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Redistricting Practices in Public Schools: Social Progress or Necessity?

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Abstract. Redistrict, a fully integrated web interface, proposes a new platform for proximity-based public schools boundary deliberations. It has been pilot-tested on one school system in the US and aims to shift, educate, and bring visibility to policy and geographical constraints. It extends current deliberations' state of practice, held in person or over video conference using static pdf/printed maps. This research draws knowledge from computer science, educational policy, social sciences, and geographic information systems (GIS) to allow public school officials, parents, and community at large to compute "what if " scenarios towards a better understanding, discovery learning, and optimization when redesigning school attendance zones. We explore possible areas of improvement for the broader community to cast an informed, unique vote, while maintaining privacy, supporting ingenuity, and transparency. This speculative research prototype creates space to support a concrete path of much needed advancement in complex social deliberation using interdisciplinary research.

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Public School Rezoning in United States of America

Public schools are the main educational system in the US, with an enrollment of over 90% of school-aged children to account for 55.3 million students as of 2006, 56.2 million in 2017, and projected to be 58.2 million in 2027, as per the National Center for Education Statistics [1]. Given this steady increase, public school districts are engaged in a revolving decision-making process to best allocate limited building space for a growing student population. Because in the US, residences are paired up to neighborhood schools based on a complex proximity/cluster assignment, school attendance plays a deciding role when choosing a home in many families. Figure 1 shows GIS visualization corresponding to a school district in Virginia. In proximity-based assignments, each neighborhood is designated to attend a specific elementary, middle, and high school. Population fluctuations require change in neighborhood assignments from one school to another over the years, in an attempt to optimize building capacity, neighborhood composition, and accessibility, and so on. This re-assignment of neighborhoods from one school attendance area to another is decided through public hearings, where community participation is sought. These public school boundary deliberations are traditionally held in person and often controversial (Kelly, 2019).

— To prepare for traditional deliberations, before COVID-19 pandemic, public school officials (often a handful of people from the school planning department) produced printed maps and presentations aiming to illustrate land computation, geographical constraints, and educational policy directives. School officials made suggestions to move school boundaries based on complex and customized constraints discernment using advanced GIS software and best-practices-education policies for equitable distribution of students. However, each of these tools used independently requires the aggregation to be computed manually. Additionally, often changes in the school board's leadership shifts policy interpretation. This calls for customized solutions to fit each rezoning effort, becoming a cyclic strain on the public school officials. More so, lack of standardization raises concerns of equity, making room for (intended or un-intended) bias.

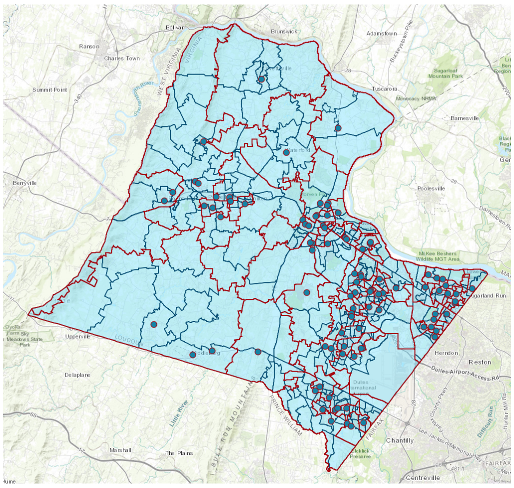

Figure 1. A GIS visualiation showing the school district corresponding to Loudoun County Public schools.

[1] https://nces.ed.gov/fastfacts/display.asp?id=84

This setup is difficult for community members too. Some have multiple jobs and children of various age groups in the public school, trying to participate in decisions over their children's education can be a real time and organizational challenge. During 2017-2020 our researchers witnessed evening gatherings in school cafeterias, pushing capacity limits. Some came, after a full day at work, with small children-crying picked up from school, or daycare. All just to participate in an 2.5 hour open discussion on school boundaries. These decisions dictated if the children would have the same classmates next year or not, if they will need to go to another school, if children travel sometimes over an hour to school, if they will study in a trailer or a crowded classroom, and so on. In these meetings, parents lining up to speak, but only for 2-3 minutes due to time limitations. The public sessions were normally information fire-hoses and more often than not, the community was left more divided and confused than when they came, easily envisioned in this setup. Especially in the state of Virginia, some schools are rezoned every 2-3 years, meaning some children need to change schools this often (Svrluga, 2013). This reverberates in families core values, neighbors, and home real estate value as some schools are perceived as better than others. Rightfully so parents are frustrated, children feel displaced. It is a strain on the community's well being, communication, and trust. If we factor the size of public school systems, needing to accommodate 50+ million children and constant population growth, it is not surprising to come across tensed neighborhoods, adversity, litigations, and newspaper articles siding with one area or another (Kelly, 2019). Traditional setup of public school boundary deliberation was impossible during COVID-19 pandemic, and consequently many public school systems suspended boundary decision-making sessions or moved to video conference for concerns of participants' well-being and impossibility of public social distancing. While this allowed to elevate the concerns on time commitment, the participants' understanding and input remained highly limiting.

The Redistrict Interface

Our initiative sprang from participatory observation of more than ten public school boundary rezoning efforts as parents, educators, and researchers. (Dantec and DiSalvo, 2013) Additionally to the field work, community-based research involved collaboration with school planners, (Meng et al., 2019) educators, and subject matter experts to design, test, and deploy a pilot software through an iterative improvement process (Mahyar et al., 2018). Initially the GIS shape files were imported to transform a static map in a-drag-and-drop interface, allowing the user to change neighborhoods assignment from one school attendance zone to another (Yoon and Lubienski, 2018) (Dow et al., 2018).

With each assignment the planners wanted to see the impact on school capacity. A subsequent improvement was the approximation of school population growth based on projected urban increase. Previously, this computation was highly manual in the traditional boundary allocation methodology (Lubienski and Lee, 2017). A subsequent concern was raised about prioritization of community feedback (Saxena and Guha, 2020) (Holten Møller et al., 2020).

During the public meetings, anyone can express opinions, and it becomes almost impossible to discern between affected residents' and other community members unaffected by the school boundary change. To overcome this limitation, the application landing screen informs and authenticates the user. The home address provided is used for attendance validation and enforced by IP address as shown in Figure 2. As well, it casts only one vote per residence. Once authenticated, the user is shown a map of the public school district reactive to hovering and clicks. It informs the community of proposed boundary changes and allows the user to submit a different configuration.

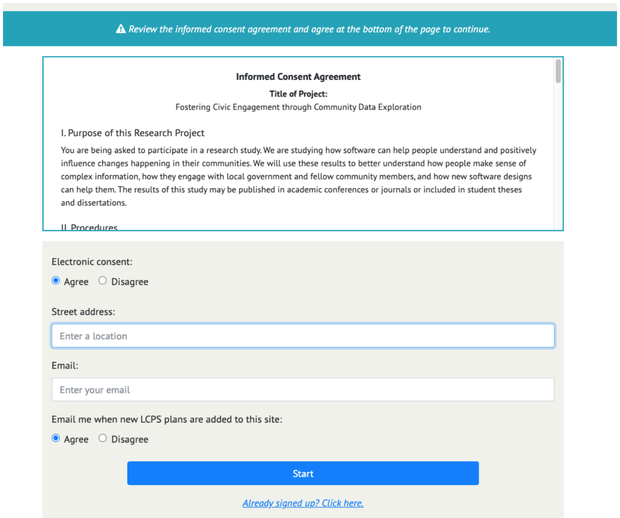

Figure 2. The landing screen with unique IP identification.

The tiles represent the smallest planning zone parcels. Their color visually refers to a certain school, as each school attendance area has a different color as shown in Figure 3. This color coordination was adopted from current state of practice, utilized in paper printed maps. Each tile represents a neighborhood and are collectively called basic school planning areas (SPAs). They remain indivisible during any rezoning. This is due to the need to keep small communities together. Solid colored tiles are not proposed to be moved. The hashed SPAs are proposed to change planning zones. In the process of trying to find a better than proposed parcel allocation the user can review and understand the impact changes have on student projection and building capacity.

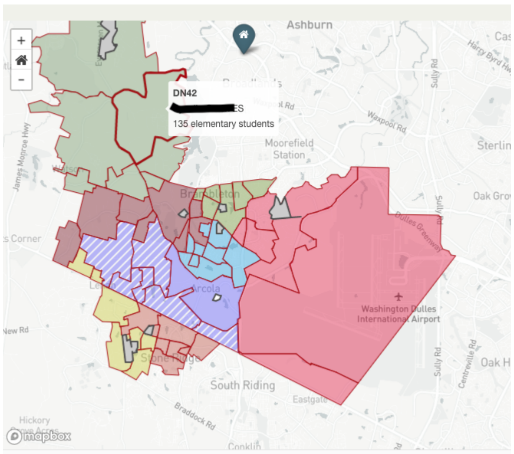

Figure 3. The map of a public school district.

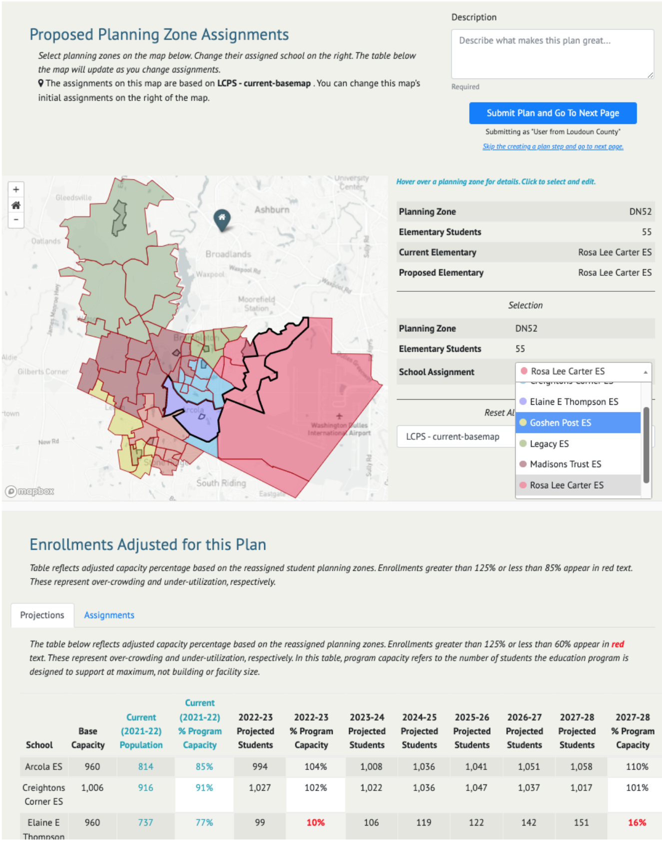

Figure 4. The map of a public school district.

When the user hovers their cursor over the SPA, it highlights and a text appears with more details (School Name, Number of Students). Otherwise, the web interface hides details of the parcels until the user hovers over - both to not deter attention or overwhelm with abundant details. For the parcel reassignment, the user is shown an estimation of the school building utilization for the current and the upcoming years. In the process of computing the “what if ” scenarios the users can possibly test and understand true physical building constraints and very low margins for a “perfect” solution. A screenshot of the interface is shown in Figure 4.

Interactive GIS and spatial optimization

Biswas et al. (2019, 2020b,a) developed a series of optimization algorithms to calculate the best distribution of the parcels given many education policy and geographic constraints. It uses the geographic shape files to identify the school planning areas (SPA) that contain the actual school buildings. Adjacent SPAs are incorporated based on a shared boundary. This assignment continues until every SPA is assigned to a base school. Traditional boundary allocation was highly manual involving individual calculations for every SPA, our algorithm proposes a consistent optimization across all schools in a standardized and automated manner.

Conclusion

Using the Redistrict interface, school planners are able to quickly and efficiently compute and propose school boundary changes calculated on consistent allocation criteria across the entire public school district. This takes subjectivity out and allows for a uniform data-based decision-making, while decreasing planners' workload. Using the interface they are able to inform the community members and request real-time input. Changes can be implemented and disseminated instantaneously, allowing users time and flexibility to participate in boundary change. In turn, the community members are able to understand the proposed boundary changes and new school allocations, with estimated impact. The community members are able to try out their ideas attempting a better school allocation, and submit these proposals to the planning department for further review, with comments. Each vote is unique and valid only for affected residents / neighborhoods. The interactive design allows for highly-complex data and constraints to become just a drag-and-drop exercise.

Our exploratory prototype expands on the status quo of participatory design (Kozubaev and DiSalvo, 2021) through full immersion of the user in both the entire process of boundary realignment and optimization of the difficult constraints this process entails. By participating in the action of rezoning the user not only can fully understand immediate and long-term impact of the decisions (or lack-thereof) on schools' capacities, but can become intimately knowledgeable of constraints public school officials need to account for when making decisions. The ability to efficiently compute complex data and interdisciplinary priorities can better equip authorities to face the continuous challenges this process entails. It gives fast answers to community members, and creates the opportunity to raise awareness and rebuild trust (Corbett and Le Dantec, 2019). Participation in the process itself educates the community and holds public school systems accountable, transparent, and equitable in the assignment of every single SPA in their jurisdiction. More so, because every SPA is assigned to a public school, using the same criteria, it promotes standardization, and eliminates fluctuation in decision-making from one school board to the next, which can finally introduce bias in assignments. Since the interface not only promotes personal well-being in a socially distant community, but in the context of COVID-19 pandemic becomes a necessity in the evolution of complex decision making of participatory design, it is fully supported by interdisciplinary research and best HCI practices. It enables informed, active, participatory decisions towards a transparent design of public schools boundaries. This reverberates in well-being for the community to learn who we are and choose who we want to become.

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