From Data to Knowledge

Improving K-12 Assessment Results with Knowledge-based Data Visualization

NYSSBA
October 16, 2009

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Knowledge-based Data Visualization
Knowledge-based Data Visualization
• As we look for that one button solution, we begin to see and search for understanding on three topics:
  1. Student Information Systems
  2. Data-Driven Decision Making
  3. Data Visualization

1. Student Information Systems
Three Generations of SIS

- Mid-1980s to mid-1990s: demographic data – names, address, phone numbers, etc.
- Mid-90s (until NCLB) electronically filing state reports – enrollment, financial reports, etc.
- NCLB and beyond – AARA curriculum, instruction, and assessment data

Gartner Industry Research
Publication Date: 23 March 2009
ID Number: G00166334

Key Issues for K-12 Education, 2009:
Making Decisions That Work Now but Look Beyond the Present

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1. **Run**

2. **Grow**

3. **Transform**

• “… an administrative suite [SIS] that satisfies current business needs (that is, run) might very well be malleable or extendable enough that in the future it might serve broader audiences (grow) or facilitate an entirely different — if not radical — school organization (transform).” Emphasis added.

**Two Essential Questions**

1. What should you expect your student information system to do for your district?

2. How should your student information system benefit your school community?
What should you expect your student information system to do for your district?

Any student information system must: (RUN)
1. Registration and Enrollment
2. Schedule
3. Attendance
4. Grading
5. Reporting

How should your student information system benefit your school community?

Today’s student information system must do more. It must help us to GROW and TRANSFORM our schools
1. Curriculum
2. Assessment
3. Data Analysis
4. Planning Instruction
5. Improve Communication
6. Growth Path

Student Information System Maturity Model

“Our district is using our student information system for 3 years now. We haven’t changed anything since our go-live ...“
Student Information System Maturity Model

“Our district is using our student information system for 3 years now. We haven’t changed anything since our go-live…”

Focus on basics:
- enrollment data
- student schedules
- attendance
- academic grades
- report cards
- transcripts
- state and federal reporting

The second year? The third year?

Will the SIS support the district in five years?

The Student Information System Maturity Model has 4 stages:

Year: 1  Stage 1  Go-Live
Years: 2-3  Stage 2  Run
Years: 3-4  Stage 3  Grow
Years: 4-5  Stage 4  Transform

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The Transformative Stage – Stage 4

• Focuses on using data to identify issues, options and to make informed decisions
  – Data-Driven Decision Making
    • Using quantitative data for decision making
  – Knowledge-Based Decision Making
    • Using quantitative and qualitative data and data visualization techniques for informed decision-making

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2. Data Warehousing
Data, data everywhere ...

But often not a lot of usable information ...

**Essential Questions**

What question or questions do we want data to help us answer?
What data do we need to answer the question(s)?
Where do we put or "house" the data?
How do we access, analyze and visualize the data?

**Knowledge-based Data Visualization**
Data-Driven Decision Making requires that we are able to effectively and efficiently:
- gather
- store (warehouse),
- access, and
- analyze
quantitative (numeric) and qualitative (text) data about school district and school operations and especially about teaching and student learning outcomes.

The data that we can gather, warehouse, and analyze to improve education decision-making can be defined by the following four categories:
1. Demographic Information
2. Student Information
3. Curriculum Information
4. Instruction Information

Let’s take a closer look...

Knowledge-Based Decision Making

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Knowledge-based Data Visualization

Two-way interactions

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<th>Instruction Information</th>
<th>Student Information</th>
<th>Related Information</th>
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Demographic and Curriculum Components

Knowledge-based Decision Making

- Disaggregate and analyze summative data by student demographic factors.
- Disaggregate and analyze summative data by school, class, student, content area, strand, and item.
- Disaggregate and analyze summative data by subject, class, grade, content area, strand, and item.
- Disaggregate and analyze student achievement by school, class, and content area.
- Disaggregate and analyze student achievement by demographic factors.
- Disaggregate and analyze student achievement by school, class, and content area.

Homework
- Quizzes
- Tests
- Grades

Standards-based reports

Instruction Information
- Units
- Lessons
- Materials
- Strategies
- Differentiated Instruction
- Authentic assessment
- Rubrics
- Professional Development

Core Purpose

- Formative assessment to inform lesson design and presentation based on student and class readiness for learning.
- Adjust class instruction based on learning feedback.
- Adjust instruction for small groups based on learning acquisition feedback and demographic information.
- Adjust individual student instruction based on learning acquisition feedback.
Demographic and Curriculum Questions

- Benchmarks
- Standards
- Similarities
- Differences

Curriculum and Instruction Information

- Curriculum Information
  - Standards
  - Benchmarks
  - Testing
  - District assessments
- Units
- Lessons
- Strategies
- Differentiated instruction
- Authentic assessment
- Professional development

Curriculum and Instruction Questions

- Curriculum Alignment
- Curriculum Mapping
- Instructional Methodology
- Professional Development

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Student and Instruction Questions

- Content Delivery
- Differentiated Instruction
- Classroom Assessment Techniques
- Assessment Effectiveness

Demographic and Student Information

Demographic Information
- Gender
- Ethnicity
- English as a Second Language (ESL)
- Instructional modifications? (504 Plans)
- Special Education

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Demographic, Curriculum, and Instruction Information

Demographic Information
- School
- Class
- Student name
- Ethnicity
- Gender
- Learning experiences
- Language proficiency

Curriculum Information
- Standards
- Benchmarks
- Curriculum mapping
- State assessments
- District assessments

Instruction Information
- Using
- Strategies
- Differentiated
- Instruction
- Authentic assessment
- Professional development

Knowledge-based Data Visualization
Curriculum, Instruction, and Student Questions

- Student Achievement
- Curriculum Modifications
- Instructional Interventions
- Professional Development
- Assessment Techniques

Demographic, Instruction, and Student Information

- School
- Class
- Student name
- Grade
- Ethnicity
- Gender
- Learning provision(s)
- Language Proficiency

Demographic, Instruction, and Student Questions

- Student Achievement
- Instructional Methodology
- Assessment Effectiveness
- Professional Development

Knowledge-based Data Visualization
Demographic, Curriculum, and Student Information

Demographic Information
- School
- Class
- Student name
- Grade
- Ethnicity
- Gender
- Learning provision(s)
- Language proficiency
- Characteristics

Curriculum Information
- Standards
- Benchmarks
- Assessment measures
- Language proficiency

School Information
- Intended
- Implemented
- Attained
- Standards-based reports

Class Information
- Homework
- Quizzes
- Tests
- Grades

Student Information
- Perceptions
- Standards-based reports

Instruction Information
- Units
- Lessons
- Materials
- Strategies
- Differentiated instruction
- Authentic assessment
- Rubrics

Professional Development
Questions For Thought

What curriculum, instruction, assessment and student demographic data is available?
What data is available in electronic form?
What equipment and programs might be needed to access and analyze and visualize the data?
Do any staff members have experience analyzing student data?

How do we “house” data?

There are commercial software products called data warehouses. These commercial products provide a place to put a variety of information and a way to search and display results.

A true data warehouse, however, is more than one software application.

How do we “house” data?

A data warehouse is a central repository that brings together what might otherwise seem to be disparate information about the education process.

This information is often “locked up” in the personal computers (often called information silos) of individual employees.
How do we “house” data?

Bringing together data residing in computer systems and applications throughout the organization into a data warehouse provides a way to overcome the problem of seeing every tree, but never seeing the forest.

Data Warehouse Components

Inputs:
- Curriculum, Demographic, and Budget Information including: curriculum maps, student characteristics and program costs
- Instruction Information including: methods, materials, resources and assessment models
- Outcomes: Student Information including formative and summative assessment data

The Knowledge Pyramid

System maturity
Understanding principles
Understanding patterns
Understanding relationships

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Questions For Thought

Once we have a data warehouse and populate it with the appropriate data ...

Once we have formulated our questions and identified that we have the data to answer the questions ...

How can we get actionable information from our data warehouse?

3. Data Visualization

Data Visualization

- The main goal of data visualization is to communicate information clearly and effectively through graphical means.
- To convey ideas effectively, both aesthetic form and functionality need to go hand in hand, providing insights into a rather sparse and complex data set by communicating its key-aspects in a more intuitive way.
Knowledge-based Data Visualization

Data Visualization

- The field's origins are in the early days of computer graphics in the 1950s, when the first graphs and figures were generated by computers.
- A significant boost was given to the field with the appearance, in 1987, of the NSF report "Visualization in Scientific Computing." (edited by Bruce H. McCormick, Thomas A. DeFanti and Maxine D. Brown)

Data Visualization

- The phrase "Visualization in Scientific Computing" which turned into Scientific Visualization was used initially to refer to visualization as a part of a process of scientific computing: the use of computer modeling and simulation in scientific and engineering practice.
- More recently, visualization is increasingly also concerned with data from other sources, including the large and heterogeneous data collections found in business and finance, and yes, education.

What is Data Mining

Data mining is the term used to describe the application of computer technology to attain beneficial information from what is often at first glance a vast and a seemingly unrelated enormous quantity of data.

Data visualization is a form of data mining.
What is Data Mining

Data mining is a way to:
answer questions that educators are interested in answering and
to identify and answer questions that educators did not know enough to ask.

For Example

Data mining can answer questions such as:

- Are student demographic characteristics a factor in the type of pleasure reading that students enjoy?
- Are students that transfer into the school after grade 2 reading at the same level as students that have been in the school since kindergarten?

Questions For Thought

How will data be mined for information?
What will we do with the results of our data mining?
Questions For Thought

What does data visualization look like. How is it different from the charts and graphs I am used to creating and using to understand and communicate information to others?
Conclusion

- The interactions of a student information system, data warehousing and data visualization create a synergy that can
  - identify learning strengths and weaknesses
  - provide insight and understanding
  - translate into practices designed to improve achievement for all students.

In The Future

- There are people who believe that there may be an easier way to achieve these goals.
- Such approaches are still somewhat experimental. For example...
If we could wire our students directly to the computer we could teach, test, and remediate with precise accuracy!

Maybe this day is not so far away ...

Q & A

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