ASSESSING TEACHERS' DISCOURSE ABOUT THE PRE-K–12 GUIDELINES FOR ASSESSMENT AND INSTRUCTION IN STATISTICS EDUCATION (GAISE)

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ABSTRACT

This paper starts from the premise that teachers' discourse communities influence how ideas for reform are implemented. In order to understand some of the discourse surrounding the reforms proposed by GAISE, an online focus group activity was conducted. The focus group consisted of pre-service and practicing teachers responsible for teaching statistics at various grade levels. Focus group discourse was used to formulate a set of working hypotheses about actions that need to be taken to facilitate the implementation of GAISE. Working hypotheses emphasized that statistics educators need to play roles in developing teachers' content knowledge, helping teachers understand the differences between mathematics and statistics, deepening teachers' pedagogical knowledge, building teachers' curricular knowledge, and influencing the writing of state-level standards.

Keywords: *Statistics education research; Educational standards; Teachers' perceptions; Qualitative research; Focus groups*

1. BACKGROUND

The past two decades have seen a proliferation of educational standards documents. Among the first of these was *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989). It was followed by companion standards documents for teaching (NCTM, 1991) and assessment (NCTM, 1995). These three NCTM Standards documents were used as the basis for *Principles and Standards for School Mathematics* (NCTM, 2000). NCTM then attempted to provide further focus and coherence for school mathematics curricula with the release of *Curriculum Focal Points* (NCTM, 2006). Although recommendations for statistics curricula were included in each of the NCTM Standards documents, the statistics education community has recently provided a more detailed vision for the substance of Pre-K-12 statistics with the release of the Guidelines for Assessment and Instruction in Statistics Education (GAISE) report (Franklin et al., 2007).

The Pre-K-12 GAISE report describes three developmental levels (A, B, and C) through which students should progress as they study statistics in school. As they move through the levels, they study progressively more sophisticated ideas about concepts like experimental design, variability, and descriptive statistics. The three level descriptions essentially help flesh out the NCTM (2000) recommendations for data analysis concepts that should be learned in the Pre-K-2, 3-5, 6-8, and 9-12 grade bands. The GAISE document also elaborates upon pedagogical principles for teaching statistics by offering a framework for statistical problem solving. The framework consists of four interrelated

processes: formulating questions, collecting data, analyzing data, and interpreting results. These four processes are to be employed at each of the three developmental levels. The GAISE pedagogical recommendations are built upon current discourse themes within the statistics education community, including:

- Statistical literacy should be a prominent curricular goal because of the central role it plays in democratic citizenship, personal choices, careers, and evaluating scientific findings.
- Statistics and mathematics differ as disciplines. Statistics utilizes mathematics but should not be mistaken for a branch of mathematics.
- The study of variability should have a central role in school statistics. Students should understand a variety of types of variability, including measurement, natural, induced, and sampling variability.
- Statistical problem-solving is heavily reliant upon context. It is not possible to give plausible interpretations of data without some knowledge of the context that generated them.
- Pre-college experiences with statistics require an intuitive grasp of probability. Probability is an important tool in statistical analysis, but doing mathematical probability problems should not be mistaken for doing data analysis.

Many of the themes in the list above are more pronounced in the GAISE document than they are in previous curricular recommendations for teaching statistics, such as the NCTM Standards and *Curriculum Focal Points*.

As statistics educators become more involved in writing curriculum standards like GAISE, an important lesson learned by mathematics educators during the writing and release of the NCTM Standards documents should be kept in mind: The audience for a curriculum standards document often interprets the document in ways its writers may not expect. For example, the *Curriculum and Evaluation Standards for School Mathematics* sparked the "math wars" of the past two decades because its writers saw the document as an endorsement of a richer view of mathematics than what was provided by conventional curricula, but critics saw it as a retreat from rigorous mathematics (Schoen, Fey, Hirsch, & Coxford, 1999; Schoenfeld, 2004). This controversy continued through the release of *Principles and Standards for School Mathematics*. When NCTM released *Curriculum Focal Points*, some readers interpreted it to be a reversal of the positions taken in the previous NCTM Standards documents, whereas its writers saw it as providing guidance for organizing curricula to attain those very standards (Fennell, 2007). Those who write and revise curriculum standards documents must grapple with the reality that their work will be interpreted in different ways by readers.

Of all the audiences to which a standards document must speak, the teacher audience is perhaps the most vital. Tyack and Cuban (1995) argued, "If the aims of reform seem vague, contradictory, or unattainable, educators often respond by turning reforms into something they already know how to do" (p. 64). Tyack and Cuban's argument is supported by empirical data from the field of mathematics education. For example, in one study, Remillard and Bryans (2004) described the case of a teacher who was asked to implement a reform-oriented mathematics curriculum. The teacher responded by continuing to use a more traditional textbook as his guiding instructional framework and using the reform-oriented text as an occasional supplement. In another study, Lloyd and Behm (2005) found that pre-service teachers tended to seek out familiar, traditional instruction components when asked to analyze both reform-oriented and traditional texts. The Remillard and Bryans (2004) and Lloyd and Behm (2005) studies are not isolated or unusual instances. Several other studies have shown that teachers often perceive reform recommendations as small supplements or revisions to their existing pedagogical thinking

frameworks rather than recommendations for larger-scale changes in thinking (Groth, 2007; Lambdin & Preston, 1995; Spillane & Zeulli, 1999). The result is that there has been a persistent gap between the mathematics curriculum intended by reform and the curriculum actually implemented by teachers (Usiskin & Dossey, 2004).

In order to minimize the gap between the "intended curriculum" in Pre-K-12 statistics (i.e., the GAISE report) and the "implemented curriculum," it is important to attend to teachers' perceptions of the "intended curriculum." Because the degree of implementation of a reform depends heavily upon how teachers perceive it, gauging teachers' perceptions of GAISE is a vital step in the eventual large-scale implementation of its recommendations. Listening to teachers' perceptions can help reveal both barriers and inroads to the implementation of GAISE recommendations. Therefore, this article will focus upon the exploration of teachers' interpretations of the Pre-K-12 GAISE report in order to help move Pre-K-12 statistics education toward attaining the curricular vision set forth in the document.

2. THE ROLE OF PROFESSIONAL DISCOURSE COMMUNITIES IN THE PERCEPTION OF REFORM RECOMMENDATIONS

It is common to speak of "dissemination" of standards and educational reform recommendations as a one-way process: Reformers write recommendations and then send them to teachers for implementation. Lesh and Lovitts (2000) argued that this is not an accurate depiction of communication between researchers and teachers:

> In mathematics and science education, the flow of information between researchers and practitioners is not the kind of one-way process that is suggested by such terms as *information dissemination*. Instead, to be effective, the flow of information usually must be cyclic, iterative, and interactive. (p. 53)

This viewpoint suggests that researchers have at least as much to learn from teachers as teachers have to learn from researchers. Researchers and teachers both have a hand in shaping reform. Researchers may have the primary responsibility for drafting curriculum and reform recommendations, but teachers have the primary responsibility for translating those ideas to the classroom. Therefore, the ultimate impact of a document such as GAISE depends upon how its recommendations are perceived by teachers.

In order to fully understand teachers' perceptions and interpretations of a document like GAISE, it is not sufficient to study teachers in isolation from one another. As Lesh and Lovitts (2000) argued,

> All of these individuals [e.g., teachers] involve systems that are more like complex and continually adapting biological systems than they are like simple machines. In each case, the system as a whole is more than the sum of its parts; the parts interact in complex and recursive ways, and, when actions are applied to these systems, the systems react. (p. 54)

From this perspective, teachers' discourse with one another provides a powerful lens for examining perceptions of reform proposals like GAISE because their perceptions can be studied in the context of interaction with other practitioners. Lesh and Lovitts' (2000) view acknowledges that such perceptions do not develop in a vacuum, but are shaped within the context of the discourse communities that teachers inhabit. Perception, interpretation, and practice can be understood as having collective aspects rather than being understood as strictly individual processes.

Literature on teacher education bears out the idea that teachers' discourse communities exert influence and shape beliefs and practices. At times, these discourse communities have been spoken of in a positive vein, as when Davis and Simmt (2003)

described how interactions among teachers led to the solution of a problem that none of them would have been likely to solve individually. Also, the idea of a "community of practice" (Lave & Wenger, 1991) is often (although not always) invoked to emphasize the idea that teachers can begin to more successfully navigate the task of teaching by learning from one another's experiences. On the other hand, teachers' discourse communities have also, at times, been viewed in a more negative light. For example, Putnam and Borko (2000) argued, "patterns of classroom teaching and learning have historically been resistant to fundamental change, in part because schools have served as powerful discourse communities that enculturate participants (students, teachers, administrators) into traditional school activities and ways of thinking" (p. 8). Stigler and Hiebert (1999) expressed a similar sentiment in portraying mathematics teaching in the United States as a cultural system that is highly resistant to change. These examples help to illustrate, for better or for worse, teachers' pedagogical thinking is situated within collective discourse systems.

Given that discourse among practitioners plays a fundamental role in shaping beliefs and practices, for the present study it is important to consider the types of conversations that may provide insight about teachers' perceptions of the GAISE document. Greeno (2003) suggested that it may be helpful to examine how teachers use standards documents when designing curriculum and when carrying on reflective conversations with one another. He hypothesized a set of questions that may come up during reflective discourse about educational reform recommendations:

- What are we accomplishing now?
- What could we accomplish that we would value if we changed our practices?
- Why would that accomplishment be valuable?
- What would our changed practices look like?
- What resources would we need to accomplish these changes?
- In the process, what would be lost that we would regret? (p. 305).

The above set of questions goes beyond simply discussing the content of reform recommendations to forming a collective vision of the implications of a proposed reform. In turn, teachers' discourse around this set of questions is likely to provide insight about how they perceive reform proposed by standards documents.

3. METHODOLOGY

3.1. STUDY DESIGN

Given that teachers' perceptions of GAISE as situated within professional discourse communities were of interest in the present study, a focus group interview involving teachers was used as the primary means for collecting data. Morgan (1997) defined a focus group as "a research technique that collects data through group interaction on a topic determined by the researcher…it is the researcher's interest that provides the focus, whereas the data themselves come from group interaction" (p. 6). Focus group interviewing has been utilized frequently in business and marketing (Greenbaum, 1993), but has recently been employed widely for qualitative research in social sciences such as education and psychology (Vaughn, Schumm, & Sinagub, 1996). Focus groups are not intended to produce statistically generalizable conclusions, although some researchers recommend using focus group findings to produce questions for surveys administered to a sample of a population of interest (Fuller, Edwards, Vorakitphokatorn, & Sermsri, 1993; Rossi, Wright, & Anderson, 1993). Instead, the primary value of focus groups is that they provide the opportunity to observe complex group interactions about a topic of interest at

a level of detail and degree of efficiency not afforded by other methods like individual clinical interviews or even classroom observations (Morgan, 1997).

Stewart and Williams (2005) discussed the viability of taking focus group research online using both asynchronous (time-independent) and synchronous (time-dependent) discussions. They made the case that both forms of online focus groups have advantages as well as drawbacks when compared to face-to-face groups. Advantages to online groups include the ability to question participants over longer periods of time and to engage participants in more open discussions. Focus group participants may feel more freedom to express their opinions online because the online environment often helps remove inhibitions about speaking that may be present in a face-to-face setting (Joinson, 1998). Disadvantages of online focus groups include challenges related to recruiting participants and finding workable times for online interaction. In the present study, an asynchronous online focus group was used in order to help overcome challenges related to finding workable meeting times. The asynchronous environment also provides advantages like allowing extended wait time for participants to reflect on a question after it has been asked and encouraging meaningful contributions from group members who would otherwise be likely to remain silent (Groth, 2006). Further details about how the online group design used for this study compared to a more conventional face-to-face group are provided in Table 1.

Table 1. Comparison of online focus group to conventional face-to-face group

Online focus group used for present study	Conventional focus group
11 members	Approximately 6-8 members
Moderator-posed questions used to catalyze conversation	Moderator-posed questions used to catalyze conversation
Multiple streams of discourse at any given time	Single stream of discourse at any given time
Streams of discourse are self-shaping	Stream of discourse may be more tightly guided by moderator.
Asynchronous interaction: Virtually unlimited wait time	Real-time interaction: Limited wait time
Conversation transcript visible to all participants as the conversation unfolds	Conversation transcript visible to the moderator only after the conversation is completed and transcribed
Time provided to go back to re-read the GAISE document after another focus group member makes a comment about it	Continuous flow of interview and time constraints upon it makes going back to the original GAISE document difficult

3.2. PARTICIPANTS AND PROCEDURE

Individuals participated in the online focus group for this study as part of a final project in a class taught by the researcher/moderator. The class was a master's level course designed to introduce practicing teachers to the field of mathematics education research. The primary texts for the course were *The Teaching Gap* (Stigler & Hiebert, 1999) and *Lessons Learned from Research* (Sowder & Schappelle, 2002). *The Teaching*

Gap describes, in detail, how mathematics teaching practices in the United States differ from those in other countries, especially Japan. *Lessons Learned from Research* is a compilation of condensed articles from the *Journal for Research in Mathematics Education*. All participants were given the option to have their comments excluded from the study without harming their semester grade, but all of them provided consent for their comments to be used for the purpose of the research.

The focus group activity to be described in this paper represented participants' most prolonged and substantive contact with recent ideas from statistics education. Up to this point, they had done just two brief activities directly related to statistics education: evaluating the quality of several different statistics items appearing on standardized tests and discussing a condensed version of the Watson and Moritz (2000) study on students' understanding of statistical sampling.

Participants' career responsibilities outside the class represented a variety of different grade levels relevant to the Pre-K-12 GAISE guidelines. Each participant was asked to read the introduction and framework for the Pre-K-12 GAISE report before participating in the online focus group. They were also asked to read the developmental level description from the report (level A, B, or C) most relevant to their career interests. A summary of participants' grade-level responsibilities and the GAISE levels they selected to read is provided in Table 2. Table 2 also shows that all teachers participating in the study had seven or fewer years of teaching experience. Hence, the study can be understood as representing the perceptions of a group of relatively new teachers.

Table 2. Summary of characteristics of focus group participants

Pseudonym	Grade levels taught	Number of years teaching	GAISE level of interest
Andrea	Elementary resource teacher	1	A
Alex	1, 5	One semester of student teaching	A
Amanda	2, 3, 4	7	A
Amy	5	4	A
Becky	Pre-service secondary teacher	0	B
Brenda	6	2	B
Brandon	6	5	B
Cecil	8	1	C
Candice	Pre-service secondary teacher	0	C
Chad	10	1	C
Cindy	Community College	1	C

In order to engage teachers in conversation that would elicit their perceptions of the GAISE document, the online focus group was set up to foster participation in curriculum design and reflective discourse (Greeno, 2003) centered on GAISE recommendations. Toward this end, two types of asynchronous online interaction were set up for the activity: the collaborative construction of a wiki (an online document that can be easily revised by any participant in the group) and contribution of comments to a discussion board. On the wiki, participants were to write criteria that they would use to ensure that textbooks or curriculum materials were aligned with GAISE recommendations. On the discussion board, participants were to carry on reflective discourse about the recommendations given in the document. The researcher/moderator provided a set of questions, adapted from Greeno (2003), to catalyze this conversation. The manner in which Greeno's questions were adapted to the present study is shown in the fourth bullet point in Appendix A, along with the full set of instructions that were given to participants for the activity.

3.3. DATA GATHERING AND ANALYSIS

As noted in the assignment description in Appendix A, the wiki and discussion board portions of the website for the online focus group were open for a period of two weeks. All contributions to the wiki and the discussion board made during the two week time frame were retained for analysis. The finished wiki consisted of a series of questions that participants would use to evaluate whether or not a text or set of curriculum materials was aligned with GAISE recommendations, and the discussion board contained responses to the questions for reflective discourse posed in the assignment description. At the end of the two weeks, the finished wiki and the discussion board transcript were loaded into the software program ATLAS.ti (Muhr, 2004) to facilitate qualitative data analysis and coding. The completed wiki was analyzed in order to discern how participants would use GAISE for a curriculum design task, and the discussion board was analyzed to provide insight about the types of reflective discourse catalyzed by GAISE.

Qualitative data analysis was done first on the finished wiki from the focus group website. The data analysis process for the wiki can best be described as consisting of open coding followed by axial coding (Strauss & Corbin, 1990). During open coding, the researcher began by reading the criteria for evaluating statistics curriculum materials that participants had posted to the wiki and then assigned a conceptual label to each criterion posted. For example, one participant posted the criterion, “Does the text incorporate cooperative learning activities and areas for open discussion about students’ individual thinking?” This criterion was given the conceptual label, “student-to-student discourse.” Another participant posted the criterion, “Does the textbook include activities that utilize technology such as a graphing utility or computer program?” This criterion was given the conceptual label “technology usage.” After all criteria posted to the wiki had been assigned conceptual labels during the open coding process, the researcher looked for similarities among codes assigned during open coding and clustered conceptually-similar codes into categories (i.e., axial coding). For example, segments of text given the label “student-to-student discourse” during the open coding process were clustered together with those given the label “technology usage” because both pertained to *how* GAISE-aligned teaching should be carried out. This larger cluster of codes was given the label “learning process-related concerns,” partially to distinguish it from a different large cluster that pertained to *what* content should be included in a GAISE-aligned curriculum. The larger axial clusters were not mutually exclusive (e.g., some criterion posted to the wiki contained statements about *what* should be taught as well as *how* it should be taught). The wiki coding process produced five large clusters summarizing and characterizing teachers’ use of GAISE for a statistics curriculum design task, and the nature of each cluster is described in the results section of this paper.

The discussion board portion of the focus group website was analyzed after qualitative data analysis on the wiki had been completed. To facilitate coding of the discussion board dialogue, a set of start codes (Miles & Huberman, 1994) was created. The start codes were based on the six questions for reflective discussion that were posed in the assignment description shown in Appendix A. Each discussion board post was labeled according to which of the moderator-posed questions it addressed. For example, one participant commented, “As of right now, there is an intro to statistics that is incorporated in Algebra I. Otherwise usually only a handful of juniors or seniors in high school end up coming close to getting Level C.” This comment was labeled as addressing the moderator-posed question that asked participants to compare GAISE recommendations to present practices. Each post was also assigned a more descriptive conceptual code in order to distinguish among different areas of focus that were pursued

in responding to the moderator-posed questions. For example, the participant comment mentioned earlier in this paragraph was given the label "how GAISE recommendations could fit within existing mathematics curricula" to distinguish it from other categories of comments comparing GAISE to present practice (e.g., "how GAISE recommendations could fit within non-mathematics curricula" and "how GAISE recommendations could fit within existing standardized testing constraints"). In some cases, individual discussion posts were assigned a number of different codes because they contained thoughts that addressed different moderator-posed questions or discussed different aspects of a single moderator-posed question. Collectively, the categories of response formed through data analysis helped shed light on the type of reflective discourse about GAISE recommendations occurring within the focus group.

4. RESULTS

The results reported in this section are divided into two sub-sections. The first subsection presents results from the wiki portion of the online focus group activity, which concentrated upon using GAISE to design a document that could be used to evaluate statistics curriculum materials and textbooks. The second subsection presents results from the discussion board portion of the online focus group activity, which was intended to spark reflective discourse about the GAISE recommendations. Collectively, the results reported in the two sub-sections help reveal prominent features of teachers' conceptions of the GAISE document. Spelling and punctuation mistakes in posts participants made online have been corrected in this section.

4.1. USING GAISE AS THE BASIS FOR A DESIGN TASK: WIKI ANALYSIS

At the end of the focus group activity, participants had posted a set of 38 criteria that could be used to determine the extent to which a curriculum or text is aligned with the vision set forth in GAISE. Five main categories were apparent in the criteria:

- Content-related concerns (pertaining to *what* is to be taught)
- Process-related concerns (pertaining to *how* content is to be taught)
- Teacher support (resources that should be available to support curriculum implementation)
- Accessibility of the materials (dealing with clarity and understandability)
- Credibility of the materials (pertaining to authors' credentials and correctness of content presentation).

Some of the criteria that participants posted fit into more than one of the five categories. The Venn Diagram shown in Figure 1 illustrates the manner in which categories of criteria related to one another. Each number inside the Venn Diagram represents one of the criterion posted to the wiki and shows its order of occurrence in the discussion. The text following Figure 1 further describes the characteristics of the criteria fitting within each of the regions in the Venn Diagram.

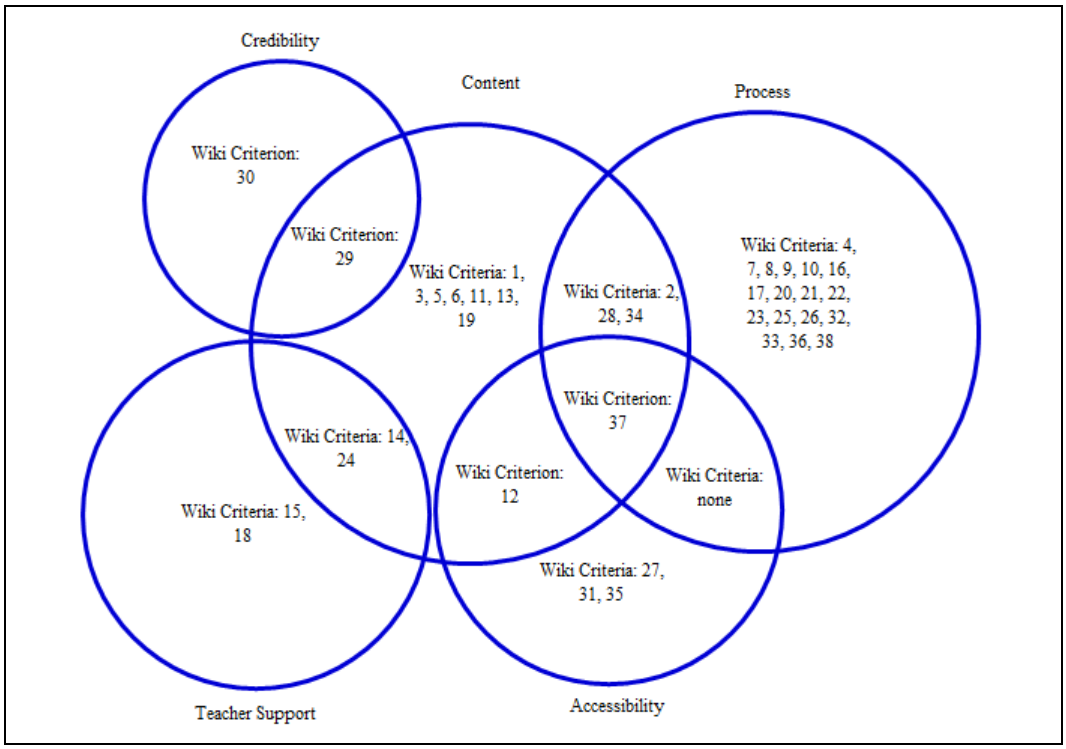

Figure 1. Categories of textbook/curriculum evaluation criteria posted to the wiki

Content-related concerns Evaluation criteria related to the content included in curricula were among the first to be posted to the wiki. Many of these criteria were concerned that specific topics mentioned in the GAISE guidelines were included in the curriculum under evaluation. Topics that teachers listed included: comparing groups, conducting experiments, describing center and spread, understanding misuses of statistics, constructing graphical displays, and making inferences from data. Whereas these types of content concerns dealt with the fidelity of the included content to the discipline of statistics as portrayed in GAISE, one criterion, posted by Becky, mentioned that the content should also be aligned with topics in the state and school district standards. Concern about alignment with local standards surfaced throughout the online activity, and appeared to be reflective of the fact that high-stakes tests used to evaluate the teachers were designed around state standards. Hence, although teachers were concerned that the content of the curriculum would align with the discipline of statistics as it is portrayed in GAISE, they were also concerned that it would align closely with the content they were held accountable for teaching.

Process-related concerns Teachers wrote a variety of evaluation criteria relating to how the statistical topics included in a curriculum or text should be taught. The types of process-related criteria mentioned are shown in the first column of Table 3, accompanied by examples to illustrate each one in the second column.

Table 3. Summary of process-related criteria

Process related criteria	Sample quote
Usage of authentic problems	How many of the examples/problems are open-ended to facilitate meaningful statistical discussion and increase statistical literacy among the students? How many examples/problems are just a statistical procedure that does not engage conceptual and abstract thinking of the students?
Usage of technology	Does the textbook include activities that utilize technology such as a graphing utility or computer program?
Learning style accommodation	A textbook needs to look at the needs of different types of learners. Not every student learns in one particular way. It is important that the textbook provided different ways for a student to learn a concept.
Equity in learning	Does the text relate statistical education to various cultures and ethnicities? Does the text include activities on several levels, not just for special needs students but also for high achieving students?
Assessment	Does the text use multiple forms of assessment? (projects, portfolios, journals)
Student-to-student discourse	Does the text incorporate cooperative learning activities and areas for open discussion about students' individual thinking?
Curriculum integration	Does the text integrate statistics education with other content standards?
Explanations and examples	Does the text provide clear and coherent examples?

Most of the teachers' process-related concerns related, at least on the surface, to pedagogical recommendations found in the GAISE document as well as in the NCTM (1989, 2000) Standards documents. The only category of criteria aligned with a more traditional view of instruction (in the sense "traditional" instruction is portrayed by Ross, McDougall, & Hogaboam-Gray, 2002) was the last category shown in Table 3, which was concerned with the clarity of examples provided in the text. The emphasis of this category seemed to be more on trying to accurately transmit facts from the text to the student than on the facilitation of students' construction of their own understanding. Although the other categories seem to stem from GAISE and NCTM recommendations, the lack of description for some of the criteria leaves open the possibility that teachers who posted the criteria did so with a transmission-oriented perspective of learning in mind. For example, the "usage of technology" category of process-related concerns does not go beyond simply asking if technological activities are included in the curriculum. Although technology is recommended as a teaching tool in the GAISE and NCTM documents, it is possible to utilize technology (or any other pedagogical tool, method, or principle) in a transmission-oriented manner of teaching rather than emphasizing the teachers' role as facilitator of learning.

Overlap between content and process The GAISE document's "statistical problem solving framework" and its idea of developmental levels helped stimulate some teachers' thinking in the intersection of content and process. One criterion posted to the wiki by Alex stated that a text should include opportunities not only to study specific content, but to do so in a way that aligns with the investigative process of formulating a question, collecting data to answer a question, analyzing the data, and interpreting the results. Other criteria posted to the wiki stated that teaching strategies suggested by a curriculum should be arranged to develop students' understanding of certain content using the progression suggested by the document. For example, Cecil wrote, "Does the text make clear what material is appropriate at what level, e.g., dotplot/stem and leaf plots introduced at level A and bar graphs (histograms) at level B?" This particular comment reflected some attention to the GAISE recommendation that individual data values should be visible to students when they first learn to construct statistical displays. In general, criteria in the intersection between content and process considered *what* should be taught simultaneously with *how* it should be taught. Therefore, such criteria more fully reflected the sort of thinking that teachers need to do everyday in considering what to teach along with how to teach it. An examination of Figure 1 reveals, however, that there were relatively few criteria posted lying in the intersection between content and process when compared to those concerned with just content or just process.

Teacher support Some criteria posted to the wiki reflected the belief that textbooks should come with materials to help teachers carry out the recommended curriculum. One such criterion posted by Cindy simply stated, "Does the textbook have supplementary materials for the students and/or instructors?" A criterion posted by Becky was more specific in what teachers might wish to gain from supplementary materials, stating "Do the text materials provide opportunities for the instructor or teacher to increase their own understanding of the mathematics ideas that students are studying?" The latter criterion reflects a desire for supplementary materials to play a role in developing teachers' content knowledge along with students' content knowledge. In so doing, it resonated with the observation of the Conference Board of the Mathematical Sciences (2001) that teachers often need substantial content knowledge development in order to be able to teach statistics effectively.

Overlap between teacher support and content Two of the criteria posted to the wiki mentioned specific content considerations that teachers would expect to find in teacher support materials. In the first of the two, Cindy wrote, "Is there an opportunity for students to perform experiments (empirical data) in collecting and analyzing data? Are the experiments contained in the textbook or supplementary materials?" In the second of the two, Brenda wrote, "Is a scope and sequence included to show where other mathematical topics can be included in relation to the statistics material?" Whereas the first of the two criteria in this overlap area seeks to remove some burden from the teacher in regard to incorporating content into specific lessons, the second seeks to help the teacher understand where all of the content to be included may fit within the broader context of the entire course.

Accessibility Concerns about the accessibility of a text or curriculum series were posted to the wiki. These concerns appeared to stem from teachers' own experiences rather than anything mentioned specifically in the GAISE guidelines. Abby, for example, wrote a criterion related to the reading level of the text: "Is the reading level appropriate for all students?" Another accessibility criterion posted by Abby related to organization:

"Is the textbook organized in a logical, 'easy to follow' manner? Are similar or related topics grouped together?" Abby also posted a third related to the layout of the text: "Is the textbook visually appealing and easy for students to understand?" Although these criteria were drawn largely from concerns not expressed directly in GAISE, they were still "on task" in the sense that the group goal was to construct a relatively complete set of criteria for evaluating existing texts and curricula.

Overlap between accessibility and content One text/curriculum evaluation criterion posted to the board encompassed a concern about content as well as accessibility. Becky wrote, "Does the text provide common vocabulary and terminology including definitions for student understanding?" The concern that "common vocabulary" be included related to the other concerns about the content of the text or curriculum under consideration. The concern about the understandability of the definitions was similar to other concerns expressed about the clarity of the text or curriculum for students.

Overlap among accessibility, content, and process One criterion on the wiki included concerns that cut across the accessibility, content, and process categories. Candice wrote, "When studying statistics, graphs and other visual aids are important for students' additional understanding. Does the text provide clear and coherent examples? Does the text give example/homework questions that the students can develop their own graphs?" The concern about the "clearness" of the examples revealed a concern for the accessibility of the text. The inclusion of statistical graphs was largely a content concern. Finally, the remarks about providing examples and homework exercises relate to the manner of presentation and assessment, which are both teaching process-related issues.

Credibility Near the end of the focus group online activity, a criterion relating to the credibility of the text was posted. Becky raised the issue of authorship of the text or curriculum series: "Is the textbook written, edited and published by qualified and credible professionals?" As happened with some earlier criteria, this statement did not appear to be directly motivated by the GAISE document. Nonetheless, it did have some relevance to the task of evaluating a text or curriculum.

Overlap between content and credibility One criterion dealt with issues of content and credibility simultaneously. Cecil stated, "Does the textbook focus on the right mathematics and is the mathematics right?" The exclusive focus of this criterion on "mathematics" was curious in light of the GAISE document's message that statistics and mathematics differ as disciplines. It was also not counterbalanced by any criteria specifically discussing the "correctness" of the non-mathematical elements of statistics that may be included in a curriculum or text. This occurrence appeared to reflect the presence of the persistent notion that statistics is a branch of mathematics rather than a discipline in its own right (Moore, 1992).

4.2. USING GAISE AS A BASIS FOR REFLECTIVE DISCOURSE: DISCUSSION BOARD ANALYSIS

Discussion board discourse was catalyzed by six moderator-posed questions adapted from Greeno (2003) pertaining to reflective discourse about educational standards:

1. How do the GAISE recommendations compare to current practices for teaching statistics?

2. What of value could be accomplished if the GAISE recommendations were implemented?
3. Why would it be valuable to align current teaching practices with the GAISE recommendations?
4. What would GAISE-aligned teaching strategies look like?
5. What resources would be needed to carry out the GAISE recommendations?
6. In the process of aligning teaching practices with the GAISE recommendations, what would be lost that we would regret?

By the end of the online activity, participants had posted 58 messages to the discussion board as they discussed the six questions above. Participants' discourse surrounding the six questions is discussed in this subsection. During data analysis, it was discerned that the conversation surrounding the second question was not separable from the third, so participants' comments related to those two questions are discussed together.

Question 1: Comparison to present practices A large amount of the discussion about how GAISE-aligned teaching compared to existing practices dealt with how the recommended content might fit together with existing mathematics curricula. Some participants wondered whether it would be possible to reform existing curricula to include GAISE recommendations. Chad, for example, stated "Do you think that it will be possible to reform all already existing mathematics curriculum to include the statistical education instruction?" In another post, Alex wrote "Is there any part of your math curriculum that would be a stretch to fit statistics into the lessons? I feel like they are really stretching it out, but maybe I'm just skeptical." Other comments reflected more optimism about the possibility of reforming existing curricula to achieve the GAISE goals, including one made by Brandon:

> In my sixth grade curriculum there are several opportunities to implement some of it within statistics content standards as well as in rational number content standards. The middle school portion of the document mentions a lot about proportional reasoning which can be applied in an algebra context as well.

No final consensus was reached among participants, however, about the possibility of reforming existing mathematics curricula to accommodate GAISE recommendations.

The mathematics content area of algebra received further attention as a possible site for integration of GAISE recommendations with existing mathematics curricula. Chad observed "There is a big push for probability, statistics, and data analysis. Algebra textbooks are adding new chapters at the end to incorporate the newest trend." Chad later added "As of right now, there is an intro to statistics that is incorporated in Algebra I. Otherwise usually only a handful of juniors or seniors in high school end up coming close to getting Level C," revealing that some of the content recommended by GAISE had currently only partially found its way into his existing algebra curricula. Some participants began to think specifically about how the study of bivariate data might fit into existing algebra curricula. Brandon, for example, wrote

> I checked the eighth grade curriculum in Maryland and could not find correlation coefficients or positive and negative association. I think that this might be included in the Algebra I curriculum but I am not sure. Can anyone comment on when this is first part of the curriculum?

This query was answered by Cindy with the observation that the state curriculum mentioned the use of lines of best fit but did not directly mention correlation coefficients or positive and negative association. This exchange again reflected participants' general concern about adhering tightly to the state standards that dictated the content of high-stakes standardized tests taken by their students.

Concerns related to standardized testing constraints also caused discussion about how and when the statistical content recommended by GAISE might fit into the existing curriculum. Because the content of GAISE was not identical to the state curriculum participants were responsible for teaching, some felt that the GAISE content would have to be included in such a way as to not risk lowering students' performance on the standardized tests designed around the state curriculum. Two different proposals emerged along these lines. For the elementary and middle school levels, Abby proposed that the GAISE material could be implemented after the standardized tests were given in March. For the high school level, Chad proposed that the GAISE guidelines might be implemented in "non-assessed" classes. None of the participants proposed going beyond the curriculum prescribed by the state. They appeared to perceive little room within existing mathematics curriculum sequences to fully implement the GAISE recommendations.

Although the group reached no firm resolution to the problem of how GAISE might be fully implemented within existing mathematics curriculum sequences, some ideas about how GAISE recommendations might be attained in classes outside of mathematics did emerge. Abby mentioned science as one subject area that would lend itself to some alignment with GAISE:

> I usually try to discuss statistics in my science classroom when my children are designing science fair experiments. We discuss variability and make predictions about what could affect their data. They seem to actually understand it a little better in that context.

Abby also mentioned social studies as another GAISE-related subject. However, along with this idea, she raised the concern that "It is difficult to explain to your social studies or science supervisor why you are teaching math content in 'their' time." Like the discussion of how GAISE might be folded into existing mathematics curricula, the discussion of integrating statistical content into other subject areas was impeded by the perception of curriculum-related constraints beyond teachers' direct control.

Questions 2 and 3: What could be accomplished with GAISE implementation

Participants expressed the belief that curricula guided by GAISE could help improve students' engagement with statistics and their interest in the subject. The use of interesting, "real world" examples was identified as the driving force behind possible increased student engagement and understanding, as reflected in the following comments:

- To help a student read, books are chosen that students are interested in so why aren't we doing the same thing in math? It only makes sense. (Brenda)
- I was reading through the Level A report and saw the lesson ideas they used as examples. They seemed like they would be pretty motivating to students with more connections than normal lessons. (Alex)
- If learning doesn't mean anything to the student then there is no reason to learn the information. Students want to know why they need to know something and what they can use it for. (Amanda)

Although participants hypothesized that there would be learning benefits from the use of contextualized ("real world") problems, they did not discuss how students' learning from a contextualized statistics problem might differ from learning by doing a contextualized mathematics problem. This is a crucial point to consider in order to fully appreciate what might be accomplished with the implementation of the GAISE guidelines, because as Cobb and Moore (1997) noted, "In mathematics, context obscures structure…In data analysis, context provides meaning" (p. 803). This distinction did not come into play

during the focus group discussion – in fact, some of the comments (e.g., the first bullet in the list directly above) equated statistics with mathematics.

Participants also felt that the implementation of the GAISE guidelines might hone students' critical thinking skills because of the recommendation that students should study misuses of data. Comments reflecting the belief that enhanced critical thinking skills would be a benefit of GAISE implementation included:

- Today's students believe everything that they see as long it is on TV or on the radio or in print somewhere. The introduction mentions the importance of "a healthy dose of skepticism" … I agree. (Brandon)
- The whole point to students learning statistics is so they will understand and question all of the information that they are bombarded with on a daily basis. A basic understanding of statistics will help them make informed choices in everyday life. (Cindy)
- It would be really cool to have students programmed to question those claims that are thrown out in the media and just taken as fact. Most of the time it is only some form of loosely based fact. If the curriculum incorporated GAISE I really think there would be some big changes, possibly politically. (Alex)

Comments pertaining to the possible value of GAISE for increasing students' ability to critically analyze everyday data were made by participants teaching a variety of grade levels, as reflected in the comments above. Hence, though the group expressed uncertainty about how the GAISE recommendations might fit within K-12 existing curricula, they did perceive some educational value in the implementation of the guidelines at various grade levels.

Question 4: Implementation resources needed Participants felt that enhanced teacher content knowledge was one of the most vital resources needed for the successful implementation of the GAISE guidelines. Fourteen of the messages posted to the discussion board contained the idea that many teachers' present levels of knowledge were not sufficient for the task. Chad and Cecil observed that many practicing teachers have not reached GAISE level C themselves, and thought it would be difficult for such teachers to help students move toward that level. Some participants personalized the need for further professional development to themselves. Brenda, for example, remarked "Just thinking about teaching statistics worries me because I'm not sure I completely understand it. I feel that there would have to be more than just some professional development opportunities."

The need for teachers' content knowledge development led some participants to propose solutions to the dilemma. Becky wondered if it would be better to bring in outside content knowledge "experts" to teach statistics rather than trying to re-educate practicing teachers, but Brandon cast doubt on the viability of such an idea on the grounds that "it is impossible to teach anything without having experience as a classroom manager." Cindy proposed that teachers take a course to gain content knowledge: "One introductory course in statistics would prepare teachers to teach statistics at the elementary and middle school levels. However, I am not sure how that could fit into professional development." Others proposed utilizing professional development (PD) "coaches" to help with content knowledge development. Chad, for example, mentioned

> I know that at my school there is a math PD coach whose sole purpose is to help those teachers that need it with more resources for the teachers and the students. However, if you are on your own it may take a lot of 'brushing up' time on the subject.

Abby and Brandon were doubtful about the extent to which PD coaches could help resolve the content knowledge dilemma, as both mentioned the difficulties their own

schools had in obtaining people with sufficient content knowledge to take the PD coaching position. Amanda and Brenda each felt that teachers could actually learn content from students as they listened to them work on statistical tasks. Participants proposed attacking the problem of insufficient content knowledge using a variety of different strategies rather than honing in upon a single course of action.

Although most of the attention in regard to the issue of implementation resources needed was directed toward content knowledge development, some participants did mention the need for enhancing teachers' pedagogical knowledge. As part of the discussion surrounding the role of PD coaches, Abby mentioned

> I think someone who is teaching statistics may need a refresher course on the content as well as suggestions on ways to teach the skills. I do not have a math coach but I assume that would be part of that person's job responsibilities.

Andrea and Cecil each mentioned specific aspects of pedagogy they would need to learn more about in order to implement the GAISE guidelines. Andrea was concerned about tailoring instruction to meet the needs of students at different levels of understanding:

> Is it possible to have different levels in the same class? The report references that children in middle school can't just start at level B if they have no experience with statistics. What happens when some children grasp the concepts and others don't? Can you have Level A and B students in middle school, in the same class? Can you have an elementary child move onto level B before others have achieved level A understanding? If these scenarios present themselves, how does one teach to the differences? Statistics seems a little different than when adaptations are made to accommodate the various abilities when teaching other topics.

Cecil shared the view that "statistics seems a little different" when compared to other topics, stating that he would like to see research on cooperative learning strategies specific to the subject of statistics. Andrea and Cecil, therefore, saw the task of building pedagogical knowledge not necessarily as the accumulation of new teaching methods, but rather understanding how established methods might translate to the context of teaching statistics.

Curricular resources supporting the GAISE guidelines were also seen by participants as important tools for GAISE implementation. Amanda noted the need for texts and curricular materials with problems set in contexts that were understandable to students. Becky, Abby, Candice, and Cindy all mentioned the need for texts that contained instructions for using technology like graphing calculators. Cindy, for example, stated

> The graphing calculator is a powerful tool if you know how to put the info into the calculator. I have seen some stats books that have an instruction book just for using the graphing calculator. I am sure it would be of great use to the teacher. These instructions could also be given to the students as they were needed or as the course progressed.

Finally, Cecil, Becky, Marie, Brenda, and Abby all contributed to a conversation about the importance of having a text that did not contain errors. Becky explained, "One minor mistake in an example could result in student misunderstanding. But I have found that it may take several editions until all flaws are eventually diminished because it is very difficult to be perfect in the first text published." The thoughts that were expressed about the type of curriculum needed to support the GAISE guidelines helped to supplement the information gained through the wiki task, as teachers discussed in more detail the types of curricula and support materials they felt would be necessary.

Question 5: Descriptions of GAISE-aligned teaching strategies Some of the descriptions of GAISE-aligned pedagogy are implicit in the results reported in the

previous sections of this paper. For example, participants identified "real world" problems as hallmarks of GAISE-aligned teaching, even though they did not discuss differences in the role of context between statistics and mathematics problems. Cooperative learning was another strategy mentioned as characteristic of the pedagogy GAISE appeared to endorse. Andrea's observation that students may be at several different levels of statistical understanding led others to identify "differentiated instruction" as another pedagogical strategy characteristic of a GAISE-aligned classroom. Abby explained this concept in the following manner:

> I think that most children are on different levels, regardless of the content being taught. The document lays out a "sequence" in which statistics should be taught but I feel certain that students are at different levels of understanding. It is necessary for teachers to meet the needs of all of their students by differentiating instruction so I do not think statistics would be viewed any differently. It would seem to be possible for a student in elementary school to move up to a "level B" as long as the teacher was able to teach to that level while still meeting the needs of the other students. In the end, it would look like the juggling we seem to do most days.

Abby's comment appeared to be aimed at characterizing GAISE-aligned pedagogical strategies to be similar to already-existing ones, equating the task of working with students at different levels of statistical understanding to "the juggling we (teachers) seem to do most days." Her statement matched some participants' tendency to think about GAISE-aligned teaching in terms of seemingly already-familiar pedagogical strategies like usage of "real world" problems and cooperative learning.

Although participants tended to characterize GAISE pedagogy in terms of familiar strategies, there was some discussion about specific, new activities from the document that teachers might try in their own classrooms. The following exchange is illustrative:

> *Amanda*: I thought that the activity of putting students in line by the number of letters in their name was an excellent way to get students to understand median. They can actually see the concept of the same number of students on each side…Great ideas for conceptual learning. I would love to use them.
>
> *Abby*: I personally love the idea of creating a stem and leaf plot to show the jumping distances of the boys and girls in a class. It is a nice visual way for the children to see how the data 'look.' My children would love to go outside on a sunny day to collect data!

Therefore, although there was not much evidence of teachers exhibiting large-scale pedagogical paradigm shifts in response to the GAISE document, they did appear to add some ideas for individual lessons to their existing pedagogical thinking structures.

Question 6: What would be lost with GAISE implementation Very few discussion board posts mentioned drawbacks to implementing the GAISE guidelines. Among those who did express reservations about implementation of GAISE was Becky, who stated "This reform would have to include … teaching existing teachers new information… This may upset existing teachers that are already stressed…There just doesn't seem to be enough time in the day." Becky's observation implied that teachers' peace of mind might be compromised by GAISE implementation. Chad echoed Becky's concern: "Every faculty meeting I hear, 'well if this gets added on, what will get taken away?' Many existing teachers get uncomfortable with too much change." Becky also expressed concern about possible ill-effects on students:

> The curriculum is designed to build from concept to concept but I think that if this were to be incorporated into another area such as algebra it would be so much information and conceptual understanding it would be overwhelming for the students.

> Students obviously aren't even understanding the information they have now from what test scores show. Statistics I found to be difficult, it is a very different kind of math.

Finally, Andrea wondered aloud if the GAISE and NCTM recommendations were aligned, fearing a loss of consistency if there were conflicts between the two.

5. DISCUSSION

The overarching goal of the present study was to help provide guidance to statistics educators seeking to make the implementation of the Pre-K-12 GAISE guidelines a reality. Toward that end, this section will concentrate upon distilling the focus group discourse into a set of working hypotheses about actions that statistics educators need to take as they engage in this task. The working hypotheses distilled from the data of the present study will also be compared against related prevalent themes in the larger body of literature on mathematics education, statistics education, and educational reform. The hypotheses that will be made can be grouped into two main categories: actions that need to occur within the context of teacher education and actions that need to be taken in the arena of educational policy development. The findings of the present study suggest that statistics educators must be active in both settings if the intended curriculum outlined by GAISE is to become the implemented curriculum in grades Pre-K-12.

5.1. THE SETTING OF STATISTICS TEACHER EDUCATION

Participants in the present study affirmed the Conference Board of the Mathematical Sciences (2001) observation that there is a great need for teachers to develop statistical content knowledge. The need for enhanced teacher content knowledge was brought up during the wiki activity as well as the discussion board discourse about resources that would be necessary to implement GAISE. The focus group helped shed some light on approaches that might be taken to help teachers build their content knowledge. They suggested various different avenues for content knowledge development, including: taking college courses, learning from curriculum materials, working with professional development coaches, and learning from students. It became apparent that no single approach would work effectively for all teachers as they began to discuss the viability of some of these different avenues with one another. For example, the idea of relying upon a professional development coach was less enthusiastically accepted by teachers working in schools where the individual assigned to that role did not have the necessary content knowledge. The idea of learning from students was brought up but not as widely discussed as learning from curriculum materials. An important message from this exchange among teachers is that when statistics educators design programs aimed at developing teachers' content knowledge over a sustained period of time, they will benefit from taking into account the professional development resources available within teachers' school settings as well as teachers' own preferred modes of learning. A comprehensive program for developing teachers' statistical content knowledge is likely to need a multi-pronged approach that coordinates various different avenues. The means for the development of statistics content knowledge would seem to be similar to those for developing mathematics content knowledge, in that deep understanding of mathematics is also developed through various practice-based means apart from formal courses and workshops (Ma, 1999).

Although focus group participants were quite conscious of the need to develop knowledge of the content they would be responsible for teaching if the GAISE guidelines

were implemented, they were seemingly not as conscious of the need to develop knowledge of how statistics differs from mathematics. In fact, during the wiki and discussion activities, participants often spoke of statistics as if it were a branch of mathematics. Even though the GAISE document explicitly discusses how statistics differs from mathematics, an in-depth conversation of this issue did not occur during the focus group discourse. The lack of this element from the conversation meant that teachers missed opportunities to consider issues like how the role of context differs in statistics and mathematics problems. An implication is that statistics educators may need to be especially aware of drawing teachers' attention toward this content-related issue as they design and implement teacher education programs. As Rossman, Chance, and Medina (2006) noted, knowledge of the differences between mathematics and statistics is necessary if teachers are to anticipate how students' statistical reasoning differs from mathematical reasoning, and if teachers are to design lessons that accurately represent the discipline.

Statistics educators involved in teacher education should also be particularly aware of the need to help teachers delve beneath the surface of the pedagogical practices that are recommended in GAISE. For instance, the wiki activity showed that participants were conscious of the fact that the GAISE document recommended the usage of technology, but participants did not discuss *how* the technology might be used for teaching specific statistical content. As Franklin and Garfield (2006) noted, there is a danger that teachers may use technology just for the sake of using technology if they don't understand the particular pedagogical roles that software and graphing calculators can serve. The same danger seems to exist for other GAISE-recommended pedagogical strategies (e.g., using cooperative learning for the sake of using cooperative learning). One strategy for helping teachers think in depth about the substance of pedagogical recommendations would be to guide them in the direction of discussing the overlap between pedagogical process and statistical content. When participants began to think about the overlap between these two areas during the wiki and discussion board activities, they moved toward matching pedagogy to the specific developmental levels described in GAISE. The wiki material that fell exclusively in the process category was more vague and general in its discussion of pedagogy for carrying out GAISE-aligned lessons. Statistics educators can serve a valuable role in pushing teachers to articulate in detail how specific teaching strategies might be used in order to teach specific content, and then in turn challenging the efficacy of their proposed pedagogical practices when necessary. Doing so can help ensure that teachers do not interpret GAISE recommendations as slight revisions to their existing pedagogical thinking frameworks in cases where there is actually a larger disparity between the teacher's thinking and what is actually recommended in GAISE.

Statistics teacher educators should also attend to helping teachers develop curricular knowledge beyond the pedagogical knowledge needed to carry out individual lessons. When teachers began to discuss how they might fit GAISE recommendations within existing curriculum sequences, there was a fair amount of anxiety coupled with a general lack of ideas about how this might be accomplished. Some of the ideas that were floated tended to compartmentalize or confine statistical material to being taught "after the standardized test," in a "non-assessed course," or as the last chapter in an algebra textbook. Teachers need to understand how these approaches to teaching statistics would be likely to lead to a lack of overall curricular coherence and to develop more viable approaches to curriculum development. Involving teachers in the construction of the scope and sequence of a GAISE-aligned curriculum may help provide a vision of how the GAISE recommendations might be carried out within their schools. Teachers in the focus

group expressed a desire to understand such a viable scope and sequence on the wiki as well as on the discussion board.

5.2. THE ARENA OF EDUCATIONAL POLICY DEVELOPMENT

Given the current political climate of high-stakes testing and accountability, the GAISE guidelines are not likely to influence the attained curriculum in the United States unless statistics educators are involved in helping to shape the curriculum standards documents that teachers are held accountable for implementing. Even if the goal of developing teachers' knowledge to the point that they could map out viable curricular sequences was met, it is likely that the sequences they designed would be overruled by state-level curricula and accompanying standardized tests reflecting different sets of priorities (Darling-Hammond, 2006; Thomas, 2005). The power and control exerted by the state-level curriculum was apparent in various facets of the focus group discourse. In one such instance in the present study, teachers were even hesitant to introduce the ideas of positive and negative association within the context of teaching lines of best fit because lines of best fit were mentioned in the state standards document, but positive and negative association were not. In another instance, the idea of integrating statistics with science and social studies was put in doubt for fear that teaching statistics in another subject area would impinge on the standards for that subject. Such extreme adherence to state standards seems to reflect a perception of state standards documents as highly prescriptive laundry lists of discrete topics that need to be learned in a specific order. Statistics educators who are involved in the formulation of state standards documents can advocate for the richer representation of statistics provided in GAISE so that teachers are given license to construct lessons that more authentically represent the discipline of statistics. Such collaborations between statistics educators and state-level authorities have taken place in some cases (Franklin & Mewborn, 2006), but need to become the norm in all states if GAISE is to substantially impact U.S. curricula.

6. CONCLUSION

There is a real danger that the GAISE guidelines could become lost among the proliferation of standards documents that lay out expectations for the teaching of statistics and ask for teachers' attention. Such a scenario can be avoided if statistics educators are successful at working on several fronts simultaneously: developing teachers' content, pedagogical, and curricular knowledge, while also working (in the United States) to influence state-level curriculum documents. As these tasks are carried out, teacher educators should remain conscious of attending to individuals' perceptions of the GAISE reform recommendations. Although the present study has provided a set of working hypotheses about actions that need to be taken to move toward making GAISE the implemented curriculum in the United States, additional useful hypotheses are likely to emerge as teachers and policy makers are further engaged in discourse about teaching statistics. The ultimate success or failure in making the vision of the GAISE guidelines a reality will depend, in large part, upon carefully attending to those discourses and taking actions that are informed by their substance.

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APPENDIX A: INSTRUCTIONS FOR PARTICIPATING IN THE ONLINE FOCUS GROUP ACTIVITY

- The activity will take place from May 10-23. To prepare to participate, read the introduction and framework of the Pre-K-12 GAISE report online (pp. 1-21): http://www.amstat.org/education/gaise/. Then choose one of the following three sections of the report to read in detail: level A (pp. 22-35), level B (pp. 36-59), or level C (pp. 60-88) (your choice of level will depend on your teaching interests).
- You will engage in two different types of online interaction during the activity: (i) The collaborative construction of a wiki; (ii) Discussion board conversation. The webpage for both activities is: [*address for accessing the assignment inserted here*]. The wiki appears on the top portion of the page, and the discussion board on the bottom portion.
- For the wiki portion of the website, you will collaboratively design a document that can be used to evaluate statistics textbooks and curriculum materials. The finished document should contain questions that will help teachers at all levels, Pre-K-12, select textbooks and curriculum materials that support the GAISE recommendations. Your class experiences of working in groups to evaluate textbooks and evaluating data analysis test items may be helpful as you construct this evaluation document. You should make contributions to the wiki on at least two different days during the activity. Each time you revise the wiki, a pop-up box will appear to ask you to explain the reasons for the revision. You should fill in the pop-up box each time you make an edit to explain the reasons for it.
- The discussion board portion of the website should be used for a reflective discussion about the content of the GAISE document. Some questions you might choose to discuss include (but are not limited to): (i) How do the GAISE recommendations compare to current practices for teaching statistics?; (ii) What of value could be accomplished if the GAISE recommendations were implemented?; (iii) Why would it be valuable to align current teaching practices with the GAISE recommendations?; (iv) What would GAISE-aligned teaching strategies look like?; (v) What resources would be needed to carry out the GAISE recommendations?; (vi) In the process of aligning teaching practices with the GAISE recommendations, what would be lost that we would regret? You should make posts to the discussion board on at least four different days during the activity. Feel free to make as many posts as you wish. There is no limit to how many posts you may make. Some of your posts should be replies to other discussion board participants.

If you experience any difficulty completing the activity, email me immediately at [*author's email address inserted here*]