

# Successful Propagation of Educational Innovations: Viewpoints from Principal Investigators and Program Directors

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**Abstract.** We are beginning a project to help developers of educational innovations promote adoption of their work at other institutions through deliberate propagation strategies. To gain a better understanding of the current situation with regard to the spread of educational innovations, we analyzed a web-based survey of 1284 Principal Investigators (PIs) in the NSF Transforming Undergraduate Education in STEM (TUES) program and held focus groups with NSF TUES program directors (PDs). Overall, PIs tend to think of spreading their innovations through one-way transmission methods, such as publishing a paper. On the other hand, PDs think that interactive methods, such as multi-day workshops, are more effective. We conclude by advocating the need for increased explicit attention on planning and enacting propagation strategies by both PIs and PDs.

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## INTRODUCTION

Rising to meet the need to improve college-level science education, educational researchers have developed many new instructional materials and teaching strategies for undergraduate science courses. Unfortunately, research suggests that many faculty do not use these products at all and those who do typically make significant modifications [1]. Faculty also report high levels of discontinuation after trying a new instructional strategy [2]. More knowledge about and emphasis on planning for propagation is needed to help future innovators incorporate propagation strategies into their projects at the earliest stages, matching the type of innovation with a specific plan to promote adoption of their work by others. This paper is an inquiry into ideas about successful propagation held by two important groups of stakeholders: National Science Foundation (NSF) program directors (PDs) in the Transforming Undergraduate Education in STEM (TUES) program and TUES principal investigators (PIs).

## NSF PROGRAM DIRECTORS

In January 2012 we held two-hour long meetings with groups of PDs from each TUES discipline (biology, chemistry, computer science, engineering, geoscience, interdisciplinary, physics, and

mathematics). The meetings were focused on identifying PD perspectives of what leads to successful propagation of TUES projects and what problems occur in the propagation of TUES projects. Meetings were not recorded, but detailed notes were taken. From those notes, we developed major themes relating to propagation for each disciplinary group. These themes were then incorporated into a one-paragraph summary of the discussion that used the language of the PDs as much as possible. Finally, similar themes expressed by at least half of the PD groups were extracted and written in language that best represented the ideas expressed by each group. We sent this two-page document to the PDs and they agreed it represented their views.

Five themes emerged from this process. Theme 1: PDs do not think traditional academic dissemination methods (e.g., publications and presentations) are effective in getting faculty outside the developing institution to adopt a new innovation. Theme 2: PDs want to see more collaboration between multiple institutions during development, so that more faculty have a stake in the innovation and therefore more institutions will adopt the new development from the start. Theme 3: For spreading an innovation beyond the developers, PDs consider workshops to be the most effective method of propagation. The most successful workshops are in-depth, multi-day, immersive experiences with follow-up interaction with the PI as

**TABLE 1.** Example PI responses to Question 7 and Categorization.

Category	Example Response
1. Dissemination activity (20% of responses)	“Presentations at regional and national conferences, publications in widely distributed journals (focused both at practitioners and researchers), online or hardcopy publication of curriculum materials”
2. Result of using activity (55% of responses)	“25 other college faculty would use one of the instructional modules developed for this course.”
3. Both an activity and the results (11% of responses)	“Publication of products – commercialization. Use by more than one class in one institution Obviously this depends on the project”
4. Other (12% of responses)	“The innovation is shared with a significant percentage of those educators who are interested in the particular field or area.”
5. They did not know or haven’t disseminated (2% of responses)	“We have not disseminated our material yet, we are only at the developmental stage.”

participants implement the new strategy in their own institutional circumstances. Theme 4: PDs noted that many of the most successfully propagated projects received funding over an extended period (often 10 years or more) through a series of related grants. Theme 5: PDs observed that, in many cases, professional societies have played key roles in propagation. They feel that there are more possibilities for PIs and professional societies to work together.

## NSF PRINCIPAL INVESTIGATORS

In fall 2011, Tront et al. conducted an online survey of TUES PIs to learn about current dissemination practices and barriers PIs encounter to dissemination [3]. A 52% response rate yielded 1284 responses. Tront et al. shared the raw data from this survey with us and we analyzed responses to two open-ended items with the following research questions in mind:

- 1) What does successful dissemination mean to PIs?
- 2) What do PIs report as barriers to successful dissemination?

## Methods

The analysis presented here is based on the open-ended survey questions 7, 14, and 15 (Figure 1). Question 14 is included because many PIs indicated they did not understand the wording of the question and instead used the “Other (please specify)” space to discuss barriers to dissemination. Question 15 followed immediately after and many PIs used this space to provide further information on barriers. Questions 14 and 15 were combined in the analysis.

We analyzed both Question 7 and Question 14/15 using an emergent coding scheme. Broad themes and subthemes were identified and are reported below.

## Successful Dissemination for PIs

To answer the first research question we analyzed responses to survey question 7. Each response was

placed into an emergent category based on how they described “successful dissemination”. These themes are reported in Table 1.

Although these themes emerged from answers to an open-ended question, the question statement clearly primed respondents to provide answers in category 2. Thus, we can be fairly confident that responses in categories 1, 3, and 4 represent PI ideas about dissemination. We cannot be confident that the most common way for PIs to think about dissemination is in terms of the number of adopters (i.e., a response in category 2). However, an implication of the responses centered on the number of users is that PIs, like PDs, share the goal of other faculty adopting/adapting the work after it is developed.

Survey Question 7:

7. Briefly describe what successful dissemination of your educational innovation means to you? (Please be as specific as possible, e.g., instead of ‘lots of users’, tell us how many users, i.e., 1 user or 1,000 users.)

Survey Questions 14 and 15:

14. Please rate the importance of the following possible barriers in disseminating your educational innovation (Likert scale from ‘not at all important’ to ‘extremely important’).

- Dissemination of my innovation is not a priority to me
- Lack of financial resources to support dissemination activities
- Don’t know where or how to disseminate
- Lack of peer reviewed journals focusing on educational innovation in my field
- Technology changed so rapidly that educational innovation became out of date
- Lack of peer reviewed conferences focusing on educational innovation in my field
- Dissemination activities are not valued by my institution
- Other (please specify)

15. Please make any comments you have about this survey or about dissemination of your educational innovation.

**FIGURE 1.** Open-ended survey questions from Tront et al. (Ref. [3]).

## Dissemination activities of PIs

To characterize the dissemination strategies currently used by PIs, responses in category 1 (dissemination activity) were further categorized using an emergent coding scheme. Seven main categories emerged: publications, presentations, share with colleagues, workshops, web site, textbook, and other. Often multiple strategies would be listed in a response. The strategy PIs stressed was most successful was chosen during coding. If this was not readily apparent, the strategy discussed most within the response was chosen. In another analysis of all PIs who gave a dissemination activity (categories 1 and 3) we tallied each strategy given in the response, since often PIs would give more than one strategy. Through this analysis, an eighth category emerged, mentoring graduate students, though it was never listed as a top method. Both analyses are reported in Table 2. Strategies grouped into the “other” category included a white paper, producing a DVD, printing a brochure, and directly distributing a report to thousands of departments in the country and to policy makers.

As seen in Table 2, there is some overlap with the views of TUES PDs, who believe workshops to be a highly effective way to promote adoption/adaptation of teaching innovations. However, Table 2 also shows that PIs use strategies that are primarily based on one-way transmission of information. These mass-market strategies are the same type of strategies that PDs generally think are not effective. The findings that PIs use propagation strategies contradictory to the propagation strategies PDs think are most effective is consistent with the quantitative analysis of survey results carried out by Tront et al. [3].

We also note that no PIs mentioned that different dissemination strategies would be more effective in different situations, such as using a presentation to generate interest in the innovation or using a workshop to instruct others how to use it.

**TABLE 2.** Dissemination strategies given for Question 7. Reported as percent of those who gave a dissemination strategy. Note “all methods” will not add to 100.

Activity	Top Method (N=241)	All methods (N=373)
Publication	28%	48%
Conference presentation	20	35
Share with colleagues	12	14
Workshop	17	21
Website	10	23
Textbook	10	11
Other (white paper, etc)	3	7
Mentor students	0	3

**TABLE 3.** Barriers to dissemination reported by PIs.

Barrier	% mentioned (N=350)
Lack of resources	51%
Lack of NSF help	11
Other faculty	16
No barriers encountered	8
Dissemination comment	14

## Barriers to Dissemination

To answer research question 2, we analyzed responses to question 14/15 using an emergent coding scheme. 350 PIs responded to one or both of these questions. The categories are shown in Table 3.

PIs overwhelmingly cited lack of some kind of resource, especially time, as a barrier to disseminating their work. Other resources they lacked were funding and manpower. There was also demand from PIs for more help from the NSF (besides funding), such as a special conference for the dissemination of TUES projects, a marketing team for TUES projects, and help assessing the innovations for efficacy.

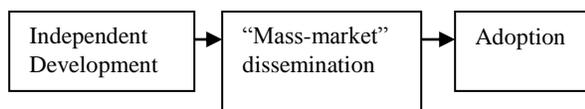
The implication of these barriers reported by PIs is that they think of dissemination as an afterthought, something that happens toward the end of the project if there is time rather than an integral part of the project from the beginning. PIs also appear to feel they are not well prepared to engage in dissemination.

## DISCUSSION

The definition of “dissemination” varies widely from person to person, as seen above. We have advocated previously [4] for developing a shared language for what it means to 1) broadcast the results of work and 2) promote adoption/adaptation of the work, rather than confuse these separate ideas under the term “dissemination”. We use “propagation” to describe the second idea.

The first important result from this analysis is that both PIs and PDs appear to have the same view of the desired results from propagation efforts: that many faculty at many institutions will adapt/adopt their instructional materials or teaching strategies.

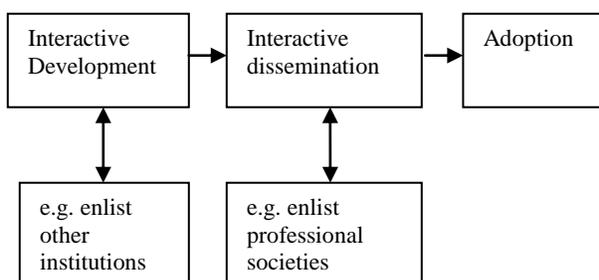
The processes leading to this result, though, are seen differently by PIs and PDs. Based on the interview and survey responses, we developed a model of how each group perceives propagation, from the process of developing an innovation to its eventual adoption by other faculty.



**FIGURE 2.** Model of PI view of propagation.

In the PI view, propagation is a simple linear progression from the development of their innovation to a “mass-market” dissemination activity (publishing papers, presenting at conferences) followed by the adoption of their work by other faculty. This process does not always lead to the desired outcome of widespread adoption, as noted by PIs in the survey.

The PD viewpoint of propagation is more complex.



**FIGURE 3.** Model of PD view of propagation.

PDs want the development of the project to involve more than one institution and the dissemination methods to be interactive. This involves the developers actively reaching out to other faculty through workshops and working with professional societies to promote the use of the new instructional strategy. PDs also tend to view the most successfully propagated instructional strategies as those that have been supported by multiple related grants. One problem with this view is that PIs face a challenge when applying for a grant to support an existing project, since there is tension on the part of NSF between being innovative and supporting successful projects.

PI and PD processes have several commonalities. They share a “development” phase that is followed by a “dissemination” phase. By placing “dissemination” second, both groups subtly imply that propagation occurs later in a project. We advocate that both groups would benefit by thinking about propagation as occurring throughout the project. A simple example is to identify potential adopters of the new instructional strategy early in the project and get them involved in some (even very minor) aspect of the project.

Another similarity between PIs and PDs is that both want to see PI innovations being used beyond the home institution and both parties acknowledge that this is not happening as frequently as they would like. PDs have a clear vision of what they think successful

propagation activities look like and sometimes are critical about the lack of creativity and interactivity found in PI propagation efforts. However, it is also the case that PDs do not provide much guidance to PIs to help them create strong propagation strategies. For example, the only guidance in the TUES solicitation is that “transferability and dissemination are critical aspects for projects developing instructional materials and methods and should be considered throughout the project’s lifetime” [5].

We conclude by advocating increased explicit attention on planning and enacting propagation strategies by both PIs and PDs. Only with more emphasis on expected outcomes of using a propagation strategy can these strategies be examined and improved.

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