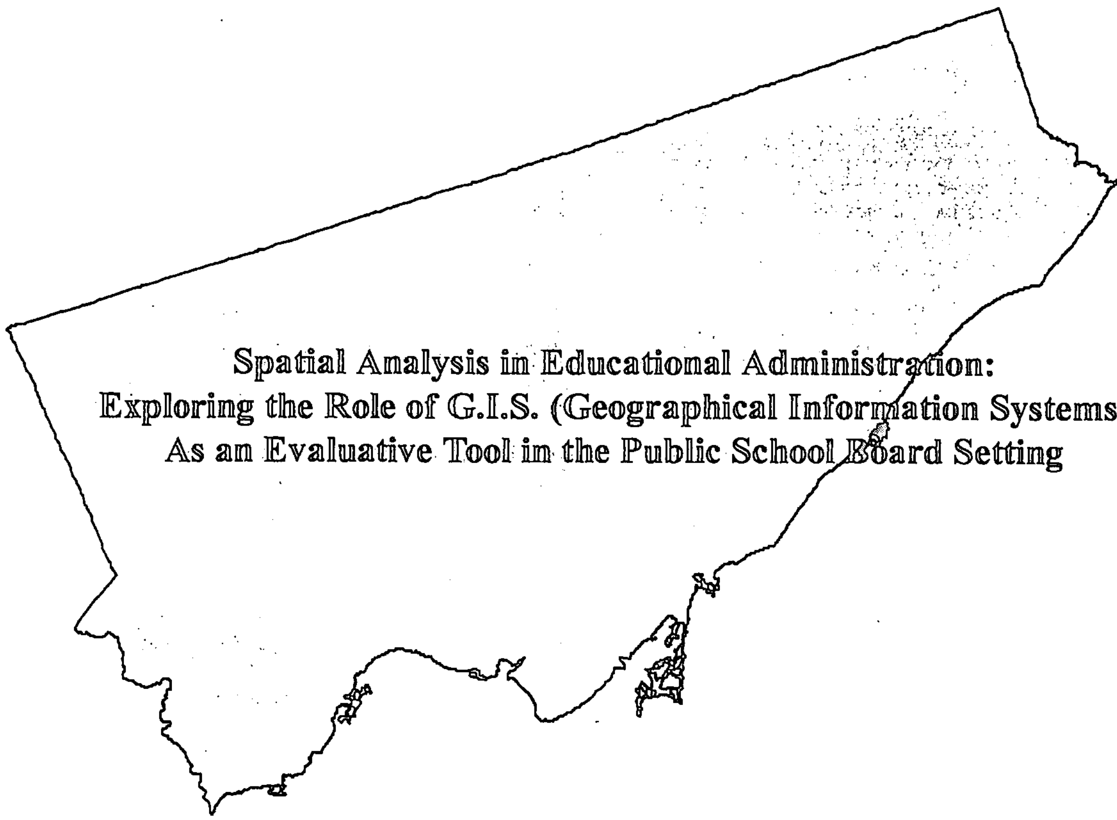
DOCUMENT RESUME

ED 435 628 | TM 030 226

AUTHOR	Brown, Robert S.; Baird, William; Rosolen, Lisa
TITLE	Spatial Analysis in Educational Administration: Exploring the Role of G.I.S. (Geographical Information Systems) as an Evaluative Tool in the Public School Board Setting.
PUB DATE	1999-05-00
NOTE	23p.; Paper presented at the Annual Meeting of the Canadian Evaluation Society (Toronto, Ontario, Canada, May 16-19, 1999). Some colored maps may not reproduce well.
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Cartography; *Computer Uses in Education; Data Analysis; Data Collection; *Educational Administration; Elementary Secondary Education; Evaluation Methods; Foreign Countries; Geographic Regions; Maps; *School Districts
IDENTIFIERS	Canada; *Geographic Information Systems; Spatial Analysis; *Toronto Board of Education ON

ABSTRACT

In January 1998, seven school boards amalgamated to form the Toronto District School Board, a board responsible for 600 schools. To deal with the complexities of the new entity, researchers have been using geographical information systems (GIS). GIS are computer-based tools for mapping. They store information as a collection of thematic layers or datasets that can be linked by geography, and they serve as tools to analyze and map data in support of the decision-making process. Used optimally, GIS allow the visualization and analysis of information in new ways. Two situations illustrate the use of GIS in Toronto. The first is using GIS as an effective communication tool in the development of school profiles that included community maps. The second example is the use of GIS to identify high-performing and low-performing schools on an assessment. In the highly diverse Toronto school board area, GIS is a valuable tool to visualize and interpret data. (Contains 11 figures.) (SLD)



Spatial Analysis in Educational Administration: Exploring the Role of G.I.S. (Geographical Information Systems) As an Evaluative Tool in the Public School Board Setting

Paper Presented to the Canadian Evaluation Society Annual Conference
Toronto, May 1999

By: Robert S. Brown, William Baird, Lisa Rosolen,
Academic Accountability Office, Toronto District School Board

Spatial Analysis in Educational Administration:
Exploring the role of G.I.S. (geographical information systems) as an evaluative tool in the public school board setting

Paper Presented to the Canadian Evaluation Society Annual Conference, Toronto, May 1999

By: Robert S. Brown, William Baird, Lisa Rosolen, Academic Accountability, Toronto District School Board

Introduction

In January 1998 seven school boards amalgamated to form the Toronto District School Board. The logistics of making sense of this new entity were enormous. First, the TDSB is easily the largest school board in Canada, with around 300,000 elementary and secondary students (by way of comparison, the next largest board in Ontario is one third the size of the TDSB). The board has 600 schools, making it the equivalent size of several provinces.

But increasing the complexity of amalgamation was the diverse student population and school cultures. It has been claimed that Toronto is the most diverse city in the world; it is certainly the most diverse in Canada, with close to 100 key languages and double that number of countries of origin. Likewise the socio-economic diversity of Toronto makes fascinating study but great challenges to a public school system. Furthermore, the board administrations of the seven former boards were quite different and well established. The Archives of the former Toronto Board of Education show an institution proud of its record of innovation since the mid-nineteenth century, while the Scarborough Board could trace its origins to the late eighteenth century. In addition to traditions and educational philosophies, there are different attitudes and methodologies towards data. With a total of nine different student administrative systems, what might appear to be straightforward questions-- such as establishing the distribution of home languages spoken by TDSB students-- become logistical nightmares.

It is within this context that researchers have been utilizing the advantages of GIS (Geographical Information Systems). With its emphasis on geographical school boundaries, the planning function of school boards was the first to utilize GIS for more than cosmetic purposes. Indeed, members of what is now the TDSB Capital and Program Planning Department (in particular Andrew Gowdy) provided absolutely vital training and advice when we started to put together our own GIS system. But within this paper we will be talking about the uses of GIS within a context of research and evaluation, rather than planning.

What GIS does

Geographic information systems (GIS's) are computer-based tools for mapping. They store information about the world as a collection of thematic layers or datasets that can be linked together by geography. They also serve as tools to query, analyze, and map data in support of the decision-making process. GIS's are dynamic (updating a database linked to a map and the map will automatically note these changes). Used optimally, GIS's allow the visualization and analysis of information in new ways, revealing previously hidden relationships, patterns and trends. (see the ESRI web page, www.esri.com for more information).

The use of GIS has changed dramatically from the domain of geographers and urban planners to a wide range of uses in many disciplines. Sims and Legg (1997) note that GIS "has become a buzzword in environmental circles. It seems that everyone from government agencies to environmental groups have wholeheartedly joined this technological revolution." Albert, Gesler, and Wittie (1995) outline the use of GIS in health care and disease ecology. Ottensmann (1997) utilized GIS to examine patterns of library use in the Indianapolis-Marion County Public Library in "ways that have previously been impractical". Nonetheless there is little research on the effectiveness of GIS as an evaluative tool, in part because the technology is so recent. Most of the literature on GIS consists of descriptions of new applications, such as the development of a curriculum of educational policy and community planning and discision-making in Bar Harbour, Maine (College of the Atlantic, 1994).

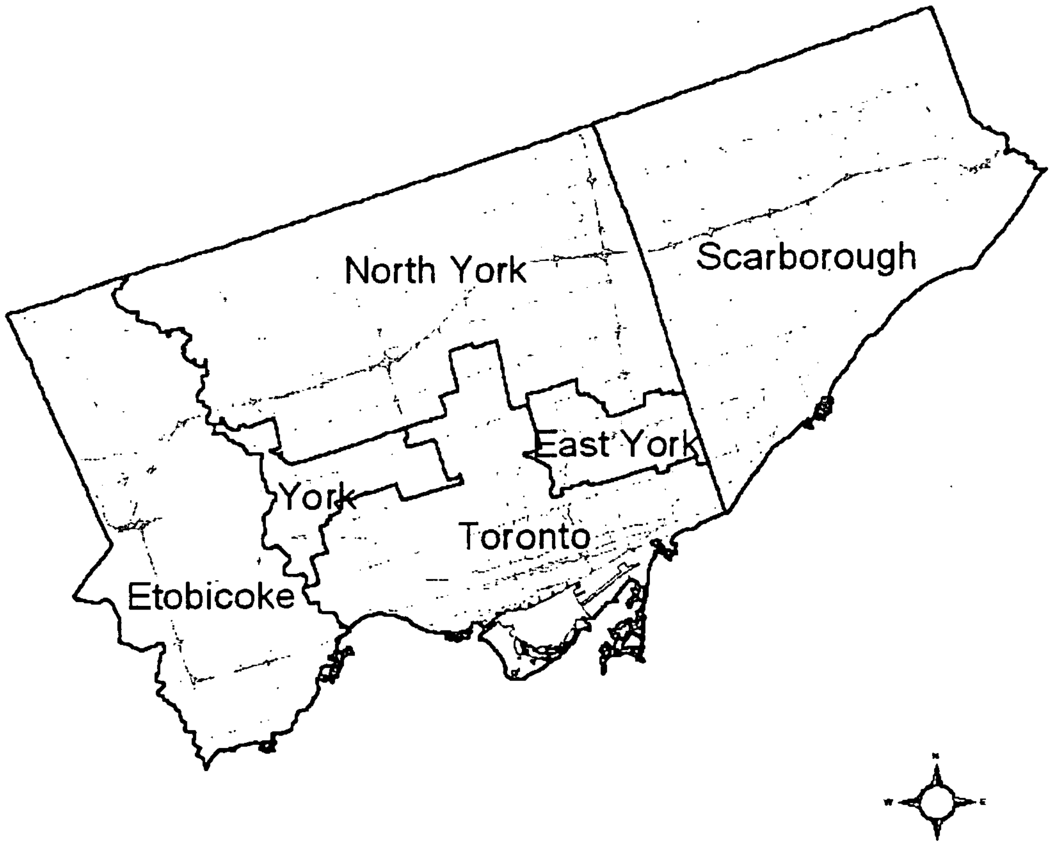
Sims and Legg (1997) claim that the limits of GIS in their field are physical: the price of computers, the limited number of datasets, and the lack of trained personnel. Others have more substantive reservations. Albert, Gesler and Wittie add that GIS may not be suitable to answer certain research questions, and that research tools and techniques should not overshadow the research question: that in some instances, the use of GIS evokes more questions than answers, which may support hypothesis generation but may also prevent answering the original research question. As well, while there is a problem with inaccessible datasets, there are also issues of incompatible and incomplete datasets. Johnston (1996) who looks at the use of GIS in business applications, has concerns that "while many people in the business community are quick to embrace the potential of GIS, there is some fuzziness about what this potential represents beyond basic information management and low-level decision support." Johnston worries about the lack of proper spatial analysis and the understanding of the fundamental principles of cartographic design. Audet and Abegg (1996) found different problem-solving typologies between novice and expert users of ArcView GIS technology, which highlights the importance of (as yet unavailable) research on how different people think and learn with GIS tools.

TDSB Research Uses of GIS

In the TDSB we are just beginning to apply this technology. In 1997 two of us had worked in setting up a GIS system to monitor the former Toronto Board of Education from a research perspective, using information gathered from a wide range of sources, including the municipal City of Toronto and the Metropolitan Toronto school board. Just as we had completed Phase I of our system, the Toronto Board ceased to exist and the Toronto District School Board came into being. For the past year the three authors, Andrew Gowdy and several others have been establishing a TDSB-wide system that can be used for a broad range of purposes. For example, it is being used as part of the Database Development Group, a committee spearheading the integration of databases from the former boards into a harmonized TDSB-wide information system. We have been using ArcView 3.1 software, a fairly user-friendly type of GIS put out by ESRI.

The advantage of GIS for a complex board like ours is that it can be a tool to provide a coherent mental map: and that mental map can be used to provide an integrated mental image of the TDSB, which at this time, does not exist for most people. The map below shows the former municipal boundaries that made up the former boards of Etobicoke, York, Toronto, North York, East York, and Scarborough:

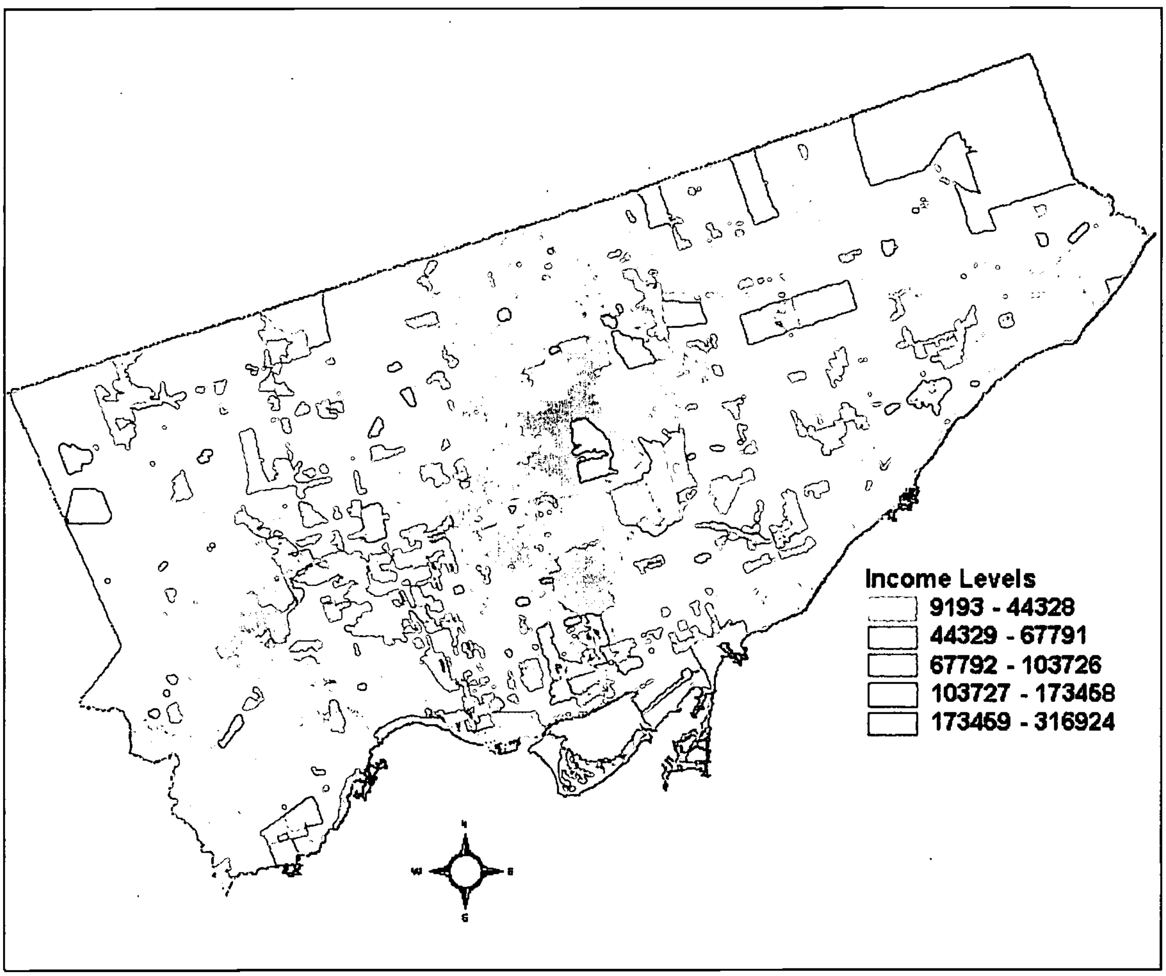
Figure 1:
Formers Municipalities
TDSB



City of Toronto; Toronto District School Board, Capital Program & Planning, Academic Accountability; Base Map: Toronto Land Information Services

Virtually everyone who works in those former boards would have had an internal map of his or her own former board, but few would have been familiar with the characteristics of the new TDSB. At this fairly large scale, it is possible to see geographic patterns that might not have been noticeable within the context of the former Boards. For example, most people in the TDSB recognize that there are tremendous variations in income among people in Toronto, and that these variations tend to be geographically based. But few people have an idea of the pattern of high and low income. One advantage of GIS is that it is an effective way to present complex relationships within a spatial context. It can do this in a way that graphs and tables cannot. The following is a map of Statistics Canada enumeration areas coloured according to average income, with yellow coloured areas having the lowest average incomes:

Figure 2:
Average Household Income of Toronto
1996 Census (Enumeration Areas)

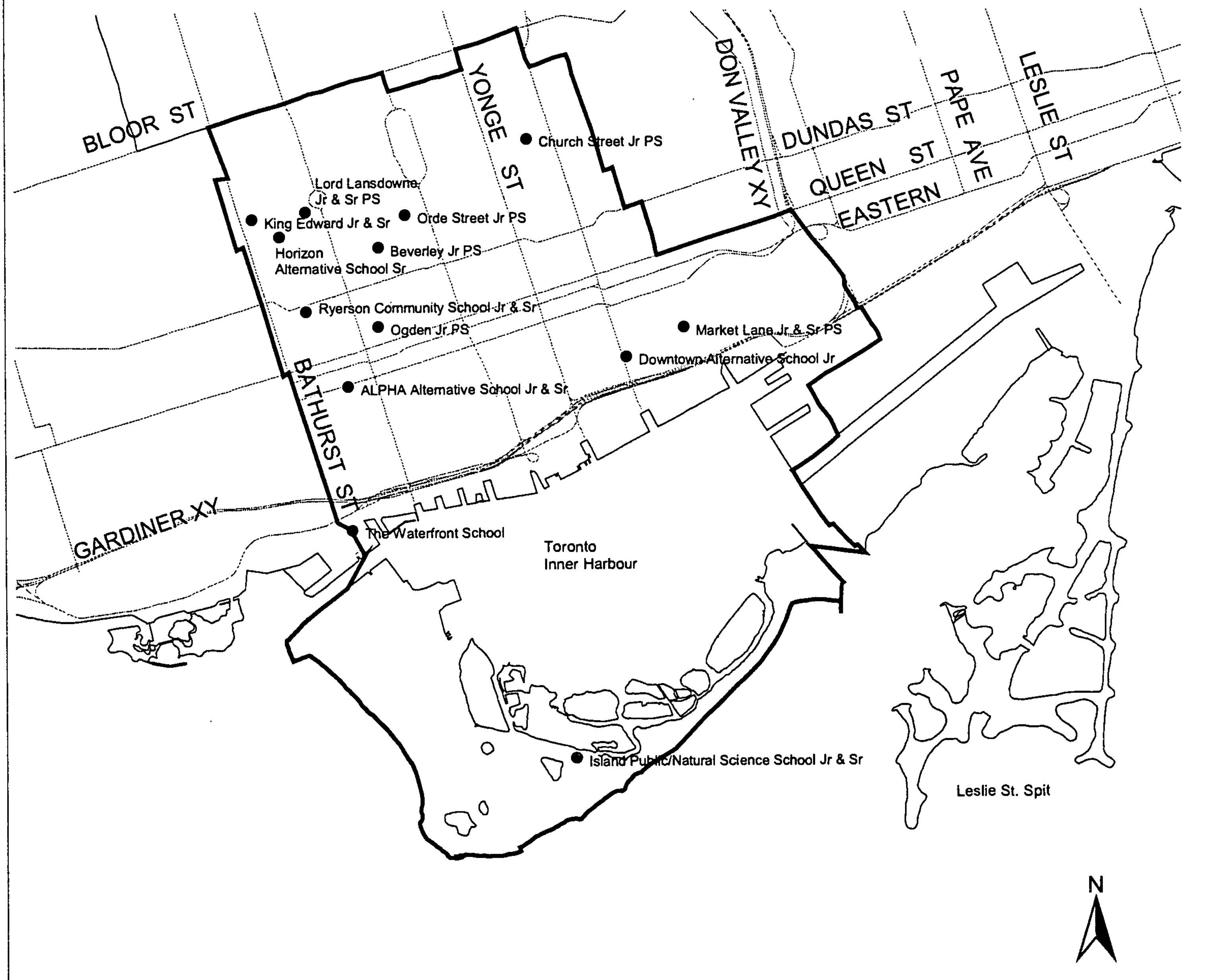


Source: City of Toronto; Toronto District School Board, Capital Program & Planning, Academic Accountability; Base Map: Toronto Land Information Services

The pattern that we see here would be virtually unrecognizable in any way except of spatial presentation. In fact, when we presented this to our Inner-city school principals, and to all the principals in one former board, they were fascinated in that they knew there was a pattern to inner-city schools, but had not been able to figure out what it was until they saw our GIS representations of socio-economic distributions. (One principal commented, somewhat tactlessly but truthfully, that it was the first research he had seen that he could see a real purpose to.)

Some of the most important uses of GIS have been what might be considered fairly simple ones-- but, as in all research, simple findings are often the most important. Two of the authors put together maps of the 32 'families of schools'-- that is, the locations and names of the schools of each of the 32 field superintendents in the TDSB. This had originally been done more for our own internal purposes, to get an idea of what the different families actually looked like. Here is one example of the Downtown family of schools in the downtown core of Toronto:

Figure 3: TDSB Families: Downtown



Superintendent: Georgina Balasas (393-9904)
Education Centre: D'arcy Street

Sources: Toronto District School Board; Base Map: Toronto Land Information Services

However, we've been told that the maps have been used by the superintendents and other administrators, and we put the maps together in one publication. Thus, something that started for one reason has ended up being used for another-- a not unusual situation in applied research.

These spatial representations are important to the TDSB because we are dealing not only with amalgamation but with ways of coping with rapid change. For example, we've talked above of how TDSB employees have been trying to adjust their perceptions of a mental image of their former boards, to the mental image of a much larger TDSB. In addition, there are substantive changes happening within the TDSB. Last year, the TDSB administration became based in eight education centres: this is where superintendents and support staff would be based, where meetings would be held, and where mail would be sent. In the past few months, it has been announced that the number of education centres is being halved, to four. For many people, this amounts to a triple adjustment. Overcoming the potential for confusion and disconnection becomes virtually impossible without visual and mental aids.

Used as a research tool, a GIS system is not just a tool for producing maps, although maps are the most recognized output. Instead, it is one of the software programs used to process and represent information. The key advantage with GIS as part of a portfolio of software programs is that data can travel back and forth between these programs. In one recent case, we had to randomly sample personnel in the TDSB based on school location. The random selection was done from a database on a mainframe, using SAS. However, researchers then wanted to know the location of the selected schools to determine meeting places that would be closest and most convenient to the largest numbers of schools, and to ensure that the sampling appeared geographically random. In this case an ASCII file with the identification number of the school was exported, and converted by EXCEL into a DBF (Database) file. The DBF file was then merged with our already existing GIS database. From there, we were able to print maps showing the location of the schools, with different colours representing the different types of samples (elementary teachers, custodial staff, etc.), the education office boundaries, and the main city streets and highways.

GIS output is best as a supplement, rather than a replacement, to traditional forms of analysis. In some ways the extraordinary clarity of GIS output can lead to misuse. In this way it has the disadvantage of graphics programs, in that clients can fixate and overinterpret maps as much, or more, than they can do with graphs. By itself, without interpretation, a map can give misleading results disguised as useful information.

We will now examine two case studies of the use of GIS. The first case study shows GIS in the development of school profiles—descriptions of elementary schools and of the surrounding school community. The second shows how GIS can be used to analyze standardized provincial assessment results.

GIS Applications - CASE 1:
Using GIS as an effective communication tool in the development of school profiles

With the release of standardized assessment data in the last two years, the public school boards of Ontario are accountable for the performance of schools across their systems. In response to this challenge, the former Toronto Board of Education released school profile documents to supplement the 1997 Grade 3 EQAO Provincial Reading, Writing and Mathematics test results with important contextual, input, process and outcome information to aid in the interpretation of the results.

The contextual piece for each school included descriptive information on: school facilities, programs and services offered, parent involvement and community linkages, and school focus. Additionally, a neighbourhood profile section included a computer-generated map depicting the boundaries of the school catchment area along with community features in the local area. Each map was accompanied by a paragraph describing local population and housing characteristics and specific community services and facilities available to the school community (see sample school profile excerpt on following page).

The purpose of this GIS application is threefold:

1. To illustrate the local area complement of community, social and recreational services which currently serve or could serve the local school population in a visually effective format.

2. To raise awareness of all stakeholders – parents, school staff, students, school board administration, and service providers – of the type, location and proximity of the school to these services.

3. To analyze internally the level of service provision/deficiency in a given area (for example, needs assessments, identification of potential community partners, etc.), and serve as a database for comparison studies at different scales of analysis – from school by school to the system as a whole.

Methodology

Each school community map was produced using ArcView 3.0 GIS software with a view to creating a relational database that could be easily updated, modified and examined at varying scales.

Below are the key steps to the production of the final maps:

Figure 4 - Sample School Profile (excerpt)

HURON STREET JR. PUBLIC SCHOOL
Toronto Board of Education
1996-97 Profile

School Address:
541 Huron St.
Toronto M5R 2R6

Tel No.: (416) 393-1570

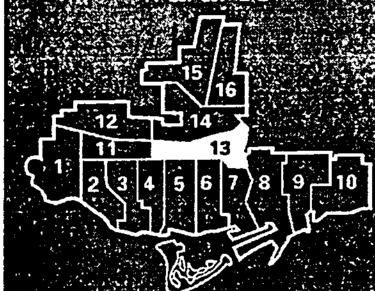
Principal:
Susan Henderson

Vice-Principal:
Carol Kinkead

Grade Levels: J.K. - 6

No. of students (June 1997): 538

Ward: 13



School Trustee:
Fiona Nelson
(416) 397-3071
Alison Pearce
(416) 397-3104

School Superintendent:
Irene Economides

Chair of the Board:
David Moll

Director of Education:
John B. Davies

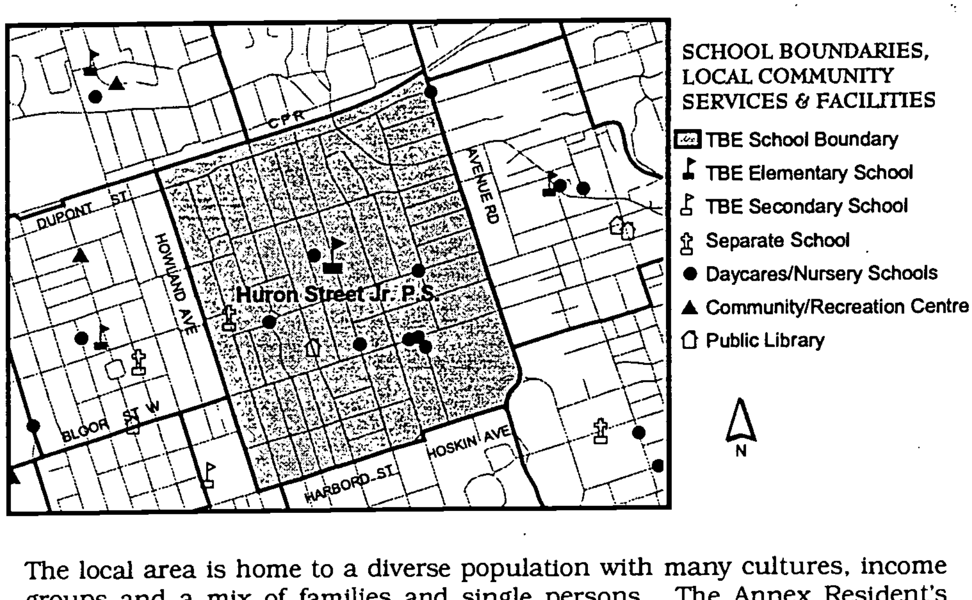
General Information:
(416) 397-3000

OUR SCHOOL

Huron Street Public School is situated in the Annex neighbourhood. The school originated in a building on Huron Street south of Bloor Street in the 1880's. In 1890, a school was built on the present site. In 1958, the 1890 building was demolished and replaced by the present, modern two-storey structure.

- The school serves nearly 550 students. Over two-thirds of the students are of English-speaking backgrounds. The remaining third represents about 30 other language groups.
- Huron Public School offers Junior level (Kindergarten - Grade 6) programs.
- Five local daycare centres feed into the school bringing in students from many cultures and all income groups.

OUR NEIGHBOURHOOD



The local area is home to a diverse population with many cultures, income groups and a mix of families and single persons. The Annex Resident's Association has a solid history of civic involvement which has shaped the growth of the community. In recent years, the area has seen a rise in cultural diversity and mobility. Residents enjoy access to Palmerston and Spadina Public Libraries and Hillcrest Community Centre.

Sources: City of Toronto: Department of Public Health; and, Urban Development Services; Metro Toronto School Board: Capital Program and Planning; Community Information Centre of Metro Toronto; Statistics Canada; Base Map: Metro Land Information Services

1. *Collecting the data*
   - ***Data sources*** - database (DBF) format files compatible with ArcView software were obtained from key data managers: City of Toronto municipal government departments e.g. Planning and Development, Community and Social Services, Parks and Recreation; and, internally generated datasets (school locations and catchment or attendance boundaries).

   - ***Data type*** - a combination of data types were used to portray several themes or attributes:
     - **point data** represented by different symbols were plotted on the maps to illustrate the locations of community resources such as: community/recreation centres, public libraries, daycares and nursery schools, as well as neighbouring public and separate school board schools
     - **area data** were used to highlight the specific school's catchment area
     - **line data** were used to delineate school boundary or catchment areas and local neighbourhood roads

2. *Merging the data*
   With each school considered as a record, the various point, line and area datasets were extracted and joined to a single database using ArcView 3.0. A number of geographically based attributes were then made available for each school. Individual themes were selected and assigned a unique symbol. An overlay technique was performed using the GIS to create a snapshot illustration of all selected themes in a single view (see Figure 5).

3. *Describing the data*
   Presented alongside each map was a text description which not only supported the information illustrated, but also provided a synopsis of the general neighbourhood character and demographic features based on the national Census of population and information provided by various municipal service providers.

Using GIS Beyond School Profiles

The production of school profile maps has proven to be a useful communication tool which has enhanced knowledge of local school communities, and in turn, has provided important contextual information intended to aid in the interpretation of standardized test results. The production of a system wide set of geographic-referenced school data also suggests that GIS can be applied as an invaluable evaluative tool. The ready ability to view selected data themes at selected scales is an important GIS feature that permits wide-ranging possibilities for analysis and presentation (see Figure 6).

For example, the generation of a consistent board-wide map series provides a platform from which comparison studies can be launched. The GIS database can be built upon to include a vast array of attributes linked to each school. Needs assessments can be conducted to identify areas that are underserved, well-served or where services may be duplicated. In school transportation studies, efficient routing systems can be established and physical barriers to access can be readily identified such as distance, railroad/highway corridors, tracts of industrial land and major rivers/ravines. Change in school location such as relocations and closures, or new locations can be tracked over time as can shifts in the locations of community services/facilities. Other information such as Census population and residential data can also be geographically incorporated and analyzed in combination with school-based data.

The benefits of using GIS to broaden knowledge of school communities is clear: patterns may be identified which can provide valuable insights into underlying complex processes that can impart and guide effective decision making.

Figure 5 - Data Type Overlays

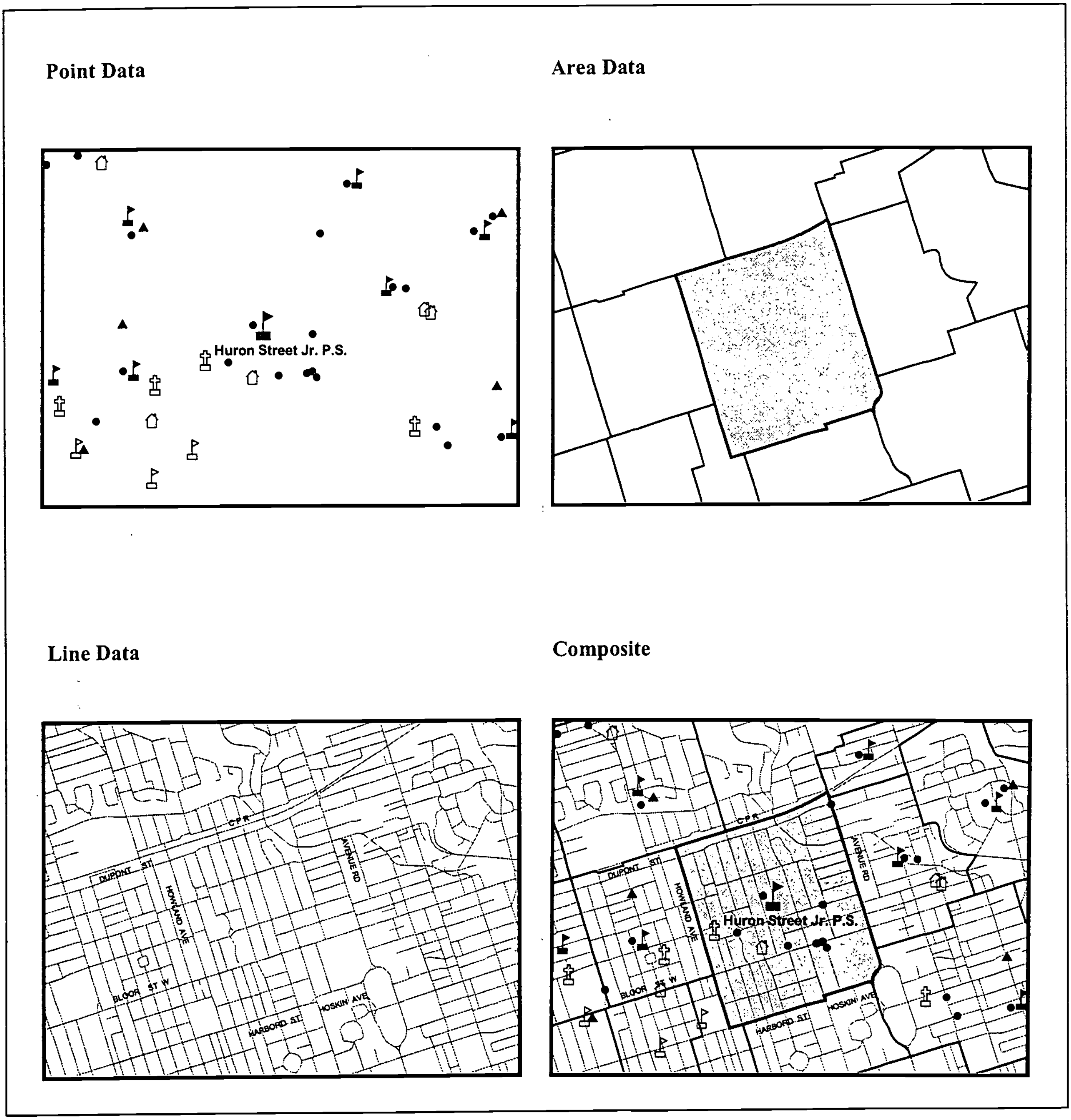
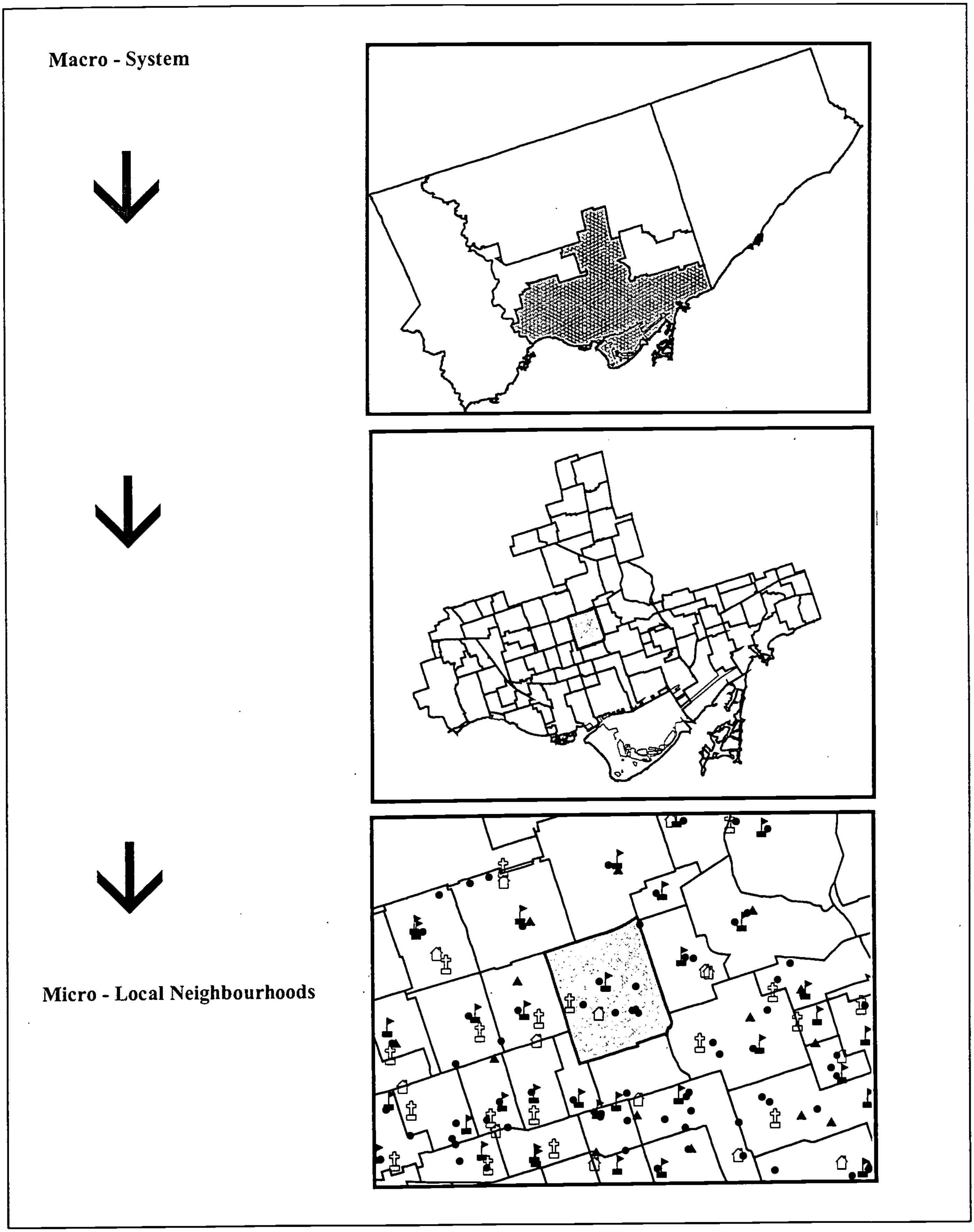


Figure 6 - Selected Data at Selected Scales



GIS Applications - CASE 2:
Identifying High-Performing and Low-Performing Schools on an Assessment

There was a time when educators in Ontario worked in a "business as usual" atmosphere. There was enough money to fund the programs that were necessary. As well, the student population was relatively homogenous and teachers knew what to expect from year to year. Those days are gone, possibly forever. Today school boards operate in a "crisis" mode -- budgets are being drastically cut back at the same time that the public and the government demand accountability and "results". The student population is of staggering diversity -- immigrants stream into the megacity on a daily basis in unpredictable patterns with shifting needs and an increasing proportion of children live in poverty.

Out of this pressure-cooker environment there has emerged a perceived need for "high-speed management" on the part of the administrative staff at the boards and schools. Educational decision-makers more than ever require information which is concise, directly useful to the issues at hand, easily digestible and available when important decisions are being made -- not after the fact.

As a consequence, research practices at the school boards have changed as well. There once was a time when school board research resembled academic research. Weeks could be spent doing the preliminary groundwork -- literature review, pilot study, etc. Reports would be voluminous and academic in presentation with the requisite preamble, review of the field, methodology and result sections before the bottom line -- the conclusions and interpretations. These reports were not always timely and not always easy to digest, and as a result utilization of research results was not always ensured.

While one-off studies and evaluations are still important in school board research, there is more and more emphasis being put on the development of ongoing indicator monitoring systems in which school boards track demographic, school process and performance indicators over time. As Douglas Willms points out, monitoring data serve a variety of functions "directly pertinent to improving schooling and reducing inequities":

- "to identify problems areas...so that corrective actions can be taken".
- "to assist administrators in determining the best allocation of resources".
- "to diagnose strengths and weaknesses in pupils' mastery of curriculum objectives".
- "to assess the effects of interventions implemented at the state, district or school level".
- "to stimulate discussion about the goals of schooling, and give rise to new ideas that affect policy and practice".

(Willms, 1992)

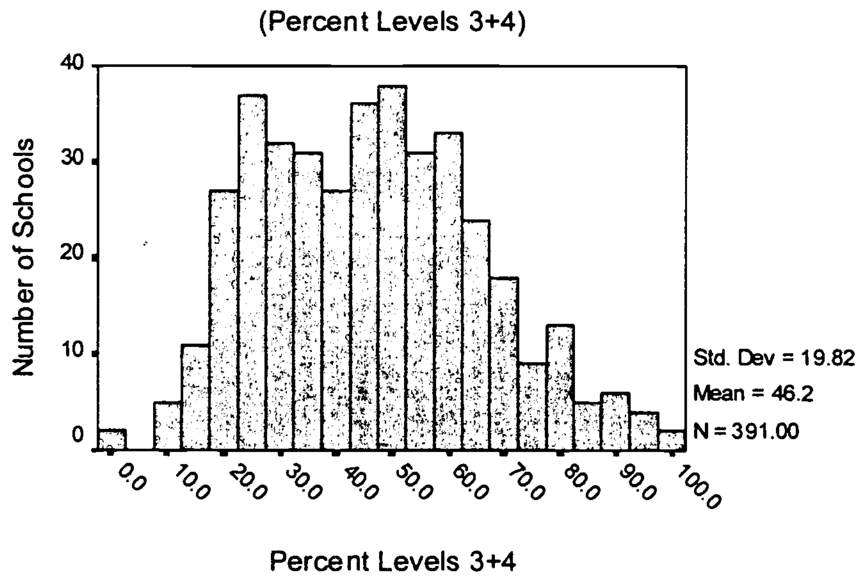
As an illustrative example of performance monitoring, let us look at the school-by-school results at the Toronto District School Board for the Reading component of the EQAO Grade 3 Assessment for 1998. In May of 1998, students in Ontario participated over a period of 5 days in an integrated unit of work on the theme of "Inventions, Investigations and Discoveries". Student portfolios collected during the assessment period were scored according to specific knowledge/skill areas within the subject areas of reading, writing and mathematics using a 5 level performance scale. The results were reported at the student level to teachers and parents, and publicly at the school, board and provincial level.

Disclaimer: The example described below reflects the views of the author solely and not those of the Toronto District School Board. The analysis was carried out for the purposes of this presentation.

We can display the results for the 391 TDSB schools who participated in the 1998 EQAO assessment with traditional graphs as in the following histogram (Figure 7). This graph displays the distribution of the percentage of students at each school who attained or surpassed the provincial standard (Levels 3 + 4) in overall reading achievement:

Figure 7

1998 EQAO Reading Results



The literature on school performance monitoring is clear on the need to "contextualize" school results such as those presented above (Gibson and Asthana, 1998). Most often, such contextualization is done statistically by using some index of relative social advantage/disadvantage summarizing a variety of socio-economic measures. In our example, we will use a draft version of a social need index that was developed by Rob Brown with the help of a committee of researchers and planners at the TDSB.

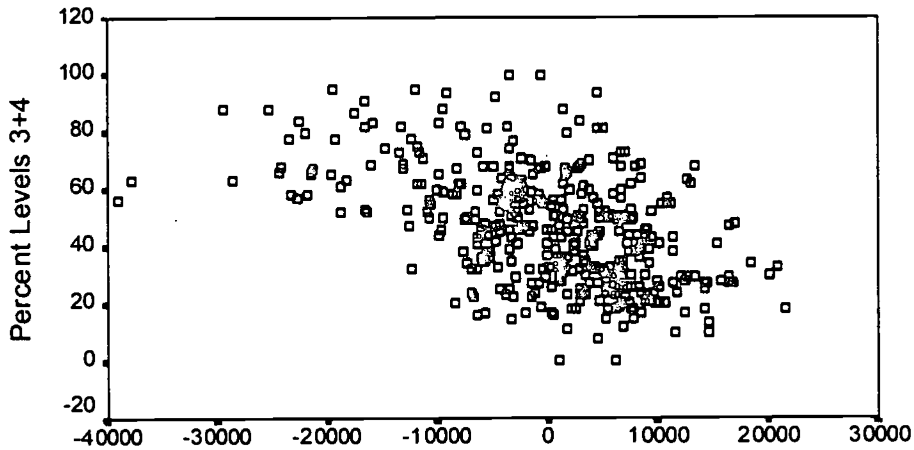
This social need index combines 5 socio-economic measures for each school -- the average household income, the proportion of adults with education less than Grade 9, the proportion of lone-parent families, the proportion of the population who have immigrated from outside Canada in the 5 years prior to the 1996 census, and the proportion of single-detached houses. Each of these 5 measures was calculated by linking students' postal codes with their associated enumeration area and calculating the weighted average. A principal component analysis of these 5 measures identified one main factor, which accounted for the majority of the total variance. The factor loadings on this one factor was used as the social need index scores.

We can display the relationship between the school-by-school EQAO reading results and the schools' relative placement on the social need index with the following scatterplot (Figure 8). (Note: positive scores on the social need index indicates **more** social need; i.e. the largest positive scores identify the "inner-city" schools.)

Figure 8

Scatterplot of Reading Results

Plotted against Social Need Index



The scatterplot suggests some relationship between the two measures: in general, schools at the higher end of social need tended to have a lower percentage of students attaining or surpassing the provincial standard in reading, and vice versa for the schools at the lower end of social need. We can determine how predictive the social need index is of reading performance using the school as unit of analysis by performing a multiple regression with the social need index as the independent variable and the reading scores as the dependent variable. The results are as follows:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.499	.249	.247	17.22

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38115.407	1	38115.407	128.547	.000
	Residual	115045.936	388	296.510		
	Total	153161.344	389			

The analysis yielded a significant regression equation, which accounts for about 25% of the variance in the school-by-school reading scores. For the purposes of this presentation we are less interested in the actual results than in the usefulness that such an analysis would be to educators. The graphs displayed above are typical of the traditional form of reporting the results of a statistical analysis. The graphs display the data in terms of different forms of distribution: univariate or bivariate. The regression analysis evaluates the data's fit to a particular derivation of a linear model. This kind of analysis is difficult to interpret for anyone who has not been trained in statistical thinking -- the construction, manipulation and interpretation of models within a "mathematical space".

However, this type of data (school-by-school demographic and performance indicators) also lends itself to spatial analysis using GIS software. Distributional information can be plotted geographically which reveals patterns not evident in the figures presented above.

Figure 9 displays the geographic distribution of the social need index scores across the Toronto District School Board. Notice the U-shaped pattern that was evident in figure 2 showing average income levels for enumeration areas across Toronto.

Figure 9
Social Need Index

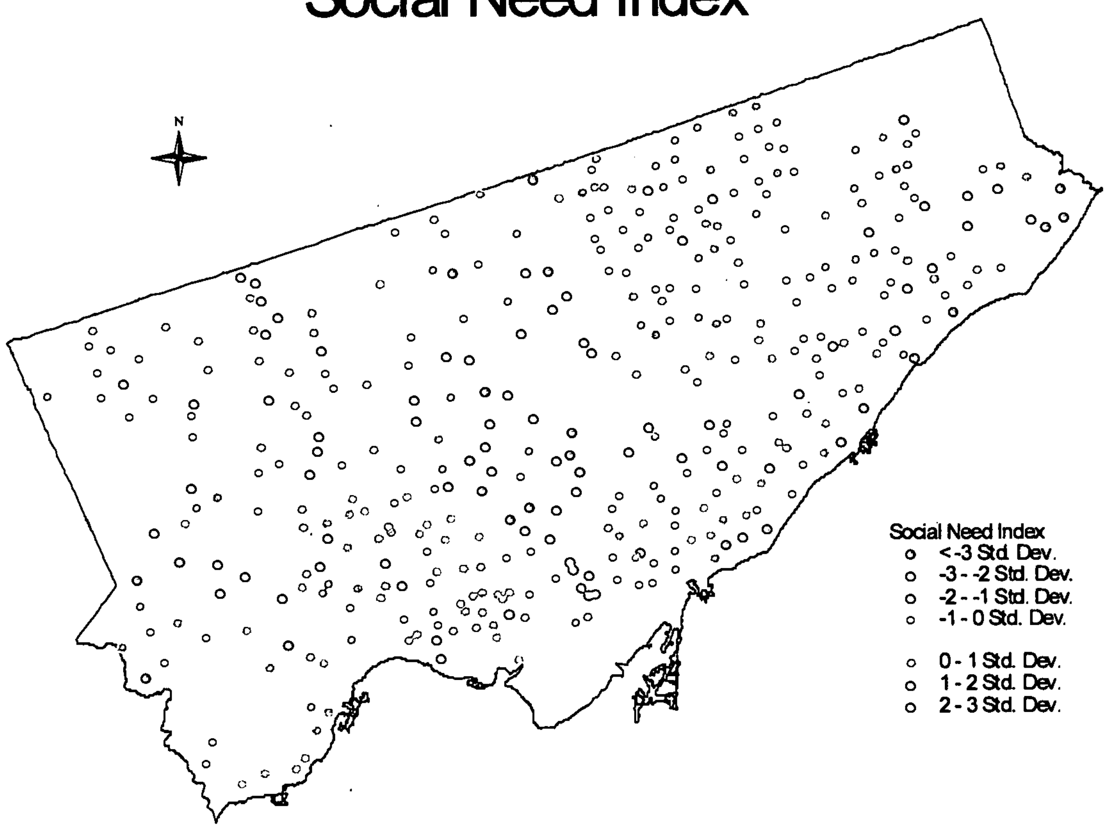


Figure 10 shows the distribution of the school-by-school assessment results (percentage of students attaining or surpassing the provincial standard) across Toronto. There is a hint of the U-shape again, but not as clearly. There is more "blue" in the areas that showed mostly red in the social need index. This is a visual analog to the regression result -- there is some relationship between social need and the reading assessment results but there is also a lot of "noise" in the relationship. This effectively gets across the idea that a significant statistical relationship describes a general state of affairs and does not necessarily extend to every individual school or to particular groups of schools, which is often what educators at the school board want to know when making resource allocation or intervention decisions.

Figure 10
EQAO Grade 3 Assessment Results: Reading
(Percent Attaining/Surpassing Provincial Standard)

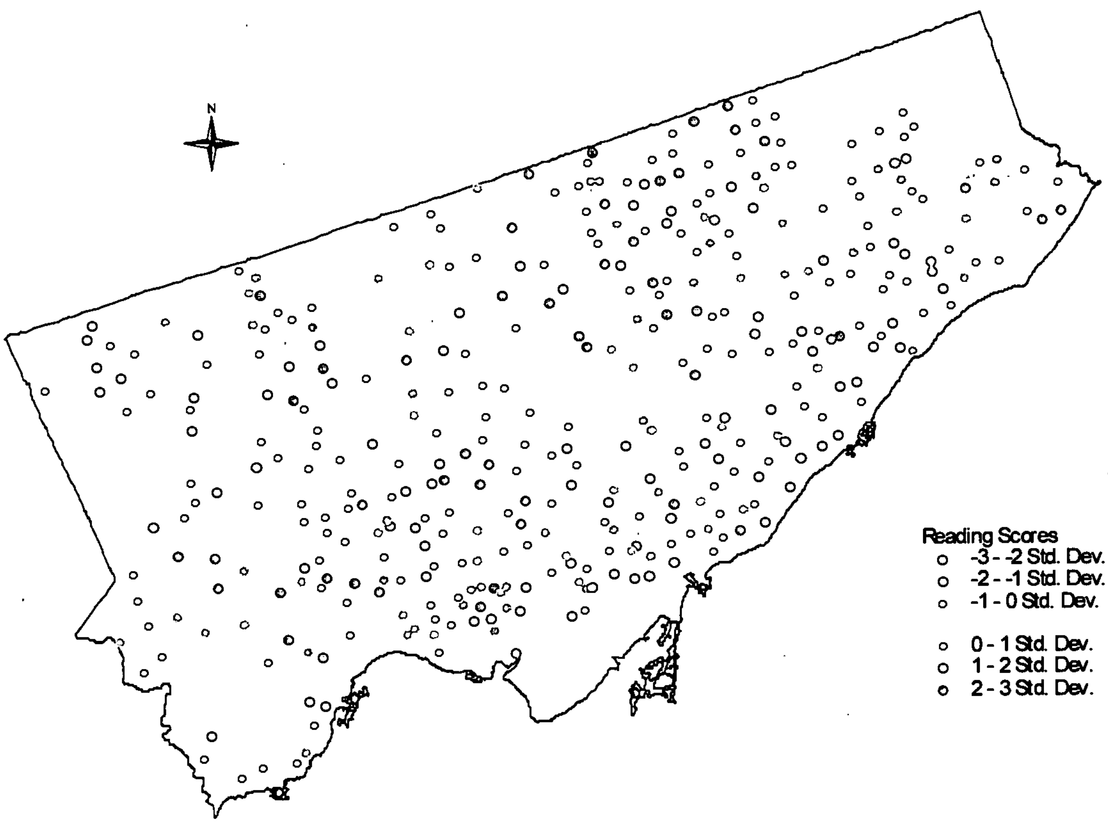
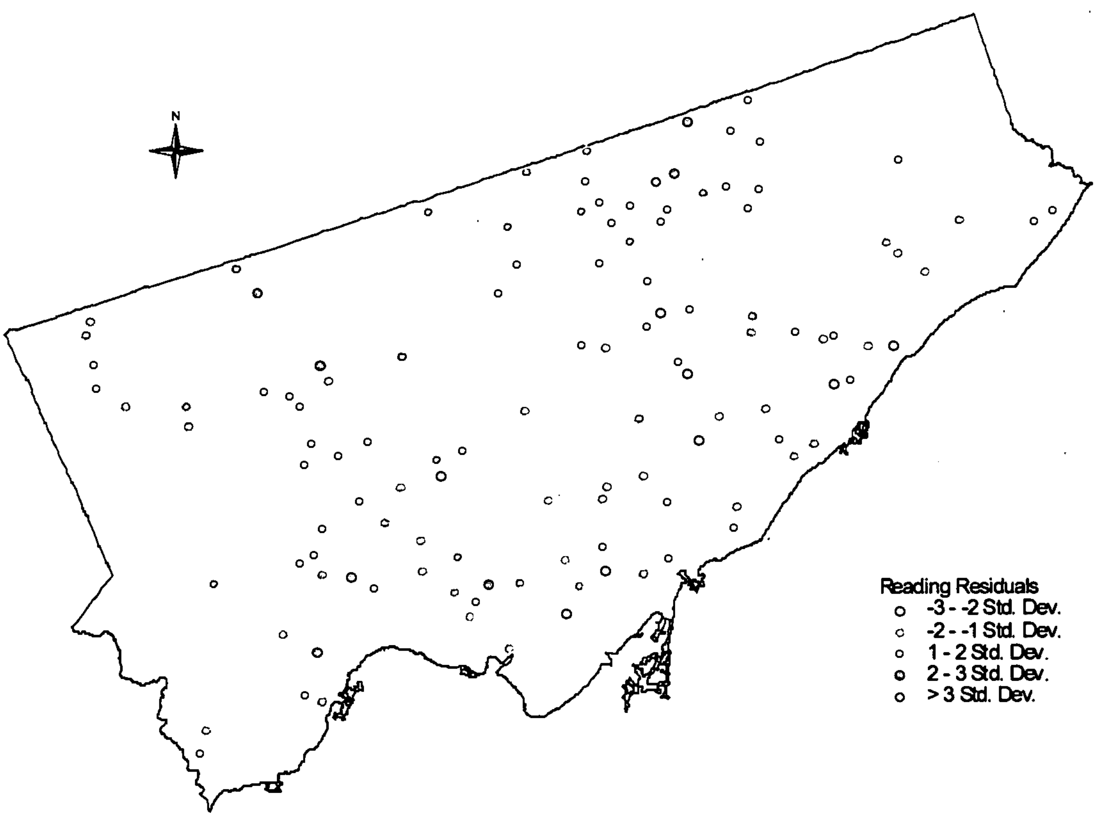


Figure 11 plots the residuals derived from the regression equation. Represented are the residuals that are greater than 1 standard deviation from the regression line. These residuals contain a number of effects not specified by the regression model -- e.g. a school effect, a group compositional effect (i.e. the nature of each group of Grade 3 students), and random error. While we cannot take the size of the residuals as a pure school effect, we can treat them as suggestive; that is, as identifying possible "high-performing" or "low-performing" schools. These are schools that are potential examples of "best practices" in reading (the dark blue schools) or of schools who need extra support in delivering the reading curriculum (the dark red schools). A follow up would have to be done to confirm these inferences.

Figure 11
Reading Residuals
(> 1 standard deviations)



BEST COPY AVAILABLE

Concurrent with the increase in the computing power of personal computers has been the development of the graphical capabilities of statistical analysis programs. Researchers have more and more options for manipulating graphical displays including such tools as pivot tables, data brushing, and 3-D rotation. Despite these new tools, the traditional method of displaying data requires expertise in understanding the mathematical modeling behind statistical analysis.

GIS representations do not replace but rather complement these traditional methods. GIS is particularly well suited to data which describe the spatial distribution of attributes of objects such as schools. In the case of school board research, spatial representations correspond to the mental models practitioners have of the school board as a collectivity of schools located within distinctive communities. The maps can reveal spatial patterns not evident from other graphic displays and may lead to follow-up questions from practitioners that would not have been elicited from traditional graphic representations. GIS representations will be of particular value to educators who have to make decisions about resource allocation and other school-targeted interventions.

Conclusion

We have examined GIS for its direct application to supplement our day-to-day research functions at the Toronto District School Board. As such, our perspective has been different from, say, software developers who are looking at possible uses of GIS, or educators examining the geography curriculum. Indeed, at least one of us, who has experienced more than his fair share of hyped but ineffective technological toys, initially approached GIS with great skepticism. We have found GIS to be an extremely useful tool, although one that should be *added* to the range of research analysis and presentation functions, rather than as a *replacement* for current practice. Specifically:

- GIS offers a form of data visualization which supplements traditional forms of data visualization by displaying spatial distributional and locational patterns in the data.

- Spatial representations correspond to educators' mental model of the school board; i.e. schools located within communities. Our use of GIS has been most applicable in this way at the micro (i.e. board or urban region) level. This may not be as applicable to macro levels, like provincial analysis.

- GIS representations are particularly helpful in relating educational outcomes to socio-demographic factors, in part because many of these factors are closely related to geographical distributions.

- GIS representations make it easier for educators to remember data patterns and to use these in their decision-making activities

We are still at the beginning stages of our integration of GIS into educational evaluation. There are a number of important questions that still have to be addressed. For example:

- Do GIS representations lead to different conclusions on the part of users compared to traditional forms of data representation?
- Do GIS representations lead to better understanding and utilization of research results compared to traditional methods?

Researchers take for granted that text, tabular and graphical depiction of data will lead to different interpretations of this data, and that what may be most appropriate for one customer may not be as appropriate for another. Likewise, it is probable that the use of GIS can both enhance, and also take away from, research presentations, but GIS is too new a technology for accepted practice to have developed. One thing is certain: that GIS has the potential to greatly increase effective evaluation in school and other settings. Given the spread of GIS technology throughout the private and public sectors, it is likely that this utilization will happen sooner than later.

References

Albert, Don. P., Wilbert M. Gesler, Peggy S. Wittie, "Geographic Information Systems and Health: An Educational Resource". **Journal of Geography**, Vol. 94 no. 2, Mar/April 1995, pp. 350-356.

Audet, Richard H., and Gerald L. Abegg. "Geographic Information Systems: Implications for Problem Solving". **Journal of Research in Science Teaching**, Vol. 33 no.1, 1996, pp. 21-45.

College of the Atlantic, Bar Harbour, Maine. **Computer-Assisted Community Planning and Decision Making**. Washington, DC: College of the Atlantic/Fund for the Improvement of Postsecondary Education (Education Department), 1994.

Gibson, Alex, and Sheena Asthana. "School performance, school effectiveness and the 1997 White Paper". **Oxford Review of Education**, Vol. 24 no. 2, 1998, pp. 195-210.

Johnson, Merrill L. "GIS in Business: Issues to Consider in Curriculum Decision-Making". **Journal of Geography**, Vol. 95 no. 3, May/June 1996, pp. 98-105.

Ottensmann, John R. "Using Geographic Information Systems to Analyze Library Utilization", **Library Quarterly**, Vol. 67 no. 1, pp. 24-49.

Sims, Raymond W., and Michael H. Legg. "Geographic Information Systems (GIS) as an EE Tool". **Clearing**, Issue 97, April/May 1997, pp.18-19.

Willms, J. Douglas. **Monitoring School Performance: A Guide for Educators**. Washington, D.C.: The Falmer Press, 1992.

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse: **University of Maryland**
ERIC Clearinghouse on Assessment and Evaluation
1129 Shriver Laboratory
College Park, MD 20742
Attn: Acquisitions

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
1100 West Street, 2nd Floor
Laurel, Maryland 20707-3598

Telephone: 301-497-4080
Toll Free: 800-799-3742
FAX: 301-953-0263
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com