Work in Progress - Improving the Dissemination of CCLI (TUES) Educational Innovations

Joseph G. Tront, Flora P. McMartin, Brandon Muramatsu
jgtront@vt.edu, flora.mcmartin@gmail.com, mura@mit.edu

Abstract - **The National Science Foundation (NSF) Course Curriculum and Laboratory Improvement (CCLI) Program (now the TUES program – Transforming Undergraduate Education in STEM) has produced a vast number of products and processes since its inception. The CCLI Program has fostered innovation nationwide and has worked to improve "quality of science, technology, engineering, and mathematics (STEM) education for all undergraduate students." More often than not these innovations 'remain local,' in that they are only developed and used by the initiating investigator(s) and are tied to the funding, once the initial funding ends the investigators move on. In recent years the CCLI Program has instituted a multi-stage program to encourage scale up of these innovations—extending the reach from small test-beds to national dissemination. However, this process typically recognizes and disseminates fairly large-scale innovation; the result is that most innovations developed through the CCLI Program continue to 'stop where they started.' Very few CCLI projects, or their results, are integrated into daily use by the larger set of teachers and learners who might benefit from these innovations, and who should take advantage of existing projects thereby eliminating the need to regularly re-invent these works.**

In the spring of 2010 a workshop was held in Washington, DC in an attempt to identify the best practices for dissemination of CCLI innovations. In preparation for the workshop, approximately 2,400 CCLI award winners were surveyed to determine their practices and what they thought were indicators of successful dissemination. NSF Program Directors were also surveyed.

This paper reports on the preliminary findings from the survey of CCLI Principal Investigators (PIs) and NSF's Cognizant Program Directors (PDs), and the results of panel discussions held during the meeting of invited experts in the area of STEM education and dissemination. Results indicate that the most frequently used methods of dissemination do not lead to desired outcomes. Several methods are proposed to improve access to resources and the adoption of these resources by other faculty seeking to improve teaching and learning.

Index Terms – Educational resources, dissemination, STEM, NSDL, adopting resource material, adapting courseware, active learning, student engagement, educational technology

INTRODUCTION

The National Science Foundation (NSF) Course Curriculum and Laboratory Improvement (CCLI) program[1] fosters innovation nationwide and works to improve the "quality of science, technology, engineering, and mathematics (STEM) education for all undergraduate students." Since 1999, the program supported a multitude of individual projects, some that have gone on to be widely disseminated while many have remained local to the individual investigator or campus.

This study was undertaken to understand how to "*foster better dissemination of CCLI-developed educational innovations"*. The research focused on understanding how CCLI principal investigators currently view dissemination of their educational innovations and what barriers might exist to broader dissemination.

This paper summarizes: preliminary findings from a survey of CCLI Principal Investigators (PIs) and NSF's Cognizant Program Directors (PDs), and results of panel discussions held during a meeting of invited experts in the area of STEM education as well as the results from that meeting.

The findings include:

1. The most frequently used methods of dissemination do not lead to desired outcomes.
2. NSF PDs and CCLI PIs hold differing opinions about what constitutes effective dissemination practice, which leads to overuse or over reliance on ineffective dissemination venues and vehicles.
3. NSF PDs and CCLI PIs hold different definitions, and possibly have different expectations, about what constitutes successful dissemination.

[1] In 2010, the name of this program was changed to: TUES – Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics. The overall purpose of the program remains similar: to encourage projects that have the potential to transform undergraduate STEM education.

EVOLUTION OF THE CCLI PROGRAM

In 2010, NSF introduced significant changes to the CCLI Program and have renamed it Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES). Part of the program expansion is a stronger mandate for individual PIs to plan dissemination activities. Another part of the change in the program is the inclusion in the proposal solicitation of an opportunity to propose dissemination activities as a follow on to the development of an educational innovation. These changes are certainly encouraging and likely to lead to broader use of newly developed educational innovations.

CURRENT DISSEMINATION PRACTICES

To determine the types of dissemination practices CCLI Principal Investigators (PIs) use and believe to be most effective, we surveyed the 2,463 CCLI PIs who had received funding since 1999. The response rate was 52% with 1,285 completing the survey either completely or partially. (In addition to the survey we also convened a panel of 35 experts and practitioners to consider the problem, typical dissemination practices and potential solutions, The preliminary survey results were used as a starting point for the discussion.)

Survey questions were developed based on the work of several groups including that of Ehrmann and the TLT Group [1]. Overall, the survey questions attempted to bring out opinions on the most effective mechanisms for the diffusion of innovations as described in the work of Spalter-Roth et al. [2]. Participants were asked to rate barriers that keep innovations from being widely disseminated as described by Dancy [3], but also to supply their own reasons that they believe are obstacles to the adoption and adaptation of newly developed innovations.

In the survey we asked CCLI PIs to rate a set of 'traditional' dissemination activities (i.e., activities perceived as more academic such as writing and presenting papers or workshops) in terms of their success as dissemination vehicles. We also asked them to rate a set of online dissemination activities. In parallel, we surveyed NSF Program Directors (PDs), asking them similar questions with regards to their perceptions of the success of these methods for disseminating innovations. We also asked both sets of respondents the open-ended question:

> *Briefly describe what successful dissemination of your educational innovation means to you?*

We asked respondents to be as specific as possible, avoiding generalities such as 'lots of students' so that in our coding we could quantify or qualify the outcomes.

The scope of this work only allowed for a high level, descriptive summary of the data, which included a first pass at content analysis of the open-ended questions. No in-depth or predictive statistical analyses were performed. At this first pass on the data analysis, we focused on looking for any discrepancies between how the PIs and PDs described effective dissemination in response to open ended questions, how the PIs view effective dissemination and their practices (what they say is effective and what they reported doing to accomplish it), and differences between the PI's and PD's ratings on the successfulness of 'traditional' and online/social networking dissemination methods.

'Traditional' Dissemination Methods

The following sections focuses on the survey question: "*Some of the ways that the NSF has recommended disseminating educational innovations are listed below. Please rate the success of using these methods in terms of disseminating your educational innovation."* For the purposes of this research, we describe the set of dissemination methods described in Tables 1 and 2 as 'Traditional' methods, that is, those methods that tend to be more familiar and historically recognized ways of sharing academic or scholarly knowledge.

Table 1 lists the percentage of all CCLI PIs who reported using a particular dissemination method. As illustrated by the table, the most popular methods are those that have undergone peer review, e.g., journal (65%) or conference (87%) papers or posters (73%) at conferences. Workshops, local, regional or presented at a conference are less popular, reported usage ranging from 45% to 58%. More 'informal' methods such as posting or writing a white paper, or using promotional materials were used the least.

While the CCLI PIs identified the particular dissemination mechanisms they used, why these PIs chose to use or reject a particular dissemination method was not directly explored in this survey. At this level of analysis it is also unclear what impact, if any, the stage of the project has on dissemination. Only 6.5% of the PIs were in the planning stages of the project and only 2% reported that the project was not as successful as anticipated so they did not disseminate it. The low numbers of these respondents suggest that they did not affect the overall finding significantly.

In addition to telling us which methods were used most frequently by PIs, the question also asked respondents to rate how successful they felt each method is as a dissemination mechanism. Table 2 summarizes the 'top box score' (the 'top box score' is the percentage of those who chose either of the two highest responses – successful or extremely successful) for the question

In analyzing these data we compared the responses from only those PIs who are currently disseminating their innovation or who have already disseminated their results at the completion of their project, to responses from all CCLI PIs to determine how experience might impact responses, if at all. Based on this level of analysis, it appears that they do differ. Experienced disseminators in contrast to their counterparts see peer reviewed methods as being more successful. One possible explanation for this difference might be in the acceptance rate of papers and presentations

for there is a tendency for peer reviewed journals and conferences to favor papers/presentations based on results, meaning reports made at the completion of a project over those in progress. Opinions about workshops also differed, especially those conducted off campus. While there appears to be good agreement about workshops held on one's home campus, once they move off campus it appears that PIs experienced in disseminating their innovation find them to be more successful. It also appears that this group tends to believe posting papers and presentations to a website is successful. It is important to note that the type of grant, in other words Type I, II or III, may have impacted these results, for those who did not indicate they were actively disseminating their innovation may be predominantly newly funded or have received a Type I grant, and therefore do not yet have access or opinions about some of the dissemination mechanisms.

More striking perhaps, are the differences between the NSF PD's and the CCLI PI's beliefs about successful dissemination methods (regardless of their dissemination effort). Although one must take into account the reduced response rate (20%) for the PDs, the results do suggest that the PDs see workshops as being highly successful (based on these results one could argue they see them as essential) dissemination efforts. PDs also see more marketing style dissemination techniques such as booths at professional conferences (43%) and promotional materials (50%) as being effective. In contrast, CCLI PIs tended to view these as not particularly successful with ratings ranging from 12% to 24%. And more than the PIs, PDs see peer reviewed publications as being much more successful.

In the discussion of the survey results, some members of the panels and meeting participants observed that the most 'successful' dissemination activities reflected the reward system for faculty members. So, the high support for publication among the PDs might reflect their desire to support faculty members' efforts to gain tenure or receive promotion. Members of the panel and meeting, especially those who are or were PIs, noted that they were unaware of how to disseminate by doing anything other than following the more 'academic' pathways, e.g., papers or presentations.

Based on other research and the experience of this project's leaders, there may be several reasons the PIs do not view workshops as positively as the PDs. They are time and resource intensive, and require that the participants already know about or are interested in learning about an innovation in-depth. Usually, this means that the project is well beyond the Type I funding available from the program. Workshops may also be hampered by the complicated relationship between adoption of innovation and dissemination, meaning that if a faculty member is not interested in adopting something, no dissemination strategy will be effective.

The reliance upon more 'passive' methods of dissemination (i.e., the non-marketing style efforts or to some level, workshops) is also interesting given that the PIs tended to define the outcomes of effective dissemination as being adoption by others. This opinion was shared by the PDs. Both PDs and those PIs who were active disseminators felt that use of their innovation as a building block to the supplementary innovation by others was a desirable outcome.

Online/Social Networking Dissemination Methods

The Web has made available new dissemination vehicles that extend and are different from those we have described as 'traditional'. We were particularly interested in learning more about the use of these methods by CCLI PIs. Tables 3 and 4 summarize responses to the question: *Please rate the success of your use of the Web as a dissemination vehicle*. In this question we listed a number of options, focusing mainly on digital libraries, repositories and social networking tools.

Table 3 shows that by far the most popular online method used by CCLI PIs was hosting a website at the campus level with information about the innovation. While recommended as a dissemination method in the CCLI request for proposals, contributing to a digital collection of some sort is not regularly used. Its reported use ranged from 17% to 29%. Even lower usage was reported for those methods often associated with social networking tools such as blogs, or community sites such as Facebook.

The practice of newer methods emerging from the use of the Web as a dissemination vehicle is in sharp contrast to the more 'traditional' methods described above. At this point in time, the results from the survey do not give us specifics about why this is so. Hosting a website seems to be becoming a normal activity for many of the PIs. This may be because there is adequate campus technology support for this kind of activity or because the materials are posted on a learning management system for the students. Regardless, this type of activity seems to be more integrated into an instructor's work habits. The results also may be affected by time. Almost half (52%) of the respondents reported that their project was complete. We do not have the data for when these projects were completed, but it is likely that a number of the projects were completed before use of the Web for dissemination purposes became possible or popular. Lack of the use of social networking sites might be explained by the relatively new and untried nature of the resource. Lack of use by PIs in this case might be consistent with the tendency on the part of all faculty members to regard these tools with suspicion. However, Wikipedia has been a well-known site with many users since 2001 and used widely in a number of disciplines such as math, as a repository for content, received the lowest use of any option suggested to the survey respondents.

Table 4, which summarizes the CCLI PIs' and NSF PDs' opinions regarding the success of these web services as dissemination vehicles, provides some insight into beliefs about the effectiveness of this mode of dissemination. It appears that NSF PDs tend to believe that online and social networking tools are effective dissemination mechanisms. Few PIs believe that anything other than posting information about the innovation on their campus websites is successful. In general, contributing to a digital collection, be it a library,

repository, open courseware collection or Wikipedia is not viewed as successful by this group, regardless of the type of collection. It is interesting to note however, the difference between ratings of Wikipedia, where all PIs rated its success much higher than those who are actively disseminating their project.

Why the survey respondents believe these methods are not effective remains an open question. When discussing these results, the panels and meeting participants observed that lack of knowledge on the part of the PIs about digital libraries, collections and repositories was a primary reason for which they are not used. This was particularly true about the options associated with the NSDL. Like other online methods, use of the NSDL may also be a result that it has not shown how effective it is in its own dissemination efforts. As a result, potential contributors such as these PIs may hesitate to contribute their materials. Compounding this hesitation may be the work or perceived work it takes to ready their materials for contribution or for cataloging. A barrier may be for example, not having a website that can be cataloged.

CONCLUSIONS

The surveys data and the panel's review of it revealed the landscape in which CCLI PIs attempt to disseminate CCLI sponsored educational innovations is a multi-layered and rocky. CCLI PIs and NSF PDs hold differing opinions about effective dissemination strategies even though for the most part they have similar ideas about what should be the outcome of dissemination. PIs struggle to balance NSF expectations about dissemination that may or may not be realistic depending on the Type of funding received; this is especially true for Type I projects. The differences are enough to raise the following questions:

- What is appropriate dissemination for the Type of project and for what audience?
- What about each project should be disseminated?
- How do we know when dissemination has been successful?

The next step in this project is to further analyze the large amount of data that was produced by the survey. We hope to be able to draw additional information related to a better suited definition for dissemination and the most effective ways to accomplish dissemination. We will also produce a set of recommendations that come from the discussion of the study group convened as part of this project.

REFERENCES

[1] Ehrmann, Stephen C., Steven W. Gilbert, and Flora McMartin, "Factors Affecting the Adoption of Faculty-Developed Academic Software: A Study of Five iCampus Projects", TLT Group Report: http://icampus.mit.edu/projects/Publications/TLT/iCampus_Assessment_Full.pdf , 2006.

[2] Spalter-Roth, Roberta, Norman Fortenberry, and Barbara Lovitts, "Acceptance and Diffusion of Innovation: A Cross Curricular Perspective on Instructional and Curricular Change in Engineering", American Sociological Association and the Center for the Advancement of Scholarship on Engineering Education of the National Academy of Engineering, http://www.nae.edu/File.aspx?id=11552, 2006.

[3] Dancy, Melissa, Charles Henderson, "Barriers and Promises in STEM Reform. Workshop on Promising Practices—Innovations in Undergraduate STEM Education", National Academies Board on Science Education, http://www7.nationalacademies.org/bose/Dancy_Henderson_CommissionedPaper.pdf , October 13-14, 2008.

Table 1: Percent of Respondents Who Reported Using a 'Traditional' Dissemination Method

	% All CCLI PIs (n = 1,209)
Paper for publication in peer reviewed journal	65
White paper	22
Paper/presentation at professional conference	87
Workshop/seminar held on home campus	58
Invited workshop/seminar at another campus	45
Workshop/seminar at professional conference	54
Poster at professional conference	73
Booth at professional conference	20
Paper/presentation posted to website	56
Promotional materials, e.g., book mark, flyer, etc.	31

Table 2. Top Box Score* for Success of 'Traditional' Dissemination Methods

	% All CCLI PIs (n = 1,209)	% CCLI PIs Actively Disseminating Innovations (n = 638)	% NSF PDs (n = 14)
Paper for publication in peer reviewed journal	46	54	71
White paper	10	10	7
Paper/presentation at professional conference	75	82	71
Workshop/seminar held on home campus	55	52	64
Invited workshop/seminar at another campus	38	45	100
Workshop/seminar at professional conference	47	52	100
Poster at professional conference	54	60	50
Booth at professional conference	12	15	43
Paper/presentation posted to website	36	43	29
Promotional materials, e.g., book mark, flyer, etc.	20	24	50

Scale: 1 = not at all successful – 5 = Extremely Successful

* Top Box Score: total results of top two ratings on five-point scale

Table 3: Level to Which Online/Social Networking Dissemination Methods Not Used

	% All CCLI PIs (n = 1,209)
Hosting a website on your campus with information about the educational innovation	70
Contributing to a digital library collection in your discipline	29
Contributing to a digital library collection or institutional repository on your campus	20
Contributing to a digital library collection such as the NSDL	22
Contributing to an opencourseware collection	17
Posting a video to YouTube or similar site describing the educational innovation	13
Posting to Wikipedia about the educational innovation	9
Using a asocial network site, e.g., Facebook or MySpace, to promote the educational	11

innovation	
Hosting a blog about the educational innovation	12
Posting to a blog about the educational innovation	14

Table 4. Top Box Score for Success of Online/Social Networking Dissemination Methods

	% All CCLI PIs (n = 1,209)	% CCLI PIs Actively Disseminating Innovations (n = 638)	% NSF PDs (n = 14)
Hosting a website on your campus with information about the educational innovation	48	54	21
Contributing to a digital library collection in your discipline	19	20	50
Contributing to a digital library collection or institutional repository on your campus	10	10	7
Contribute to NSDL	12	12	43
Contributing to an opencourseware collection	10	10	50
Posting a video to YouTube or similar site describing the educational innovation	7	6	36
Posting to Wikipedia about the educational innovation	12	2	21
Using a social network site, e.g., Facebook or MySpace, to promote the educational innovation	4	3	29
Hosting a blog about the educational innovation	4	4	14
Posting to a blog about the educational innovation	4	4	14

Scale: 1 = not at all successful – 5 = Extremely Successful

* Top Box Score: total results of top two ratings on five-point scale