Using a Lifeline to Numbers a *Personal*

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WHEN WAS THE LAST TIME THAT parents told you they enjoyed their children's homework assignment because it gave them a chance to communicate with their children? That is exactly what happened in one middle-grades classroom. Jane Hunt, a seventh-grade mathematics teacher, used a number-line activity based on students' individual timelines to help her students understand the concepts of integers and rational numbers. These personal lifelines connected mathematics with language arts and other subjects. The project allowed for concept development through real-life experiences, with the added bonus that many parents became enthusiastic about opportunities to share family history with their children.

During the middle school years, most students make large strides in their physical and social growth. These same years should also be a time for mathematical growth. The development of good number sense is especially important. *Principles and Standards for School Mathematics* (NCTM 2000, p. 220) makes this statement:

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Through teacher-orchestrated discussions of problems in context, students can develop useful methods to compute with fractions, decimals, percents, and integers in ways that make sense. Students' understanding of computation can be enhanced by developing their own methods and sharing them with one another, explaining why their methods work and are reasonable to use. . . .

Hiebert and Behr (1988) assert that students have difficulties with rational numbers because they learn to manipulate symbols without meaning. Teachers must provide contexts in which students can understand the meaning of such numbers.

Preparing for the Project

BEFORE BEGINNING THE PERSONAL-LIFELINE project, the students completed activities that involved graphing on both horizontal and vertical number lines. These activities emphasized the importance of scale, uniform spacing, and proper placement of numbers. The students practiced subdividing intervals to represent decimals, fractions, and mixed numbers. The class also discussed how integers are used in real life. Most students were familiar with the use of integers to represent negative temperatures, loss of yards at a football game, checking-account balances, and elevations above and below sea level.

To make sure that the students understood the expectations of their individual projects, Hunt gave them the story of Lu Lynne as a practice problem (see **fig 1**). The students considered the different ways in which time may be represented and worked in groups to identify and underline all refer-

Give Rational *Touch*

ences to time in the sample problem. They were encouraged to look for such phrases as "about the same time"; "21 months older"; "last year"; "September 20, 1986"; "3 months before"; "5 years, 3 months"; and "at Christmas." Hunt emphasized that the story of Lu Lynne is not a good example of a family history because it lacks organization and sound grammatical structure. The purpose of the practice problem was to help the students consider the many ways in which one can refer to time and to notice that some times are exact, whereas others are approximate.

The students were then instructed to use 0 to represent the month of Lu Lynne's birth. They were to find points on the number line that corresponded to the times that they had underlined in the sample problem. Before completing that activity, the students first needed to become accustomed to using a particular month as the origin. Middle-grades students tended to think of 1 January as 0, rather than September 1986. Another difficulty that students faced was the tendency to label the number line with just the years (1985, 1986, 1987, 1988, etc.) while neglecting to label the points with integers (–1, 0, 1, 2, etc.). One benefit of this project was that students began to understand the importance of the origin and the relationships of all other numbers to the origin.

The students quickly realized that not all the dates could be represented by integers. This discovery prompted a discussion about the practicality of different representations. For example, a decimal numeral is not a particularly good choice for representing two months. The students also discovered that some common fractions are more useful than others for representing time. For example, they found that halves, thirds, fourths, sixths, and twelfths are useful for representing numbers of months as parts of the year.

Instructions: Below is a sample of a biography that might have been submitted by a student as part of her Lifeline Project. Work with your group to underline all of the phrases that make references to time. Using 0 to represent Lu Lynne's birth date, work with your group to find points on the number line that represent the times of the events you have underlined.

Lu Lynne's Biography

Lu Lynne's birthday was Sept. 20, 1986. Her brother, Billy, was 21 months older than she. Lu Lynne began to walk when she was 9 months old. Her family moved to Kansas when she was about 3 years old. Her dad had graduated from school there in January of 1981 so he was glad to move back. Six months after his graduation, he and Lu Lynne's mother were married in Austin, Texas. They bought their first home in March of the following year. They didn't sell that house until December of 1990. Billy was hospitalized 3 months before the house sold. He was very sick and had surgery at that time. Lu Lynne was the star point guard for her basketball team when she was 10 1/2. She had only begun playing the year before. Before that she had had no interest in sports. When she was younger all she wanted to do was read. She won an award for reading at the honors' program in May, 1994. Reading a book about basketball is what began to interest her in sports. Lu Lynne's mother graduated from nursing school in June of 1997. She had had to postpone completion of her degree because Kiki, Lu Lynne's little brother, is 5 years 3 months younger than Lu Lynne. Once Kiki entered school, Lu Lynne's mother was able to finish her training. The family celebrated her graduation with a trip to Disney World in August of the year following her graduation. They had begun saving for vacation at Christmas in 1995.

Fig. 1 Lu Lynne's story

Hunt then placed a large number line on the board and asked students to label and position sticky notes on the number line to represent each of the times in Lu Lynne's biography. The students had particular difficulty in representing negative numbers that included fractions. For example, in the story, Billy was 21 months older than Lu Lynne. The students had to determine that 21 months before Lu Lynne's birth would be represented as either –1 9/12 or –1 3/4. A common mistake that students made was to place –1 3/4 between 0 and –1 rather than between –2 and –1.

The Personal-Lifeline Project

AFTER THE STUDENTS HAD SOME EXPERIENCE placing rational numbers on a number line, Hunt assigned the task in **figure 2.** She used the practice problem to illustrate that personal lifelines are more interesting if they include events that happen at various times. In their projects, the students were required to include events that had happened before and after they were born and at various

Make a personal lifeline (number line) using the month and year of your birth as 0. Dates of events that occurred prior to your birth will be represented with negative numbers, and those afterward will be represented with positive numbers.

You may include any events and as many as you like, although the minimum number (including your birth) is ten. At least three of those events must have occurred 3 to 5 years before your birth. For example, suppose that your parents were married 5 years before you were born. That event would be placed on the number line at –5 (negative 5). Or suppose that you moved to El Paso when you were 3 years old. That event would be placed on the number line at +3 (positive 3).

Events should be recorded showing your mathematical power. For example, if you began to crawl at 9 months old, you would place that event on the number line at 3/4, since 9 months out of 12 months would be the fraction 9/12, which simplifies to 3/4. Choosing such events as the births of siblings, when you began to walk, when you learned to ride a bike, when your parents met, when you cut your first tooth, and so on, should be fun for your family. Please do not include obvious events, such as your first birthday (at +1), your second birthday (at +2), and so on. You should label each point with words or pictures that communicate the event.

Finally, you should include a reflection concerning the mathematics you learned or strengthened by doing this task, as well as your thoughts concerning the task.

Fig. 2 Personal-lifeline prompt

Name of Classmate: _____
_____ Measured accurately
_____ At least 3 to 5 years on negative side of lifeline
_____ From 12 to 14 years on positive side of lifeline
_____ Positive and negative sides of lifeline in correct places
_____ Illustrations and labels for each graphed event
_____ At least 3 events before your birth (negative events) and 7 events after your birth (positive events)
_____ Birth as 0
_____ Correct numerical representation for each point
_____ Used mixed numbers and a variety of common fractions (other than just halves, fourths, and thirds)
_____ Dots in proper place for each point graphed
_____ Points graphed in appropriate place considering the time stated
_____ Integer labels above yearly tick marks
_____ Year intervals divided into useful, uniform partitions
_____ Other _____
_____ Other _____
_____ Other _____

Fig. 3 Personal-lifeline student critique

times during the year. The students were encouraged to choose events other than those represented by whole numbers, such as first birthday, second birthday, and so on. The students brainstormed possible events that they might include in their personal lifelines. The students who objected to submitting personal information were allowed to choose historical, rather than personal, events for their lifelines.

Some events that interested students were their parents' first meeting or marriage, the births of siblings, cutting or losing a first tooth, saying first words, learning to ride a bike, moving to a new home, and special vacations or celebrations, along with important historical events and births and deaths of famous people. The students used this list as a starting point but were encouraged to interview family members and choose interesting events in the histories of their families. The assignment offered opportunities for earnest communication between adolescents and adult family members.

The next step was to create individual lifelines. To successfully accomplish this goal, the students had to make two important decisions. First, they had to decide what kinds of representations they would use for the events that they had chosen. Some students chose magazine pictures, others used photographs or drawings, and some used combinations of two or more of these types of illustrations to represent events in their personal histories. Second, the students had to determine the manner in which they would represent time, especially divisions of time that were less than one year. Those decisions were based on the events that they had chosen. Hunt shared the scoring criteria in the form of a student critique sheet (see **fig. 3**).

The students next constructed rough drafts of their lifelines. Using the personal-lifeline student-critique form, the students met in pairs to provide feedback to each other. Some students were able to pinpoint such difficulties as misplacement of numbers, inappropriate use of scale and labels, and lack of correspondence between labels and points on the lifeline. After these conferences, the students revised their personal lifelines (see **fig. 4**). They corrected errors, added detail, and designed their edited copies on fanfold computer paper. The students then submitted their final copies for grading (see **fig. 5**).

The last step in the project was to write a summary of the mathematics used in creating the personal lifelines. The summary was to include a de-
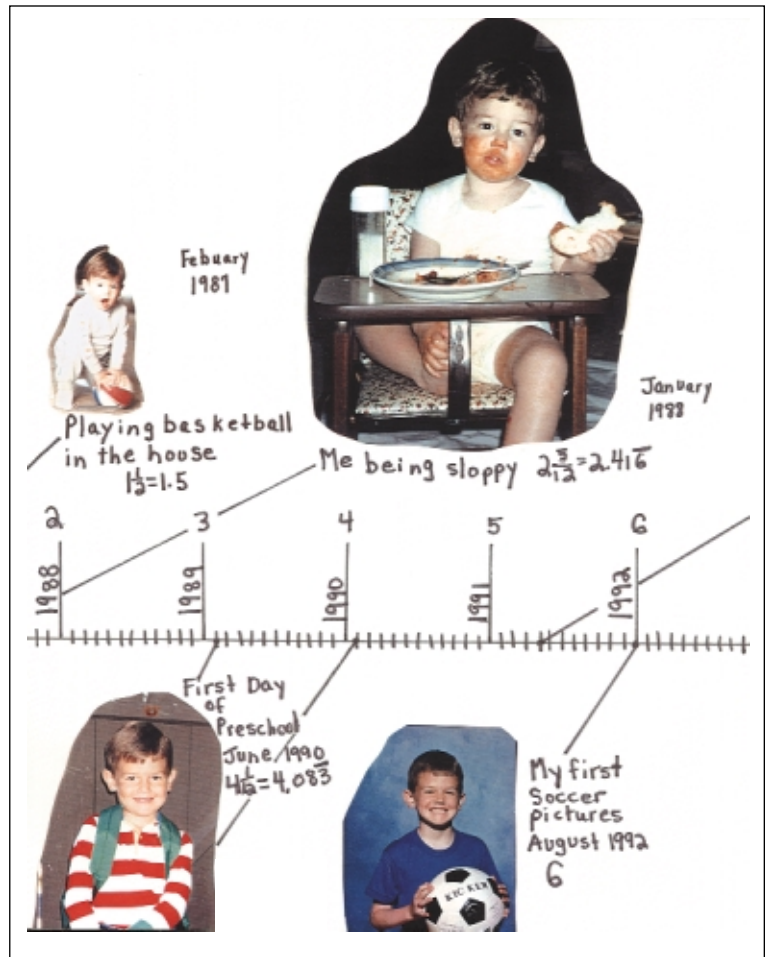

Fig. 5 Section of a student's lifeline

scription of what the students had learned about positive and negative rational numbers. The students were to explain the representations that they chose for intervals on the lifeline. In addition, they were to describe the things that they learned from the project and the areas that gave them particular difficulty.

To extend this project in conjunction with a language-arts class, students might be asked to write family histories that include the events in their personal lifelines. In preparation for the family-history writing task, the language arts teacher might have students as a class rewrite Lu Lynne's biography in a more organized sequence. This extension would help students transfer the symbolic lifeline representation to a narrative format and would serve as an appropriate culminating activity.

The teacher's scoring guide for the personal-lifeline project appears in **figure 6.** In addition, the students displayed their final projects on the classroom walls (see **fig. 7**). Other students were allowed to place sticky notes on the finished projects to make positive comments noting the differences in the lifelines.
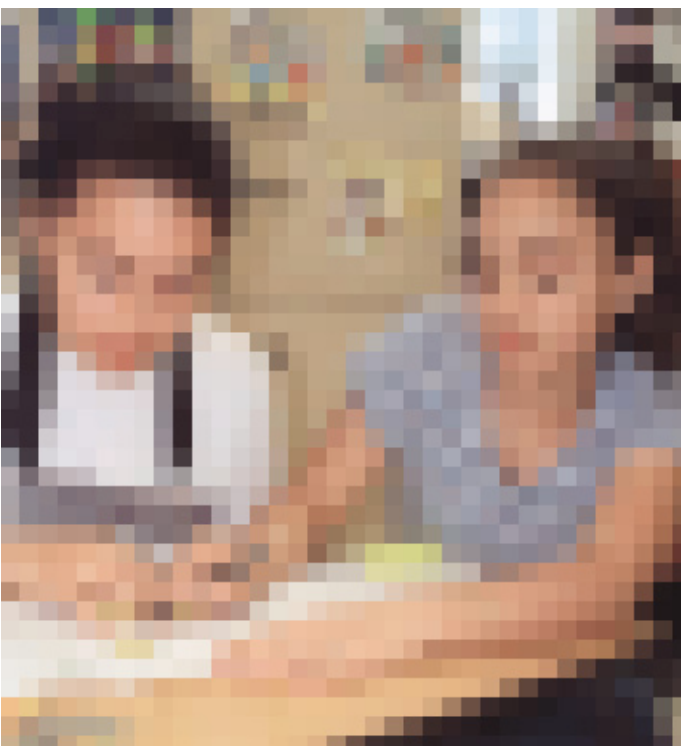
Fig. 4 Students in conference about their lifelines

| Criterion	Level 4	Level 3	Level 2	Level 1
Mathematical placement	Accurate scale with clear labeling; accurate placement of events	Accurate scale; accurate placement of events with minor errors	Integers and some fractions correctly placed	Little attention to scale; limited accuracy in placement of events
Choice of events	Includes a variety of significant events and meets criteria outlined in lifeline student critique; choice of events uses wide variety of fractional representations	Includes events outlined in lifeline student critique; several fractions are used but are limited to those that are easily represented (1/2, 1/3, 1/4)	Includes a limited variety of events or uses mainly positive and negative integers; only basic fractions used	Includes a limited variety of events; most events correspond to positive integers
Visual presentation	Creative representations of events; visually appealing	Choice of symbols accurately represents events; visually appealing	Choice of symbols or words accurately represents most events; little attention to neatness	Little attention to visual detail
Writing component	Shows clear understanding of positive and negative rational numbers, with clear rationale for choice of intervals; insightful self-assessment	Shows clear understanding of positive and negative rational numbers and good rationale for choice of intervals; lists (with examples) some areas of learning or difficulty	Shows basic progress in learning about positive and negative integers and choice of intervals; lists some areas of learning or difficulty	Shows little understanding of positive and negative integers and choice of intervals; gives little attention to areas of learning or difficulty
Family history (optional)	Well sequenced and organized; grammatically correct; gives interesting overview of family life	Well sequenced and organized; only minor grammatical errors; events accurately described	Some attention to organization and sequencing; some grammatical errors; events accurately described	Little attention to organization and sequencing; many grammatical errors; little detail in description of events

Fig. 6 Scoring guide for personal-lifeline task

Connections

THIS ACTIVITY CAN EASILY BE ADAPTED TO BEcome part of an interdisciplinary unit on historical, community, or governmental events. For example, to connect the personal timeline with history, the 0 coordinate might represent the signing of the Declaration of Independence. Events leading up to independence would be represented by negative numbers, whereas events that occurred after the signing of the document would be represented by positive numbers. Another project might use 0 to represent 1900 and show pictures depicting inventions that affect the lives of students today in transportation, communications, and other fields.

For community events, the coordinate for 0 might represent the date that the school was opened. Events before the building of the school might include the charter of the town, the construction of important historical buildings, and important milestones in the history of the town. Recent events might include school awards, major athletic competitions, or community celebrations.

Governmental connections could include the inauguration of presidents, the granting of statehood, and the passing of important pieces of legislation. The choice of the event represented by 0 is not significant; the placement of the events on the number line will reveal students' understanding of the mathematical part of the interdisciplinary assignment.
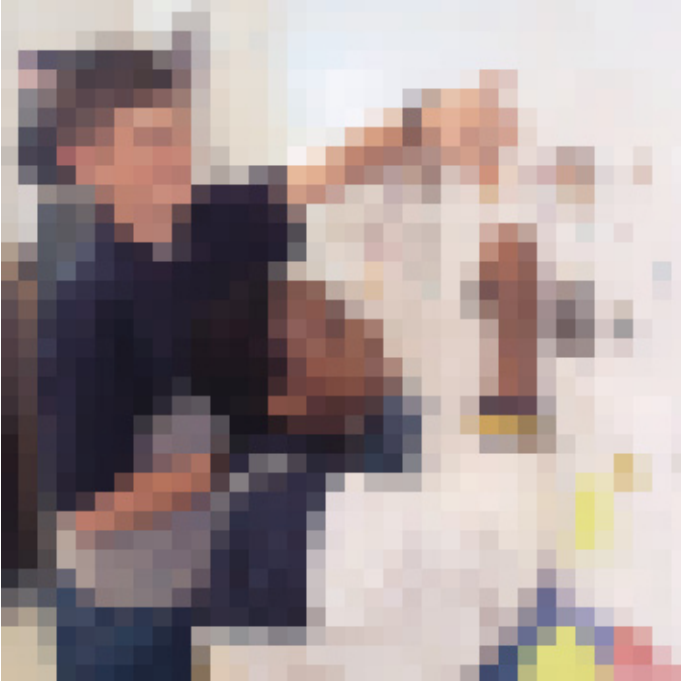
Fig. 7 A display of student lifelines

Conclusion

THIS PROJECT PROVED TO BE REWARDING IN many ways. The students strengthened their understanding of positive and negative numbers, especially those involving fractions; learned to pay attention to scale and to measure accurately; and enhanced their graphing skills on the number line.

This activity changed the emphasis in this unit from following a procedure to place numbers on a number line to completing an application task. The students used problem solving to determine scale, to choose methods for representing numbers, and to understand that the origin can represent any specific point in time. Valuable connections could be established between mathematics and language arts with the addition of the requirement of a written history of the time frames represented by the number line.

The most powerful, unexpected benefit of the lifeline project was parental enthusiasm for the activity. Adult family members were delighted to have opportunities to share important events in their personal histories with their adolescent children. One parent remarked that he had, in essence, introduced family members to his child as they worked together to choose events that happened before the child's birth. Another parent commented that the student had to explain the placement of negative numbers. The students enjoyed learning about their own families and the families of others. Because families and teams are important in the middle school environment, this activity was used near the beginning of the school year to give students a chance to learn about one another and help establish a sense of "family" among students.

Another advantage of this task is that it can be adapted to many different learning levels. The task can be used to introduce graphing on the positive number line. Younger students can label their lifelines with years only, using a specific year as the origin. For more advanced students, this activity might be used to review graphing on the number line before moving on to graphing in the coordinate plane.

In short, this activity not only presents a practical application of important mathematical concepts but also encourages the development of social skills that are essential in the middle grades and provides a link between the school and the family. Most important, however, the activity is fun and meaningful for students, families, and teachers.

References

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