

## **SUPPORTING SECONDARY NOVICES' EFFORTS TO IMPLEMENT A PEDAGOGY CONSONANT WITH THE NCTM TEACHING STANDARDS**

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*Novice secondary mathematics teachers attempting teaching consonant with the NCTM (1991) Professional Standards for Teaching Mathematics experience many stresses related to their attempts of varying intensity at such teaching. Foremost among those stresses are challenges deriving from attempts to orchestrate student-centered, whole-class mathematical discussions. Those discussions can create uncertainty and stress as novice teachers occupy a new facilitative role where they consider students' mathematical ideas, ask questions to push the class' thinking forward, and choose between multiple competing directions that such discussions may take. Novices' self reports suggest social connections, particularly teacher learning communities, offer promising support for attempting ambitious teaching that commands a central role for students' ideas, conjectures, and mathematical argumentation.*

### *Objectives*

Because U.S. novice teachers carry the same workload as colleagues, some researchers suspect novices may be too stressed to learn efficiently from their experiences (e.g. Borko & Putnam, 1996). Efforts to enact teaching practices consonant with the NCTM (1991) *Professional standards for teaching mathematics*, or NCTM Standards-based teaching (SBT), may add to those challenges. Because novices are often most familiar with “teaching as telling,” efforts to set “telling” aside to attempt SBT may increase novices' feelings of uncertainty (Smith, 1996) and heighten their stresses. The literature is peppered with examples of novices struggling to enact SBT (e.g. Van Zoest & Bohl, 2000) often due to a lack of resources (e.g. Wilcox, Schram, Lappan, & Lanier, 1991). McLaughlin (1993) identified teacher learning communities as a prerequisite to successfully reform teaching. So identifying and building up resources to alleviate SBT-related stresses appear central to educators' efforts to reform pedagogy. This study focused on six novices' teaching stresses related to attempts at SBT and coping resources employed. Here, I focus on how novices' coping resources mediated stresses related to SBT.

### *Theoretical Framework*

I situated this study in novices' classrooms as an observer-researcher to see whether they taught in ways consonant with the NCTM (1991) Standards and to base discussions of novices' stresses on actual classroom events. For this study, I define novices as teachers with less than three years of classroom teaching experience (Berliner, 1988). Based on Kyriacou and Sutcliffe's (1978) definition, I define teacher stress as a teacher's perception that an aspect of the job is demanding or induces negative affect. I operationalized that definition as a teacher's description of an event or situation as challenging or producing negative affect. Teacher words indicating stress included stressful, difficult, hard, etc. Words indicating negative affect included frustrate, disappoint, annoy, etc. I define coping resources as means of avoiding, alleviating, or eliminating teaching stress, based on Lazarus' (1966; 1976) general definition of coping resources. I operationalized that definition as teaching resources novices reported using to alleviate stresses.

I characterize SBT using the six characteristics of high quality teaching described in NCTM (1991) *Standards*, namely Standard 1: Worthwhile mathematical tasks, Standard 2:

Teacher’s role in discourse, Standard 3: Students’ role in discourse, Standard 4: Tools for enhancing discourse, Standard 5: Learning environment, and Standard 6: Analysis of teaching and learning. I operationalized that definition as teaching non-trivially qualifying in at least two of the above Standards.

*Research Questions*

Framed by the aforementioned definitions, I studied the challenges and coping resources novice secondary mathematics teachers experienced. Here, I address the following question:

- Which coping resources do novice teachers utilize to mediate the teaching stresses deriving from the different teaching stresses that they experience?

I address this question by discussing teaching stresses and coping resources teachers reported, mainly focusing on coping resources most closely related to novices’ SBT attempts.

*Methods*

Midwestern University [MU] offers a progressive, NCTM (1991) Standards-oriented secondary mathematics teacher education program. With MU’s fifth-year instructor, I generated a list of recent graduates showing promise at attempting SBT. Using an instrument I designed to measure SBT, I conducted preliminary observations in 11 prospective participants’ classrooms. I observed 7 novices make non-trivial attempts at SBT who were invited and chose to participate; only 6 of whom made non-trivial SBT attempts during formal observation; the other novice’s data was not analyzed. The remaining 5 female and 1 male participants’ certified teaching experiences ranged from 1.25 to 2.75 years [see Table 1]. Their teaching contexts also varied.

Table 1  
*Participant Demographic Data*

<b>Participant Name</b>	<b>Years Teaching</b>	<b>Context</b>	<b>Main Class Observed</b>	<b>Contrast Class</b>	<b>Other Classes</b>
Mr. Jones	1.25	Rural	Integrated 2	Integrated 1B	None
Ms. Boone	2.50	Rural	Integrated 3	Integrated 2	AP Calculus
Ms. Grant	2.00	Urban	Algebra 1	Algebra 1C	Algebra 2C
Ms. Riley	1.25	Semi-rural	Adv. Algebra	Geometry	None
Ms. Wells	1.50	Urban	Geometry	Algebra 1	None
Ms. Price	2.75	Semi-rural	Geometry	Algebra 1B	Algebra 2

*Note.* Integrated 1 and 2 contained mainly Algebra 1 and Geometry content, while Integrated 3 contained mainly Algebra 2 content. Some graph theory and statistics were also included.

An example of a non-trivial SBT attempt comes from Ms. Grant’s screening observation. She had students working to solve systems of equations using several different methods (i.e. tables, graphs, and algebraic manipulations). She had students talk about various ways they solved those systems and had them question each other. Ms. Grant and her students engaged in several activities during the lesson that I judged as SBT attempts. First, Ms. Grant organized their ideas in a table while asking questions allowing students to share multiple solution methods. I judged this as a “worthwhile mathematical task” (Standard 1). She also acted as a facilitator for this conversation, asking why their solutions worked or whether students had questions for their peers (Standard 2). Finally, some students shared their own ideas during this task or asked questions of their peers which helped them understand the other student’s strategy

or exposed a flaw in a solution (Standard 3). Because this event and others qualified her in more than two of the six NCTM (1991) *Standards*, Ms. Grant was invited to participate in the study.

With the participants, I conducted a preliminary audiotaped interview, a minimum of three videotaped observations in a class which novices described as constructively talkative, one videotaped observation of another class novices described as involving very different challenges, and a final audiotaped interview. The novices noted surprising, unexpected, and challenging events in a teaching log during observations. Melding my observations with the teaching logs, I prepared video clips of three salient, representative, and potentially stressful events to review at the final interview, giving priority to those related to SBT attempts. During the interviews, I asked novices about teaching challenges and coping resources. Information about coping resources was gleaned from the interviews.

### *Data Analysis*

While analyzing the transcribed interview data, I used a semi-open coding method (Glaser & Strauss, 1967) to refine the existing teacher stress categories in the literature. I analyzed each stress category, determining whether it appeared salient or meaningful, or a “Main” stress, based on five criteria. “Repetition within” indicates a participant mentioned a stress category more than once during a single interview. “Repetition between” indicates a participant mentioned a stress category during both interviews. “Detail” describes the use of detailed descriptions (i.e. at least three descriptive sentences in one passage) of a teaching stress category. “Magnitude” refers to using a magnitude word (such as *so* stressful, *very* frustrating, etc.) at least once in reference to a stress category. “Top” indicates that the teacher described the category as a top stress (e.g., my *biggest* challenge), which also met the “Magnitude” criterion simultaneously. If a stress category met at least three of these five criteria, it was labeled as a “Main” stress; otherwise, it is merely “mentioned.”

I also coded each coping resource into one of four categories, namely Collective, Social, Self, and Physical. Collective refers to resources that involved social interactions with groups of at least three people meeting regularly for a specific, non-trivial purpose. Social describes resources that involve other people but did not meet all three criteria for Collective. Self involved using one’s own creative ideas, pedagogical strategies, management strategies, or intrapsychic methods to alleviate stress. Physical involves the use of curricular materials, the Internet, other teachers’ lesson plans, etc. to alleviate teaching stress.

In judging how successful these novices’ coping resources were at alleviating their stresses, I looked at whether the participants talked about the stress alleviation or about the resources using strongly positive (“helpful” or “cool”), moderately positive (“pretty good,” “okay,” or it works “sometimes”), or negative (“not really helpful” or “it still happens,” respectively) language. If the teacher used strongly positive language to describe the stress, I judged that the stress was successfully alleviated. I judged that moderately positive language indicated that stress was somewhat successfully alleviated. Finally, I judged that negative language (or if the teacher avoided the stress altogether, as in “I bailed”) indicated that the stress was not successfully alleviated to a meaningful degree in that instance for that novice.

I judged which NCTM (1991) Teaching Standard(s) each stress statement met. I flagged each stress category that contained at least one reference to attempts at SBT. I also judged which stress each reported coping resource helped alleviate, either using each teacher’s explanations (55.1%) or by researcher judgment (44.9%).

## Results

Novices reported many stresses in the 22 stress categories that arose from the data analysis. 12 of those categories were judged to be “Main” stresses for them. They also linked many stresses overall to SBT, but I judged that only 7 of the 22 categories were “strongly” related to attempts at SBT (i.e. at least 50% of passages in the category appeared related to SBT attempts). But I also judged that few stresses related SBT attempts were “Main” stresses; yet one “Main” category of teaching stress novices frequently mentioned relating to SBT attempts was Managing classroom discussions, which included novices’ attempts to engage students in mathematical discussions, to elicit students’ mathematical thinking, to engage them in scrutinizing and justifying or refuting mathematical conjectures, and to act in a facilitative role during class discussions. For example, Mr. Jones felt challenged during a class discussion, because students did not understand why the angle-side-angle condition was sufficient to imply congruence. And he was frustrated that few ideas in the conversation came from the students.

Mr. Jones: I think that the students did a good job of talking about how the sides related... [But] I think that I did a little bit more talking than I should have... [And] it looked like there wasn't enough wait time for them to actually think... It was kind of 'Here, I'm going to tell you what's another reason why this works.' ...I was frustrated with myself. And I think the students were frustrated... And the students were not getting it. And I only heard from 3 students, so it wasn't necessarily engaging to the majority of students. They didn't necessarily have anything to say about it. And they maybe didn't even see a connection... It just was frustrating that we didn't get to have the conversation that I necessarily wanted to, so it didn't go [as] I had planned... It was a little frustrating that our conversation wasn't as meaningful as it should have been... I wanted them to explain, just as we did for that criterion, exactly how the sides and angles related to each other, so that you couldn't make one side longer [or shorter]. You couldn't change the angle, because...all the sides and angles had a relationship [Post, 4.29-6.6].

So while Mr. Jones may not have felt like the conversation went exactly how he envisioned it, the stress that he reported here resulted from his efforts to engage students in a conversation about mathematical concepts where the ideas were primarily coming from the students. He felt like he had ended up talking more than he wanted to and that the students had not participated as actively as he would have liked.

Novices reported the most important resources for dealing with SBT-related stresses were Social or Collective (i.e. socially-oriented coping resources). Overall, socially-oriented coping resources accounted for 50.0% to 68.2% of the resource passages for each novice; moreover, all six of the novices in this sample reported that their top coping resources were socially-oriented.

For example, for the stress category of Managing classroom discussions, 5 of the 11 coping resources novices reported for dealing with those challenges were Social; the remaining 6 were Self. The Social coping resources that novices reported were judged to be somewhat effective overall (since four were judged as somewhat effective and one was effective), while the Self resources were judged as ineffective overall (since three were judged as somewhat effective and three were ineffective) at helping them cope with those stresses.

The next quote demonstrates one example of an effective coping resource related to Managing classroom discussions. Specifically, Mr. Jones talks about how he seeks help from mentors and colleagues when he has difficulties with his teaching.

Mr. Jones: For example, I may look at the communication standard for grades 9-12. And I want to make sure that maybe during a lesson at least that I consider “how to organize and consolidate their mathematical thinking through communication.” So these things actually happen

every day without me looking in here, but it's just another way for me to make a mental note, like that I need to make sure that even though this probably happens every day, I need to make sure that this idea is communicated very well. Otherwise, we're going to lose the lesson.

I: Communicated to the students, like that they're?

Mr. Jones: Between each other.

I: Like that they're doing these things that we're talking about?

Mr. Jones: Either that or we're talking together. So either they're doing the things, they're communicating with each other. Something like that needs to happen. And the Communication Standard is probably like the biggest thing. This is definitely occurring every day with the connections. All the Standards are Representation, Connections, Communication, ... Reasoning & Proof, [and] Problem Solving. So these things occur every day, especially representation, different ways to represent the same idea. So to make sure when I look at this, I need to think to myself when I plan, "Okay, this is one way right now to plan. This is one way to set up the problem or the idea, but there's got to be more. So either I talk to my mentor teacher or someone else. "What are other ideas how I can approach this or how students will think about this?" [Pre, 5.9-5.36]

So Mr. Jones makes it clear that he talks to his mentor teacher and others to get ideas about how to approach topics in different ways or with help anticipating how the students will think about those topics initially.

In the second quote, I give an example of an ineffective strategy for dealing with difficulties related to Managing classroom discussions. In this passage, Ms. Riley relates how she struggled to get students to understand why they needed to complete the square during a whole-class discussion in which students played an active role.

Ms. Riley: ... Well, I was challenged by the fact that I did not think that they were getting [why you need to complete the square]. And I was trying to come up with other ways to explain myself. And I was having a lot of trouble... And they're good at telling me when they don't get it. They shake their head, "No, don't go on."

Interviewer: Yeah. And how did that resolve itself?

Ms. Riley: I don't know if it ever did... I just dropped it, because I couldn't handle it anymore... I think how it resolved itself was I got to the point where I said, like in my head, "We do not have enough time to tinker with [this]... Forget it... Just divide this number by 2 and square it. Just do it." [Laughs.] ... I feel like we got so off course with that, so out of what I wanted to do. I mean it was ruined from there (Post, 3.15-4.12).

Ms. Riley simply decided to drop the subject when she was struggling with helping her students understand why they would need to complete the square, rather than continue or modify those attempts. And later in our interviews, she said that no other teachers had attempted to help their students understand this topic, so she would simply help them memorize and work easy problems and move forward, rather than helping them understand it.

Taken together, these quotes illustrate how these novices' Social resources (such as peers, colleagues, friends, administrators, etc.) were more effective at helping them navigate their challenges with mathematical discussions than their Self resources (or their own knowledge, experiences, creative ideas, etc.).

Looking at the big picture, three novices, Mr. Jones, Ms. Boone, and Ms. Grant, were making more effective attempts at SBT than the other three novices in this study. In other words, they made more frequent attempts than their peers at SBT, and they also judged those attempts as successful or modified their lessons for greater effectiveness the following year, rather than discounting or abandoning those strategies and attempts. Of those three teachers, two, Ms. Boone and Mr. Jones, described a teacher learning community in which they actively participated; both of those teachers taught at the same high school. They valued their social connections at their

respective schools which they described in ways that led me to classify them at times as Social and at other times as Collective resources.

For example, Ms. Boone mentioned that she consults her colleagues, including Ms. Hyde and Ms. Knowles, when she needs help with content or with planning ideas.

Ms. Boone: We generally are very collaborative. So a lot of what we come up with comes from us talking it out and creating our own problems, which is pretty nice... That is definitely one of my best resources is my co-workers... I go to Ms. Hyde a lot because we teach the same classes. It's just easy to talk to her. So ideally, the grand plan was to meet once every one to two weeks or so. We've been more on like a 3-week schedule. Pretty much whenever a unit starts, we'll get together and talk...

Interviewer: ...And what do you do if you kind of get stuck; maybe you get to a place where you kind of go, "I don't really know what to do with this."

Ms. Boone: Definitely ask somebody... Either Ms. Hyde or Ms. Knowles usually... I'm pretty much comfortable going to anyone. I've gone to Mr. Jones a couple of times to chat with him... You can get ideas from anyone... [Pre, 7.43-8.33].

So Ms. Boone had a large number of people that she could call on. She could talk to Ms. Hyde, Ms. Knowles, Mr. Jones [who also participated in this study], and many other people at her school. She also mentioned that the teachers in her department are very collaborative; they work together to create their own problems and, as she had previously explained, their curriculum. Since they both taught at the same high school, perhaps it was not completely surprising that Mr. Jones shared coping resources similar to the ones that Ms. Boone did.

The third teacher, Ms. Grant, described an extensive social network from which she drew selectively depending on the type of problem she was facing. In particular, she had only one or two resources for attempting SBT.<sup>1</sup> Her department chair was valuable for pedagogical questions, while the school's technology coordinator was helpful with strategies that contributed to making lessons involving technology, including a few related to SBT, more effective.

Ms. Grant: And then supports among teachers—if I tell the people in the math department, that's difficult, because they all have their own idea about what a math classroom should look like. So I'm not necessarily comfortable saying some of my concerns or challenges, unless I know that they're like a universal challenge, because... they won't be understanding or compassionate to the students the way I'm thinking of it... But like pretty much every weekend, I hang out with teachers. And that's our conversation; it's education... They're mostly classmates or friends..., my husband. My mom's an elementary teacher...

Ms. Grant: I go to [colleagues] for different reasons. So one teacher I might go to to talk about technology issues... Or if we have common students or had common students, we can talk about that. Topicwise, some people are really like [district] pacing guide oriented, so I have to just feel out who can maybe help me with it... I'm not like flipping out, because I haven't finished what I was supposed to finish by the end of the school year...

Interviewer: Okay. And which of your supports do you think are most effective?

Ms. Grant: If I was still at MU, it would be like my teaching class... Like I really like talking with [my methods instructors]. People who have molded me can understand some of my concerns... Sometimes I'll talk to the principal about my challenges, just in general. It just depends... But probably my department chair is my best support, just because he needs support from me, too, a lot. We're good at like bouncing things off each other [Post, 22.26-24.18].

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<sup>1</sup> Note. The other teachers, Ms. Wells, Ms. Price, and Ms. Riley also reported social resources. Ms. Wells, in particular, reported participating in a teacher learning community. But these three teachers did not specifically and clearly relate their Social and/or Collective resources to their attempts at SBT.

So Ms. Grant felt like she had to be careful who she asked for help and with what issue. In the past, she sought help from her university instructors, but those resources were not easily accessed when teaching. It appeared the only colleague who shared similar pedagogical views was her department chair. So she described having limited resources requiring strategic use.

Ms. Grant's social skills were quite polished. While she appeared on the surface to be coping well with her challenges, she was the only teacher in the sample who mentioned that she was considering a career change (in this case, switching to teach English rather than mathematics). She described teaching lower-level, lower-track math courses as boring, because her students often were not interested in engaging in the types of activities that she attempted to create and because she was limited as to how much time she could spend on any one topic. She felt like it would be easier to hold such discussions if she were teaching English.

Ms. Grant: I think the biggest thing that might push me out of teaching math, because I know what it's like to teach English. And I know what social studies teachers do, is that I'll help students be problem solvers and I'll help those who need it, because I'm helpful. And I'll just do this to be very helpful and encouraging and I want to make them, not like math, but be successful at math when they maybe haven't in the past. And I'm just discouraged by how dull it is for me sometimes... Teaching it can be very, very dull. And I can get into it, but it's so not authentic, I think, for the students, "It doesn't make sense for her to be all excited about solving for y." And it drives me crazy that 4 weeks later, they still want me to solve for y and show the subtract 4 on both sides and then divide by 3, as if it was a linear equation. That's what frustrates me the most probably... So if I could teach solving linear equations for a month, or something, or two months. And I could do it in a lot of ways, a lot of interesting ways, creative... then I wouldn't mind. But because I'm limited to this amount of time and these students, all I can keep saying is you know, "Now subtract 3 on both sides." So that's probably what would push me out... And that's why I'm looking always [Post, 19.34-20.20].

This passage suggests that novice teachers without organized social resources, even when socially capable (as in the case of Ms. Grant), struggle with stresses relating to implementing the type of teaching that they envision in their classrooms. This may result in greater stress for these teachers than for novices in more supportive settings, particularly those lacking the support of an effective teacher learning community.

In summary, while these teachers reported many new stresses, several of which related to SBT attempts, only one of those stresses that related to their SBT attempts, namely Managing classroom discussions, was judged as both salient and frequently mentioned among their teaching stresses overall. Novices with access to a teacher learning community appeared to be less stressed than their counterparts, even when those teachers appeared to have extensive social networks.

### *Educational and scientific importance of the study*

Many teacher educators believe NCTM's (1991) *Standards* outline a powerful pedagogy for K–12 school mathematics. Opportunities to enact such reforms may be hindered by high levels of stress novice teachers experience. Attempting SBT interacts with novices' existing stresses in complex ways. These interactions may limit novices' opportunities to learn from their experiences about teaching, in particular, when implementing SBT practices. The literature describes the discourse advocated by the NCTM *Standards* as stressful for teachers to orchestrate, because they lead them in uncertain directions and press on their content and pedagogical content knowledge in unique ways (Smith, 1996). Novices, in particular, appear to have difficulty navigating such conversations while enforcing classroom norms of behavior (e.g.

Van Zoest & Bohl, 2002). Those norms of behavior often differ decidedly from those in more traditional classrooms.

While this study found innovative teaching in a wide variety of educational contexts, there was evidence that those teachers with personal commitments aligned with SBT or who were in contexts most supportive of SBT were making the most effective attempts at such teaching. But this study also found that novices appear to persevere in the most ambitious attempts to implement SBT in contexts such as teacher learning communities that actively and effectively support and promote such teaching.

If we, as teacher educators, educational administrators, and colleagues, wish to support novices in such conversations, teacher learning communities appear to offer supports that effectively sustain novices who embrace and persevere in attempting to enact elements of the NCTM (1991) Standards.

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