strategy included setting up institutional competitions, peer and benchmark comparisons, branding, awards, site visits, and partnering with influential organizations, to name a few. Every organization can influence some set of groups. Identifying and targeting these groups is the most important part of an effective influence strategy. As noted throughout this report, influence is generally an implicit strategy. Organizations typically do not conduct strategic planning for the use of influence even though it is an important lever for change. This report articulates influence strategies that organizations might consider. AAU is in a unique position to influence the higher education system; few if any other organizations in the higher education system have AAU's influence. Yet any organization might benefit from planning an influence strategy by mapping individuals, groups, and organizations with which the organization has influence.

**5. Carefully evaluate the framing and language used to communicate the change**

Little research about change processes exists that relates to the importance of the language, framing, and messaging of the intended new value system. Although much has been written about the role of language in change at a single higher education institution, little has been written about the process of altering or rearticulating "institutional logics" to guide whole system change. Just as an individual institution must carefully craft a vision of change in its strategic planning process, scaling efforts must also articulate a "common agenda" and, even more importantly, a compelling set of logics to enact that agenda. This study identified AAU's process of articulating a new institutional logic and the ways in which it was both highly successful and less successful. The study found that attention to language is particularly important in scaling changes. Language embodies the new values, which become implicit assumptions and tacit collective norms which influence attitudes and behaviors. An important lesson from institutional theory is that the strongest and most sustainable way to scale change is to alter the underlying value system – termed the institutional logics. In sum, organizations attempting to scale change should carefully define their logics and craft appropriate language for enacting them.

Differences in language can also result in barriers or issues that upend change processes. This study found that the language appropriate for implementing the Framework, as one example, varied by role group. These findings suggest the importance of working with different groups involved in a change process to identify relevant language during early stages of adoption or even before adoption. Taking this step may reduce future misunderstandings that can adversely affect adoption and scaling.

**6. Use networks to scale change**

Networks are important actors in the change process. They serve many functions including information sharing, dissemination of logics/new values, brainstorming, learning, emotional support, influence, safety in numbers for risk taking, and resource development. The study also demonstrated the benefit of connecting multiple networks, providing support for networks, and developing leadership to maintain networks. Being intentional about the use of networks in change strategies is crucial in the change process. Organizations often allow networks to develop organically rather than considering ways to make strategic use of them to scale change. AAU's effective use of networks in the Initiative came from careful planning of their various roles in the Initiative.

**The study also demonstrated the benefit of connecting multiple networks, providing support for networks, and developing leadership to maintain networks.**

**7. Apply strategies to facilitate learning and adoption, and examine barriers to learning in change processes**

AAU used several strategies to encourage adoption through learning. The AAU found it difficult for its Initiative to promote learning within its member institutions. Processes to facilitate learning at academic institutions may require the type of work with campuses that many organizations are not suited to conduct. For example, projects that successfully foster organizational learning typically use in-depth facilitated processes, set up inquiry teams, and build up organizational data and information infrastructures. In addition, the study identified how barriers can emerge to learning and adopting change. These barriers include: (a) the attention of the Initiative to the uniqueness of local context and culture made it easier for faculty and administrators to reject lessons for reform from other campuses; (b) competition among campuses sometimes made them leery to learn from each other; (c) distrusting research and data from other sources – again related to the perception of unique context; (d) AAU not being known as a leader in teaching and learning; and (e) difficulties in encouraging collective problem-solving. Organizations can benefit from understanding the capabilities needed to help shape learning among the groups with which they are working.

This study also suggests the potential benefit of identifying barriers to learning during implementation and addressing them in a timely fashion. If some of these barriers had been identified early on, AAU might have been able to change its messaging and approach. Creating feedback loops in the change process can help with organizational learning and the adoption of new practices. It can also help improve communication of logics, influence strategies, and optimal use of networks.

**8. Consider culture change at multiple levels**

This study found that changing AAU's own culture – with greater attention paid to teaching excellence – was a potentially important and as yet not fully realized part of the reform process. AAU was more engaged in encouraging change within its member institutions than in its own reform, especially in the criteria used for its membership. AAU has made considerable investment in the Initiative and has restructured its staff and resource allocation to better align them with improved teaching. Getting its member presidents and provosts on board, especially in considering expansions to membership criteria, is a complex but necessary task both to spread the reforms supported by the Initiative and to reexamine the role of membership criteria in the overall change process.

The plenary speaker at one AAU STEM Network meeting, Stan Deetz, noted that "culture eats strategy for lunch." He went on to say that STEM reform (within departments and among individual faculty) are more likely to occur if AAU (as an organization and its member institutions) changes too. He underscored that trying to improve undergraduate education without fundamentally changing the nature of the university – its culture – will always be an uphill battle especially at research universities. To support reform of AAU's culture the following relevant actions might be considered: expanding AAU's membership criteria, messaging and engaging president and provost networks, revisiting AAU policy priorities, and creating a position paper outlining the American research university in the 21st century. All of these proposed actions reinforce a more active role by AAU in fostering cultural change among its member institutions and as an organization.

**9. Create distributed leadership to improve STEM education**

The literature suggests that leadership throughout the higher education system is critical for scaling changes. Interviewees acknowledged the importance of leadership in scaling change at each level of the system: the faculty, academic department, institution, AAU presidents and provosts, and academic disciplines. Distributed leadership emphasizes the impact of leadership throughout the system in creating change. It does not distinguish between formal and informal leaders. Distributed leadership also includes external positions of authority including faculty at other institutions, professional association employees, staff at disciplinary societies, and those in formal positions of external authority such as disciplinary association leaders and policymakers. Facilitating the development of leaders at various levels is an important step of the reform process to improve undergraduate STEM education. The AAU contributed to this goal through its annual meetings for the AAU Initiative and for presidents and provosts. Additional funds and other resources likely are needed to extend leadership development across the relevant role groups in undergraduate STEM reform.

**Conclusion.** The AAU STEM Initiative was a rare opportunity to examine the role of a national organization in improving undergraduate STEM instruction. This study provides important feedback for AAU to hone its reform strategy. More generally we have identified lessons for other national organizations seeking to foster improvements in undergraduate teaching. These lessons potentially apply to regional or local organizations as well. The key concepts for organizations to play an effective role in reforms are mapping strengths and capabilities, having a coherent strategy for influence, maximizing the use of networks, and using practices that maximize learning.

**The key concepts for organizations to play an effective role in reforms are mapping strengths and capabilities, having a coherent strategy for influence, maximizing the use of networks, and using practices that maximize learning.**

The study also highlighted lessons for funders seeking to scale teaching reforms, including the importance of funding a national group to align change efforts, and the need to establish or support an organization to coordinate leadership development at multiple levels of the higher education system.

Some important lessons in reforming undergraduate STEM instruction apply only to AAU. AAU as a prestigious organization is uniquely positioned to influence institutions and garner media attention. AAU plays an important role in the entire higher education landscape. Few if any other organizations in the U.S. higher education system can shape institutional logics and encourage reforms of such complex topics as faculty reward structures. For these reasons, AAU is an essential player in the process of achieving systemic change to undergraduate STEM education.

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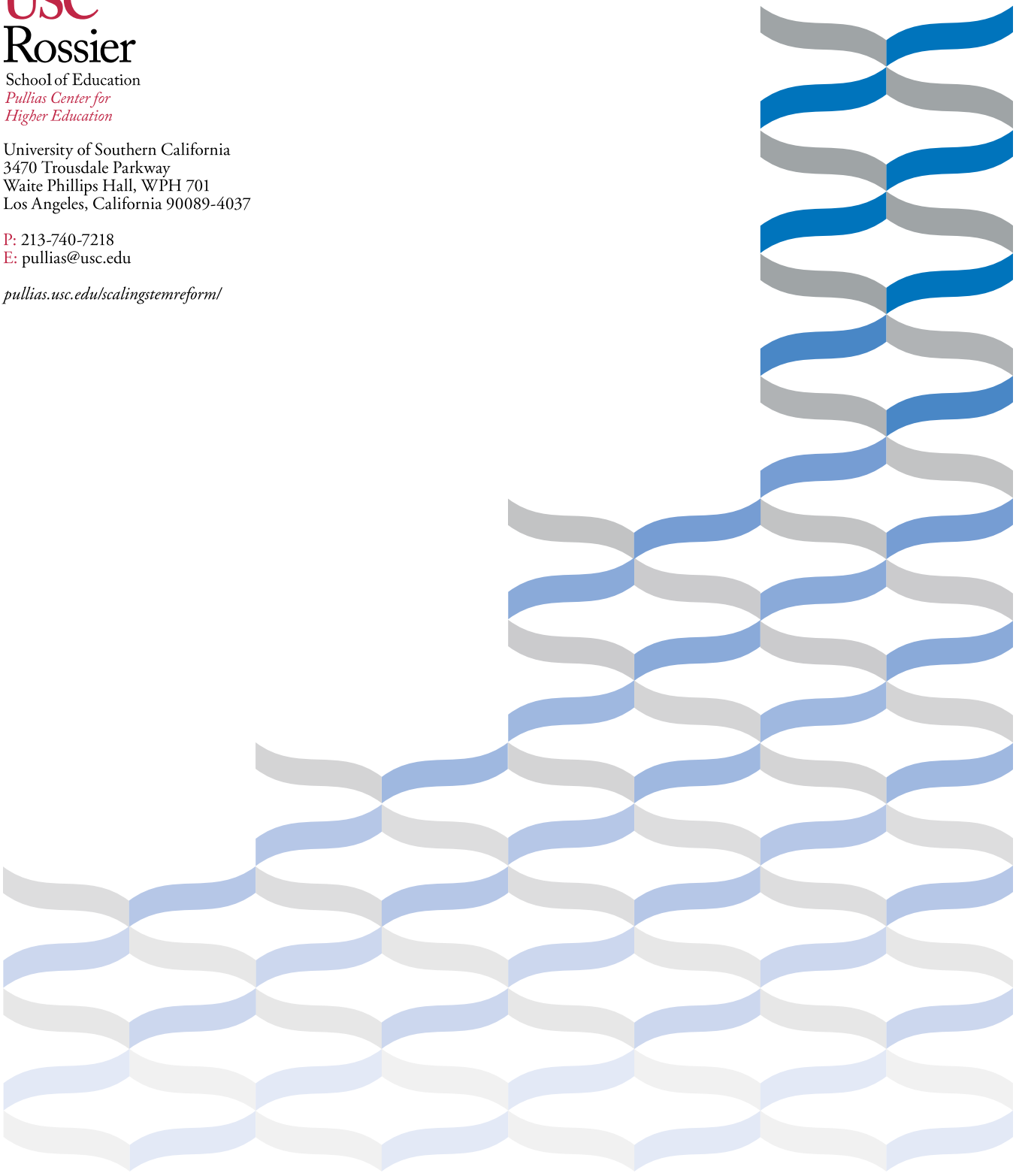

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