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Keywords

Scholarship of teaching and learning, SoTL, Disciplines, Mathematics, Future of SoTL

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From the perspective of mathematics, this paper examines efforts by the Carnegie Academy and individuals within the mathematical community to build disciplinary support for the scholarship of teaching and learning. The authors, both mathematicians and Carnegie scholars, restrict their observations to the efforts undertaken in the United States during the last decade and examine the situation in mathematics in greater depth than has heretofore appeared. They shed light on particular complications they have observed for SoTL in their discipline and offer suggestions for improving the situation within mathematics. Practitioners in other disciplines, or those involved with SoTL at a “meta-level” may find their observations applicable in other venues.

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Introduction

Recent newsletter and journal publications provide evidence that the scholarship of teaching and learning (SoTL) movement is undergoing some critical introspection. The January 2008 issue of *International Commons*, the newsletter of the International Society of Scholarship of Teaching and Learning (<http://www.issotl.org/>), contained articles that questioned the role of the disciplines in the scholarship of teaching and learning (p. 1, 2, 10-11), stated that there is no single national perspective on SoTL in the United States (p. 4), and offered a draft statement by the leaders of the CASTL (Carnegie Academy of the Scholarship of Teaching and Learning) team on the impact of SoTL intended “as a starting point for a discussion that will lead us to a better understanding of the nature of SoTL impact” (p. 13). Willox & Lackeyram (2009) have questioned whether SoTL has been placing too much emphasis on teaching and not enough on learning, while others have offered defenses of SoTL (Dewar, 2008; Pan, 2009). Gurung, Chick and Haynie (2009) mine twenty years of SoTL work in the University of Wisconsin system for insights into signature pedagogies

(Shulman, 2005) and how best to foster deep learning within and across the disciplines. Witman and Richlin (2007) observe that “scholarly recognition comes from the discipline” and set out to find out how a range of disciplines deal with the SoTL by examining professional societies’ websites and disciplinary publication outlets. As this paper will show, this last approach presents an incomplete picture of the situation for SoTL, at least in the discipline of mathematics.

With the selection of a new President in 2008, the Carnegie Foundation for the Advancement of Teaching has begun to move on to other areas to leverage its influence (Bryk, 2009) and the three-year CASTL Institutional Leadership and Affiliates programs drew to a close in October, 2009. Not surprisingly, many in the SoTL community are thinking about the future of the SoTL movement. Will it sustain its influence? Will it continue to attract new participants? What role might the disciplines play?

Using the discipline of mathematics as a case study, this paper examines efforts by Carnegie and individuals within the mathematics community to build disciplinary support for the scholarship of teaching and learning. The authors restrict their observations to the efforts undertaken in the United States during the last decade and examine the situation in mathematics in greater depth than has heretofore appeared. They shed light on particular complications for SoTL in the discipline of mathematics and offer suggestions for improving the situation for SoTL scholars in mathematics.

SoTL History from the Perspective of Mathematics

Ernest Boyer (1990) introduced the phrase “scholarship of teaching” into the vocabulary of higher education in his book, *Scholarship Reconsidered*. He proposed that colleges and universities needed a fresh vision of scholarship in order to tap the full range of faculty talents and to encourage vital connections between academic institutions and their local communities. He labeled and described four types of scholarship: discovery, application, integration and teaching, and he discussed some of the characteristics of what is now called SoTL, but did not offer a fully developed definition that included peer review and making results public. While similar concepts had previously been discussed (Cross, 1986) and later critical distinctions between scholarly teaching and the scholarship of teaching surfaced (Richlin, 1993, 2001, 2003), as President of the Carnegie Foundation for the Advancement of Teaching, Boyer brought national and international attention to SoTL. In 1998, the Carnegie Foundation instituted the CASTL Scholars program (<http://www.carnegiefoundation.org/scholarship-teaching-learning/carnegie-scholars>, accessed November 13, 2009). The program brought in 140 scholars in six cohorts over 9 years, and the scholars worked on individual scholarship of teaching and learning projects, many of which are represented at the Carnegie Foundation Gallery of Teaching and Learning (http://gallery.carnegiefoundation.org/gallery_of_tl/castl_he.html, accessed November 13, 2009).

A reflection on the number and types of mathematicians who were CASTL scholars suggests a particular strategy may have been employed for positioning SoTL favorably within the disciplines.

- Of the six cohorts of CASTL scholars, mathematicians were present in all except the first and fourth.

- The second and third cohorts in 1999-2000 and 2000-2001 included eight CASTL scholars in mathematics, four from doctoral granting institutions, three from masters level institutions, and one from a community college.
- The last two cohorts in 2003-2004 and 2005-2006 had four mathematicians, none of whom were teaching at doctoral granting institutions.

As this data suggests, in the first four cohorts of the CASTL scholars program there was an attempt to target specific disciplines. Indeed, typically the call for applications for each cohort specified a list of disciplines. More inferences might be drawn if one also knew that among the eight mathematicians in the 1999 and 2000 cohorts were

- the then president of the Mathematical Association of America (MAA),
- three members of major committees of the American Mathematical Society (AMS) and the MAA,
- one recipient of the MAA's distinguished teaching award, and
- a CASE-Carnegie national teacher of the year award winner.

This data supports the authors' impressions that CASTL initially focused on recruiting individuals well-connected within their disciplines and preparing these scholars to do SoTL work, so as to place SoTL ambassadors in the disciplines.

During the same period several Carnegie publications and speeches approached SoTL via the disciplines (Huber & Morreale, 2002; Shulman, 2005, February). In addition, in the summer of 2000, Carnegie invited representatives of disciplinary societies to a meeting and offered grant money for disciplinary action in SoTL. The MAA responded by sending its Executive Secretary and its President (and CASTL scholar), and the MAA did apply for and receive a grant.

Halfway through the decade-long CASTL scholars program, Carnegie seemed to shift from a focus on the disciplines to building support at institutions of higher education, first through the Campus Cluster program (2003-6) and then the Leadership program (2006-9). The so-called "Areas of Impact" document (Ciccone, 2008) produced by representatives of Carnegie and the Leadership program mentions the disciplines in just one of its ten areas. Instead, this document explores SoTL's impact on broader issues in higher education including assessment, accountability, student retention, meta-questions about changing the culture of academic life, institutional policies, faculty and leadership development, changes in defining and evaluating scholarship, and a range of pedagogies, technologies, and agendas.

Definitional Issues and Competing Interests in Mathematics

As the SoTL movement unfolded in the 1990s, movement leaders called for faculty to treat teaching and learning in a scholarly fashion. But some disciplines already had a pre-existing community of scholars doing educational or social science type research into college teaching in that discipline. In mathematics this community is called RUME, for Research in Undergraduate Mathematics Education. RUME has its own language and literature and was the first "Special Interest Group" to be officially recognized by the MAA (see <http://www.maa.org/SIGMAA/>). This can complicate matters as Huber and Morreale (2002) note, "...strong communities of teaching specialists whose expertise can help but also hinder mainstream faculty who might take up the scholarship of teaching and learning" (p.8).

SoTL in Math: A Bridge or a Broadening Landscape

Every discipline has faculty concerned about teaching and interested in discussing teaching methods and tips and mathematics is no exception. Banchoff and Salem (2002) saw SoTL as potentially bridging the gap between RUME and teaching mathematicians. We prefer a different metaphor: SoTL as a broadened landscape of work related to teaching. This metaphor aligns well with Huber and Hutchings' (2005) view of SoTL as increasing the "teaching commons" or shared space. The result, shown in Figure 1, is a triangle that can be populated by all sorts of work, including that of the "Math Tech Ed" community that is concerned with technology use in teaching and learning mathematics.

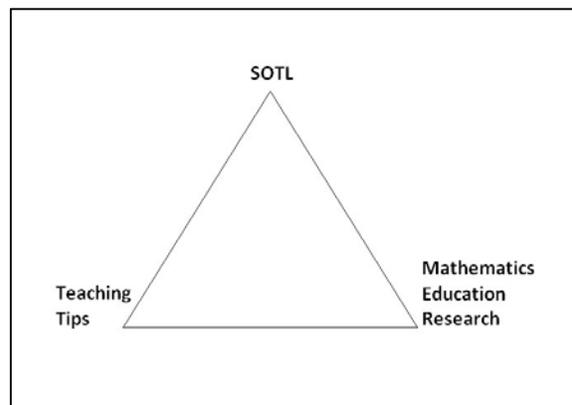


Figure 1. A Proposed Teaching Commons in Mathematics

This view allows for multiple entry points and paths toward developing, documenting and disseminating better understandings of student learning. As one begins to gather evidence from students systematically about what, if any, cognitive or affective effect a teaching method had on their learning, one begins to move toward scholarship of teaching and learning. Teaching mathematicians can move more easily from teaching tips to conclusions based on evidence from student work through SoTL than through the more established RUME community which has its own doctoral programs, significant body of literature, standards for evidence, and concern with theory and foundational questions about the nature of mathematical understanding.

SoTL Publication Venues in Mathematics

In looking at the status of Scholarship of Teaching and Learning in mathematics regarding publication, we again run into the difficulties inherent in bridging the gap between the teaching tips articles and the education research programs. As Banchoff and Salem (2002) observed, there is a divide between mathematics education researchers and mathematicians. This divide encompasses issues such as the need for theoretical frameworks, questions of interest, language, methodology and epistemology. In addition, the communities suffer from a historical division in terms of respect, and at times mathematicians can be seen as interlopers (both appropriately and inappropriately) in the field of mathematics education. The existence of specific mathematics education journals, while noted as a positive in other articles (Banchoff & Salem, 2002; Witman & Richlin

2007), also masks the fact that many of these journals come out of the mathematics education community and not the math community. In particular, neither the AMS nor the MAA publishes any journal devoted to mathematics education research or scholarship of teaching and learning in mathematics. The National Council for Teachers of Mathematics (NCTM), which is primarily aimed at K-12 education in mathematics, is the publisher of the most prominent mathematics education research journal, the *Journal for Research in Mathematics Education (JRME)*. That the NCTM has been under fire from some prominent university mathematics professors for producing the national standards in K-12 mathematics (Schoenfeld, 2004) is but another indication that the landscape in mathematics is far more complicated than one might suppose.

The three main publications of the Mathematical Association of America (MAA) do express editorial support towards articles on teaching content and pedagogy. However, the MAA's flagship journal, *The American Mathematical Monthly*, underwent an editorial change in 1992, in which the editor stated:

... articles on the Teaching of Mathematics are not separated from articles on mathematics... The *mathematical* principle motivating these changes is the belief that mathematics ought to be viewed as a unified field, both horizontally and vertically. Articles on the mathematics of computers belong next to articles on Riemann surfaces; comments on teaching Calculus ought to be read with as much enthusiasm as comments on the representations of Lie groups... (Ewing, 1992, p.2)

Admirable as such a sentiment is, the net effect of removing the "Teaching of Mathematics" section was to cease publication of virtually all articles directly discussing pedagogy in the *Monthly*. Indeed, a MathSciNet (<http://www.ams.org/mathscinet/search.html>) search on June 17, 2009 for articles appearing in the *Monthly* since 1992 with the word "teaching" in the title or review, brings up primarily book reviews. Moreover, only two such articles have appeared since 1998, neither of which would be considered to be an article on pedagogy or scholarship of teaching and learning. This is a significant shift, as prior to 1992 the *Monthly* typically included two or three articles per issue in its "The Teaching of Mathematics" section. The two other MAA print journals, *The College Mathematics Journal* and *Mathematics Magazine*, typically publish articles focused on mathematical content for teaching. In fact, a search for articles devoted to scholarship of teaching and learning over the last two years turns up no articles in these two journals that look at evidence of student learning. This is not to say that these journals would not publish scholarship of teaching and learning articles, but rather to point out that they have not done so in recent history.

Because a major catalyst for scholarship of teaching and learning in mathematics was the calculus reform movement and the associated use of technology in teaching mathematics (Banchoff & Salem, 2002), there is another major community in mathematics to examine for scholarship of teaching and learning work, namely the mathematics technology education community. *The Journal of On-Line Mathematics (JOMA)*, now replaced by *Loci*, an on-line publication of the MAA's Mathematical Sciences Digital Library (<http://mathdl.maa.org/mathDL/23/>, accessed November 13, 2009), published articles on applets and other technology associated with teaching. While *JOMA* may have requested that authors include some evidence-based reflection on the effect of their applets on student learning, a recent search of the editorial standards at *Loci* (<http://mathdl.maa.org/mathDL/23/?pa=content&sa=viewDocument&nodeId=3167>,

accessed August 13, 2009) does not show any requirement that student evidence be presented for the effectiveness of the resources presented in articles that appear in *Loc*.

To summarize, the most recognized journals for faculty teaching undergraduate mathematics students not planning to be K-12 teachers are the three print-based MAA journals and *Loc*. While each of these indicates a willingness to publish work in the scholarship of teaching and learning, currently, there is little evidence that any such work is being published in these journals.

Recent Activities Promoting SoTL in Mathematics

Despite the dearth of venues for publishing SoTL in mathematics, SoTL does have a growing presence in the mathematical community. The last four years have witnessed a number of SoTL-related activities in mathematics aimed at increasing awareness and understanding of this work, attracting new practitioners, and providing venues for dissemination. A workshop (four hours spread over two days) entitled Beginner's Guide to the Scholarship of Teaching and Learning in Mathematics has been offered at a national meeting of the Mathematical Association of America in 2006, 2007, 2008, and 2009. More than 100 mathematics faculty from all types of institutions and a few graduate students have attended, including a few members of the RUME community.

In order to provide a venue for presenting SoTL work at the national mathematics meetings, the workshop organizers began submitting proposals for SoTL paper sessions. Despite fierce competition for slots on the program, a SoTL paper session has run as a contributed paper session sponsored by the MAA (2007) and open to submissions from anyone, as a special session jointly sponsored by the AMS and the MAA (2008 & 2009), where most, but not all, of the slots are filled by invitation, and as an invited paper session co-sponsored by the MAA and the AMS (2010), where all of the slots are invited speakers. In addition, in 2010, one of the 2006 Beginner's Guide workshop attendees is a co-organizer of an MAA contributed paper session on SoTL in undergraduate mathematics. Some SoTL topics, for example, *How to get students to read the text and does this matter?* and *Promoting deep learning for math majors through experiential learning, writing and reflection*, now have their own contributed paper sessions and seek papers that include evidence garnered from student work.

At the 2009 national mathematics meetings, Project Next, an organization for mentoring junior mathematics faculty, sponsored a panel titled "Engaging in and Publishing the Scholarship of Teaching and Learning" with speakers from both the SoTL and the RUME communities. All of the paper sessions and the panel have been well attended.

Conclusion

We have described a complicated landscape of SoTL in mathematics, one with competing interests and few well-identified mathematical venues for getting SoTL work published. Overall, the situation for SoTL in mathematics is mixed but promising. Efforts to cultivate and expand a community of teaching mathematicians who systematically gather evidence from students in an attempt to better understand and foster their learning is producing positive results in terms of attracting and mentoring new scholars and providing

opportunities at well-established disciplinary conferences to present papers. As long as publication in peer-reviewed journals continues to function as the coin of the realm in higher education, an important next step will be to obtain space in disciplinary journals for SoTL work. For mathematics, *PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies* (<http://www.dean.usma.edu/math/pubs/primus/>), published by Taylor and Francis, offers one possibility, but more opportunities are needed in the journals of the major professional mathematical societies. Calls continue to go out for additional research in teaching and learning mathematics (see, for example, Ernie et al, 2009) as well as more generally across the academy (Schmidt, 2008). The mathematical community would be well served to respond positively.

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