Investigating the Impact of Field Trips on Teachers’ Mathematical Problem Posing

Scott A. Courtney¹, Joanne Caniglia¹, and Rashmi Singh¹

Abstract

This study examines the impact of field trip experiences on teachers’ mathematical problem posing. Teachers from a large urban public school system in the Midwest participated in a professional development program that incorporated experiential learning with mathematical problem formulation experiences. During 2 weeks of summer 2011, 68 teachers from eight low-achieving city schools explored city landmarks that were not only accessible to the general public but were also considered rich in mathematical connections. Field trips included museums, historical landmarks, a local airport, and an international sporting event. Following each field trip, teachers were asked to create inquiry-based mathematics problems grounded in these experiences to implement in their classrooms. This article discusses the impact field trips and accompanying professional development activities had on teachers’ ability to create problems that provide students with opportunities to engage in meaningful mathematics.

Keywords

field trips, problem formulation, rich mathematics problems, inquiry-based mathematics problems

Field trips as a teacher professional development (PD) tool have been shown to provide positive learning outcomes under certain favorable conditions (Bitgood, 1989; Storksdieck, 2006). For students, field trips provide opportunities for positive

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affective and social experiences (Anderson, Kisiel, & Storksdieck, 2006). Furthermore, field trip learning goals frequently include strengthening students’ content knowledge and process skills, and broadening their general knowledge and perspectives (Storksdieck, Robbins, & Kreisman, 2007), such as developing an awareness of lifelong learning community infrastructure such as museums. Field trips are not only considered an extension to classroom teaching, but also a valuable supplement to classroom instruction and an excellent way to prepare students for future learning (Hofstein & Rosenfeld, 1996; Storksdieck, 2006). Although the impact of field trips on students’ learning has shown varying degrees of success, a common research finding is that field trips can have a positive influence on learning (e.g., Anderson & Lucas, 1997; Bamberger & Tal, 2008; Knapp, 1996). This study seeks to extend these results to mathematics teachers’ instructional practices by examining the impact(s) of field trip experiences and accompanying PD on teachers’ abilities to formulate rich mathematics problems for their students. More specifically, this study addressed the following research question:

Do particular field trip experiences encourage the formulation of rich problems? If so,

1. What elements of a field trip site (e.g., signage, materials, online resources, tour guides) help teachers to create rich mathematics problems?
2. What PD elements accompanying a field trip experience (e.g., preparation before the trip, discussion and activities after the field trip, additional resources) help teachers to create rich mathematics problems?

Review of Literature

Over the past two decades, researchers in teacher education and teacher change (Borasi & Fonzi, 2002; Loucks-Horsley, Stiles, Mundry, Hewson, & Love, 2010; Wilson & Berne, 1999) have identified characteristics of high-quality PD. In an extensive review of such literature, Clarke (1994) argued providing teachers with opportunities to act as students in “classroom activities . . . or real situations” (p. 38) was 1 of 10 key principles for effective PD for teachers of mathematics. Although existing PD studies (e.g., Schifter & Simon, 1992) have demonstrated that engaging teachers as learners in classroom activities (e.g., solving challenging mathematics problems) can impact instructional practice, research is devoid of studies exploring the impact out-of-school experiences, such as field trips, have on mathematics teaching practices.

Noted creativity scholar Getzels (1979) asserted, “Despite the self-evident role of problems in initiating thought toward new solutions, very little is known about how problems are found and formulated” (p. 167). Kilpatrick (1987) observed that the process of problem formulating in mathematics had received little systematic study, and called for research to explore issues surrounding problem formulation. Although mathematics educators have demonstrated an increased interest in the area of problem solving, Gonzales (1996) asserted, “Little attention has been directed toward gaining knowledge about the processes of conceiving, formulating, and posing a mathematical
problem” (p. 152). Such assertions highlight a need for research to expand its focus to include the area of problem formulation.

Recent research in mathematics education has demonstrated a relative increased focus on two areas of problem formulating: exploring preservice teachers’ capacity to formulate problems (e.g., Crespo & Sinclair, 2008), and investigating aspects of students’ problem-posing processes (e.g., English, 1998; 2003). Although, several studies have explored in-service teachers’ selection and implementation of worthwhile mathematical tasks (Boston & Smith, 2009; Stein, Grover, & Henningsen, 1996), research focused on in-service mathematics teachers’ capacity to formulate complex problems or tasks has been relatively limited.

This study attempts to fill the void involving research into in-service mathematics teachers’ problem formulation abilities and out-of-school experiences for teachers by exploring the role field trips play in supporting teachers’ capacity to formulate rich problem-based learning experiences. Furthermore, this study compliments the recent work of Borden and Wagner (2011) to help students “better understand and value the role of mathematics in their own cultural or community context” (p. 11). The annual Show Me Your Math (SMYM) event (Borden & Wagner, 2011; Wagner & Borden, 2011), focusing on Aboriginal communities in Atlantic Canada, brings together students, teachers, and community representatives, to initiate and showcase student investigations into the mathematical knowledge and reasoning inherent in their culture and community. In a complementary manner, through field trip experiences for teachers, the current study attempts to provide teachers with opportunities to experience the mathematics embedded in their community, and, as a result, to develop meaningful problems or tasks that help their students connect to the mathematics in their communities.

Any discussion of rich problems is inherently problematic without a clear description of how the term was used and the criteria by which problems are evaluated. Brahier (2009) described a rich problem as “non-routine and can be solved in a variety of ways” (p. 14). For Swan (2005), a rich task (a) is accessible and extendable; (b) allows for decision making by the learner; (c) involves testing, explaining, proving, interpreting, and reflecting; (d) promotes communication and discussion; (e) encourages invention and originality; (f) encourages questions that focus on “what if” and “what if not”; and (g) is enjoyable and provides an opportunity for surprise. Finally, Principles and Standards for School Mathematics (National Council of Teachers of Mathematics [NCTM], 2000) describe rich mathematical tasks as problems that “prompt students to use and develop mathematical understandings and connections . . . [that] encourage students to think about how familiar concepts and procedures can be applied in new situations” (p. 275). The specific criteria used to evaluate teacher-created problems in this study will be explicated below.

**Method**

Data consisted of written artifacts generated from a group of K-12 teachers as part of a funded project to provide a field-based approach for exploring mathematics in urban
settings. Artifacts included teacher-created mathematics problems or tasks related to these urban explorations. The project was designed to provide teachers with opportunities to experience the mathematics embedded in the world around them. Accompanying PD supplemented each field trip visit by engaging teachers in the practices of modeling situations mathematically, developing solutions, setting up relationships, and analyzing and justifying their own ideas and those of their peers. In addition, PD experiences were designed to engage teachers not only as learners of mathematics, but also as developers and facilitators of others’ learning.

Participants and Sites

Participating schools and teachers from a large urban district in the Midwest were selected based on the socioeconomics of their students (e.g., high poverty rate) and the school’s poor performance on state mathematics achievement assessments. The project’s 2-week (nonconsecutive) program was publicized as one of several PD options open to district teachers. Teams of principals, special education, and mathematics teachers were highly encouraged to apply.

A total of 68 teachers from eight distinct district schools participated in the project. Forty teachers participated in the 1st week of the project, whereas, the 2nd week involved 32 teachers (some teachers participated in both weeks).

The 10 field trip sites were chosen to provide participants with the setting and atmosphere to observe, discuss, and design rich mathematics problems. Furthermore, sites were chosen on the basis of their urban commonality (i.e., common to most urban areas) and included museums, a minor league baseball stadium, a historic bridge, notable architectural structures, a local airport, a cemetery, the city zoo, music and performance halls, and an international sports venue. The choice of urban commonality as the basis for site selection was made in an attempt to advance the notion of math as embedded in the world around us.

During PD activities, teachers were grouped by grade level and by school to ensure horizontal and vertical alignment of their work. For example, sixth-grade teachers focused on designing mathematics problems that met the sixth-grade Common Core State Standards for Mathematics (CCSS-M; Common Core State Standards Initiative [CCSSI], 2010, pp. 41-45) and then shared these problems with participating teachers from the same school to ensure problems aligned and connected to students’ understandings prior to and after the sixth grade. A sample middle school teacher–created problem related to the baseball stadium field trip is shown below:

Calculate the volume of the baseball stadium and figure out how many of an item of your choice would be needed to fill the stadium.

Data Collection Procedures

Teachers were requested to construct site-related mathematics problems to use in their own classrooms to build students’ conceptual mathematics understandings. The
problems themselves, and their development, were influenced by a variety of sources, including: site-specific brochures, teachers’ opportunities to interact with the site, tour guides, and PD activities. Project participants developed 88 site-related mathematics problems.

**Analyses of Teacher-Created Problems**

The project team used quantitative and qualitative methods to analyze the 88 problems. Each problem was coded by a panel of three project members in terms of whether it met each of eight rich mathematics problem characteristics. These criteria emerged through meta-analysis of existing research and were operationalized by the project team as shown in Table 1.

A sample third-grade problem demonstrates the team’s coding procedures:

Problem: You and a group of 23 friends went to a baseball game. You can’t all sit in the same row. How many rows will you need if an equal number of students are sitting in each row?

### Table 1. Operationalized Characteristics of Rich Mathematics Problems.

<table>
<thead>
<tr>
<th>Rich Mathematics problem characteristic</th>
<th>Operational criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High cognitive demand (Boaler &amp; Staples, 2008; Stein et al., 1996)</td>
<td>Problem involves creating, evaluating, and analyzing (comparing) versus remembering or statically using or applying procedures, facts, or skills.</td>
</tr>
<tr>
<td>2. Significant content (Hiebert et al., 1997)</td>
<td>Problem meets one or more of the Common Core State Standards for Mathematical Content.</td>
</tr>
<tr>
<td>3. Require justification or explanation (Boaler &amp; Staples, 2008)</td>
<td>Problem includes a statement or question specifically asking students to justify or explain their answer.</td>
</tr>
<tr>
<td>4. Make connections between two or more representations (Lesh, Post, &amp; Behr, 1987)</td>
<td>Problem incorporates two or more of the following representations: real life, manipulative, pictures, diagrams, or symbols.</td>
</tr>
<tr>
<td>5. Open-ended (Borasi &amp; Fonzi, 2002; Lotan, 2003)</td>
<td>Problem includes more than one solution strategy; more than one solution.</td>
</tr>
<tr>
<td>a. Strategy b. Solution</td>
<td></td>
</tr>
<tr>
<td>6. Allows multiple entry points (Tomlinson, 1999)</td>
<td>Problem allows for a variety of entry points.</td>
</tr>
<tr>
<td>7. Allows multiple ways to show competence (Lotan, 2003)</td>
<td>Problem allows for more than one way to show competence (e.g., draw, write, or graph answer); the emphasis is on the product.</td>
</tr>
</tbody>
</table>
a. Show your work
b. Write a number sentence.
c. Explain how you found your answer
d. Represent the problem using a drawing.

This problem was coded as meeting the criteria for seven of the eight rich mathematics problem characteristics:

Characteristic 1: High Cognitive Demand. The problem requires that students make conjectures, examine constraints, and make inferences from the information to make sense of the problem and work toward a solution.

Characteristic 2: Significant Content. The problem meets the following third-grade CCSS-M content (CCSSI, 2010, p. 23):
Domain: Operations and Algebraic Thinking.
Cluster: Represent and solve problems involving multiplication and division.
Standard: 3. Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, for example, by using drawings and equations with a symbol for the unknown number to represent the problem.

Characteristic 3: Require Justification or Explanation. The problem explicitly asks students to explain their thinking and reasoning.

Characteristic 4: Make Connections. The problem asks that students connect the real world baseball stadium with pictures, diagrams, and/or symbols.

Characteristic 5: Open-Ended Strategy and/or Solution. The problem involves more than one solution strategy but has only one solution, so it is open-ended in terms of strategy (5a), but not in terms of solution (5b).

Characteristic 6: Multiple Entry Points. The problem allows for a variety of entry points, such as multiple strategies of multiplication (e.g., arrays, equal groups, repeated addition).

Characteristic 7: Multiple Ways to Show Competence. The problem allows for more than one way to show competence (e.g., representing the situation through a number sentence and/or drawing).

In contrast, the following problem was coded as meeting the criteria of only one rich problem characteristic (Characteristic 2):

Problem: Clear plastic panels on a city bridge cost 2,000,000 dollars. One fifth of the funding for the panels was paid by the State Department of Transportation, \( \frac{3}{10} \) of the funding came from the city, and \( \frac{1}{2} \) of the funding came from a federal grant. How much did each pay?

The project team coded the problem as follows:

Characteristic 1: High Cognitive Demand. The problem does not meet the high cognitive demand criteria involving creating, evaluating, or analyzing.
Characteristic 2: Significant Content. The problem meets the following fourth-grade CCSS-M content (CCSSI, 2010, p. 30):
Domain: Number and Operations—Fractions
Cluster: Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers
Standard: 4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number
c. Solve word problems involving multiplication of a fraction by a whole number, for example, by using visual fraction models and equations to represent the problem

Characteristic 3: Require Justification or Explanation. The problem does not ask students to justify or explain their thinking or reasoning.

Characteristic 4: Make Connections. The problem does not ask for a representation beyond the real world bridge connection.

Characteristic 5: Open-Ended Strategy and/or Solution. The problem only involves one solution strategy and has one solution, so it is neither open-ended in terms of strategy (5a) nor solution (5b).

Characteristic 6: Multiple Entry Points. As written, the problem does not allow for the variety of entry points needed for diverse learners.

Characteristic 7: Multiple Ways to Show Competence. As written, the problem elicits a procedural response from students.

Results

The discussion of results is presented in three sections. The first section addresses the main research question; subsequent sections address each of the two subquestions.

Table 2 provides a descriptive summary of the ratio of site-specific problems met each of the characteristics. Specifically, quantities displayed in Table 2 represent the ratio of the number of problems for a particular site that met the criteria of a rich problem. For example, 6 of the 10 problems related to the Zoo met the High Cognitive Demand criteria (Characteristic 1).

As illustrated in Table 2, the two characteristics that teacher-created problems met most frequently were Significant Content (Characteristic 2) and Mathematical Connections (Characteristic 4). The pervasive nature of the Significant Content characteristic \((M = 1.00, SD = 0.00)\) can be explained by the project directors’ request that problems be aligned to CCSS-M (CCSSI, 2010). Similarly, the preponderance of the Mathematical Connections characteristic \((M = 0.74, SD = 0.23)\) can be explained by the request that problems be explicitly linked to the field trip sites. As such, all problems met the real life representation criteria by default, and, therefore, needed to include only one other representation to meet the Mathematical Connections criteria.

In contrast, Justification or Explanation (Characteristic 3) was the least frequently met characteristic \((M = 0.54, SD = 0.37)\). Although a majority (54%) of the problems met the criteria for Characteristics 3, teachers’ disinclination to require students to justify or explain their thinking is an issue PD and teacher education will need to
address as States begin to focus on the Common Core’s Standards for Mathematical Practice (CCSSI, 2010).

Overall, any individual characteristic was met on average by 68% of the problems ($M = 0.68$, $SD = 0.14$). If we factor out the two characteristics (Characteristics 2 and 4) accounted for above, then each individual characteristic was met by 62% of the problems ($M = 0.62$, $SD = 0.07$). Furthermore, a one-sample chi-square test was conducted to assess whether the teacher-created problems met a number of characteristics different from expected from chance alone (expected value set at the average number of possible characteristics, 4.0).

The results of the chi-square test were significant $\chi^2(7, N = 88) = 21.82$, $p = .003$. This suggests that field trip experiences have a positive impact on teachers’ ability to create problems that provide students with opportunities to engage in meaningful mathematics. The following two subsections delve further into this relationship.

**Do Particular Field Trip Experiences Encourage the Formulation of Rich Problems?**

For a particular field trip site to be considered as having encouraged the formulation of more rich problems than another site, the quantity of problems produced and the number of rich problem characteristics met was examined. The project team chose to define the “richness” of a problem as the number of characteristics met by that problem. For example, the problem involving the baseball field described earlier had a richness score of seven, because it met the criteria for seven of the eight rich problem characteristics described in Table 1. Conversely, the sample bridge problem was given a richness score of 1.

### Table 2. Ratio of Number of Problems Meeting Criteria to Number of Problems by Field Trip Site.

<table>
<thead>
<tr>
<th></th>
<th>Zoo</th>
<th>Cemetery</th>
<th>Art museum</th>
<th>Bridge</th>
<th>Architecture</th>
<th>Baseball field</th>
<th>Aviation</th>
<th>International sporting event</th>
<th>Music hall</th>
<th>Canal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cognitive demand</td>
<td>.6</td>
<td>.66</td>
<td>.63</td>
<td>.7</td>
<td>.75</td>
<td>.91</td>
<td>.75</td>
<td>1</td>
<td>.875</td>
<td>.28</td>
</tr>
<tr>
<td>2. Significant content</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3. Justification or explanation</td>
<td>.2</td>
<td>.17</td>
<td>.125</td>
<td>0</td>
<td>.125</td>
<td>.36</td>
<td>.33</td>
<td>.625</td>
<td>.125</td>
<td>.14</td>
</tr>
<tr>
<td>4. Mathematical connections</td>
<td>.6</td>
<td>.66</td>
<td>1</td>
<td>.7</td>
<td>.625</td>
<td>1</td>
<td>.91</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5a. Open-ended: Strategy</td>
<td>.4</td>
<td>.33</td>
<td>.75</td>
<td>.6</td>
<td>.75</td>
<td>.73</td>
<td>.75</td>
<td>1</td>
<td>.75</td>
<td>.28</td>
</tr>
<tr>
<td>5b. Open-ended: Solution</td>
<td>.5</td>
<td>.5</td>
<td>.75</td>
<td>.7</td>
<td>.75</td>
<td>.55</td>
<td>.66</td>
<td>.875</td>
<td>.75</td>
<td>.43</td>
</tr>
<tr>
<td>6. Multiple entry points</td>
<td>.6</td>
<td>.33</td>
<td>.5</td>
<td>.7</td>
<td>1</td>
<td>.63</td>
<td>.75</td>
<td>1</td>
<td>.5</td>
<td>.28</td>
</tr>
<tr>
<td>7. Multiple ways to display competence</td>
<td>.4</td>
<td>.33</td>
<td>.375</td>
<td>.6</td>
<td>.75</td>
<td>.81</td>
<td>.66</td>
<td>1</td>
<td>.375</td>
<td>.28</td>
</tr>
</tbody>
</table>
The richness score for any particular site was determined by calculating the mean of the richness scores for all of the problems created based on that site. Table 3 lists the richness scores and the number of problems created for each field trip site.

To determine whether particular sites encouraged more and richer problems, and thus, answer the study’s main research question, the project team looked at the Combined Scaled Richness and Number Score. This metric was determined by summing the Scaled Richness Score for each site (mean richness score of all sites, 5.4, scaled as 1) and Scaled Number of Problems Score (mean number of problems for all sites, 8.8, scaled as 1). For example, the Baseball Field, which had a Richness Score of 6 (Table 3) and for which there were 11 teacher-created problems (Table 3), had a Scaled Richness Score of 1.11 (6 / 5.4) and a Scaled Number of Problems Score of 1.25 (11 / 8.8). Therefore, the Baseball Field had a Combined Scaled Richness and Number Score of 2.36 (1.11 + 1.25).

Table 4 displays the rankings of the Combined Scaled Richness and Number Scores for the 10 field trip sites, including the percentage each site’s combined score was above or below the mean. For example, the Baseball Field’s Combined Score of 2.36 was 18% above the mean of 2.00.

As indicated in Table 4, the field trip sites that created the richest and a significant portion of the problems were Aviation, the Baseball Field, and the International Sports Event (Soap Box Derby). The combined number and richness of the problems teachers created for these sites encouraged the project team to explore the significance of the elements of the site itself and the accompanying PD activities.

1. What elements of a field trip site (e.g., signage, materials, online resources, tour guides) help teachers to create rich mathematics problems?

Table 5 displays the internal characteristics of each field trip site, such as whether the site provided a tour guide, distributed informational handouts, and whether the teachers engaged in more than observing at the site.
Although two of the top three field trip sites (Baseball Field and International Sporting Event), in terms of Combined Scaled Richness and Number Scores (Table 4), provided participants with a significant number of internal features (Table 5), the Canal, with a Combined Scaled Richness and Number Score 15% below the mean (Table 4) also provided teachers with a significant number of such features. In addition, there was not a significant correlation between the Combined Scaled Richness and Number Score and the number of internal features, \( r(8) = .38, p = .28 \). Therefore, it does not appear that the number of internal features of a site played a significant role in the richness of problems created by teachers.

Common internal features among the three highest-ranking field trips sites (Aviation, the Baseball Field, and the International Sports Event) were a tour guide, informational brochures, and each involved teachers in experiences that included more than mere observations. Each of these features were also included at the Canal and the Bridge (Combined Scaled Richness and Number Scores 15% below and 3.5% above average, respectively), which suggests that the influence each feature played is more nuanced than their mere existence at the site.

Although comparisons of the types of information provided by brochures did not yield any conclusive differences, the type of information provided by tour guides did
vary. When guides emphasized features of the site in mathematical terms, such as describing the dimensions of the stadium or the slope of the derby racetrack, problem richness and quantity were larger. Conversely, when guides focused on nonmathematical features, such as the difficulties encountered in constructing the bridge or the types of items sold at the canal’s general store, problem richness and quantity were each lower.

The form teacher of engagement at the site appeared to further enhance the richness of problems. More specifically, when teachers were able to physically interact with site features, such as riding down the racetrack in an actual soapbox car or inspecting the interior and exterior of an aircraft, the problems they created were richer than when their interactions were more restricted.

2. What PD elements accompanying a field trip experience (e.g., preparation before the trip, discussion and activities after the field trip, additional resources) help teachers to create rich mathematics problems?

Table 6 provides an overview of the PD activities accompanying each field trip. PD activities served to introduce and reinforce the field trips’ purposes and included teachers sharing their classroom experiences associated with the site and opportunities for teachers to engage in hands-on site-related activities, such as making musical instruments, creating paper bridges, and simulating derby races.

Although two of the top three field trip sites (Baseball Field and International Sporting Event) provided participants with all four accompanying field trip activities (Table 6), the Cemetery and Zoo (with Combined Scaled Richness and Number Scores of 29% below and 3% below average, respectively) provided teachers with all four as well. In addition, there was not a significant correlation between the Combined Scaled Richness and Number Score and the number of activities accompanying the field trip, \( r(8) = -0.05, p = 0.89 \).
These results led the project team to look deeper into the types of pre-/postvisit activities teachers engaged in. Such analysis involved reviewing the problems, activities, and discussions before and after each field trip visit, with an eye toward identifying those features common to high Combined Scaled Richness and Number Score sites (Aviation, Baseball Field, and International Sports Event) and those common to lower scoring sites (Museum, Canal, and Cemetery).

One theme that emerged through such analysis involved teachers sharing out of prior site experiences, with results similar to those involving site-supported tour guides. When these sharing-out discussions included other disciplines (e.g., social studies and science with the canal trip) the mathematics content was diffused and fewer rich mathematics criteria were met. For example,

Problem: When powered only by water, cascade mills had 12 millstones in operation and could produce 2,700 bushels of flour each day. With the addition of steam power, the mill expanded to 18 millstones and estimates 4,000 bushels a day. How many bushels of flour could the mill produce in 30 days when powered only by water? With the addition of steam power, how many more bushels of flour could the mill produce in 30 days?

Although the problem provides a significant amount of information regarding the Canal, the project team determined that only two rich problem characteristics were met (Characteristic 2—Significant Content, and Characteristic 4—Mathematical Connections).

Pre- and postvisit activities that engaged teachers in solving mathematics problems as students, followed by pedagogical discussions related to these problems appeared to enhance the richness of the problems they created. For example, prior to visiting the baseball field, teachers were provided batting and pitching statistics for four professional teams (e.g., runs scored, hits, innings pitched) and asked to determine which team was the best. Engagement with this problem was followed by pedagogical discussions regarding teachers’ conceptions for how such an open-ended problem, requiring one to determine which statistics were most important in making a decision and to justify one’s own and critique other’s reasoning and decisions, could be used in their own classrooms. Such mathematical and pedagogical discussions appeared to stimulate teachers to be on the lookout for mathematics once they arrived at the field trip site.

In addition, postvisit activities that extended teachers’ focus on the mathematical and pedagogical aspects of the site appeared to further enhance the richness of problems they created. For example, after visiting the Soap Box Derby, teachers were provided with a schematic displaying the actual measurements of a soapbox car and asked to solve the following problem:

How many model (smaller sized) soapbox cars can you construct that are proportional to the full-sized car shown above? Draw a blueprint for each model that you find.

After solving the problem, teachers were prompted to discuss potential pedagogical issues regarding the use of such a problem in their own classrooms.
Of the 10 field trips, 3 involved such pre- and postvisit activities and discussions: the Baseball Field, Aviation, and the International Sporting Event. These were also the top-three field trip sites in terms of Combined Scaled Richness and Number Scores (Table 4), suggesting the importance of stimulating teachers to think about the mathematical and pedagogical aspects inherent in the site prior to the site visit and extending such a focus on returning from the site.

Conclusion

According to a recent Newsweek article (Popescu, 2008), “Class [field] trips have plummeted at some of the country’s traditional hot spots for brown-bag learning (p. 12).” More specifically, a Los Angeles Times article (Mehta, 2008) reports that, “Sixty percent of teachers surveyed across the nation reported decreased funding for field trips in recent years.” Both articles suggest the No Child Left Behind (NCLB) Act (Bush, 2001) has contributed to the reluctance of districts to leave the classroom for out-of-school experiences when pressure to perform on standardized tests is a primary focus. Clark (2012) characterized a more direct link between NCLB and the decrease in class field trips: “No one saw it coming at the time, but when then-President George W. Bush . . . sign[ed] the historic No Child Left Behind act, he also signed the death warrant for many school field trips” (p. A4). According to Clark (2012), “In the decade since [NCLB], schools have had to spend more classroom time focusing on test-based instruction, leaving less time for field trips” (p. A4). Such a trend makes it imperative that teachers, schools, and school districts know which characteristics and qualities of field trip sites support students’ learning in the classroom.

As indicated in the work of Borden and Wagner (2011), learning that promotes respect for community knowledge “helps students see that mathematical reasoning is a part of their cultural identity . . . [and] positions the community as a source of mathematical knowledge, thus dispelling the myth that mathematical knowledge comes from teachers and textbooks” (p. 10). Field trips can provide students and teachers with such culturally and community relevant and responsive experiences. In this article, we examined the relationship between field trip experiences and accompanying PD for teachers and teachers’ capacity to formulate rich mathematics problems for their students.

For teachers, problem-based inquiry provides an opportunity to gain insight into their students’ understanding of concepts and processes and to identify existing misconceptions. Furthermore, the process of problem formulation, accompanied by opportunities to reflect on the formulation process, has been shown to be productive for teachers and students of mathematics (e.g., Crespo & Sinclair, 2008; English, 1998; Silver, 1994).

Our study found that field trip experiences could significantly enhance teachers’ capacity to formulate rich mathematics problems. Particular sites providing significant mathematical experiences included a minor league baseball stadium, a local airport, and an international sporting event. Furthermore, this study found that accompanying
PD activities that focus teachers’ attention on the mathematical and pedagogical aspects of the site pre- and postvisit can further strengthen the experience.

It is important to note that due to district constraints, the PD reported in this study occurred in 2 separate weeks. As such, not all teachers were able to participate in both weeks. Although this separated schedule allowed more teachers to participate in the study, it did not allow researchers the opportunity to explore changes in individual teacher’s ability to pose problems. Furthermore, teachers created their problems in grade level groups and these group discussions were neither audio nor videotaped. As such, the project team was unable to follow the trajectory of changes in individual teachers’ problem formulation ability. Such examination remains an area open for future research.

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References


**Author Biographies**

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