Mathematics Teachers’ Use of Instructional Time and Relationships to Textbook Content Organization and Class Period Format

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Abstract
In this paper we report findings and implications related to secondary school mathematics teachers’ use of instructional time and how patterns of classroom time utilization relate to the type of textbook used (content organization) and the class period format in place. The findings reported are based on data collected from 325 classroom observations of 109 teachers in 5 states during the first two years of the NSF-funded project, Comparing Options in Secondary School Mathematics: Investigating Curriculum (COSMIC), a longitudinal comparative study of the impact of high school mathematics curricula on students learning. Class time data were classified and analyzed based on Activity Codes (e.g., Warm-Up, Review, Lesson Preview, Teach, Practice and Apply, Assess) and two textbook types: Subject-Specific content organization (Algebra, Geometry, and Algebra II) in which the content each year is centered around a core mathematics area, and Integrated content organization (Course 1, Course 2, Course 3) where the content is presented in an integrated manner with attention to algebra, geometry, statistics, and discrete mathematics each year. Three class period formats (Regular, Block, Modified Block) were taken into account. Teachers of the Integrated curriculum spent significantly more time developing new mathematical ideas than did teachers of the Subject-Specific curriculum, but this came at the expense of students practicing and applying what they had learned during class time. This paper provides summary descriptions of time utilization, identifies activity codes where there is substantial variation across curriculum types, and suggests factors that may account for variation in time utilization.

Introduction

Teachers’ use of classroom instructional time can significantly impact student learning in mathematics classrooms. Among their many responsibilities, teachers plan and manage what takes place in their classrooms and thus they make daily decisions about how class time is used. Previous studies have characterized this use in classrooms (Doyle, 1986; Fisher et al., 1980), and the way classroom time is used has been shown to be important in terms of what students learn (Good, Grouws, & Ebmeier, 1983). Teachers’ allocations of instructional time to such things as introducing mathematical concepts or methods, reviewing previously taught mathematical topics, developing new mathematical ideas, and assessing student learning of mathematics have potential implications for student achievement in mathematics. Although previous studies of teachers’ use of time have been conducted, there have been few recent studies of time utilization, despite many calls in the last decade for reforming what takes place in mathematics classrooms. Furthermore, there have been important changes in mathematics textbooks in recent years with

This paper was presented at the Hawaii International Conference on Education in Honolulu, HI on January 7, 2010 and is based on research from the Comparing Options in Secondary School Mathematics: Investigating Curriculum (COSMIC) project, a project supported by the National Science Foundation under grant number REC-0532214. Any opinions, findings, and conclusions or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the National Science Foundation. We wish to acknowledge the helpful comments we received from Professor Wei-Min Hsu, National Pingtung University, Taiwan and Professor Melissa McNaught, University of Iowa.
regard to how the mathematics content of the textbooks is organized. Considering that mathematics is a core subject in U.S. schools, it is imperative that researchers study how time is used in today’s mathematics classrooms. Therefore, our study seeks to extend the research on time utilization by providing a 21st century perspective on mathematics teachers’ use of classroom instructional time.

**Related Literature**

There is strong evidence that teaching makes a difference in mathematics classrooms; however, identifying exactly how it makes a difference is difficult (Hiebert & Grouws, 2007). Researchers have examined a wide variety of potential influences, including teachers’ content, pedagogical, and pedagogical content knowledge; professional development experiences; and teacher beliefs about mathematics teaching and learning. Recent research, however, has overlooked the role that teachers’ time allocation may play.

In past decades, researchers have studied the choices mathematics teachers make with regard to their use of instructional time. For example, Good and Grouws (1979) in a classroom based study examined the instructional behaviors of effective fourth grade teachers, including time for review, development of the lesson, seatwork, and homework. They found that students of teachers trained to follow a lesson structure similar to that of effective teachers tended to demonstrate higher achievement. More recently, investigations by the Horizon Research, Inc. (Weiss, Banilower, McMahon, & Smith, 2001; Weiss, Pasley, Smith, Banilower, & Heck, 2003) surveyed K-12 teachers’ use of class time using a nationally representative sample. They found that teachers reported using 87 to 95% of class time for “instruction.” In particular, they found that the most common instructional activities included answering textbook or worksheet questions, practicing computations, reviewing homework, and using mathematics concepts to interpret and solve problems. Similarly, results from the National Assessment of Educational Progress have included reports of students’ typical activities in class (Braswell et al., 2001). For example, doing mathematics problems from their textbooks was more common than talking with other students about solving problems. With regard to technology, the use of calculators during class time increased with grade level. Results from the Trends in International Mathematics and Science Studies (TIMSS) also provided information about how time was spent on various activities in eighth grade mathematics classes in several nations. Teacher self-report data from the TIMSS study suggested that in the United States, the most common elements of class time included homework review, lecture-style presentations by teachers, teacher-guided student practice, and student independent practice. Collectively, these elements on average comprised 70% of class time (Mullis et al., 2000).

Two trends in secondary schools raise additional questions about how teachers make use of instructional time. First, is the development of integrated mathematics curricular programs and their adoption for use in many schools. In integrated mathematics curricula, students study a variety of mathematics content strands each year and lessons are structured in a fundamentally different manner (Senk & Thompson, 2003). For example, the Core-Plus Mathematics Project (Schoen & Hirsch, 2003) calls for teachers to: (1) introduce students to a mathematical investigation, (2) allow students to explore questions in order to learn new content, (3) share and summarize ideas from the investigation, and (4) apply ideas from the investigation to new
problems. This process can take several class periods, in contrast to traditional mathematics lessons that are typically contained in a single class period. Researchers have begun to identify differences in how teachers use these curricula, for example, McNaught (2009) found that teachers often were not following textbook authors’ recommendations, frequently omitted steps in the recommended instructional sequence. Certainly such an alternative arrangement of the mathematical content could lead teachers to use class time differently than teachers who teach more “traditional” (subject-specific) courses.

A second trend is that many schools are implementing “block” schedules in which student often times attend fewer classes per week but for longer time periods. Analysis of the impact of such schedule modifications on student achievement have provided mixed results (Veal & Schreiber, 1999). Research also suggests that block scheduling has had a varied impact on teachers’ classroom practices. For example, Veal and Flinders (2001) found that some teachers whose schools switched to block schedules tended to use a greater variety of instructional techniques and experienced improved interactions with students, while other teachers reported feeling more pressed for time and thus tended to lecture more and interact with students less.

This study provides needed current information about how mathematics teachers are using their classroom time. It also makes special contributions to our understanding of the current state of instruction in mathematics classrooms where new types of curriculum are in place and provides information about non-standard class period organization.

**Research Questions**

In this study we examine the relationship of curriculum type and class format on teachers use of class time in secondary mathematics classrooms by addressing the following research questions:

1. How do high school mathematics teachers use their class time for instructional activities (such as warm-up, review, lesson introduction, development of new mathematics content, practice and apply, and lesson closure) and non-instructional activities?
2. Does high school mathematics teachers’ use of instructional time differ by curriculum type (Subject-Specific vs. Integrated)?
3. Does high school mathematics teachers’ use of instructional time differ by class period format (Block vs. Regular)?

**Methodology**

Over a period of two years, the University of Missouri’s Comparing Options in the Secondary Mathematics – Investigating Curriculum (COSMIC) researchers visited classrooms in five US states. Although the primary mission of the COSMIC project was to study the impact of different types of mathematics curricula on student learning, our research design necessitated documentation of teachers’ implementation of curricula, and this data included teachers’ use of time. In each participating school, students were allowed to choose between following a path of subject-specific courses or a path of integrated content courses. Thus, using a Classroom Visit
Protocol (CVP) with demonstrated high inter-rater reliability, we were able to characterize in
detail teachers’ use of class time across these two curriculum types as well as in three class
period organizations.

Sample
The sample for this study was the 109 teachers\(^1\) participating in the COSMIC research
study who taught from one of the two curriculum types; 62 teachers taught using Subject-
Specific curricula and 47 teachers taught using the Integrated curriculum. Almost all teachers
were observed for three class periods. In total, COSMIC researchers observed 325 class periods
over two years. Classroom visits were pre-arranged to ensure that the observed class period was
not primarily devoted to the assessment of students’ learning. The average length of time of
class periods observed by researchers was 64.4 minutes with a standard deviation of 18.29. The
average length of time of class periods for teachers of Subject-Specific curricula was 66 minutes
with a standard deviation of 18.35. The average length of time of class periods for teachers of
the Integrated curriculum was 62.2 minutes with a standard deviation of 18.04.

Class period formats were separated into three categories based on an examination of
time lengths of observed class periods. Teachers classified as Regular class format taught all
observed class periods in 64 minutes or less. Teachers classified as Block class format taught all
observed class periods in 74 minutes or greater. Teachers classified as Modified Block consisted
of all other combinations of class formats that were not deemed Regular or Block. Some of these
teachers regularly taught classes of length between 64 and 74 minutes. However, Modified
Block also included teachers who taught some class periods shorter than 64 minutes and others
longer than 74. In all, 54 teachers were classified as Regular and 159 class periods were
observed. The Regular class format consisted of 25 teachers of the Integrated curriculum and 29
teachers of Subject-Specific curricula. The average length of time of class periods for teachers
classified as Regular was 50.9 minutes with a standard deviation of 4.38. A total of 26 teachers
were classified as Block and 82 class periods were observed. The Block format consisted of 6
teachers of the Integrated curriculum and 20 teachers of Subject-Specific curricula. The average
length of time of class periods for teachers classified as Block was 87.3 minutes with a standard
deviation of 3.79. The Modified Block category included 29 teachers and 84 observed class
periods. 16 of these teachers taught the Integrated curriculum and 13 teachers taught Subject-
Specific curricula. The average length of class periods for teachers classified as Modified Block
was 67.6 minutes with a standard deviation of 19.45.

Coding
Before describing the development of the codes, a description of the lesson elements in
the curricula involved is provided in order to provide meaning for the codes that follow. The
Integrated curriculum in the COSMIC project is represented by a single textbook series produced
by the Core-Plus Project (Coxford et al., 2003a, 2003b, 2003c). The names for lesson elements

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\(^1\) Teachers that taught both curriculum types were treated as two independent teachers, one for each curriculum. Likewise, teachers that participated in the project multiple years were considered independent of each other with respect to time. There were three teachers using Integrated curricula who participated and were observed for years 1 and 2 of the project. Their participation was considered independent in respect to the year, because the courses taught by them differed in years 1 and 2.
in italics are the names used in the Core-Plus materials. Lessons in Core-Plus begin with a Launch, which is designed to introduce students to the mathematical ideas in the lesson. The Launch provides a context for the student to situate problems they will study in the lesson and helps them make connections to their prior knowledge. Often the Launch is teacher-directed, although students are intended to be actively engaged. Following the Launch is the Explore. In this lesson element, generally small groups of students engage with problems that lead students to investigate the new mathematical concepts of the lesson. The curriculum materials encourage teachers to support and encourage students’ exploration and not to directly present new material to the class as a group. After students have explored the content of the lesson, the class discusses the main ideas through the Share and Summarize, often by answering a set of questions designed to focus them on key concepts. Often this lesson element is lead by the teachers, who are encouraged to have students share their thinking and draw conclusions about the main ideas of the lesson. Once students have had the chance to summarize their thinking, they have an opportunity to put their new knowledge to use in the Apply, which consists of students engaging with questions related to the content of the lesson. Often these questions are designed to have students apply similar reasoning in new contexts or to extend their thinking beyond what was required in the Explore.

The Subject-Specific curriculum in the COSMIC project was represented by a number of popular publisher-developed textbooks. All of these textbooks, however, presented content through similar lesson elements. The names for lesson elements in italics that follow reflect names used in at least one of the curricula and are intended to capture the essence of the lesson element. All Subject-Specific lessons include Lesson Preview activities, which are intended to introduce the students to the mathematical content of the lesson. Often Lesson Previews include problems or questions for students to engage with that use students’ prior knowledge to help them make connections to the new concepts. Textbooks generally do not specify whether teachers should lead the entire class through the Lesson Preview or whether students should take a more active role. Following this is the Teach, which generally involves the teacher presenting the new mathematical content of the lesson. Often this lesson element includes presentation of definitions, theorems, formulas, procedures, and a variety of worked examples. Following the Teach, students generally then use the new content from the lesson in the Practice and Apply, which consists of problems for the students to solve. These problems usually offer ample opportunities for the students to practice the techniques demonstrated in the Teach as well as use similar reasoning in other contexts or extend their thinking.

In addition to the lesson elements specified by the curricula, we anticipated observing activities common in U.S. mathematics classrooms. Often teachers provide some type of warm-up activity that includes students working on general mathematical problems that are not specific to the lesson’s mathematical content for that day. These problems are often used at the beginning of a class period to help the students begin thinking about some mathematical content, even if it is not directly connected to the lesson. Teachers also often provide opportunities for students to review mathematical content they have already learned. This can include examining or scoring of previous homework or assessments, review games, or other formats for review of content previously learned. Teachers often provide time for students to review material before an assessment, which includes any measurement of student knowledge such as quizzes and tests. Some teachers also provide closure, which includes activities at the end of the class period.
intended for review of the main points of the instruction. As its name suggests, closure should help draw together the mathematical ideas and highlight to the students the important mathematical concepts from that class period. Lastly, we also anticipated that teachers would spend time on non-instructional activities. Such activities would be any time not spent on mathematics, such as school announcements or discussion of outside of school activities.

Codes for lesson elements developed through several stages. Initially, as the CVPs were developed, codes were created for observers to use to categorize lesson elements they observed. Different CVPs were created for each curriculum and codes included in the CVP were based on lesson elements specified in the textbook as well as lesson elements common in typical U.S. classrooms. At the end of the class period, observers were encouraged to use these codes as they completed a table indicating time spent on various lesson elements. However, some observers did not use these exact codes and instead wrote other descriptions of what occurred in the classroom. For this reason and to facilitate analysis of how teachers used their time, once data from the CVPs was gathered and examined, a revised set of codes was developed that categorize every minute of time observed. Because each curricula type differed in its basic structure, codes of three types were developed:

1. Segments in class periods taught by teachers of Subject-Specific curricula,
2. Segments in class periods taught by teachers of the Integrated curriculum, and
3. Segments in class periods taught by teachers of either type of curriculum.

Codes that applied only to segments in class periods taught by teachers of Subject-Specific curricula reflected the lesson elements in these textbooks as noted previously and as shown in Table 1. At this point, data from the CVPs included a variety of names for the same lesson element. For example, different textbooks used “Practice and Apply,” “Practice,” and “Exercises” to refer to problems for students to practice material from the new lesson, and observers had used all of the terms. In order to arrive at common codes for all of the different Subject-Specific curricula, we confirmed that each lesson element was the same across curricula and chose one name. Codes that applied only to segments in class periods taught by teachers of the Integrated curriculum were lesson elements from the Core-Plus materials and are shown in Table 1. Codes that applied to segments in class periods taught by teachers of either curriculum type reflected the anticipated common activities and are included under both curriculum types in Table 1.

Finally, in order to make comparisons across curriculum types, we developed general codes for lesson elements specific to curriculum type. Because the Lesson Preview for teachers of Subject-Specific lessons and the Launch for teachers of Integrated lessons both served to introduce students to the mathematical content in the new lesson, these two codes were combined to form a new classification called Introduction. Similarly, because Teach, Explore, and Share and Summarize all involve the development of mathematical ideas in the lesson these codes were combined into a Lesson Development. Finally, because Practice and Apply and Apply both involve students working on problems related to the content of the new lesson, these codes were combined into the code Practice and Apply. Figure 1 shows both the curriculum specific codes and the general codes.
Table 1. Code descriptions for Integrated and Subject-Specific curricula.

<table>
<thead>
<tr>
<th>Subject-Specific Lesson Element</th>
<th>Description</th>
<th>Integrated Lesson Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-Up</td>
<td>Focus on general mathematical concepts not related to the primary instructional objective of the class period.</td>
<td>Warm-Up</td>
<td>Focus on general mathematical concepts not related to the instructional objectives of the class period.</td>
</tr>
<tr>
<td>Lesson Preview</td>
<td>Introduction of the instructional objective for the class period.</td>
<td>Launch</td>
<td>Introduction of a context for the instructional objective for the lesson.</td>
</tr>
<tr>
<td>Teach</td>
<td>Presentation of new mathematical concepts.</td>
<td>Explore</td>
<td>Presentation of new mathematical concepts.</td>
</tr>
<tr>
<td>Practice and Apply</td>
<td>Students work independently or collectively to solve problems related to content taught during the class period.</td>
<td>Apply</td>
<td>Students work independently or collectively to solve problems related to the lesson’s objective.</td>
</tr>
<tr>
<td>Assessment</td>
<td>A measurement of students’ learning using test or a quiz.</td>
<td>Assessment</td>
<td>A measurement of students’ learning using a test or quiz.</td>
</tr>
<tr>
<td>Closure</td>
<td>The wrapping up of the mathematical content in a lesson that can occur in various forms at the end of a class period.</td>
<td>Closure</td>
<td>The wrapping up of the mathematical content in a lesson that can occur in various forms at the end of a class period.</td>
</tr>
<tr>
<td>Non-Instructional</td>
<td>Activity not related to mathematics.</td>
<td>Non-Instructional</td>
<td>Activity not related to mathematics.</td>
</tr>
</tbody>
</table>
Figure 1. Curriculum-specific and general codes.
Data Analysis

Once lesson elements had been coded, for each class period observed, the number of minutes spent on each lesson element was recorded. Then, using the total minutes for the class period, the percent of the time for each lesson element was calculated. For each teacher, the percent of time for each lesson element was then averaged over all observed lessons. These teacher averages were then used to calculate average percents of lesson elements for all teachers and groups of teachers separated by curriculum type and lesson format. Differences between groups were analyzed through ANOVAs.

Results

Teachers’ use of time

Table 2 depicts the distribution of time allocated to various lesson components for the entire teacher sample. Although the largest portion of class time was devoted to Lesson Development (42.4%), this element nonetheless represents less than one-half of the time available to teachers. Students spent nearly as much time on reviewing past mathematics content (16.3%) as they did practicing and applying what they had learned (19.4%). A negligible amount of time was devoted to the introduction of the lesson (1.8%) and bringing closure to the lesson (0.5%). Nearly one-third of class time was spent on mathematics content taught previously (Warm-Up plus Review) or on Non-Instructional activities. It is worth noting that although only 3.4% of observed class time was allocated to assessments, teachers likely devote substantially more time to administering quizzes and tests, given the stipulation not to attend to these things on observation days. Finally, a key finding is that relatively few teachers brought closure to the lesson at the end of the class period. More specifically, the Closure code was assigned in only 8% of the class periods observed, an astonishingly low percentage given that closure was considered to be an essential element by authors of both textbook types. Among teachers who did bring closure to lessons, they devoted approximately 6% of class time in doing so.

Table 2
Percentage of class time for all teachers

<table>
<thead>
<tr>
<th>Lesson Elements</th>
<th>All Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 109</td>
</tr>
<tr>
<td>Warm-Up</td>
<td>7.4</td>
</tr>
<tr>
<td>Review</td>
<td>16.3</td>
</tr>
<tr>
<td>Introduction</td>
<td>1.8</td>
</tr>
<tr>
<td>Lesson Development</td>
<td>42.4</td>
</tr>
<tr>
<td>Practice &amp; Apply</td>
<td>19.4</td>
</tr>
<tr>
<td>Assess</td>
<td>3.4</td>
</tr>
<tr>
<td>Closure</td>
<td>0.5</td>
</tr>
<tr>
<td>Non-Instructional</td>
<td>8.9</td>
</tr>
</tbody>
</table>
Curriculum Type

Table 3 displays the average percentages of a class period that mathematics teachers teaching the Integrated curriculum devoted to various lesson components. Teachers of the Integrated curriculum spent the most time on the Explore lesson component and spent approximately equal portions of time on Review as was spent on Apply. Collectively, these three components comprised approximately three-fourths of class time.

Table 4 displays the average percentages of a class period allocated to various lesson elements by teachers teaching a Subject-Specific curriculum. In this context, teachers allotted the greatest amount of time to the Teach component, followed by Practice & Apply, and then Review. These three components together comprised more than three-fourths of class time.

Comparing Table 3 with Table 4 shows how the time allocation decisions of the group of teachers teaching the Integrated curriculum compares with the decisions of the group of teachers teaching a Subject-Specific curriculum. This comparison shows that the percentage of time teachers used for warm-up activities, review, assessment, non-instructional time, and closure were nearly identical for teachers across curriculum types. However, opportunities for students to practice and apply mathematical concepts during a mathematics class period were significantly more likely to be provided in a Subject-Specific class period than in an Integrated class period (Practice & Apply vs. Apply, \( F = 6.09, p = .015 \)). In fact, teachers of the Subject-Specific curricula spent better than 60% more time on practice activities than did teachers of the Integrated curriculum. There was also a significant difference between the teachers of the two curriculum types on the amount of time allocated to lesson development (Teach vs. Explore + Share & Summarize, \( F = 6.98, p = .010 \)). Integrated teachers devoted almost one-half the class period to development (48.2%), which was substantially more than Subject-Specific teachers allocated (38.0%). Thus the additional time teachers of Subject-Specific curricula devoted to practice came at the expense of lesson development with teachers of the Integrated curriculum devoting approximately 30% more time to introducing new mathematics material during the class period than did teachers of Subject-Specific curricula.

Table 3
Percentages of class time for teachers of the Integrated curriculum

<table>
<thead>
<tr>
<th>Lesson Elements</th>
<th>Integrated Curriculum n = 47</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-Up</td>
<td>8.0</td>
</tr>
<tr>
<td>Review</td>
<td>14.6</td>
</tr>
<tr>
<td>Launch</td>
<td>2.3</td>
</tr>
<tr>
<td>Explore</td>
<td>43.5</td>
</tr>
<tr>
<td>Share &amp; Summarize</td>
<td>4.6</td>
</tr>
<tr>
<td>Apply</td>
<td>14.7</td>
</tr>
<tr>
<td>Assess</td>
<td>2.5</td>
</tr>
<tr>
<td>Closure</td>
<td>0.9</td>
</tr>
<tr>
<td>Non-Instructional</td>
<td>8.9</td>
</tr>
</tbody>
</table>
Table 4
Percentages of class time for teachers of Subject-Specific curricula

<table>
<thead>
<tr>
<th>Lesson Elements</th>
<th>Subject-Specific Curricula n =62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-Up</td>
<td>6.9</td>
</tr>
<tr>
<td>Review</td>
<td>17.5</td>
</tr>
<tr>
<td>Lesson Preview</td>
<td>1.4</td>
</tr>
<tr>
<td>Teach</td>
<td>38.0</td>
</tr>
<tr>
<td>Practice &amp; Apply</td>
<td>23.0</td>
</tr>
<tr>
<td>Assess</td>
<td>4.2</td>
</tr>
<tr>
<td>Closure</td>
<td>0.2</td>
</tr>
<tr>
<td>Non-Instructional</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Class Period Format

To compare teaching in different class period formats codes were combined in the way previously described and as shown in Figure 1. There were percentage similarities and differences across class formats relative to teachers’ use of class time. Table 5 displays how time was used relative to the class formats of Regular, Block, and Modified Block. We focus on similarities and differences between Regular and Block formats in order to answer the research questions of this study.

Table 5
Percentage of class time for three class period formats*

<table>
<thead>
<tr>
<th>Lesson Elements</th>
<th>Regular Format n = 53</th>
<th>Block Format n = 25</th>
<th>Modified Block Format n = 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-Up</td>
<td>6.8</td>
<td>5.6</td>
<td>10.1</td>
</tr>
<tr>
<td>Review</td>
<td>15.5</td>
<td>18.9</td>
<td>15.4</td>
</tr>
<tr>
<td>Introduction</td>
<td>2.1</td>
<td>1.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Lesson Development</td>
<td>45.0</td>
<td>40.5</td>
<td>39.1</td>
</tr>
<tr>
<td>Practice &amp; Apply</td>
<td>18.9</td>
<td>18.9</td>
<td>20.8</td>
</tr>
<tr>
<td>Assess</td>
<td>2.4</td>
<td>4.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Closure</td>
<td>0.3</td>
<td>0.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Non-Instructional</td>
<td>8.9</td>
<td>10.5</td>
<td>7.5</td>
</tr>
</tbody>
</table>

* percentages may not sum to 100% due to rounding

The amount of time teachers in Block and Regular class formats used for introducing the lesson (in the form of a Launch or a Lesson Preview) was remarkably similar. Time spent on practicing and applying new concepts and skills was also similar in both formats. Furthermore, the amount of time spent on non-instructional activities was relatively the same regardless of the type of class format. The slight percentage difference in teachers’ time allocation for Warm-Up
activities was not statistically significant. Additionally, although it appears that teachers of Regular class format allot more time for Development, and that teachers of Block format use more time for Review, these percentage differences are not statistically significant ($p > .05$). At first glance, the table suggests that teachers of Block format allotted greater amounts of time for assessing and diagnosing students learning than did teachers of Regular format. However, the difference observed in Assessment was not statistically significant. Only a small amount of instructional time was allotted for the closure of the lesson, and this was true for teachers in both class formats. The difference observed in the amount of time allotted for closure was not statistically significant ($F = 3.98, p = .064$).

**Discussion**

The results of our study indicate that in most US classroom warm-up activities, typically not directly related to the specific mathematics content of the lesson, and non-instructional activities amount to about 16% of class time. Moreover, another 16% of time is spent in general review and in reviewing homework. Therefore, collectively these results indicate that one third of available time is either spent on previously learned content or squandered altogether. Although these results are disheartening they are consistent with findings of previous studies. More specifically, we found that that 84% of available class time in mathematics at the secondary school level is used to foster mathematical learning by teaching new concepts, reinforcing previously learned concepts, or assessing students understanding of mathematical concepts. Our results are within range of the lower limits of teachers reported use of time in the Weiss et al. (2003) study, and are within the upper range of the TIMSS findings (Mullis et al., 2000). Thus, despite a variety of reform initiatives in mathematics textbooks and class format, it appears that teachers’ use of class time has changed little in the past decade.

Differences among teachers of each curriculum type suggest the possibility that the use of an integrated curriculum may be associated with differences in the way teachers use their class time. Compared to teachers of Subject-Specific curricula, teachers of the Integrated curriculum spent significantly less time having students practice and apply during class, while spending more time having students explore and share results about new concepts. However, the time spent on other lesson elements was remarkably similar across the two curriculum types.

The observed similarities between the use of time for Regular class format and Block class format did not support the findings of Veal and Flinders (2001), who suggested that Block format provided longer periods of time for the teaching of mathematics, that is for the development portion of the lesson. In our study, the potential differences between Regular and Block class format for teachers’ allocation of time for development of students learning was not statistically significant. We would argue that this refutes a common argument in support of block scheduling, that it allows teachers to conduct longer, more in-depth lessons, because teachers’ use of time for development of students mathematics learning was similar regardless of class format.

Additionally, teachers’ allocation of class time for warm-up activities, review, lesson introduction, practice and apply, assessment, and non-instructional activities did not statistically differ between class formats. These observed similarities, and the insignificant differences
between class formats, suggest that the differences in teachers’ use of class time may not be due to class format but rather to the type of curriculum taught.

The lack of teachers’ attention to lesson closure continues to be an issue of concern. In this study, closure was defined “as the wrapping-up of the mathematical content at the end of a class period.” Closure can foster learning by assisting students in conceptualizing mathematical meaning and helping them make connections among the mathematical ideas that were addressed during the lesson (Stein, Engle, Smith, & Hughes, 2008). It is unfortunate that so little time is spent on providing closure to lessons during a typical mathematics class period. Efforts should be made to increase the amount of time devoted to closure during a mathematics class period and to the frequency with which teachers employ closure.

**Conclusion**

Despite various reform initiatives in mathematics curricula and the popularity of the Block class format in many districts, it appears that few changes have occurred in U.S. mathematics teachers’ use of class time in relation to studies conducted in the latter part of the 20th century. The amount of time allocated to warm-up activities, the introduction of new mathematical concepts, closure, assessment and non-instructional activities were basically the same across curricula types. However, there were noticeable differences in the amount of time used to introduce new mathematical ideas and the amount of time allotted for students to practice and apply. In particular, teachers of the Integrated curriculum utilized more time to develop new mathematical ideas than teachers of Subject-Specific curricula, while teachers of Subject-Specific curricula devoted more time to having students practice and apply. These observed differences suggest that the differences in teachers’ use of class time are related to the curriculum they teach. Future investigations should consider the association between the allocation of instructional time and student achievement, as well as reexamine the impact of Block Format and Regular format on students learning with a larger sample of teachers of both types of curricula.
References


