The Challenges Facing Secondary School Mathematics Department Heads and a Web Resource to Support Them

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Abstract

The head of a secondary school mathematics department faces many challenges in providing the best math experience possible for students. There are a variety of matters, among them curriculum, pedagogy, technology, and staff management, that demand a department head’s time and energy. This project has two components: an investigation of the priorities and challenges that secondary school mathematics department heads face and the development of a web resource designed specifically to benefit secondary school mathematics department heads. After an initial investigation it was clear that very little exists to provide targeted support for this particular group, and so one of the main goals for this thesis project was to create a resource that would be useful for department heads.

As part of the first component of this project, a survey of secondary school math department heads was conducted. The purpose of this survey was to identify issues that are problematic for department heads and to analyze the data to see what common experiences mathematics department heads share. One finding from the survey was that a majority of department heads would appreciate having a forum to find resources and share information with each other. Many department heads also reported not having enough time to perform crucial aspects of their job, such as observing teachers in the classroom and considering alternative curriculum options.

The results of the survey were used to inform the second component of the project, the development of a web resource catering specifically to secondary school
mathematics department heads. This resource, titled “The Math Chair Connection,” focuses on issues relevant to secondary school mathematics department heads. It includes both a website with links and resources as well as a discussion group for department heads. While this thesis project was the catalyst for this resource’s creation, the web resource will be maintained on an ongoing basis after the thesis project has been completed.
Dedication

To Amy, Sara, & Katie for their

laughter, love and support.
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Chapter 1  Introduction

The head of a secondary school mathematics department faces numerous challenges in providing the best math experience possible for students. There are a variety of matters, among them curriculum, pedagogy, technology, and staff management, that demand a department head’s time and energy. This project includes two components: an investigation of the priorities and challenges that secondary school mathematics department heads face and the development of a web resource designed specifically to benefit secondary school mathematics department heads, hereafter referred to as “department heads.” The primary instrument of investigation in this project was a survey given to department heads that sought to identify the major issues that department heads face in this day and age (the survey instrument appears in Appendix 2). The results of this survey, and the author’s own experience as a department head, were used to inform the creation of a web resource for department heads that has two main purposes. The first is to create a repository of information, and links to information, that will be a helpful resource for department heads. Second, the web resource aims to connect department heads to each other through a discussion group, so that department heads can learn from each other and provide advice to their peers.

Background

In March 2012, I was named mathematics department head of a grade 7-12, all-boys private school at which I am currently in my sixteenth year of teaching. Over my
two years as department head, I have experienced the variety of responsibilities the
position entails and the challenge of meeting each of these responsibilities. Overall, I
have nineteen years experience teaching mathematics in private schools at the secondary
school level, specifically grades 7-12, in courses ranging from Pre-Algebra through AP
Calculus BC. Over my years of teaching, I have benefitted greatly from the variety of
resources available in this digital age. This project affords me the opportunity to create a
resource with the potential to benefit a group, secondary school mathematics department
heads, that I know from my own experience faces many challenges.

This project arose out of my motivation to explore and to identify the challenges
that department heads face and to create a resource that would benefit the mathematics
teaching community, specifically department heads. As I began thinking about this
project, I found myself reflecting on an experience I had during my second year teaching.
Prior to that year, I volunteered to teach AP Statistics, a course which our school was
planning to offer for the first time during the 1996-97 school year. (This was the first year
that the College Board administered the Advanced Placement Examination in Statistics.)
I was the only teacher in my department teaching AP Statistics, and I had little support
internally in my teaching of the subject. I found myself looking outward to the World
Wide Web for support and resources, discovering a discussion group dedicated to AP
Statistics that ended up being an invaluable support to my teaching and which I still find
useful to this day. This discussion group was a supportive forum where statistics teachers
could ask questions on any topic and receive informed advice from experienced teachers.
Through reading and participating in this forum, I have learned an immense amount over
the years about the teaching of statistics, and I know my teaching of statistics, and thus
the experience my students have in my class, has benefitted as a direct result of the help obtained through this discussion group.

Now, in 2014, as a department head, I find myself in a similar situation as the only person at my school in a given role. Of course, there are now more issues to deal with than simply my own teaching. In addition to managing my own classes, I am responsible for curriculum choices, pedagogy, staff development, student placement, and any other math-related issue that arises over the course of the year. Looking outward now is not so easy, for there are currently so many resources available that it is difficult to know where to begin. Thus, I hypothesized that the creation of a web resource attuned specifically to the needs of secondary school mathematics department heads – a place where useful information could be pulled together and shared – would be helpful not only to me but also to other department heads. There are, of course, voluminous resources available both in the digital and non-digital realm, but in my research, I have not found a web resource specifically designed for secondary school mathematics department heads.

In the latter stages of my project, another department chair alerted me to an organization called the National Council of Supervisors of Mathematics (NCSM) which I had not come across in my research. This organization serves a broader audience than I intend to reach (it includes a K-12 grade range and is not restricted to department heads), but it is precisely the type of organization that I wished I had known existed when I started my work as a department head. Information about this group and a link to their web site is now available on my web resource for department heads. While my web resource and discussion group will be in no way a replacement for such a national
organization, it is this type of resource that I hope department heads can learn about through my web resource.

**Similar Research**

While there is certainly much literature on the department head role (particularly in post-secondary education), an investigation into the literature did not yield recent research that focused specifically on secondary school *mathematics* department heads and the specific challenges they face. (There is certainly much research on mathematics *teachers* but there is not as much focus on department heads.) Ernest (1989) examined the role of mathematics department heads in British secondary schools. This paper attempted to use existing research to answer the following questions, “What are the demands on the head of the mathematics department? Are these constant demands, or are they changing? How are heads of departments responding to these demands? What roles is the head of department expected to fulfill? What problems are arising and what are their causes?” (Ernest, 1989). The paper reviews evidence “which suggests that heads of mathematics departments: 1. find their positions difficult and stressful, and 2. often fail to perceive and meet the demands of their positions in full” and suggests that this is due to three factors:

- Heads of mathematics are commonly not:
  1. fully informed of the role they are expected to fulfil;
  2. suitably trained to meet the demands of their position;
  3. given sufficient time to meet the demands of the position. (p. 329)

Though this study is 25 years old, its conclusions resonate with my own experience, particularly with regards to having enough time to perform the role. As the survey results
will indicate, this concern about time, or lack thereof, is shared by many department heads.

Kruskamp and Zepeda (2007) performed a case study on three department heads (math, science, and social studies) in a southeastern United States high school that focused on the issue of instructional supervision of members of their department. Departmental supervision was a component of the department head survey, and the findings of this study listed below resonate with my own experience as a new department head and as a long time teacher on the receiving end of instructional supervision:

From interview data, three primary findings emerged.
1) The high school department chairs experience role conflict and ambiguity relative to providing instructional supervision.
2) The meaning of instructional supervision for the department chairs was intuitive and reflected in differentiated approaches; and
3) The constraints of instructional supervision include time and lack of emphasis. (p. 44)

The mention of time as a constraint of instructional supervision is particularly interesting to me, for, as we will see, time is a challenge for department heads in many aspects of their role, not just in instructional supervision. The survey in Appendix 2 has an item concerning time, and in Chapter 3 we examine in detail the responses to this item.

Challenges for Department Heads

In this section, I elaborate on two specific areas in which, based on my own experience prior to starting this project, I envisioned department heads facing challenges. These two areas are curriculum and professional development, and the results of the survey indicate these are indeed two challenging aspects of the department head role. It is my belief that in each of these areas – and in several other areas not described in detail here – information that may be useful in making decisions is difficult and time-
consuming to obtain. Useful information could come from department heads that have experience with the same challenges, and facilitating the exchange of such information is a major goal of the web resource.

Department heads are responsible for the curriculum in their departments. From coordinating the order and scope of topics being taught to selecting textbooks and supplementary resources, the department head has a significant impact on what ideas are being taught and what materials are used to teach them. In my own case, I am acutely aware of what ideas and materials our school is using, somewhat aware of what a few neighboring peer schools are using, and uninformed about what the large majority of schools are using. If I am not content with, say, our current geometry book, it would be beneficial to have access to a group of department chairs to whom I could pose the question of what alternative geometry resources are out there and, more importantly, get vital feedback about what department heads have found particularly successful. The proposed web resource could be an environment in which department heads could not only get information but also contribute their opinion and their expertise to help their colleagues.

My role as department head includes the charge to oversee the instruction students are getting, through both formal classroom observations and informal discussions with teachers in my department. As part of encouraging the professional development of members of my department, I also must suggest ways in which they may improve their teaching by attending conferences, taking summer classes, or even seeking a graduate degree. This year, I am working with a teacher in his second year at our school and in his third year of teaching. The teacher is quite enthusiastic about furthering his development
and wishes to attend workshops, conferences, and possibly graduate school. While I know of some options for summer conferences and graduate classes and can investigate options that are out there, I am not an expert on the subject. I imagine there are department heads throughout the country who have similar teachers on their staffs and have dealt with a similar situation. Tapping into the knowledge other department heads have on this topic would presumably be useful to other department heads who are providing counsel for their teachers.

The survey results will identify many of the challenges that department heads face. Before discussing the results of the survey, it is obvious that teaching mathematics is a challenging proposition, as there is a variety of sometimes conflicting perspectives on the best way to serve the needs of students. Thus, before examining the survey results, we will consider some issues about teaching and learning mathematics that are helpful for department heads to be aware of and to consider.
Chapter 2  Teaching Mathematics

The first half of the title of this project – “The Challenges Facing Secondary School Mathematics Department Heads” – refers to two aspects of the life of a department head. First, by using the survey results, the goal was to learn about the self-identified challenges that department heads face. Second, we must acknowledge that teaching mathematics well is a formidable task in light of the shifts in thinking around mathematics education that have occurred over the last 30 years. Thus, before moving into details about the department head role, it is useful to provide some context about the environment in which department heads are not only teaching but also working to support their teachers.

The interpretation of what it means to “understand” mathematics has changed over the years. For much of the 20th century, understanding mathematics meant that students mastered rules and procedures presented by a teacher and then demonstrated their mastery of these rules and procedures on assessments (Schoenfeld, 1992). For the interested reader, Schoenfeld (2004) provides an informative summary of trends in mathematics teaching and curriculum during the 20th century. There is an extensive body of research over the past 30 years dedicated not only to defining “mathematical understanding” but also to formulating the best way to develop it and to assess it. In this chapter, we describe current conceptions of mathematical understanding and the implications for curriculum that arise from such conceptions.
The “Public” View of Mathematics

The research about mathematical understanding and curriculum that will be mentioned in this chapter is not a part of the public discourse, and this section provides a few examples of how math has been presented in the mainstream press. A recent piece by the Editorial Board of the New York Times (“Math Boring”, 2013) begins with a bleak outlook:

American students are bored by math, science, and engineering. They buy smartphones and tablets by the millions but don’t pursue the skills necessary to build them…. Nearly 90 percent of high school graduates say they’re not interested in a career of a college major involving science, technology, engineering, or math, known collectively as STEM, according to a survey of more than a million students who take the ACT test. (p. SR10)

While the first sentence of this piece is a broad generalization – plenty of students are energized by math, science, and engineering – the sentiment expressed by that opening is not uncommon in American culture and the concern about lack of interest in the STEM fields is not entirely unfounded, as evidenced by the high percentage of high school graduates not interested in STEM majors. Analyzing the causes of such a worrisome state of affairs is a complex undertaking (and one outside the scope of this project), but such a dire pronouncement is especially depressing given the fact that mathematics teachers have a variety of resources and technologies available to them. But regardless of the resources teachers have available, discussion about teaching mathematics can be broken into two broad categories captured by the following questions: “What content do students need to learn?” and “How is the content to be taught to students?”

The Common Core State Standards, released by the National Governors Association in 2010, outlines not only what should be covered in mathematics in a K-12
curriculum but also describes eight standards of mathematical practice. These eight standards of mathematical practice support the conception of understanding that we will define in this chapter. Assessing the validity and appropriateness of the Common Core State Standards is also outside the scope of this project, but some consideration of the effects of the implications of the standards is not. One view sees the Common Core Standards as a continuation of the status quo (Garfunkel & Mumford, 2011):

Today, American high schools offer a sequence of algebra, geometry, more algebra, pre-calculus, and calculus (or a “reform” version in which these topics are interwoven). This has been codified by the Common Core State Standards, recently adopted by more than 40 states. This highly abstract curriculum is simply not the best way to prepare a vast majority of high school students for life. (p. A23)

Another view recognizes the potential benefits of the Common Core Standards, but still expresses concern about its implementation (“Math Boring”, 2013):

The Common Core math standards now being adopted by most states are an important effort to raise learning standards, particularly in primary and middle school, when many students begin to fall behind. They encourage the use of technology and applied thinking, moving students away from rote memorization…. But the standards also assume that all high school students should pursue a high-level math track, studying quadratic equations, transformational geometry and logarithms. The standards need more flexibility to ensure that they do not stand in the way of nontraditional but effective ways to learn, including career-oriented study. (p. SR10)

Depending on the nature of a particular school, course content may or may not be prescribed in detail. Private schools generally have more leeway than public schools concerning the material that must be covered, but pedagogy is something all schools, under the leadership of the mathematics department chair, must confront individually.

The question of “What content do students need to learn?” is difficult to answer in a satisfying way, but it is a question that the makers of the Common Core Standards
sought to address. Publishers naturally want to have their textbooks aligned to the Common Core Standards, and the following critique (Baker, 2013) of one such textbook alignment shows that simply aligning existing materials to the Common Core Standards is not a guarantee of success:

*Algebra 2 Common Core* is, in other words, a typical, old-fashioned algebra textbook. It’s a highly efficient engine for the creation of math rage: a dead scrap heap of repellent terminology, a collection of spiky, decontextualized, multistep mathematical black-box techniques that you must practice over and over and get by heart in order to be ready to do something interesting later on, when the time comes. (p. 33)

While the Common Core Standards outline what topics to teach and standards for mathematical practice, they do not prescribe the exact content to teach or the pedagogy that should be used to enact the standards. This brings us to the second fundamental question – “How do we teach the material?” The way in which material is presented to students affects the quality of student understanding, and in the following sections we consider both modern conceptions of understanding and the impact that curriculum has on student learning.

**Developing Mathematical Understanding**

Romberg and Kaput (1999) summarize well the expectations and limitations of “traditional” school mathematics:

Mathematics is perceived by most people as a fixed, static body of knowledge. Its subject matter includes the mechanistic manipulation of a variety of numbers and algebraic symbols and the proving of geometric deductions. This perception has determined the scope of the content to be covered and the pedagogy of the school mathematics curriculum. Specific objectives, which students are to master, have been stated; the teacher’s role has been to demonstrate how a concept is defined; and students have been expected to memorize facts and to practice procedures until they have been mastered. (p. 4)
This view of mathematics casts a student into the role of a “scribbler” rather than expecting the student to be a “thinker” (Herbal-Eisenmann, 2007). The Standards published in 1989 by the National Council of Teachers of Mathematics (NCTM) and the Common Core State Standards released in 2010 each provide guidelines for educators to follow in striving to educate students who “think” about math rather than “scribble” about it. Before we can consider how students develop mathematical understanding, we need a working definition of understanding. Barmby, Harries, Higgins, and Suggate (2007) define understanding as follows:

- To understand mathematics is to make connections between mental representations of a mathematical concept.
- Understanding is the resulting network of representations associated with the mathematical concept. (p. 42)

While this definition of understanding is useful as a model for picturing, in terms of connections and networks, what understanding is, it does not address how such understanding can be developed. To address this issue, Carpenter and Lehrer (1999) propose “five forms of mental activity from which mathematical understanding emerges.” These are

(a) constructing relationships  
(b) extending and applying mathematical knowledge  
(c) reflecting about experiences  
(d) articulating what one knows  
(e) making mathematical knowledge one’s own (p. 20)

The traditional mathematics curriculum, as described previously by Romberg and Kaput (1999), does not gear itself to promoting these “forms of mental activity.”

As an example of how a different view of understanding can influence pedagogy, we consider the Calculus Consortium based at Harvard University. Formed in the early 1990’s, the consortium champions the “Rule of Four” in the teaching of Calculus. This
rule stipulates that in teaching Calculus, instructors should emphasize analytical (or symbolic), graphical, numerical, and verbal aspects of a topic, rather than focus exclusively on the analytical. The hallmark of this approach is the making of connections between different representations of the same topic (Hughes-Hallett et al., 2005). To understand, for instance, the concept of the derivative, a student must understand the analytical (the limit definition), graphical (slope of the tangent line to the curve at a point), the numerical (estimating the derivative from a table of values), and the verbal (explaining the meaning of the derivative.) In my experience, the questions asked on the AP Calculus exams force students to understand concepts from these multiple perspectives, thus promoting the modern conception of mathematical understanding and the forms of mental activity from which it emerges. One significant challenge for a department head is to champion practices and to find curricula that will help students develop this modern conception of understanding.

Curriculum and Influence on Student Learning

The curriculum that will be taught is, of course, a prime concern for a department head, but in this section we consider more broadly the influence curriculum has on student learning. Stein, et al (2007) surveyed the research concerning how mathematics curriculum influences student learning. This research is important for department heads to consider because it reveals that the curriculum, in and of itself, is not the sole influence on the experience that students have:

Research on teaching and curriculum, however, has revealed that a substantial difference exists between the curriculum as represented in instructional materials and the curriculum as enacted in the classroom by teachers and students. (p. 321)
In their survey of the research, the authors distinguish between the written curriculum, the intended curriculum, and the enacted curriculum. The written curriculum is what is provided in the curricular materials while the intended curriculum is the results of teachers’ interactions with the written curriculum as they decide how to implement the curriculum in their classrooms. The enacted curriculum refers to the actual teaching and learning that occurs in the classroom (Stein, et al, 2007).

This examination of the research on curriculum and student learning highlights the need to keep all three aspects of curriculum in mind when considering the effects on student learning:

> When considered together, the research conducted on the phases of curriculum use paints a complex picture of how curriculum influences student learning. More specifically, it points to the fallacy of assuming that the materials themselves are the primary agent in shaping opportunities for student learning and instead uncovers the important role played by the interpretive and interactive influences of teachers and students. (p. 323)

The implication of this research for a department head is clear. A department head should not expect to change, say, a geometry textbook without considering the way that his or her teachers will interact with the new resource. Simply changing the book is not enough. Such change must be accompanied by an understanding that how the teachers approach the new book and the manner in which they convey the curriculum to students will be determining factors in how students understand the material. Curriculum by itself will not get the job done, and department heads must keep this in mind in considering how to affect student learning.
Implications for Department Heads

As the research indicates, developing mathematical understanding is not simply a case of getting the “right” curriculum and unleashing it on students. Department heads must carefully consider how their teachers will interact with the curriculum and communicate it to their students. Presumably, many teachers learned math in the “traditional” way and not in the manner that fosters the development of understanding as defined above. Department heads face a challenging task in not only finding curricula that will support their teaching and learning goals but also in working to get their teachers to teach in what may be an unfamiliar way.
Chapter 3  Being a Department Head

Into this complex environment steps the mathematics department chair. Often classrooms teachers themselves, department chairs oversee a school’s philosophy about math and provide leadership to the teachers in their department. They must articulate a vision about what mathematics should be taught. Should the mathematics that is to be taught be prescribed for them, say by the Common Core Standards, they still must give guidance and feedback on how the standards should be taught. If teaching the aforementioned “Rule of Four” in each subject is a departmental goal, department chairs convince their teachers to work towards achieving that goal.

Mirra (2003) outlines six principles which the National Council of Teachers of Mathematics in 2000 proposed as a foundation for high-quality mathematics programs. These six principles – Equity, Curriculum, Teaching, Learning, Assessment, and Technology – should ideally guide a school in putting together its mathematics program (Mirra, 2003). Secondary school mathematics department heads have a primary role in ensuring that a school’s mathematics program adheres to these six principles in working to meet the needs of all its students. This project seeks to identify the aspects of the department head role that are particularly challenging and that can be supported by creating a web resource connecting mathematics department heads to relevant information and, perhaps more importantly, to each other.
Survey Description

In late August 2013, a pilot survey was conducted as part of the thesis project; invitations were sent out to 25 mathematics department heads to complete a survey through the online service SurveyMonkey about the department head role. Ten responses were received which were helpful to provide input as to what other questions should have been included. The survey was then fine tuned based on these results.

In November 2013, approximately 150 mathematics department heads throughout New England (mostly in Massachusetts) were e-mailed descriptions of this project and an invitation to complete a survey, again through SurveyMonkey. E-mail addresses were obtained through visiting school websites and department heads were e-mailed directly. Sixty department heads responded to the survey, 30 from private schools and 30 from public schools. This was not a random sample and no claim is made that the survey results are accurately representative of the population of all department heads. But the results do reflect the thoughts and beliefs of a group of individuals in a similar position at a shared point in time. The purpose of the survey was to hear the opinions and thoughts of a number of department heads and to create a web resource that would help to serve their needs.

The responses to two survey questions which relate to the web resource “The Math Chair Connection” give evidence that the resource could fulfill a need in the department head community. In response to an open-ended question asking for suggestions concerning information or resources they would find helpful to have on the site, 62% of the department heads responded with specific thoughts or requests. In addition, when asked about their interest in participating (either by reading or posting
messages) in an online discussion group addressing issues faced by department heads, 87% of the respondents indicated that they would be interested. With this feedback received, it was possible to determine additional content and information that should be added to the web resource in response to this information.

Three Most Important Roles

Clearly, department heads have a myriad of responsibilities and answers to the open-ended question “What do you view as the three most important roles of a mathematics department head?” included a wide range of responses. These text-based responses were evaluated and classified into 15 different categories. There were four areas that stood out among the 15. First, 73% of the respondents identified some aspect of curriculum development/alignment/supervision as an important role for a department head. Two separate categories that dealt with staff management – “supervision and evaluation of teachers” and “support department members” – were mentioned by 40% and 47% of the department heads, respectively. Finally, 47% of the respondents mentioned being a leader as one of the three most important roles. This sentiment concerning leadership was expressed in a variety of ways. A few examples follow:

“Creating an environment that is conducive to great learning.”

“Keep everyone in the department working toward a common goal.”

“Creating a vision for the department using the strengths of the department members you have.”

“Moving department forward in terms of pedagogy and curriculum.”

Curriculum management, teacher supervision and assistance, and general leadership are three themes that jump out from the responses to this question. One would reasonably
presume that for those department heads that did not list one or all of these in their top three that their job entails their taking on responsibility in each of these three areas.

In addition to gathering information on what department heads identified as their three most important roles, the survey provided department heads the chance to offer advice for someone serving in the department head role. A selection of thoughtful responses is provided in Appendix 3. It is interesting to observe the range of ideas and topics expressed in this advice.

Time Analysis

What might be considered the most interesting data from the survey concerned how much time department heads felt they had to carry out some of the primary tasks of a department head. For seven different tasks, department heads were asked to rate whether they had “No time at all,” “Less than enough time,” “Enough time”, or “More than enough time” to complete each of the tasks (Table 1). In each of five of the seven categories, more than 60% of department heads responded with “No time at all” or “Less than enough time.”

Recalling that curriculum management, teacher supervision and assistance, and general leadership were three of the most mentioned themes in the three important roles item, it is concerning to observe that four of the five tasks fell into one of those three categories. To summarize, for the 57 respondents to this item:

- 50 (87.7%) had “Less than enough time” or “Not enough time” for “Searching for and evaluating alternative curriculum options”
- 46 (80.7%) had “Less than enough time” or “Not enough time” for “Reading math journals or other material to stay current”
o 44 (78.6%) had “Less than enough time” or “Not enough time” for “Making classroom observations of teachers” (56 respondents)

o 36 (63.2%) had “Less than enough time” or “Not enough time” for “Meeting as a full department to discuss curriculum”

The above results suggest the department heads do not have the resource of time to be as informed as they could be about the variety of curriculum that exists or the latest issues and topics in the mathematics community.

Of 57 respondents to the item concerning time, 37 have a reduced teaching load because of their department head duties while 20 do not. The data concerning time was broken down into two sub-groups, the “reduced load” group and the “not reduced load” group (Tables 2 and 3). The most interesting fact this breakdown reveals is that all 19 of the “not reduced load” heads who responded to this item had “No time at all” or “Less than enough time” for making classroom observations of teachers. The 12 department heads who indicated they had enough time for observations all teach a reduced load.

Informing the Web Resource Content

“The Math Chair Connection” is intended to help a specific educational group, the population of secondary school mathematics department heads. While I am aware of groups among regional subsets of this population, to the best of my knowledge there is not both a web resource and discussion group geared specifically to this entire population. In considering the content and organization of “The Math Chair Connection,” the results of the survey have been invaluable in getting firsthand knowledge of what department heads need and want. There are other factors that have influenced the construction of this resource, which are described in the following.
Recall that 77% of department heads indicated that they have “No time at all” or “Less than enough time” for reading math journals or other materials to stay current. This is clearly not an issue isolated to the mathematics department head community, as evidenced by the existence and success of “The Marshall Memo.” The Marshall Memo, written by educational consultant Kim Marshall, is a weekly publication “designed to keep principals, teachers, superintendents, and others very well-informed on current research and best practices in the field.” With over 4,000 subscribers, Marshall subscribes to 64 publications in the education field and selects 5-10 articles per week to summarize and provide links to when possible (Marshall, 2014). The content of the memo is wide-ranging, covering all disciplines and grade-ranges. It is hoped that one role of “The Math Chair Connection” would be to act as a smaller-scale, more-targeted version of the Marshall Memo, highlighting important results and information for department heads. The one difference would be that with the discussion group aspect of the web resource, encouragement would be given to other department heads to make suggestions about results and information to highlight.

As will be described in the next chapter, the survey results informed the initial construction of the web resource. The ultimate goal for “The Math Chair Connection” is that any secondary school mathematics department head would want to have the site bookmarked since they know that helpful information useful to doing their job can be found there. It should also be emphasized that the website will enable this project to be ongoing, as I intend to add and modify content on the site moving forward, with the aim of creating a resource that is dynamic and can respond to the requests and feedback of department heads.
Chapter 4  The Math Chair Connection

Creating an informative and productive website needs to be an intentional activity with a purpose and a defined population to which the resource should appeal. In thinking about the purpose of “The Math Chair Connection” a useful model has been the previously described Marshall Memo, which was relayed, incidentally, by a department head on the survey. “The Math Chair Connection” has the potential to be a smaller-scale Marshall Memo, focusing on a specific subject and a specific population. In addition, instead of one person doing all the collation of information, there can be multiple contributors that make suggestions concerning content.

The discussion group aspect of the web resource provides the opportunity to connect with other department chairs in an informal way. In conjunction with “The Math Chair Connection,” I moderate a discussion group that, as of March 2014, contains 47 department heads spread out throughout the country, and I am striving to share useful information with this group and promote productive discussion among group members. For example, in early March 2014, I received an e-mail from the College Board with information about the revised version of the SAT that will be given starting in April 2016. In case not all department heads received this information, I forwarded this e-mail to the group and posted a link to the College Board website on my website.

Contents of the Website

On January 7, I announced via e-mail to approximately 150 department heads the launching of the website “The Math Chair Connection” and invited these heads to join
the associated discussion group that would be associated with the site. In structuring the website, the goal was to keep several key principles in mind, based on my own experience and the feedback from the survey.

First, the goal was to create a site that would enable department heads to get important information they need, or links to such information, in one centralized place. It is likely the case that every teacher, in this day and age, has online resources they find helpful. The initial content of the website is meant to be a conduit to this information, reflecting what I have found useful in the past and what those who responded to the survey indicated has been useful or what they would find helpful. But unlike an academic paper or article that might provide such a resource for department heads, “The Math Chair Connection” has the potential to be a dynamic resource, responding to the needs, comments, and suggestions of department heads. In putting together this website, I make no claim that I have all the answers or know everything of value that is out there. Rather, the intention of the website is to share the information, knowledge, and experience of department heads, so that, ultimately, we can serve our students as best we can. One function of this site, as it is envisioned, is as a collective “bookmarks” resource for the department head community.

With this in mind, it was intended that the overall design of “The Math Chair Connection” would be straight-forward and not flashy. It is hoped that department heads will be able to find what they need easily and to make a comment or suggestion if they cannot find what they want. At the website home page, a user encounters a selection of topics in tabular form at the top of the screen (Figure 1). Clicking on any of these tabs leads to a page with links and resources on that specific topic.
Figure 1. Website home page.

The broad categories on the tabs are common topics of concern for department heads. As an example, selecting the “Professional Development” tab leads to a page with information about several graduate programs for teachers and a number of summer workshops, providing a handy resource for department heads working to inform their teachers of opportunities for professional growth. It should be noted that within each of the main pages are subpages that offer more detailed information. For instance, within the “Professional Development” page is a link to a subpage concerning AP Statistics summer workshops (Figure 4 of Appendix 4). Selecting the “Contests” tab sends the user to a page describing several prominent mathematics competitions for secondary school students (Figure 5 of Appendix 4), giving links to information about these contests and to problems from past competitions. It is intended that having these tabs on the home page will help department heads find the information they want or discover a resource they did not know existed. A summary of the nine main sections of the website and the rationale for each one can be found in Table 5 of Appendix 4.
Preliminary Results and Observations

When the launching of the web resource was announced in early January 2014 via e-mail to department heads, many positive comments were received about the creation of the site. Several department heads expressed gratitude and felt that the site had the potential to be a helpful resource for department chairs. The web resource will not be static and is a project whose development will be ongoing, and it is incumbent on me to provide material relevant to the department head experience on the web resource. The discussion group that is associated with the web resource has 47 members as of March 2014, and one discovery is that one challenge in starting a discussion group is simply getting the discussion going. It is presumed that for department heads belonging to this group, participating in the discussion is a small sliver in their pie of responsibilities and tasks that occupy their time. Through their joining the group, 47 department heads have shown they want to engage, or at least follow, a dialogue about issues relevant to department heads, but there is no reason to believe that contributing to the group is anyone’s top priority.

One early challenge has been trying to stoke activity on the discussion group so that a culture of contribution and feedback is created in the group. To that end, “Questions of the Week” have been posed about topics relevant to department heads in order to generate comments and discussion. Table 4 in Appendix 1 presents a list of the first six questions of the week. The questions that have generated the most discussion in the first two months of the group were the ones that were specific and targeted. This makes sense, for we have already seen that time, or lack thereof, is a big concern of department heads. In reading through e-mails, department heads are presumably more
likely to respond to a targeted question that can be answered quickly, rather than a more open-ended and philosophical question that might require a larger investment of time. For example, question 5 concerning geometry textbooks was the simplest question asked to date, and it generated the most productive commentary, as nine department heads provided information not only on what texts they are using but also added helpful insights about their experiences with those texts. This response stands in contrast to the minimal commentary that was elicited by question 3, as asking about what textbooks people are using was too broad a question to ask. It is unrealistic to expect department heads to devote lots of time to contributing to the group, and moving forward more targeted questions will be posed to the group. It is hoped that this approach will generate the most activity and a variety of contributions from members of the group.

One goal for the discussion group is that activity on the group will inform the creation of content on the web resource. This result happened in response to question 5 concerning geometry textbooks. The group discussion included a variety of textbooks that schools were using, and a page on the web resource was created that included links to information on all the resources mentioned in the discussion. It is intended that the creation of this page will alleviate some of the frustration that I have experienced in other discussion groups. In other groups, there will be messages that mention resources, but mustering the time and energy to cull a listing of these resources from different messages has proven to be difficult. Creating a page on geometry textbooks based on the group discussion should be a convenient and helpful aid for department heads who want to see what geometry texts other schools are using. This model of group discussion informing
content creation on the web resource will be a major way in which the web resource will stay fresh and relevant.

Another example of content added since the creation of the web resource is a page devoted to listing, by state, summer workshop opportunities for teachers of AP Statistics. In late February, several leaders of AP Statistics workshops announced their summer workshops on the AP Statistics discussion list. While this is certainly useful information, having it spread out over numerous postings does not make it easy to keep track of. The College Board has a tool for searching for AP summer workshops, but it was believed that a more efficient listing of specific workshops on statistics could be created. Thus, a page on the web resource was created that listed AP Statistics workshops by state, with links to each specific workshop, in order to help a department head seeking a summer opportunity for one of their teachers or for themselves. In my own experience as a department head, this is the kind of information that is helpful to have quick and easy access to and is an example of how this web resource can connect department heads to information relevant to their responsibilities.

Now that the resource has been established, I will work to publicize the website more directly to different groups of department heads. While the web resource has been broadly announced to my e-mail list of approximately 150 department heads and to the AP Calculus and AP Statistics discussion groups, more targeted informing of specific groups of department heads will likely generate more users to the web resource and more members of the discussion group. For instance, my private school is part of a sixteen-school league in New England, and I plan on individually contacting the department head at each school to inform them about the site and to invite them to the group. In addition,
new content will be added to the website, and there will be a continuing effort to elicit activity on the discussion group with a “slow and steady wins the race” approach. If “The Math Chair Connection” is to be an ongoing resource, I do not want to overwhelm the department head population with too much information or too many postings that may begin to be disregarded over time. This web resource will only succeed, if it becomes one tool, among many, that department heads have to help them do their job.
Chapter 5  Summary and Conclusions

This project helped me put into perspective my role as a mathematics department head. By exploring the modern view of what understanding represents, I have become more aware of how my department fosters understanding and in what ways we could improve. In addition, the research concerning curriculum and its influence on student learning has been an important facet of the learning process to consider. It is vital to keep in mind that curriculum in and of itself will not have an impact unless there is careful consideration of how teachers will interact with the curriculum and enact it with their students. The department head is vitally important to the success of a school’s mathematics program, as it is by supporting teachers in their work that department heads can impact student achievement and understanding.

In addition, this project has afforded me the opportunity to connect with fellow department heads and to learn firsthand, through both the survey results and the initial months of the discussion group, that we share the same concerns and face similar challenges. The experience of reaching out to department heads is reminiscent of my first experiences with the AP Statistics discussion group back in 1996, and it is hoped that “The Math Chair Connection” can provide for department heads an experience similar to the one I received through my interactions with the AP Statistics community.

The hypothesis at the start of this project was that secondary school mathematics department heads would value having a web resource and discussion group dedicated to their interests and needs. This hypothesis was validated by the results of the survey which
showed that a majority of department heads surveyed would appreciate having a resource attuned to their needs. My hypothesis was further validated in late February 2014 during a meeting of mathematics department heads from 14 private schools around Eastern Massachusetts. At this meeting, this project and its purpose were explained to the group, and the project was well-received by the department heads in attendance. Many of the issues discussed at the meeting, such as student placement and textbooks, are conversations that can continue through the discussion group.

Looking forward, it is hoped that the web resource and discussion group will continue to grow and increasingly become a useful tool for department heads in doing their job. To reach its full potential, “The Math Chair Connection” would benefit from the contributions of department heads besides me. While contributions to the discussion group often provide useful information, it would be helpful if other department heads took on a more defined role in adding content and value to the website. Another department head could, for instance, be in charge of updating the professional development portion of the website. Giving other department heads the authority to add content to the website would presumably lead to more varied and rich content, as others bring in their perspectives and expertise.

The aspiration for keeping the website going, and including others in this process, is challenging in light of the fact that the most telling finding of this project is the time constraints department heads feel in performing their job among the variety of other responsibilities they have. Based on my experience the past two years as a department head, this was not an unexpected finding. Teaching mathematics well is a challenging task, and supporting teachers as a department head while teaching requires a tremendous
amount of time and energy. Teachers can use all the support they can get and while
department heads are obviously in the position to give that support, they do not always
have enough time to do so. The twin goals of “The Math Chair Connection” are, and will
remain going forward, to connect department heads to resources that will help them lead
their departments and to connect department heads with each other, so that all may
benefit from the accrued experience and wisdom of the department head community.
Appendix 1  Survey Information

Table 1
*Time for Various Tasks*

<table>
<thead>
<tr>
<th>Task</th>
<th>No time at all</th>
<th>Less than enough time</th>
<th>Enough time</th>
<th>More than enough time</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making classroom observations of teachers</td>
<td>12.5% (7)</td>
<td>66.1% (37)</td>
<td>21.4% (12)</td>
<td>0% (0)</td>
<td>56</td>
</tr>
<tr>
<td>Meeting as a full department to discuss curriculum</td>
<td>1.8% (1)</td>
<td>61.4% (35)</td>
<td>35.1% (20)</td>
<td>1.8% (1)</td>
<td>57</td>
</tr>
<tr>
<td>Searching for and evaluating alternative curriculum options</td>
<td>8.8% (5)</td>
<td>78.9% (45)</td>
<td>12.3% (7)</td>
<td>0% (0)</td>
<td>57</td>
</tr>
<tr>
<td>Preparing for your own classes</td>
<td>0% (0)</td>
<td>31.6% (18)</td>
<td>66.7% (38)</td>
<td>1.8% (1)</td>
<td>57</td>
</tr>
<tr>
<td>Placing students in the appropriate math sections</td>
<td>5.3% (3)</td>
<td>31.6% (18)</td>
<td>61.4% (35)</td>
<td>1.8% (1)</td>
<td>57</td>
</tr>
<tr>
<td>Reading math journals or other materials to “stay current”</td>
<td>21.1% (12)</td>
<td>59.6% (34)</td>
<td>19.3% (11)</td>
<td>0% (0)</td>
<td>57</td>
</tr>
<tr>
<td>Working with other departments on inter-disciplinary learning</td>
<td>45.6% (26)</td>
<td>47.4% (27)</td>
<td>5.3% (3)</td>
<td>1.8% (1)</td>
<td>57</td>
</tr>
</tbody>
</table>
Table 2

*Time for Various Tasks – Reduced Course Load*

<table>
<thead>
<tr>
<th>Task</th>
<th>No time at all</th>
<th>Less than enough time</th>
<th>Enough time</th>
<th>More than enough time</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making classroom observations of teachers</td>
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<td>64.9%</td>
<td>32.4%</td>
<td>0%</td>
<td>37</td>
</tr>
<tr>
<td>Meeting as a full department to discuss curriculum</td>
<td>2.7%</td>
<td>59.5%</td>
<td>35.1%</td>
<td>2.7%</td>
<td>37</td>
</tr>
<tr>
<td>Searching for and evaluating alternative curriculum options</td>
<td>8.1%</td>
<td>78.4%</td>
<td>13.5%</td>
<td>0%</td>
<td>37</td>
</tr>
<tr>
<td>Preparing for your own classes</td>
<td>0%</td>
<td>27.0%</td>
<td>70.3%</td>
<td>2.7%</td>
<td>37</td>
</tr>
<tr>
<td>Placing students in the appropriate math sections</td>
<td>8.1%</td>
<td>27.0%</td>
<td>62.2%</td>
<td>2.7%</td>
<td>37</td>
</tr>
<tr>
<td>Reading math journals or other materials to “stay current”</td>
<td>21.6%</td>
<td>59.5%</td>
<td>18.9%</td>
<td>0%</td>
<td>37</td>
</tr>
<tr>
<td>Working with other departments on inter-disciplinary learning</td>
<td>40.5%</td>
<td>51.4%</td>
<td>8.1%</td>
<td>0%</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 3

*Time for Various Tasks – Not Reduced Course Load*

<table>
<thead>
<tr>
<th>Task</th>
<th>No time at all</th>
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<th>Enough time</th>
<th>More than enough time</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making classroom observations of teachers</td>
<td>31.6%</td>
<td>68.4%</td>
<td>0%</td>
<td>0%</td>
<td>19</td>
</tr>
<tr>
<td>Meeting as a full department to discuss curriculum</td>
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<td>65%</td>
<td>35%</td>
<td>0%</td>
<td>20</td>
</tr>
<tr>
<td>Searching for and evaluating alternative curriculum options</td>
<td>10%</td>
<td>80%</td>
<td>10%</td>
<td>0%</td>
<td>20</td>
</tr>
<tr>
<td>Preparing for your own classes</td>
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<td>40%</td>
<td>60%</td>
<td>0%</td>
<td>20</td>
</tr>
<tr>
<td>Placing students in the appropriate math sections</td>
<td>0%</td>
<td>40%</td>
<td>60%</td>
<td>0%</td>
<td>20</td>
</tr>
<tr>
<td>Reading math journals or other materials to “stay current”</td>
<td>20%</td>
<td>60%</td>
<td>20%</td>
<td>0%</td>
<td>20</td>
</tr>
<tr>
<td>Working with other departments on inter-disciplinary learning</td>
<td>55%</td>
<td>40%</td>
<td>0%</td>
<td>5%</td>
<td>20</td>
</tr>
</tbody>
</table>
Table 4
*Questions of the Week*

<table>
<thead>
<tr>
<th>Week</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Has your school moved to the TI-Nspire series from the TI-84 series? If so, how have things changed from using the older series? If no, why not make the change?</td>
</tr>
<tr>
<td>#2</td>
<td>What does “Algebra 2” mean to you and where does it fit into your curriculum?</td>
</tr>
<tr>
<td>#3</td>
<td>What textbooks are you excited about or are working well in your program?</td>
</tr>
<tr>
<td>#4</td>
<td>How have the Common Core State Standards affected your department and/or changed your approach to teaching math?</td>
</tr>
<tr>
<td>#5</td>
<td>What text are you using for Geometry? (Any comments you want to make about the text are appreciated)</td>
</tr>
<tr>
<td>#6</td>
<td>What are your thoughts about and/or experiences in the use of digital textbooks?</td>
</tr>
</tbody>
</table>
Appendix 2  Math Department Head Survey

The below survey was administered using the online service SurveyMonkey. Survey items without choices listed required a typed in response.

1. Including the 2013-2014 academic year, how many years have you served as a mathematics department head?
   - 1-5 years
   - 6-10 years
   - 11-15 years
   - More than 15 years

2. Including full-time and part-time mathematics teachers, how many teachers do you supervise as department head?
   - Fewer than 10 teachers
   - 11-15 teachers
   - 16-20 teachers
   - More than 20 teachers

3. Do you teach at a private or public school?
   - Private
   - Public

4. Do you teach a reduced course-load because of your department head role?
   - No
   - Yes

5. What do you view as the three most important roles of a mathematics department head?

6. Describe three challenging aspects of being a mathematics department head.
7. Do you use the Internet to gather information or other resources as part of your role as department head?
   o No
   o Yes
   If Yes, please describe any specific Internet resources you have found particularly helpful.

8. Do you participate in any online discussion groups/forums dedicated to math education?
   o No
   o Yes
   If Yes, please list these groups and/or the topics these discussion groups address.

9. Feedback from this survey will be used to shape the creation of a website – tentatively titled “The Math Chair Connection” – geared to the needs of math department heads. Please suggest information or resources that would be helpful for you to have on this site.

10. Would you be interested in participating in (either by reading or posting messages) in an online discussion group addressing issues faced by secondary school math department heads?
    o No
    o Yes

11. What technology is available to your students in their math classes (working in class and/or at home)? (Check all that apply.)
    o Scientific calculator
    o Graphing calculator (Texas Instruments series, Casio series, or the like)
    o Tablet (such as the iPad)
    o Laptop computer
    o Desktop computer
    Other (please specify)

12. What do you find useful in how your students use technology?
13. What do you think could be improved in how your students use technology?

14. What technology is available to your teachers in their math classes (working in class and/or at home)? (Check all that apply.)
   - Scientific calculator
   - Graphing calculator (Texas Instruments series, Casio series, or the like)
   - Tablet (such as the iPad)
   - Laptop computer
   - Desktop computer
   - Smart Board
   - Other (please specify)

15. What do you find useful in how your teachers use technology?

16. What do you think could be improved in how your teachers use technology?

17. Based on your experiences as a mathematics department head, rate how much time you have for each of the following tasks:

<table>
<thead>
<tr>
<th>Task</th>
<th>No time at all</th>
<th>Less than enough time</th>
<th>Enough time</th>
<th>More than enough time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making classroom observations of teachers</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Meeting as a full department to discuss curriculum</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Searching for and evaluating alternative curriculum options</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Preparing for your own classes</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Placing students in the appropriate math sections</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Reading math journals or other materials to “stay current”</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Working with other departments on inter-disciplinary learning</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

18. As the mathematics department head, are you required to make classroom observations of your department members?
o No
o Yes

If Yes, how many classroom observations do you typically make for each teacher each year?

19. Please describe any aspect of being a department head that you feel is important but which has not been addressed by this survey.

20. Based on your experience in the department head role, is there any advice you have for a secondary school mathematics department head? If so, please share below.
Appendix 3 Advice for Department Heads

The final item on the survey asked department heads to offer, based on their experience, advice for a secondary school mathematics department head. A number of thoughtful responses were selected and are presented below:

“Seek as much professional development as possible.”

“Meet with all the teachers in your department individually as you begin the job.”

“Keep your head up and don’t get mired in the details – force yourself to make time for thinking about the big picture.”

“Perhaps the most important part of my job is to observe teachers’ classes and give them quick and thoughtful feedback. This piece is often overlooked, but it is very important for teacher development.”

“Work with the strengths of your department as opposed to imposing a vision on the department.”

“Goal set with teachers and with the overall department. Constantly cycle back to these as a point of reference to enable growth.”

“It can be overwhelming. Make a priority list of what needs to be accomplished and set reasonable goals. Then work towards checking off each task.”

“Be organized, stay ahead of schedule, and most importantly make sure your teachers have everything they need.”

“You don’t need to be the best mathematician in the department to be successful at the role.”
Appendix 4 The Math Chair Connection

The address of the website “The Math Chair Connection” is https://sites.google.com/a/roxburylatin.org/mathchair/. This appendix contains four screenshots of the website showing some of the different information available there. Underlined words are hyperlinks to websites with information on the content described. At the end of this appendix is a table that briefly describes the intention of each of the nine parts of the website.

Figure 2
Sample Book Description

Bridge to Higher Mathematics by Sam Vandervelde (Post-Calculus option)

This insightfully written book is a wonderful, challenging text for students who have completed Calculus before their senior year. We are in our second year using this as our primary text in our Advanced Math Topics course, taken primarily by seniors who have completed Calculus as juniors. Written by the co-founder and question writer of the Mandelbrot Competition, this book aims to give students practice with the skills and techniques necessary to succeed in higher-level college courses such as Linear Algebra and Real Analysis. In addition to teaching basic logic, set theory and methods of proof, the text delves into number theory, combinatorics, functions, and concludes with a fascinating chapter on cardinality.

Figure 3
Articles/News Section

Articles/News

Below are links to articles or talks dealing with issues relevant to department chairs.

- "Is the AP Program Still Good for Mathematics Education?" -- Address given by Dan Kennedy at NCTM Anaheim, 2005
- What the New SAT and Digital ACT Might Look Like -- New York Times, 8/2/13
- New SAT delayed until 2016 -- Inside Higher Ed, 12/3/13
- Information about the Redesigned SAT -- released by the College Board on 3/5/14

Figure 4
Portion of the AP Statistics Summer Workshops Section

There are wonderful summer opportunities available for inexperienced or experienced teachers to explore the AP Statistics curriculum. A variety of veteran teachers, many of whom are authors of AP Statistics textbooks, offer week-long workshops that provide activities, insight, and support for those teaching or starting to teach AP Statistics. Attending Fred Djang’s AP Stat workshop in the late 90s at Choate in Connecticut was one of my best professional development experiences!

Below is a listing of workshops planned for the summer of 2014 and links to information about each one. I have sorted them by the location (by state, and then Canada in there) of each workshop. (Most of these were recently announced on the AP-Statistics discussion list.) Many workshops have residential options. The roster of instructors that are offering workshops across the country is terrific, and if you have a teacher who needs some professional development in AP Statistics, hopefully there is something in your neck of the woods.

California
- **Pacific AP Institute** at California State University at Monterey Bay
  - June 23-27 -- Chris Olsen
- **AP by the Sea Summer Institute** at the University of San Diego
  - July 7-10 -- Daren Starnes
- **AP Seminars Silicon Valley** at Stanford University in Palo Alto
  - July 21-24 -- Chris Olsen

Figure 5

Portion of the Contests Section

Contests

There are probably hundreds of mathematics competitions across the nation (I’m getting mail for new ones all the time!), many locally or regionally run. Below are a few contests that have a national reach with which my students have had productive and fun experiences.

**American Mathematics Competition (AMC)**
- The AMC 8 (given in November) and AMC 10/12 (given in February) are national contests. Those who do extremely well on the AMC 10/12 qualify for the **American Invitational Mathematics Examination (AIME)**. Those who do extremely well on the AIME are amazing! and qualify for the USAMO or USAJMO, tests that help determine the American team at the annual International Math Olympiad.
- The organization **Art of Problem Solving** has old tests and solutions posted at their website. The links to specific tests are below.
  - AMC 8, AMC 10, AMC 12, AIME, USAMO, USAJMO

**The Mandelbrot Competition**
- This is a challenging contest in which students take a 40-minute, 7-question test individually. The contest is given 5 times a year. In addition, there is a separate “Team Play” competition, given 3 times a year, in which students work in teams of four for 60 minutes to solve a multi-part, proof-based question. The problems are creative, challenging, and exceedingly well-written.
- The three books of past problems — the competition has been running since 1998 — are highly recommended and provide creative and challenging problems on a variety of topics. Even if you do not participate in the competition, you might consider getting one or all of these books. They may be purchased here.
### “The Math Chair Connection”

<table>
<thead>
<tr>
<th>Section</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Statement about myself and the motivation behind and intention for “The Math Chair Connection.”</td>
</tr>
<tr>
<td><strong>Curriculum</strong></td>
<td>Links to Curriculum materials (e.g. resources that support the Common Core State Standards).</td>
</tr>
<tr>
<td><strong>Professional Development</strong></td>
<td>Links and commentary about a variety of opportunities (e.g. graduate schools, summer workshop and conferences).</td>
</tr>
<tr>
<td><strong>Books/Technology</strong></td>
<td>Links to websites of popular textbooks in a range of math subjects.</td>
</tr>
<tr>
<td><strong>Contests</strong></td>
<td>Access to information about major math contests (e.g. the AMC 10-12 series, the Mandelbrot Competition).</td>
</tr>
<tr>
<td><strong>Articles/News</strong></td>
<td>Links to information about mathematics in the news (e.g. the revised SAT officially announced in March 2014).</td>
</tr>
<tr>
<td><strong>Math Blogosphere</strong></td>
<td>There are a myriad of teachers out there writing about math, and I do not have the experience or time to read all of them. I will rely on the community of department heads for recommendations of website and blogs to highlight.</td>
</tr>
<tr>
<td><strong>Fun Stuff</strong></td>
<td>Information about interesting games and other mathematical curiosities.</td>
</tr>
<tr>
<td><strong>Google Group</strong></td>
<td>Web interface for “The Math Chair Connection” discussion group.</td>
</tr>
</tbody>
</table>
References


understanding. In E. Fennema & T.A. Romberg (Eds.), *Mathematics classrooms that promote understanding* (pp. 3-17). Mahwah, NJ: Lawrence Erlbaum Associates.


