National Study of Education in Undergraduate Science

Background Research Paper No. 7

Facilitation and Motivation Concerning Undergraduate STEM Reform: The Current Status of non-Funded NOVA Participants

Corinne H. Lardy and Cheryl L. Mason
San Diego State University

College science, technology, engineering, and mathematics (STEM) faculty play an important, sometimes overlooked, role in the community of science teacher educators (Backhus & Thompson, 2006; Barinaga, 1991; Christopher & Atwood, 2004; Schneider, 2007). STEM faculty not only influence pre-service K-12 teachers' understanding of scientific content, but also provide models for how science should be taught (Lee & Krapfl, 2002; Luera & Otto, 2005; McGinnis, Watanabe, & McDuffie, 2005). Therefore, by improving undergraduate STEM education and aligning the teaching practices in these courses more closely to reformed student-centered practices, pre-service teachers should gain a better understanding of not only science, but science education as well.

Because undergraduate STEM courses are so important for pre-service teachers, a large amount of resources and energy now are being put towards the professional development of STEM faculty for the purpose of improving science teacher education, such as in the National Aeronautics and Space Administration's pre-college preparation program, NOVA (NASA Opportunities for Visionary Academics). From 1996 to 2006, NOVA invited the participation of undergraduate faculty concerned with how universities prepare pre-service teachers. Through NOVA, entry-level reform science courses were developed by collaborative teams of faculty in the sciences and education (NSF, 1999). Participation in NOVA included opportunities for, and commitment to, enhanced knowledge and skills through workshops, exemplary models, grants, mentoring, evaluation site visits, and collaboration within and between higher education institutions. The NOVA professional development model was delivered in 3 *phases*: (1) *planning and preparation*, involving training, collaboration, and action planning for addressing baseline needs in faculty skills and knowledge enhancement; (2) *development and implementation*, involving initial course change, action research, mentoring, and sharing of expertise; and (3) *continuing development and long-term sustaining activity*, involving action research, networking, monitoring including site visits, and dissemination (Sunal et al., 2004).

Currently, the *National Study of Education in Undergraduate Science* (NSEUS) is working to extensively examine the impact and sustainability of the 167 reformed undergraduate STEM courses that have been established at the 103 universities who received NOVA funding to implement proposed course reforms (Sunal et al., 2009). Very little, however, is known about the 65 institutions that began the NOVA professional development process but were not granted funding to support their reform efforts.

Many barriers exist for STEM faculty development, some of which, such as lack of grant funding, may be insurmountable, even with the support of professional development and a high motivation to change undergraduate science teaching. Understanding the personal process STEM faculty must go through to make their teaching practices more student-centered is key to sustaining the successes of any professional development program, such as NOVA.

Purpose of the Study

The purpose of this study was to examine the long-term success of undergraduate STEM faculty in instituting and sustaining reforms in their courses following participation in the NOVA program, even though NOVA did not provide supplemental funding for these reform efforts. Specific research questions for the study are as follows.

1) To what extent were NOVA participants who did not receive funding from NOVA able to institute and sustain proposed reforms in their undergraduate STEM courses?

2) What factors facilitated non-funded NOVA participants in their efforts to institute and sustain proposed reforms in undergraduate STEM courses?

3) If non-funded NOVA participants were not able to institute and sustain proposed reforms, what factors hindered their reform efforts?

4) How did participants believe the non-funding of their proposals in particular affected their ability to institute reform?

5) What initially motivated subjects to participate in NOVA and how might these motivational factors have affected their ability to institute and sustain reform?

Data Collection Methods and Analysis

A survey was designed to assess subjects' perceived success in instituting and sustaining their proposed reforms, as well as the factors that may have influenced that success. (See Appendix for a copy of the survey.) Of these factors, those that are not directly related to the NOVA program were based on prior research related to undergraduate STEM reform and included academic rank, motivation, sources of ideas for instructional innovation, along with other factors described in the related literature.

The survey included both multiple choice and open-ended questions, in order to obtain both quantitative and qualitative data about the subjects' experiences with STEM reform. Some questions were adapted from the *Incentives and Supports for Instructional Innovation Survey* (ISIIS), a survey "designed to assess obstacles to, incentives for, supports of, and attitudes regarding instructional innovation in college" (Walczyk, Ramsey, & Zha, 2007, p. 89). To increase validity of responses, all multiple choice questions were followed by a space for clarification comments. Iterations of the survey were reviewed and refined by a panel of STEM and science education faculty. The survey subsequently was sent to 142 faculty members from 60 of the original non-funded universities who participated in NOVA between 1996 and 2003 via email through the program *Survey Monkey*, with follow-up reminders over a two-month period.

Answers to multiple-choice survey questions were analyzed quantitatively and frequencies of common responses were recorded. Common themes among open-ended responses were coded and recorded by frequency among individuals. Data from multiple-choice and open-ended responses were combined to obtain an overall picture of the reform process as experienced by each subject and each university. The triangulation of qualitative and quantitative data provided richer answers to the aforementioned research questions.

Results

Ultimately, 31 subjects from 26 universities responded, giving a response rate of approximately 30% based on deliverable surveys. This rate is statistically highly acceptable, especially considering the fact that subjects were asked to reflect upon an experience that began (and in some cases ended) up to 11 years ago (Walczyk & Ramsey, 2003; Walczyk et al., 2007).

The majority of subjects reported their current main teaching assignments to be in mathematics and/or science (62%), followed by teacher education (20%), and a combination of the two (10%). Three subjects identified themselves as administrators. Subjects reported that, at the time they participated in NOVA, their academic ranks were Instructor (3.2%), Assistant Professor (48.4%), Associate Professor (16.1%), Full Professor (22.6%), and other (9.7%). Current subject academic ranks were reported as Instructor (3.1%), Assistant Professor (3.1%), Associate Professor (56.3%), Full Professor (25%), and other (12.5%). Neither teaching assignment nor academic rank were found to be correlated with success in instituting reform.

Success Instituting and Sustaining Reform

A summary of the success of subjects in instituting and sustaining proposed STEM course reforms is shown in Figure 1. More universities were able to institute the reformed course (56.5%) than were not (43.5%). However, two of the thirteen universities that were able to institute the reformed course were not able to sustain it.

Although all universities were not able to institute a new reformed course as described in their proposals, 21 subjects (75%) reported that they were able to institute at least some reforms following the NOVA workshop. Fifteen of these 21 subjects reported that the reforms they were able to institute were facilitated, at least in part, by their participation in the NOVA workshop, although most stated that they could not remember which specific parts of the NOVA workshop were most beneficial. (Please see Figure 2). There were differing extents, however, to which subjects reported instituting reforms. These ranged from the creation of a new course, to incorporation of or experimentation with some new instructional strategies.

Figure 1. Summary of reported success of subjects in instituting and sustaining proposed course (*n*=23).

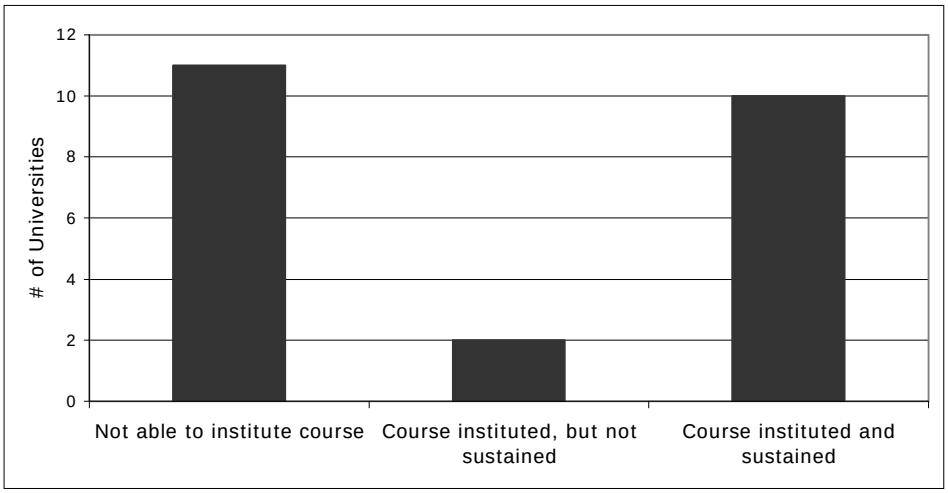
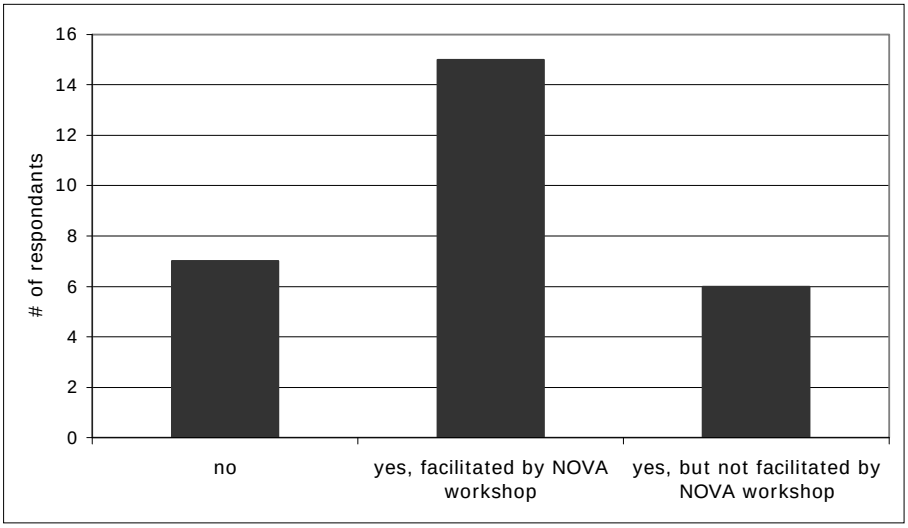


Figure 2. Summary of subjects' responses as to whether they were able to institute any reforms following the NOVA workshop (*n*=28).



Non-NOVA Factors Facilitating Reform

Table 1 shows the common factors perceived by subjects to facilitate undergraduate STEM course reform for prospective K-6 teachers, in descending order. Factors drawn from common themes in open-ended responses are highlighted in bold and, where appropriate, illustrative examples are given. All other factors were included as multiple-choice options on the survey. Factors given as multiple-choice options, but not indicated by subjects as factors supporting their reform, were paid and unpaid sabbaticals, overload compensation, and an institutional newsletter that supports educational innovation.

Table 1. Factors perceived by subjects to facilitate undergraduate STEM course reform, excluding those related to NOVA workshop (*n*=29).

Factor	**# Responses**	**% Responses**	**Examples**
Release time from teaching	7	24.1	
Receptive departmental/ university climate	**6**	**20.7**	**"A climate of support for reform from administrators and colleagues, and a student body who welcomes cutting edge information."**
Summer employment	6	20.7	
Internal grants that support travel to external workshops	6	20.7	
Internal grants that support the purchase of instructional materials or technology	6	20.7	

External grants	**5**	**17.2**	
Internal grants that compensate faculty for time spent in course or program improvement	4	13.8	
Institutional office that supports educational innovation	4	13.8	
teaching assistants	4	13.8	
Support from colleagues	**3**	**10.3**	**"Support within the NOVA team." "Colleagues who are prepared to listen"**
Self-motivation	**2**	**6.9**	**"Self-motivation to improve student learning"**
Professional conferences	**2**	**6.9**	

Note. Factors in bold are those written in by the subjects and were not provided as multiple-choice options on the survey.

Non-NOVA Factors Hindering Reform

Table 2 shows the common factors perceived by subjects to hinder undergraduate STEM course reform for prospective K-6 teachers, in descending order. Factors drawn from common themes in open-ended responses are highlighted in bold and, where appropriate, illustrative examples are given. All other factors were included as multiple-choice options. All factors given as multiple-choice options on the survey were chosen by at least one subject.

Table 2. Factors perceived by subjects to hinder undergraduate STEM course reform besides lack of funding from NOVA (*n*=29).

Factor	# Responses	% Responses	Examples
Lack of time outside of class	12	41.4	
Lack of resources	12	41.4	
Lack of incentive	11	37.9	
Colleague resistance	9	31.0	
Administrator resistance	7	24.1	
Lack of on-going professional development	6	20.7	

Difficulty negotiating between STEM and teacher education	**5**	**17.2**	**"Currently there is no tenure track person in either physics or education departments with a specialty in science education."** **"At the time the college of science…had very limited interaction with the college of education."**
Lack of information about research-informed instructional techniques	4	13.8	
Lack of time in class	3	10.3	
Lack of training	3	10.3	
System restrictions	**3**	**10.3**	**"…the NOVA group was disbanded during a reorganization of the University which eliminated the College of Arts and Sciences."** **"State mandated conversion to semesters from quarters became the dominant issue."**
Lack of internal monetary support	**2**	**6.9**	
Student resistance	1	3.4	

Note. Factors in bold are those written in by the subjects and were not provided as multiple-choice options on the survey.

Impact of NOVA Non-funding

A majority of subjects felt that the non-funding of their project had a negative impact on their ability to institute proposed reforms (Figure 3). Comments varied in their perceived level of negative impact, from complete failure to institute a reformed course as a result of non-funding ("without funding, none of the changes were possible") to more minor levels of perceived impact ("we could have done more").

An interesting theme in responses related to the negative impact of lack of funding from NOVA is the frequency of responses that reflect a level of validity tied to the funding itself. Four subjects specifically indicated in their comments that the lack of continued funding led to the removal of validity of their reform efforts in the eyes of university administration. This idea is most clearly reflected in the attitude of the following comment:

> The NOVA funding for our course was coveted by the institution and its disappearance created an air of 'invalidation' to our reform effort, in my view. [Essentially] if NASA isn't willing to fund these reforms, why should my institution do it?

Five subjects indicated through their open-ended responses that they perceived no impact from not receiving NOVA funding. One of these subjects stated that this was the case because of personal motivation. Two believed they were not impacted due to the supportive climate of their universities, relating that the university was committed to the reforms, regardless of NOVA funding. The final two subjects who perceived no impact from non-funding stated that they were not hindered due to their ability to secure funding elsewhere.

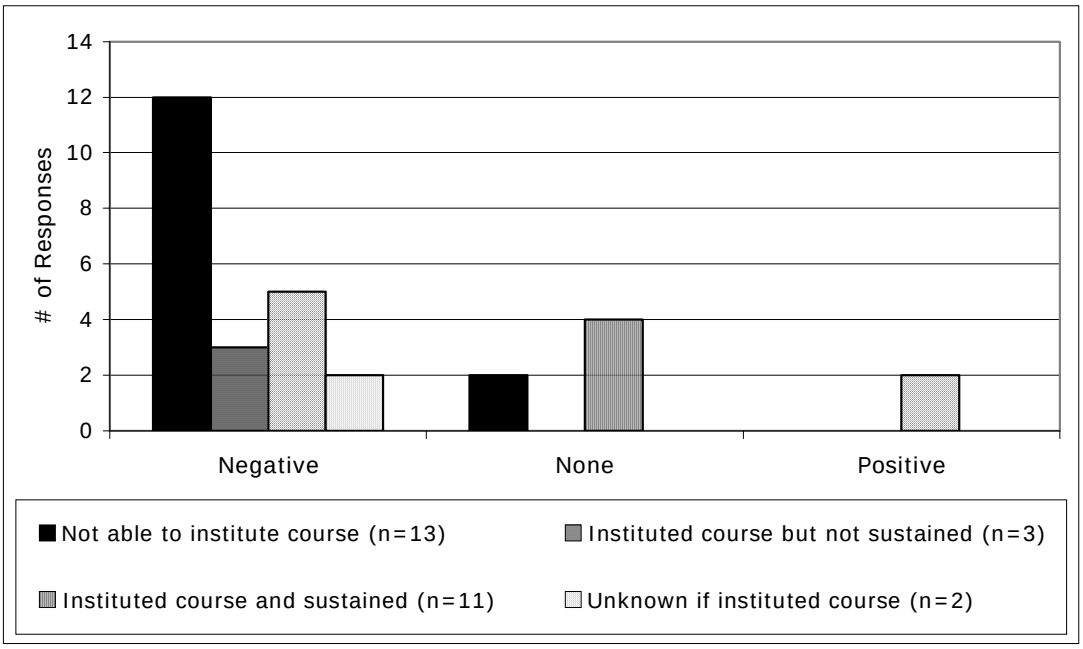
Surprisingly, two subjects reported that they felt that there was a positive impact from not receiving NOVA funding.

> Non-funding was a blessing. We were motivated to get the funds to make lasting changes.

> It made us more determined since we believed in our project. We now offer 4 sections of one course with a waiting list and 2 sections of a component course that is growing rapidly. We are very proud of our accomplishments despite the lack of NOVA funding.

These responses indicate that at least a few non-funded NOVA groups saw the lack of funding as having a positive impact, encouraging them to work harder and fight for the reforms in which they believed. These responses came from individuals whose universities were able to successfully institute and sustain proposed reform courses through extramural funding and university administrative support.

Figure 3. Subjects' perceived impact of not receiving funding from NOVA according to success in instituting and sustaining the proposed reformed course (*n*=28).



Motivation for Reforming Undergraduate Science

Ten common themes of motivating factors were identified from open-ended responses. The overall most frequent motivating factor reflected in subjects' comments was the desire to improve pre-service K-6 teacher STEM education. Four subjects identified this factor alone as motivating them to participate in NOVA, while eight subjects combined this factor with others in their responses. Eight subjects mentioned the opportunity to receive funding as a specific factor motivating their participation in NOVA. Two of these subjects indicated funding as their sole motivating factor to participate in NOVA, while six combined this factor with a mixture of others. (See Table 3.)

The complex combination of motivating factors for some subjects is reflected in the following comments:

> We wanted to make changes to our curriculum for future elementary teachers. Getting a grant would make it easier to instigate change and having a grant would help us get promoted.
>
> [We saw it as] a chance to develop an interdisciplinary science course in an attempt to gestate interest/understanding in science, both content and process, from a population of students that had bad attitudes about science.

Table 3. Factors motivating subjects to participate in NOVA in descending frequency.

Motivating Factor	Total # Responses (n=28)	% Subjects who were not able to institute course (n=12)	% Subjects who instituted course, but did not sustain (n=3)	% Subjects who instituted course and sustained (n=11)
Desire to improve preservice K-6 teacher STEM education	12	50.0	66.7%	27.3
Potential funding	8	25.0	0	36.4
Help to create a new course and/or reform an existing course	7	16.7	66.7%	18.2
General personal interest in STEM course reform	4	16.7	33.3%	0
Desire to strengthen connections between departments/ promote interdisciplinary collaboration	4	8.3	33.3%	18.2
Desire to improve how STEM courses are taught at the undergraduate level in general	3	8.3	33.3%	18.2
Internal pressure from university (including promotion requirements)	2	0	0	18.2
Interest in doing educational research related to STEM course reform	2	8.3	0	9.1
Desire to improve students' attitudes about science	2	8.3	0	9.1
Specific interest in working with NASA and/or NOVA	2	8.3	66.7%	0

Discussion

Research Question #1: To what extent were NOVA participants who did not receive funding from NOVA able to institute and sustain proposed reforms in their undergraduate STEM courses?

The results of this study, with respect to the subjects' overall success of instituting and sustaining course reforms, are encouraging; the fear that lack of NOVA funding would cause a broad abandonment of reform goals was not realized. Despite a lack of funding from NOVA, 75% of the universities who responded to the current survey were able to institute at least some reforms following the NOVA professional development workshop, and over half were able to institute their proposed reformed course. In addition, ten of the twelve universities who were able to institute a reformed course were able to sustain it.

However, an important question remains: "What are the possible causes for these outcomes?" The results of this study provide information as to what factors may have influenced the success of those who were able to implement and sustain course reform following the NOVA

program, as well as the factors influencing those who were unsuccessful. These factors are discussed within the framework of the next four research questions.

Research Question #2: What factors facilitated non-funded NOVA participants in their efforts to institute and sustain proposed reforms in undergraduate STEM courses?

The most important factors found to influence successful reform were similar to those found in previous studies, and can primarily be divided into two categories: social and practical support. Social support seemed to be most important in regards to a university/departmental climate that included administrators who are receptive to instructional reform. To a lesser extent, supportive colleagues and students are noted as being part of a supportive social community that allowed subjects to be successful in instituting and sustaining course reform. Some subjects specifically cited their NOVA team as a key component of social support, indicating that the collaborative team approach of NOVA was an important factor in facilitating reform.

Equally important to social factors were practical factors. Practical factors refer to resources and/or time needed by faculty to tangibly aid in the institution and sustainability of course reforms. These included factors such as release time from teaching and the provision of teaching assistants. However, a larger portion of practical factors facilitating course reform were related to monetary assistance that included internal and external grants to support travel to workshops, provide for the purchase of instructional materials including hardware and software technology, and compensate faculty for time spent in course or program improvement.

Research Question #3: If non-funded NOVA participants were not able to institute and sustain proposed reforms, what factors hindered their reform efforts?

It is not surprising that the major reasons subjects reported as hindering the institution and sustainability of reform were related to a lack of factors the survey results identified as necessary for reform efforts. The most cited practical factors included (a) not enough time outside of class to prepare and (b) resources to facilitate reformed courses. Other practical factors included a lack of on-going professional development, information about research-informed instructional techniques, and available class time. Contrary to the results related to factors facilitating reform, the specific practical factor cited least frequently by subjects was a lack of monetary support, although it might be implied that financial support would have allowed subjects to gain many of the things they cited as needed for reform.

Some of the social factors facilitating reform for non-funded NOVA subjects also may be seen as a reciprocal of those inhibiting reform. A social factor that was commonly reported as hindering change was colleague and administrator resistance; the support of both were indicated by subjects as important facilitating factors. In addition, a relatively substantial proportion of subjects cited a difficulty negotiating between STEM and teacher education faculty or departments, but the reciprocal was not necessarily the case for successful reform. This study supports other research that demonstrates how the lack of communication within

the university setting is a potential road-block to reform efforts (Serow Van Dyk, McComb, & Harrold, 2002), and appears to have more of an impact on inhibiting as compared to the effect that open communication has on facilitating reform efforts.

While research literature has suggested that both academic rank and primary teaching assignment may influence undergraduate STEM faculty members' ability to institute reform (Serow et al., 2002; Walczyk et al., 2007; Wright & Sunal, 2004), this does not seem to be the case with non-funded NOVA participants. Those with lower academic rank and a primary teaching assignment in mathematics and/or science were just as likely to be successful as those with high academic rank and a primary teaching assignment in teacher education. In retrospect, these results make sense. Those who participated in NOVA collaborative teams included faculty members of varying ranks from mathematics/science, teacher education, and administration. It seems that this collaborative model, including a diversity of members to share the responsibility for reform, aided in efforts to counteract the potentially negative effects of academic rank and teaching assignment that could have been amplified the non-funding of their NOVA action research proposals.

Research Question #4: How did participants believe the non-funding of their proposals in particular affected their ability to institute reform?

Unexpectedly, while lack of NOVA funding turned out to be a factor hindering reform for some, it was cited as a facilitating factor by others. Since the lack of monetary resources has been listed as a common factor hindering STEM undergraduate course reform, both in the related literature and in the survey responses for this study, it was expected that subjects would agree that the non-funding of their reform plans by NOVA had a negative impact on their reform efforts to varying degrees. Results, however, indicate that the perceived impact of non-funding was mixed. While a majority of subjects believed that not receiving funds had at least some negative impact on their reform efforts, the remaining subjects indicated that the lack of NOVA funding had no or a positive impact on their reform efforts. In the cases in which non-funding was cited to have a positive effect, it actually became a facilitating factor rather than a hindering one. These results indicate that lack of initial funding cannot be taken for granted as a factor hindering reform. It may not be a factor at all for some, as indicated by subjects who were able to find financial support elsewhere or had high amounts of social support from their university administration and colleagues. Also, non-funding is not a detriment for those who have particularly high personal motivation for success in changing their undergraduate science courses and programs.

Research Question #5: What initially motivated subjects to participate in NOVA and how might these motivational factors have affected their ability to institute and sustain reform?

The factors motivating STEM faculty to reform their teaching practices have been suggested in this study and others to be important in not only making reforms, but sustaining them as well. It might be expected that those faculty whose primary motivation to participate in NOVA centered around external influences, such as continued funding or pressure from their

university, were more likely to abandon reform efforts once funding was not granted. On the other hand, those NOVA participants who were motivated more by internal factors, such as a desire to improve STEM education, might be expected to be more likely to continue their reform efforts despite not receiving funding from NOVA. The results, however, indicate that this was not the case. On the contrary, more subjects who were able to institute and sustain their proposed reform course were motivated by potential funding than they were by the desire to improve K-6 teacher preparation. For these individuals, when their reformed course proposals were not funded, there was more incentive from external pressure to find funding elsewhere. This is supported by the fact that all subjects who cited the opportunity to receive funding as their only motivating factor for participation in NOVA, and who cited internal pressure from their university as another important motivational factor, were able to institute and sustain proposed reformed courses.

Internal motivation, on the other hand, apparently was not enough to carry all of the non-funded NOVA participants through the reform process. It may be that social factors such as motivational support of colleagues and administrators are critical for supporting the internal motivation of faculty, especially when practical factors supporting reform are lacking.

Conclusions and Recommendations

The results presented here are encouraging. Despite fears to the contrary, it seems as though the lack of monetary support for their action research plan to introduce reform in undergraduate science programs was not enough to dissuade these non-funded NOVA participants. While finding other sources for practical support, both related to monetary and concrete resources, was key in allowing subjects to ultimately implement and sustain course reform, it was not the only important factor. Social factors also played an important part in allowing subjects to be successful in their reform efforts, just as the lack of these factors hindered other subjects' success.

Although many of the cited factors that related to the success or non-success of subjects seemed to go beyond the scope of the NOVA professional development program, some characteristics of the program helped facilitate those who were successful in their reform efforts. NOVA provided key elements of social support to help facilitate at least some level of success for the majority of the subjects. The NOVA collaborative group design provided the subjects with the beginnings of a support system by requiring the participation of STEM and teacher education faculty, as well as administrators, all working towards a common goal. In addition, the collaborative group model seemed to be successful in canceling out other factors that could have potentially increased the negative impact of non-funding, including the influence of academic rank and primary teaching assignments.

While, ultimately, practical factors such as other sources of funding were imperative for many of the subjects to carry out and sustain reforms, it is important to note that many of the factors that subjects commented to be personally important for facilitating or hindering reform are ones that involved social support. These are factors that can be introduced by any university

through facilitating communication among STEM and teacher education faculty, and administrators, and by creating an environment that supports and values individuals who attempt to reform their teaching practices. With support from their teacher education colleagues and administrators, STEM faculty who realize the importance of reformed teaching practices will be much more successful in instituting and sustaining reform. One STEM faculty reinforced this by stating: "We have a great team of hard working faculty who believe we can make a difference [in undergraduate science preparation for K-6 teachers]."

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Appendix

Survey

Please answer the following questions as thoroughly as time permits. We are interested in your honest feelings and beliefs about the reform process, as you experienced them. You may begin the survey, save your data, and complete it later. Data received will be kept strictly confidential.

1) **At the time that you participated in NOVA**, what was your academic rank?

__ Instructor __ Assistant Professor __ Associate Professor __ Full Professor

__ Other: _____

2) **Currently**, what is your academic rank?

__ Instructor __ Assistant Professor __ Associate Professor __ Full Professor

__ Other: _____

3) Your main teaching assignment is:

__ Mathematics and/or Science __ Teacher Education __ Administrator

__ Other: _____

4) a. Is a NOVA team still active at your university? (If no, please skip to question #5)

__ Yes __ No

Please add any additional comments here:

b. How many of the members of your original NOVA team are still active? ____

c. If any of the members of your original group have become inactive, please list reasons why (if possible).

d. How many new members have joined your NOVA team? _____

e. If new members have joined your NOVA team, please list reasons why/how they became involved (if possible).

5) What motivated you to participate in the NOVA professional development project?

6) What reforms, if any, did you institute in a course (or courses) following the NOVA workshop?

7) a. Did the NOVA workshop facilitate, in any way, the reforms that were carried out?

__ Yes __ No

b. If yes, what aspects of your participation in the NOVA workshop do you feel facilitated your ability to institute change in your undergraduate course(s)?

8) What components could have been added to the NOVA workshop to aid you to facilitate reforms in your undergraduate course(s)?

9) How do you feel your ability to carry out reforms in your undergraduate course(s) was impacted by the non-funding of your NOVA proposal?

10) What other factors (besides lack of NOVA funding) do you feel hindered your ability to institute your proposed changes? (Please check all that apply.)

- student resistance
- colleague resistance
- administrator resistance
- lack of incentive
- lack of time in class
- lack of time outside of class
- lack of information about research-informed instructional techniques
- lack of training
- lack of ongoing professional development
- lack of resources
- other (please specify): _____

Please add any additional comments related to factors (not related to NOVA) hindering your ability to institute curricular and/or instructional change here:

11) What factors (besides those related to your participation in the NOVA program) do you feel facilitated your ability to institute your proposed changes? (Please check all that apply.)

- teaching assistants
- release time from teaching
- paid sabbaticals
- unpaid sabbaticals
- overload compensation
- summer employment
- internal grants that support travel to educational workshops
- internal grants that support the purchase of instructional materials or technology
- internal grants that compensate faculty for time spent in course or program improvement
- institutional office that supports educational innovation
- institutional newsletter that supports educational innovation
- other (please specify): _____

Please add any additional comments related to factors (not related to NOVA) facilitating your ability to institute curricular and/or instructional change here:

12) a. If you were able to institute your proposed reformed course, is it still being offered?

Yes No

Please add additional comments here:

b. If yes, what factors have helped to sustain the course?

c. If no, what barriers have prevented sustaining the course reform?

Please add any additional comments about course sustainment here:

13) What sources of information did you use to consult for ideas about instructional innovation **before attending NOVA**? (Please check all that apply.)

- formal input from students (ratings, open-ended comments, etc.)
- informal input from students (interviews, etc.)
- discussion with colleagues
- observation of colleagues classes
- publications (articles)
- publications (books)
- educational workshops/seminars (other than NOVA)
- Internet
- television
- through trial and error in your own classroom
- meetings of professional organizations
- other (please specify) _____

14) Besides the NOVA workshop, what other sources of information have you used to consult for ideas about instructional innovation **after participating in NOVA**? (Please check all that apply)

- formal input from students (ratings, open-ended comments, etc.)
- informal input from students (interviews, etc.)
- discussion with colleagues
- observation of colleagues classes
- publications (articles)
- publications (books)
- educational workshops/seminars (other than NOVA)
- Internet
- television
- through trial and error in your own classroom
- meetings of professional organizations
- other (please specify) _____

Please indicate any additional comments related to sources of ideas for instructional innovation here: