

Maps, mobile tools, and media boards:

Technologies for learning about the mathematics of place-based phenomena

Laurie Rubel, Maren Hall-Wieckert, Vivian Lim, *City University of New York*; Sarah Williams, *Civic Data Design Lab, MIT*

INTRODUCTION

City Digits is a design-based research project which leverages the power of technology to bring real-world information and a critical context into mathematics education. Through the curriculum students learn to use mathematics as a way to understand local phenomena from a critical perspective. Using a combination of mapping, data, and media technologies students are enabled to explore mathematics using social and demographic information.

Our project developed two modules:

Local Lotto focuses on patterns of lottery spending and winning across New York City neighborhoods.



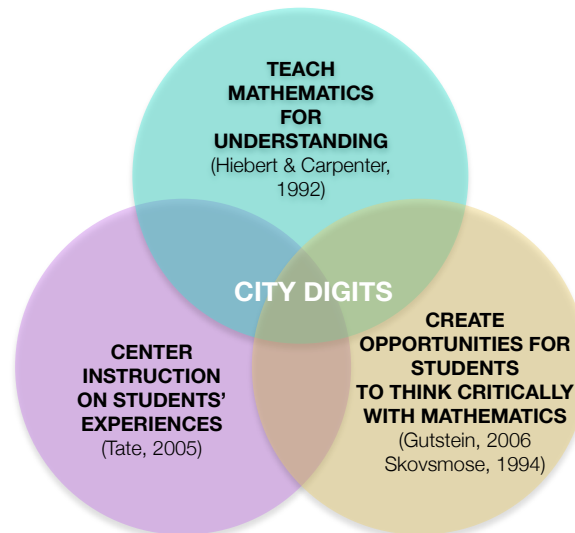
Cash City focuses on the distribution of banks and alternative financial institutions (AFIs) including pawnshops, check cashing stores, and wire transfer services across New York City.



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THEORETICAL FRAMEWORK

CULTURALLY RELEVANT MATHEMATICS PEDAGOGY
(Ladson-Billings, 1995; Rubel & Chu, 2012)
CRITICAL PEDAGOGY OF PLACE
(Gruenewald, 2003)



DESIGN PRINCIPLES FOR INTEGRATING PLACE, CULTURE, AND MATHEMATICS

(Rubel & Lim, under review)

I. Mathematics as essential for understanding the phenomenon	How does it work?
II. Spatial and Quantitative Components	Where does it occur? How much or how often?
III. Subject Dimensions	Who is involved and how do they participate?
IV. Social Justice Ramifications	Who is impacted and is it fair?

RESEARCH QUESTION:

What role can digital technologies play in a curriculum focused on integrating place, culture, and mathematics?

See back to learn about the curriculum and how technology addresses the frameworks and design principles set forth by the project.

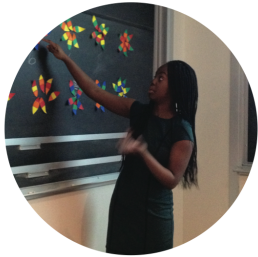
CONCLUSIONS

Digital technologies can facilitate a critical, place-based approach to mathematics teaching and learning. In both modules, students investigate an issue in place, at multiple levels of scale, from local streetscapes to neighborhood comparisons to trends across the larger city. The digital maps of the city in which students live invite them to place their own neighborhood in a broader context and extend their understanding of local phenomena to more abstract scales. The mobile tools further reinforce this connection by making it possible for students to directly upload information from their physical neighborhoods onto the digital maps. The tools bring students' learning from inside the classroom back out into the real world, as publishing students' opinions on the web makes them viewable to the public and therefore meaningful in a context that extends beyond school boundaries. In the context of a critical place-based curriculum, digital technologies mediate between students' critical understandings of mathematics and realities of their daily lives.

For more information, visit www.citydigits.org

OVERVIEW OF CURRICULUM AND THE ROLE OF TECHNOLOGY IN *LOCAL LOTTO* AND *CASH CITY*

I. Mathematics as essential for understanding the phenomenon / *How does it work?*



In *Local Lotto*, students play and analyze games of chance. They learn to calculate probability by creating a physical, collective tree diagram to represent all possible outcomes in a game, then apply their learning to figure out the probability of winning various jackpot lotteries in New York. Students consider what these probabilities mean to respond to the New York Lottery's slogan: Hey, You Never Know.

In *Cash City*, students use mathematics to calculate the cost of obtaining a loan. They learn to calculate interest using a mental math (ratio table) strategy and use APR as a metric for comparing interest rates between AFls and banking options available to them.

3. Pawn Rite charges 4% interest per month in addition to a \$25 fee for a loan. The term of the loan is for 4 months.

- a) Elroy needs cash, so he pawns his gold watch for \$250. How much will he owe the pawn shop when the 4 months are up? Show how you got your answer.

$$\begin{array}{r} \text{month} \quad 100 \quad 50 \quad 25 \\ \text{interest} \quad 4 \quad 2 \quad 1 \\ \hline 100 + 4 = 104 \\ 104 + 2 = 106 \\ 106 + 1 = 107 \end{array}$$

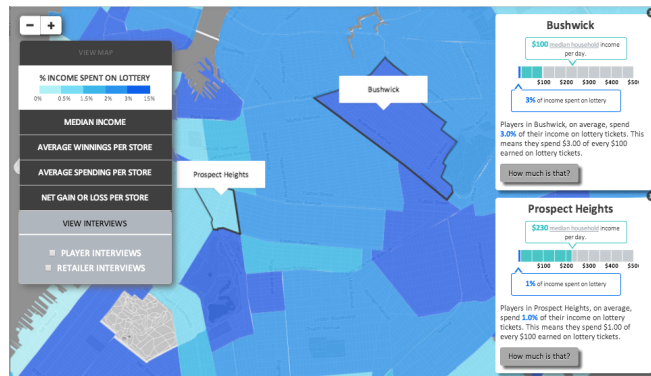
Elroy will owe the pawn shop \$107 after 4 months.



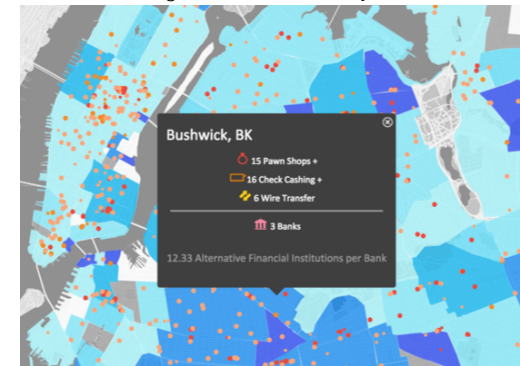
II. Spatial and Quantitative Components / *Where does it occur? How much or how often?*

In both modules, students work with maps that allow them to explore data about the phenomena across New York City's neighborhoods. City Digits utilizes web-hosted mapping tools developed in collaboration with the Civic Data Design Lab at MIT. The tools provide students with interactive, authorable map spaces that shows a variety of rich demographic map layers as well as geo-located points of interest.

In *Local Lotto*, students analyze an interactive choropleth map of the city to address questions about the lottery's local and aggregated impact. The maps enable students to identify patterns in lottery spending and winnings and analyze the large-scale effects of the lottery as a system.



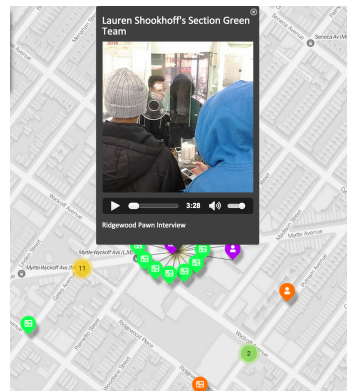
In *Cash City*, students analyze the distribution of AFls and banks in the city. Students first explore a walkable map of New York City to begin thinking about distribution in space, then delve into digital, interactive maps to explore locations and densities of financial services relative to other variables across neighborhoods in the city.



III. Subject Dimensions / *Who is involved and how do they participate?*

For both modules, students gather data in the neighborhood around their school using mobile devices in conjunction with the web-hosted tool to collect photographs of the neighborhood and conduct interviews with both inhabitants and store owners.

All media gathered using these mobile devices is then geo-located and uploaded to the site.



IV. Social Justice Ramifications / *Who is impacted and is it fair?*

Finally, students use snapshots of the digital maps as well as media uploaded to the site to create multimedia narratives supporting their opinions about the fairness of the lottery and the distribution of financial services in New York City. These opinions are published on the public tool site, encouraging further discourse around the issues.

