Mapping the Educational Landscape: New Techniques to Meet Educational Challenges

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Introduction

• International and national comparisons of achievement drive reform efforts: PISA

• **Narrow range** of educational data used: reading and mathematics

• **Limits understanding**: What? Why? How to Improve?

• Conversations: **Polarized and Politicized**

• Student Achievement: **Complex and Nuanced**

• Need a **different way** to visualize data:

  Geospatial Mapping!
What is Geospatial Mapping?

*Geospatial mapping is an approach to applying statistical analyses, data visualization, and other analytic techniques to data that have geographical dimensions.*

- The UNM Center for Education Policy Research has focused on major educational issues around student achievement and variables that define it.

- Geospatial Mapping approaches make these variables **obvious and easier** to understand in the specific context of educational achievement.

- Some authors argue that a geospatial perspective is essential in developing a type of **visual political literacy** in the areas of education, health and human services.
MAPPING IS POWERFUL

• Geospatial mapping is important because:

  • images, illustrations, and graphic representations strongly support learning, understanding and other aspects of cognition

  • maps have long been useful in engaging multiple groups in civic debates and other political discussions because they can be used as planning tools
The UNM Center for Education Policy Research (CEPR) has made extensive use of geospatial data presentation and analysis to:

- Inform legislative policy decisions.

- Assist local communities in identifying their assets and challenges.

- Help foundations and agencies determine whether their funding strategies are effective.
Why Geospatial Mapping?

*Asking and answering* “critical policy” questions…

What are the key questions that must be answered in order to understand the underlying problem(s)?

- What are the most important issues facing our communities?
- What local, state, national and international data will help us address these issues?
- How can we display the data in ways that enhance people’s understanding of the issues?
- How can we analyze the data to highlight priorities, deploy resources, and monitor impact?
The Power Of Geospatial Mapping

• **Description:** Making the data **accessible** to all audiences
  – Painting the picture of urgency
  – Identifying risk, needs, and assets

• **Analysis:** **Making sense** of the data
  – Identifying gaps in resources
  – Setting priorities
  – Measuring impact

• **Action:** Using data for **change**
  – Providing a basis for advocacy
  – Strengthening public engagement
  – Developing policy
A Few Advantages of Geospatial Mapping

• Geospatial mapping is used extensively in other fields including health and human services, natural resources, public safety, defense, and urban and regional planning.

• The data in the maps are immediately accessible to a wide range of audiences including policy-makers, community members, educators, students, and parents.

• Maps are powerful conversation starters. Everybody sees something different in the maps based on their perspectives and experiences.

• Maps equalize the conversations among different groups at the table. People want to know what others think!
Types of Data

• **Both** spatial and table-based data are required

• Decisions include at what level data will be **aggregated**, for example:
  – School District
  – Municipality
  – Individual School Location
  – Census Tract (U.S.)

• Aggregation level depends on **data availability** and story to be told.
Overview of Examples

The following geospatial mapping examples draw data from both the U.S.A. and Spain.

There are two examples from the state of New Mexico: Albuquerque and Santa Fe.

There are two examples from Spain – focusing on out-migration from Spain, and one that focuses on immigration into Barcelona.
Types of Data

• Education
  • **School Data** (graduation rates, early leaver rates, students entering vocational programs, tests scores)
  • **Disaggregated student group data** (gender, language spoken, socioeconomic status, migration status)
  • **Financial** (per-student spending by school)
    • Sources include local schools and governments, Instituto Nacional de Estadistica (INE)

• Health
  • Prenatal care, birth weights, food access
  • World Health Organization, INE

• Economic
  • Household income, unemployment
  • World Bank, EU Labor Force Survey, INE
Population Dynamics

• Young students emigrating out of the country because they cannot find jobs to match qualifications\(^1\).

• This is called the, “brain \_ rain” — removing many talented young, motivated people from the country.

• **One Strategy**: present data showing which regions of Spain have been hit particularly hard by this trend.

• Focus **economic development** on these areas — give hope to young workers.

Source: Education in Crisis website, [http://www.educationincrisis.net](http://www.educationincrisis.net), The story on current education reforms in Spain: The past will come back, by Maria Luisa Sanchez Simon.
Net Migration of 15-34 year olds out of Spain from 2008-2012 by Province (map) and Region (chart, data not available for all provinces)
Organizing Data for Meaning

Examples:

1. Identifying **geographic disparities** between neighborhoods, schools, municipalities, regions or countries.

2. Showing potential **need/asset gaps** related to local resources.

3. Creating **indexes** that combine a collection of indicators to rank geographies along a continuum.

4. Showing **flows of people or things** into and out of a region.
Why is Geospatial Mapping Important?

EXAMPLE # 1: What is an Issue facing Albuquerque?

How Do We Address The Educational, Economic, And Health Disparities Among Our Communities And Across Our Generations?
Percentage of Individuals Living In Albuquerque Below Poverty Level with Less than High School Education

Less than High School Graduate
- 0% - 8.9%
- 9% - 21%
- 21.1% - 37.7%
- 37.8% - 82.6%

Percentage Below Poverty Level
- 0% - 10%
- 10.1% - 20%
- 20.1% - 30%
- 30.1% - 52.8%
Habitual Truancy Is A Problem Across New Mexico

51,034 Students Were Habitually Truant In 2011-2012

50,929 Truant Students are Enrolled In 66 Of New Mexico’s 89 Districts

BERNALILLO, BLOOMFIELD, LOVINGTON, TAOS, PORTALES, RUIDOSO, POJOAQUE, LAS VEGAS CITY, SOCORRO, WEST LAS VEGAS, ZUNI, HATCH, TRUTH OR CONSEQUENCES, COBRE, RATON, TUCUMCARI, DEXTER, TULAROSA, ESTANCIA, DULCE, CUBA, PECOS, SANTA ROSA, LORDSBURG, LOVING, EUNICE, CLAYTON, TEXICO, QUESTA, CAPITAN, PEÑASCO, MORA, JEMEZ VALLEY, CIMARRON, MAGDALENA, CLOUDCROFT, HAGERMAN, CHAMA, JAL, MESA VISTA, JEMEZ MOUNTAIN, MOUNTAINAIR, TATUM, FT. SUMNER, FLOYD, ANIMAS, DORA, LOGAN, SPRINGER, MELROSE, QUEMADO, CARRIZOZO, RESERVE, HONDO, SAN JON, LAKE ARTHUR, ELIDA, GRADY, VAUGHN, DES MOINES, MAXWELL, CORONA, HOUSE, WAGON MOUND, ROY, MOSQUERO

If All These Students Were In One District, It Would Be The Second Largest District In New Mexico And Twice The Size of Las Cruces

Source: NM Public Education Department: 2010SY 40D Enrollment by District; Habitual Truant Students By District and School Type 2011-2012
Percentage Of APS Elementary School Students Who Were Habitually Truant In 2011-2012

Source: Albuquerque Public Schools, RDA Department, 2011-2012 School Year. A student is identified as a Habitual Truant when the student has accumulated 10 or more days of unexcused absences.
Percentage Of APS Middle School Students Who Were Habitually Truant In 2011-2012

Source: Albuquerque Public Schools, RDA Department, 2011-2012 School Year. A student is identified as a Habitual Truant when the student has accumulated 10 or more days of unexcused absences.
Percentage Of APS High School Students Who Were Habitually Truant In 2011-2012

Source: Albuquerque Public Schools, RDA Department, 2011-2012 School Year. A student is identified as a Habitual Truant when the student has accumulated 10 or more days of unexcused absences.
Habitual Truancy In APS Elementary, Middle, And High Schools

Elementary School

Middle School

High School

These maps show truancy moving like a red tide that engulfs Albuquerque Public Schools students by the time they are in high school.

Source: Albuquerque Public Schools, RDA Department, 2011-2012 School Year. A student is identified as a Habitual Truant when the student has accumulated 10 or more days of unexcused absences.
Percentage of APS Students Attending New Mexico Colleges Who Took Remedial Courses, 2000-2009, By Sending High School

Source: “Ready For College? A Report on New Mexico’s High School Graduates Who Take Remedial Courses In College,” June 2010, New Mexico Office of Education Accountability. Data were unavailable for Volcano Vista & Atrisco Heritage Academy.
Creating An Index

- The previous maps have demonstrated the power of viewing single and multiple variables on a map. An **index** combines multiple variables and provides a means of ranking these in an objective way.
- Indices can **support decisions** about where to allocate funds and focus resources.
- Indices can **focus attention** on negative (risk) factors, or positive (opportunity) factors.
- The Kirwan Institute\(^1\) at Ohio State University and The Trust for Public Land\(^2\) have both used index mapping to **engage community conversation and action** in relation to urban planning issues.

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\(^1\)Reece, Jason, Christy Rogers, Matt Martin, Liz Colombo, Dwight Holley, Melissa Lindsjo (2012), Neighborhoods and Community Development in Franklin County, Kirwan Institute, Ohio State University.

<table>
<thead>
<tr>
<th>COMBINED RISK INDEX FACTOR</th>
<th>VARIABLE</th>
<th>DEFINITION</th>
<th>SOURCE</th>
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<tr>
<td>COMBINED RISK INDEX FACTOR 1</td>
<td>PMMEDu12</td>
<td>Percent Births to mothers who did not complete high school</td>
<td>NMPED &amp; NCES</td>
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<td>COMBINED RISK INDEX FACTOR 2</td>
<td>INVPBSBHC</td>
<td>Percent of All Schools that DO NOT have a School Based Health Center</td>
<td>NMASBHC</td>
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<td>COMBINED RISK INDEX FACTOR 3</td>
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<td>GRADS Program</td>
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<td>COMBINED RISK INDEX FACTOR 4</td>
<td>invGRA10</td>
<td>Percent of students who did not graduate 4 years after entering 9th grade, school year 2009-2010 (note: there are no zeros, but there are missing values due to low numbers of students assessed)</td>
<td>NMPED &amp; NCES</td>
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<td>Percent of students who did not score proficient or above in combined reading and math standard based assessment test, school year 2009-2010 (note: there are no zeros, but there are missing values due to low numbers of students assessed)</td>
<td>NMPED &amp; NCES</td>
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<td>Percent of students receiving free or reduced priced meals, school year 2009-2010 (note: only Los Alamos SD is rated zero)</td>
<td>NMPED &amp; NCES</td>
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<td>COMBINED RISK INDEX FACTOR 7</td>
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<td>Percent Population 25 years and over without high school graduation</td>
<td>US Census American Factfinder, ACS 06-10 5 yr, S1501</td>
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<td>COMBINED RISK INDEX FACTOR 8</td>
<td>PctTitl</td>
<td>Percent All Schools that are Title I schools</td>
<td>NCES, 2008-2009</td>
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<td>COMBINED RISK INDEX FACTOR 9</td>
<td>PPupPS</td>
<td>Dollars expended on personnel salaries per pupil, All Schools</td>
<td>NCES, 2008-2009</td>
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<td>COMBINED RISK INDEX FACTOR 10</td>
<td>PctDF100</td>
<td>Percent Elementary Schools Graded ‘D’ or ‘F’ (percent)</td>
<td>NMPED, 2011-2012</td>
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<td>shortname</td>
<td>Index</td>
<td>textindex</td>
<td>totenroll</td>
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<td>1 to 10 (Highest)</td>
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<td>101 to 10 (Highest)</td>
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<td>111 to 20 (High)</td>
<td>727</td>
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<td>DULCE</td>
<td>131 to 20 (High)</td>
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<td>WEST LAS VEGAS</td>
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<td>LOVING</td>
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<td>JEMEZ MOUNTAIN</td>
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<td>BLOOMFIELD</td>
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<td>0.239</td>
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<td>211 to 40 (Above Average)</td>
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<td>0.376</td>
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<td>221 to 40 (Above Average)</td>
<td>193</td>
<td>0.229</td>
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<td>231 to 40 (Above Average)</td>
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<td>0.301</td>
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<td>JAL</td>
<td>241 to 40 (Above Average)</td>
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<td>LORDSBURG</td>
<td>251 to 40 (Above Average)</td>
<td>881</td>
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<td>244</td>
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<td>SANTA FE</td>
<td>271 to 40 (Above Average)</td>
<td>12660</td>
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<td>MOUNTAIN AIR</td>
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<td>318</td>
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<td>TATUM</td>
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<td>HOBBBS</td>
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<td>CLOVIS</td>
<td>311 to 40 (Above Average)</td>
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<td>PECOS</td>
<td>321 to 40 (Above Average)</td>
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<td>JEMEZ VALLEY</td>
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<td>ROSWELL</td>
<td>361 to 40 (Above Average)</td>
<td>9751</td>
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<td>RATON</td>
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<td>LAS VEGAS CITY</td>
<td>381 to 40 (Above Average)</td>
<td>2003</td>
<td>0.190</td>
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<tr>
<td>SPRINGER</td>
<td>391 to 40 (Above Average)</td>
<td>197</td>
<td>0.214</td>
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</table>
Opportunity-Based Index

The CDC has identified several factors related to high risk for child maltreatment. The goal is to introduce a possible technique for identifying neighborhoods that may benefit from resources.

The best opportunity for children to grow up without becoming victims of maltreatment include:

- Having parents with higher education levels;
- Living in a household with 2 parents;
- Living in a household with income above poverty level;
- Living in a household with fewer dependent children;
- Living in neighborhoods with low unemployment;
- Living in neighborhoods where people have lived at least a year in the same house;
- Living in neighborhoods with a lower density of alcohol outlets.

Source: http://www.cdc.gov/violenceprevention/childmaltreatment/riskprotectivefactors.html
Opportunity Mapping in Santa Fe: A Tale of Two Cities

Opportunity Index

To better understand the factors within the City of Santa Fe that affect educational and other life outcomes, we constructed a **composite index of opportunity** that combines 3 socioeconomic indicators:

- educational attainment (bachelor’s degree or higher),
- poverty level (100% FPL), and
- households with children under 18 headed by a single female

**Assumption** - areas with high educational attainment, low poverty and fewer households headed by single mothers, may offer the best opportunities for success to children living there.
Elementary School Boundaries and Opportunity Index

Opportunity Index
- High
- Moderately High
- Moderately Low
- Low
Early Childhood Challenges in Barcelona
Infancia Temprana

Early Childhood Challenges Index

Large numbers of recent, young immigrants from non-Spanish-speaking countries can put strain on an educational system.

Barcelona has experienced high rates of immigration from Africa in the past few years. The First Map shows the numbers of 0-4 year olds by province who have immigrated recently.
Education Challenges: Early Childhood (Infancia Temprana)

Map Shows Total 0-4 year olds immigrating from Africa between 2008-2012 by Province (data not available for all provinces)
Early Childhood Challenges Index in Barcelona

• In order to better understand the context for early childhood education and outcomes we have created an index for municipalities with populations >50,000 combining the following:

  • Mother’s educational attainment (less than compulsory education diploma),
  • Preterm birth rate, and
  • Births to unmarried mothers

• Assumption - children born before their due date, to single mothers, or to mothers with low educational attainment, may require greater support early in life than others
Education Challenges: Early Childhood in Barcelona

Map Shows Municipalities in Barcelona Ranked by Early Childhood Risk Indicators Including Births to Unmarried Mothers, Pre-term Births and Births to Women with Less Than A Compul or Level Education Degree in Barcelona’ Municipality > 50K Population

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Combined Z Score</th>
</tr>
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<tbody>
<tr>
<td>Sant Cugat del Vallès</td>
<td>-2.777969676</td>
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<td>Cerdanyola del Vallès</td>
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<td>Cornellà de Llobregat</td>
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<tr>
<td>L'Hospitalet de Llobregat</td>
<td>1.829417523</td>
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</table>
The Future of Geospatial Mapping

1. The **future is very bright** for these kind of mapping technologies. GM compresses the masses of data so that they are more understandable and usable.

2. Create **real-time, dynamic displays** of multiple variables interacting simultaneously.

1. We will be able to use GM as a **research tool** in a dynamic manner.
SUMMARY

First, these statistical tools, conceptual frameworks and analytical techniques can offer *unique insights* when specifically applied to complex educational issues.

Second, geospatial data visualization are *immediately accessible* to a wide range of audiences including policy-makers, community members, educators, students, and parents.

Third, geospatial maps can help convey the message that *we are one community, bound together by a sense of place*.
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Selected References For GIS-Based Analysis


