REAL-WORLD CONTEXTS AND CLASSROOM CURRICULA: RELEVANCE AND MATHEMATIZABILITY

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This practitioner research considers how real-world problem contexts can support mathematics teaching and learning. Examining both a specific curriculum unit in depth and the growth of the practitioner’s curriculum over time, this report articulates and applies frameworks of relevance and mathematizability to problem contexts and centeredness, individualization, re-presented complexity, and congruence to curriculum.

This short oral report summarizes the findings and understandings emerging from three years of practitioner research on the role of real-world context in mathematics curriculum. As a high school mathematics teacher, the researcher has engaged his students in a variety of projects with real-world problem contexts. This report addresses the following research question: "What features of problem contexts and classroom curricula engage students in building deeper understanding of both mathematics and the real world?"

Theoretical Framework

Mathematical understanding is connecting mathematical ideas to each other and to other knowledge (Hiebert et al., 1997). Depth of understanding correlates with the depth, number, and type of connections students make with mathematics. Real-world problem contexts, such as currency for place value, can help students to make connections. Many of these problem contexts, however, can be “foreign” to students. In addition to failing to acknowledge cultural resources, this mismatch also inhibits students’ mathematical learning. School mathematics can instead “center” on students’ lived experiences (Tate, 2005). This centrality of curriculum with students’ lives is consistent with culturally relevant pedagogy (Ladson-Billings, 1995).

The process by which real-world problems are analyzed and solved entails mathematization. Mathematics can further serve as a tool for advocating for change when contexts of social injustice are brought into the classroom (Gutstein, 2005). Students may still fail to connect procedural school mathematics with problems set in real-world contexts (Boaler, 2002). In a different sense, mathematization could refer to the study and formalization of everyday cultural practices using a mathematical lens, an ethnomathematical perspective (Barton, 1996).

Classroom Setting

The data for this study come from the researcher’s classroom in a school that serves recently immigrated English language learners in New York City. Students come from twenty-two countries and speak twelve different languages; 71% of students qualify for free or reduced lunch. The school is part of a growing network of schools dedicated to integrated content and English language instruction, project-based instruction, experiential learning, and support for students’ first languages. Students take classes in blocked groups with an interdisciplinary team of teachers. To encourage peer support for English language development, students stay in the same “institute” for two years so that the classes in this study consist of both ninth and tenth graders.

The researcher develops some of his classroom work with a collaborative group of teachers and a university researcher. In Centering the Teaching of Mathematics on Urban

Youth, participating secondary mathematics teachers meet monthly during the school year and intensively during the summer to share their experiences as teachers as well as to learn more about how to incorporate real-world social justice contexts into their classroom teaching.

Methodology and Data Sources

This qualitative action research study begins out of intrinsic interest, but then moves into a more instrumental view in the development of a set of dimensions with which to classify curricula according to the relevance and mathematizability of the problem contexts (Sagor, 2004; Stake, 2000). Classroom curriculum and student work and reflections are coded using open and focused coding (Emerson, Fretz, & Shaw, 1995). The objective of this coding is to find instances of relevance and mathematizability and then to develop subcodes which identify more specific features of curriculum.

The data for this study come from multiple sources:
- Curriculum: projects, handouts and other materials from instructional units.
- Teacher fieldnotes
- Students’ written reflections: daily, at the end of each unit, project, and semester.
- Student work: daily products collected in folders, drafts, and final products.

The researcher also collaborates with a university researcher who visits the classes during certain projects. The researcher engages in reflective discussion about his ongoing work with the visiting researcher and with the other participating teachers.

Results

In the highlighted project, students constructed cartograms based upon current data on their native countries to investigate proportionality. Through this project, students make connections: within mathematics; between mathematics and the world; with each other, their native countries, and the world; and between variables and questions within the world.

This in-depth analysis of a specific curriculum unit yields a description of features of curriculum, which are the ways in which students are presented tasks and support for exploring real-world problem contexts. As far as a problem context is relevant to students, the curriculum may explore topics which are centered on students’ everyday lived experiences and require them to produce individualized final products. Insofar as a problem context is mathematizable, the curriculum that implements it will need to re-present complexity in the real world and employ mathematical methods which may vary in terms of congruence with the practices in the real-world context. An elaboration of these four features, as outlined in Table 1, is the main result of this study.

These features are further applied to other curriculum units, such as ones about taxation, text-messaging systems, community mapping, the consumer price index, technical analysis of stock prices, and structural package design. The researcher’s curriculum demonstrates a trend toward greater prominence of these features over time. These features are further related to students’ expressions of interest as measured by reflections and evaluations.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Questions and Characteristics</th>
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<tbody>
<tr>
<td>Centeredness</td>
<td>To what extent does the curriculum take students’ everyday lived experiences and interests as a point of departure to pose tasks which draw upon students’ cultural resources and knowledge?</td>
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<tr>
<td>Individualization</td>
<td>To what extent are students tasked with creating products which are unique and reflect their own individual perspectives and knowledge?</td>
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<tr>
<td>Re-presented</td>
<td>How does the curriculum explicitly make assumptions, simplifications,</td>
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Complexity
omissions, or other modifications in order to present students with a
problem to which mathematics can be more easily applied?

Congruence
How closely and authentically do the mathematical processes used in
the curriculum parallel how people in the real-world context approach
the problem or task?

Table 1. Elaboration of features of curriculum.

Discussion
If these curricular features are indeed central to using real-world contexts which are both
relevant to students and mathematically rich, then it is still unclear how teachers learn to
develop curriculum units with these features. What knowledge about students and
dispositions toward students’ cultural knowledge and resources facilitate the development of
curriculum with these features? From the point of view of developing curriculum, where is it
more useful to start—the mathematical content or the real-world contexts?
As a first attempt, these features have been introduced as questions which can be
answered descriptively for each project. A further step would be to use these categories to
develop a rubric for evaluating curriculum. How might these rubrics apply to commercial
curricula which claim to draw primarily upon real-world contexts in the teaching of
mathematics?

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