How Practitioners Interpret and Link Data to Instruction: Research Findings on New York City Schools' Implementation of the Grow Network

Daniel Light
Dara Wexler
Juliette Heinze

EDC/Center for Children and Technology

Paper presented at AERA 2004, San Diego, CA

Contact information:
dlight@edc.org
dwexler@edc.org
cheinze@edc.org

Funded by the Carnegie Corporation

Introduction

Urban districts have faced the intense external scrutiny of a high-stakes accountability climate for some time (Fullan, 2000), but the shift in the funding and regulatory environment caused by the *No Child Left Behind Act* (NCLB) is prompting district and school administrators to think differently about the potential that newly accessible data has to inform instruction and decision-making aimed at raising student achievement. In particular, with NCLB holding educators as well as students accountable, the exploration of how data can inform instructional decisions is increasingly becoming a main topic of educational policy (Salpeter, 2004; Secada, 2001).

Using data to make decisions is the focus of a two-year study being conducted by Education Development Center's Center for Children and Technology (CCT). The independent study, funded by Carnegie Corporation, examines a large-scale data reporting system, developed by the Grow Network for the New York City's Department of Education, that organizes students' standardized test data into reports customized for teachers, school leaders, and parents. For teachers, the reports provide overviews of class-wide priorities, group students in accordance with the state performance standards, and support teachers in focusing on the strengths and weaknesses of individual students. For the administrators, the reports provide an overview of the school, and present class and teacher-level data. For the parents, the report explains the goals of the test, how their child performed, and what parents can do to help their child improve their score. Each Grow Report, which is delivered both online and in print, summarizes the data into rankings by score and groups students according to New York State performance levels.

This paper presents a conceptual framework that explores the intersection of decision-support technologies, educators, and the process of transforming data into knowledge. To illuminate this framework, we will share initial findings from our research around the question of how teachers analyze the information provided by the Grow Reports, as well as synthesize it into their understanding of the classroom to make decisions about instructional practices and their students.

Importance of this Study

Prior research has demonstrated that effective accountability occurs when external and internal measures are aligned and used in coordinated fashion by schools to support improvements in student learning (Elmore & Abelmann, 1999; Fullan, 2001). The use of assessment data for decision-making assumes alignment between standards, instruction, and assessment. Therefore, administrators and teachers are increasingly pressured to use accountability data to improve instruction. However, as CRESST researchers note, "Despite both the mandates and the rhetoric, schools are woefully under-prepared to engage in such inquiry. The practice of applying large-scale data to classroom practice is virtually nonexistent" (Herman & Gribbons, 2001).

While several technical advancements enabling innovative reporting mechanisms have brought data-supported decision-making to the classroom level, questions about how teachers understand and use standardized test data for instructional purposes remain unanswered. Some preliminary work on the experiences of different design sites that are developing data-systems are seen in: the Quality School Portfolio (QSP) developed at CRESST (Mitchell, 1998), and IBM Reinventing Education data projects in Broward County Florida (Spielvogel, Brunner, Pasnik, et al., 2001), the Texas Education Agency, and the South Carolina Department of Education (Spielvogel & Pasnik, 1999). Research on the role of data systems and applications in practice is also being done in Minneapolis (Heistad & Spicuzza, 2003), Boston (Sharkey & Murnane, 2003), and on the implementation of QSP in Milwaukee (Thorn, 2002; Webb, 2002). Still, the New York City school system's partnership with the Grow Network is possibly the largest project of its kind.[1] Our research, therefore, speaks to important policy concerns about the role of standardized testing and data-driven decision-making, as well as raises questions about how data are used and supported in schools and classrooms.

Advances in technology and reporting capabilities have created new opportunities for schools to use test data for decision-making at multiple levels of the educational system. The current experience of the New York City Department of Education in conjunction with the Grow Network, an education company that helps to "transform assessment results into instructional tools for teachers, principals, and parents" (Grow Network, 2004) is a prime example of how newly emerging tools that use standardized testing data have the potential to bring coherency to this process of alignment.

New York City uses the Grow Network's web-based reporting system to provide 30,000 fourth to eighth grade educators access to assessment data for 400,000 students. Through the Grow Reports, teachers are able to see the previous years' test results, overall scores, and scores by each standard tested for each one of their current students (See Appendix A). This paper draws upon our preliminary research findings, focusing on the qualitative aspects of how teachers make meaning of Grow Reports and the ways they use them in the classroom.

Conceptual Framework

Through the course of this research project we have begun to piece together a three dimensional conceptual model to understand the phenomena of data-driven decision-making in classrooms. The basic framework takes into account the process by which raw data becomes useable information, the effect of the data-reporting tool in shaping that process, and the role of prior knowledge of the decision-maker. This emergent framework connects research and insights from three different bodies of literature. First, we draw from Management

[1] The Consortium on Chicago School Research is studying the Grow Network's implementation in Chicago (Easton & Luppescu, 2004).

Information Systems literature in the fields of organizational and business research and the Wisconsin Center for Education Research at the University of Wisconsin-Madison's application of this perspective to education - an underlying concept of the entire decision-making process. Second, we draw on research around technological affordances and socio-technical relations to understand the data tool itself. Last, we consider the factors educators bring to the process of synthesizing and understanding data. We will discuss each of these dimensions in more detail below.

From Data to Knowledge: A Management Information Systems Perspective

The Grow Reports and the test data that the reports present are currently being integrated into a multi-tiered system teeming with complex decision-making processes. Before we could research what access to this type of data might mean for urban schools, we needed to map out a preliminary model of data-driven decision-making within which to situate our research questions. To understand the process by which teachers understand and interpret standardized test data, we used a knowledge management framework borrowed from management theory and organizational psychology and sociology (Ackoff, 1989; Choo, 2002; Thorn, 2002).

Most theories of information management draw distinctions among data, information, and knowledge. For example, knowledge, unlike information, is regarded in management literature as being embedded in people, and knowledge creation occurs in the process of social interaction about information (e.g. (Sveiby, 1997). This perspective is supported by Nonaka and Takeuchi (1995): "information is a flow of messages, while knowledge is created by that very flow of information anchored in the beliefs and commitment of its holder. This [...] emphasizes that knowledge is essentially related to human action." Likewise, Drucker (1989) claims that "[...] knowledge is information that changes something or somebody - either by becoming grounds for actions, or by making an individual (or an institution) capable of different or more effective action." Therefore, data, prior to becoming information, is in a raw state and is not connected in a meaningful way to a context or situation.

Borrowing from Ackoff's (1989) work in the field of organization and management theory, in collaboration with Dr. Andreas Breiter (2003), we adapted a simplified version of Ackoff's conceptual framework that links data, information and knowledge. Within the framework, there are three "phases" of the continuum that begins with raw data and ends with meaningful knowledge that is used to make decisions. They are the following:

- **Data** exist in a raw state. They do not have meaning in and of itself, and therefore, can exist in any form, usable or not. Whether or not data become information depends on the understanding of the person looking at the data.
- **Information** is data that is given meaning when connected to a context. It is data used to comprehend and organize our environment, unveiling an understanding of relations between data and context. Alone, however, it does not carry any implications for future action.

- **Knowledge** is the collection of information deemed useful, and eventually used to guide action. Knowledge is created through a sequential process. In relation to test information, the teacher's ability to see connections between students' scores on different item-skills analysis and classroom instruction, and then act on them, represents knowledge.

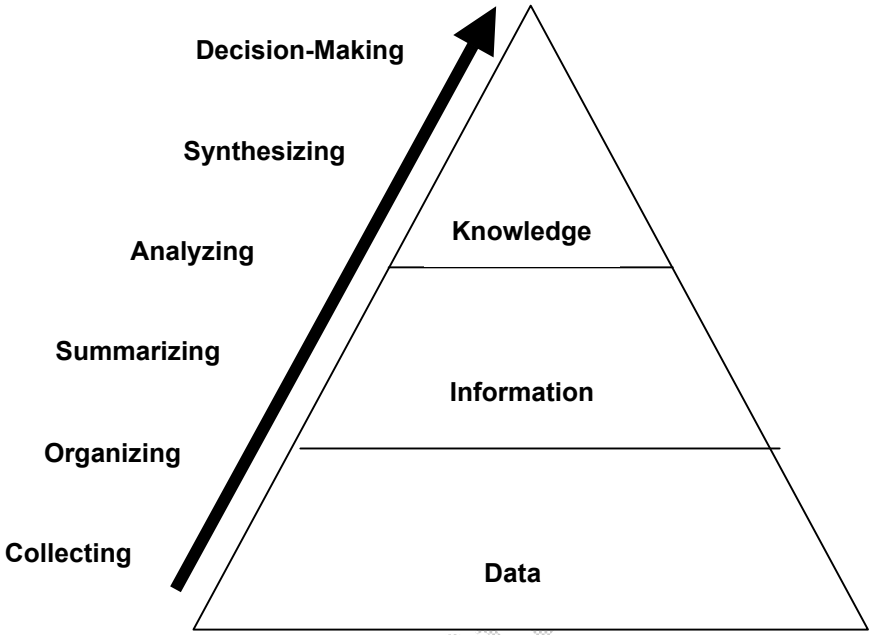


Figure 1: The process of transforming data into knowledge

The literature identifies six broad steps (see Figure 1) that a person goes through to transform data into knowledge (Ackoff 1989; Drucker, 1989). The transformation entails collecting and organizing data, along with summarizing, analyzing, and synthesizing information prior to acting (decision-making). Through this process, raw data are made meaningful, by being related to the context or situation that produced it; consequently, human action underlies all decision-making. This sequential process, therefore, forms the basis of our understanding of how teachers interact with data.

How Data Technologies Shape the Transformation Process

In the case at hand, as in the case of most examples of data-driven decision making, technology can play a central role in transforming data to knowledge. Tools can channel and shape this flow to some extent (Sarmiento, n.d.; Wayman, Stringfield, & Yakimowski, 2004). For example, data warehouse technologies play a first step in collecting and organizing data. The way a data warehouse collects data and structures the database influence the next steps in the process. Reporting and retrieval technologies shape the organization and summarization of data into information. Potentially simple things like interface and visual presentation can make the information more understandable to the end user. There are also data analysis tools and technologies that shape the process of summarization, analysis and synthesis of data. Basic issues of access (like

passwords or Internet connections) influence who can use the data or information. Building from the literature on information management systems and data-driven decision-making, we have identified continuums of six traits that help understand how a data support system affects the process of understanding and using data in an educational context. These factors refer to functionality of the tool as well as to how the tool enables the user to interact with the data. They are:

1. *Accessibility*. How accessible are the tools, and how does the tool support access to the data or information?
2. *Length of feedback loop*. How much time passes between the time the data are generated and when results are reported to the end-user? Is the data/information still relevant by the time they are reported out?
3. *Comprehensibility*. How understandable is the functioning of the tool? How clear is the presentation of the data? How easy is it to make reasonable inferences from the information presented?
4. *Flexibility*. Are there multiple ways to use the tool? Does the tool allow the user to manipulate the data?
5. *Alignment*. Does the data align with what is happening in the classroom? Are they aligned with standards? Are they aligned with the curriculum?
6. *Links to instruction*. Does the tool bridge information (either physically or conceptually) and practice?

It is important to keep in mind that these factors are interactive. For example, increasing the flexibility in terms of either multiple ways to use the tool or manipulate data, would mostly likely decrease comprehensibility by requiring the user to learn how to use the tool, or to do "data analysis."

What the Educator Brings to the Transformation Process

Based on the perspective that knowledge is embedded in people (Nonaka & Takeuchi, 1995; Sveiby, 1997), the third important dimension in data-driven decision-making is the educator and what he or she brings to this process. Based on our research we have focused on three aspects of the practitioner experience which affect how educators use data: (1) the school context in which they teach; (2) pedagogy; and, (3) prior knowledge. In the case of teachers, important elements of the school context that we have been researching are administrators' vision for using data in classroom-level planning and test pressure as defined by whether the school is making adequate yearly progress (AYP) on test performance. The second element is important because teachers synthesize this information into their worldview, which is shaped by their teaching style and pedagogy. Relevant dimensions of prior knowledge are represented in teachers' experience in classroom management and lesson planning, their level assessment literacy, and their knowledge of the learning process and knowledge acquisition.

The Intersection of the Technology and Educator on the Way to Transforming Data into Knowledge

By folding these two dimensions (the technology and educator) into the theoretical model of transforming data into knowledge, the resulting framework takes into account the process by which raw data becomes useable information,

the effect of the data-reporting tool to shape that process, and the role of prior knowledge of the decision-maker (See Figure 2).

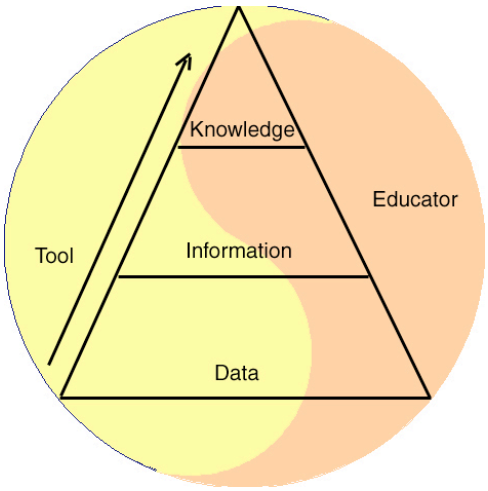


Figure 2: The process of transforming data into knowledge and the interaction between the technology and the educator

In the following sections we map the experience of New York City teachers with the Grow Reports onto this framework to illustrate how educators interact with data-support technologies to make instructional decisions.

Description of Grow Network and the Grow Reports

The Grow Network made one of the first efforts to provide New York City classroom teachers with a clear and comprehensible "picture" of their classes' and individual students' test scores on the city and state English Language Arts (ELA) and math exams,[2] bringing high-stakes data directly to teachers and administrators in a way that saves them time and energy compared to how these data had previously been made available (see Appendix B). The Grow Network makes the data more accessible to teachers through a mix of print and web-based reporting systems and their materials can be distributed in multiple formats, online and paper. Each fall the Grow Network delivers customized reports to teachers, administrators, and parents, as well as mirrors the data displayed in the printed reports on the web (see Appendix A).

For teachers, Grow Reports provide overviews of class-wide priorities, group students in accordance with the state performance standards, and enable teachers to focus on the strengths and weaknesses of individual students. For administrators, the reports provide an overview of the school, and present class and teacher-level data. For the parents, the reports explain the goals of the test, how their child performed, and what parents can do to help their child improve their score. For example, a sixth grade math teacher teaching during the current

[2] New York City students are required to take the city-wide CTB exams in ELA and math in grades 3, 5, 6, and 7, and the state ELA and math exams in grades 4 and 8.

school year 2003-2004, would have access to a customized report that is grouped according to three questions: (1) How did my students do? (2) What do they need to learn? And, (3) what tools are on the web? This report performs a level of summarization and analysis of the data and identifies "class priorities." In response to "How did my student do?" the teacher would see the overall scores for all of her sixth grade students grouped according to the New York State standards across four levels, ranging from *Far Below Standards* (Level 1) to *Far Above Standards* (Level 4), along with the students' scale score. On "What do they need to learn?" the teacher would see how her students did in each standard on the Grade 5 test according to New York State's key ideas. She would also see her students as a group compared to all New York City students. In addition, she would have an overview of class priorities, based on last year's test results on the sub-skills. The priorities are divided into three levels – *need help with fundamentals*, *need additional instruction*, and *likely to benefit from advanced work*. These levels are calculated by Grow Network through a complex algorithm comparing each student's sub-skill results to the performance profile of all Level 4 students on that skill, and so on, for each level. The delivery of these reports has made data more accessible to teachers and enabled practitioners – both teachers and administrators – to make decisions about this data directly in their classrooms.

In addition to the reports, the Grow Network website supports teachers' analysis of the information and instructional decision-making with two additional features. Administrators and teachers often cited the explanations and definitions of the skills, standards and concepts on the test as an important component of the information provided. The online reports contain hotlinks that define each skill or standard and explain challenges for students in mastering this skill. An elementary principal commented that she "really likes Grow because it tells you what the item on the test means, and knowing what it means helps the teachers to better understand the test." The class priorities lists as well as the explanation of the tested concepts are also hotlinked to instructional materials and resources for teachers and administrators that suggest activities and teaching strategies to promote standards-based learning in the classroom. The reports also link to external resources approved by the New York City Department of Education.

Our Study

In order to learn how educators used the Grow Reports and instructional materials to make data-driven decisions within their schools and classrooms, we constructed our research project as a combination of qualitative and quantitative methodologies, drawing upon data gathered from observations, interviews, and surveys. Based on the complexity of the study, we divided our research into three phases.

Phase One focused on understanding key stakeholders' and educational leaders' objectives in bringing this project to administrators, teachers, and parents, while examining how districts supported the Grow Network resources. During Phase

One, we conducted structured interviews with decision-makers and instructional leaders, and piloted focus groups with teachers and staff developers. We interviewed a total of 47 educational leaders, including: central office stakeholders, superintendents, deputy superintendents, math coordinators, ELA coordinators, staff developers, district liaisons, technology coordinators, directors of research and curriculum, and individuals who work with the United Federation of Teachers. We also spoke with several people representing non-government organizations working closely with the New York City schools on issues like educational reform and professional development.

Phase Two combined different qualitative research strategies, and consisted of three parts: (1) observations of professional development training sessions, which focused on how teachers spoke about using the Grow Reports; (2) interviews with teachers and administrators (including staff developers, coaches, principals, and assistant principals) about their beliefs and practices related to using Grow Reports; and (3) interviews with teachers and administrators using sample Grow Reports to probe about understanding and interpretation of the information. This was accomplished by conducting ethnographic research in 15 schools across four school districts in New York City that represented various neighborhoods, student populations, and overall performance levels. Each district identified four schools where we conducted 45 semi-structured and open-ended interviews with principals, assistant principals, staff developers, and teachers. In addition, we observed ten grade-wide meetings and/or professional development workshops. To triangulate our data, we also designed a structured interview protocol, using sample Grow Reports as projectives. This protocol enabled us to explore teachers' responses about the different data interfaces presented in the reports. We then conducted 31 of these projective interviews with teachers in the two "high stakes" testing grades – fourth and eighth - in New York City, as well as with a sample of sixth grade teachers. The sample of the upper grade teachers was equally divided between those who teach math and those who teach language arts.

Phase Two of the research helped us to develop a deeper understanding of how classroom teachers think about these resources in relation to their everyday practice, and helped to contextualize the data gathered to inform Phase Three. This final phase of the study involved the development and administration of two separate surveys across the New York City public school system – one for teachers and one for administrators – and tested the hypotheses we developed in the previous two phases of work. The surveys asked teachers and administrators about how they interpret data and conceptualize the use of the Grow Reports for instructional planning. We also inquired about the types of supports needed to fully leverage the use of data to improve instruction. We disseminated over 750 surveys through the mail to 17 schools across the city, as well as an online survey sent to over 1,400 teachers and administrators. We received 146 administrator responses and 213 teacher responses from eight schools. We are currently analyzing the survey data.

How Teachers Understand the Information

During the qualitative components of the research, we spent a considerable amount of time talking with classroom teachers about their use of data in classroom decision-making and more specifically, their use of the Grow Reports. For the first set of interviews, we sampled for teachers who were known to be using the Grow Reports, and for the second set of interviews, we selected a random sample of teachers within specific grades. During the interviews, the teachers' conversation, when talking about students, seldom isolated the test results, nor did they refer to specific scale scores. Instead, they talked about test results in terms of their holistic knowledge of the students. It is our understanding that the teachers were synthesizing the quantitative information with their qualitative understanding of the classroom. They commonly understood the test results in relative terms of their students' strengths and weaknesses. For example, one teacher said that she liked the Grow Reports because they showed that every student has strengths. Therefore, even for her lowest performing students she could start a conversation with "here's where you are strong…."

A consistent exception to this pattern of teachers and administrators not focusing on actual test scores is represented in discourse around "bubble kids." "Bubble kids" refers to those students scoring within a range of five to ten points above or below the cut off. Because of their statistical location, the probability of moving them is much higher; hence, some administrators report targeting the bubble kids for extra resources, such as pull-outs, after-school and special programs, in an effort "to move" them up a level. A core measure of AYP is the number of students at Level 3 or moving from Level 2 to 3. Teachers, therefore, also said that the phenomenon of the bubble kids is some place where actual test scores are meaningful to the classroom context.

During interviews, we learned that teachers found the reports clear and comprehensible. Because of the importance placed on these test results, New York teachers already had prior knowledge of the performance levels. The fact that the Grow Reports were organized and summarized within that structure made the reports readily meaningful to them. When we probed deeper into teachers' understanding of the levels themselves, we found that teachers had a qualitative understanding of the levels that was integrated into a conception of grade-level progression. As one fourth-grade teacher explained:

> Well, it gives you a number, it tells you the number. It says right here that Level 1 is from 475-617. That number range is telling you that a student within that number is far below the standards, they are not even at grade level. Grade level is between 656- 700.

A number of the teachers translated the levels into "at grade-level" for Level 3, and then above and below grade level. Level 1 was understood as a catchall category for students more than one grade behind.

Validity and Reliability Concerns

In interviews with teachers, we also explored teachers' knowledge of assessment, which ranged from teachers who had received training in measurement and psychometrics to teachers with less statistical understandings. Most teachers with whom we spoke mentioned issues of validity and reliability, although oftentimes using varied terms when speaking about them. In terms of the reliability of the test results, teachers primarily spoke about students' test-taking anxiety: that some students were better test takers than others. A few educators even told stories about students who were so stressed out by the idea of taking the test that they broke down in tears or actually became ill. Whenever teachers had a doubt about reliability of the data, some said that they verified student ability using their own assessment strategies. For example, one sixth grade teacher used peer tutoring as both a teaching and an assessment strategy: "I watch them pair up with somebody, if they can show someone else, then you know that they understood."

Several teachers also expressed concern both that some students "test poorly" and would be placed in activities below their level, and, conversely, that other students "test well," scoring higher than their true understanding, and therefore, might not be eligible for the academic supports needed to really master the material. As one teacher of high performing fourth grade students commented:

> Some students did not appear to know as much as their Grow score said they did. At first they were not as strong as I expected, then the previous teacher said that the whole class did not do as well on tests. They're very weak on the quizzes throughout the year, but then they got higher scores on the state test. So, you wonder what is up with that?

Teachers had a wider range of concerns when it came to issues regarding validity. In relation to content validity, the teachers with whom we spoke expressed few concerns about the alignment of standardized tests with the state's standards. New York State is one of the states with the strongest alignment between the test and the standards (Princeton Review, 2002). Teachers expressed construct validity concerns over the reporting of the sub-skills regarding how the different sections of the test were weighted. The reports do not indicate the number of items behind each sub-skill, and teachers did not know if the number of items in a section of the test truly represented a students' ability on that skill. Teachers expressed more concerns with face validity of the test and whether the test measures the "life skills" that students need to succeed. A sixth grade teacher admitted that, "you really do start teaching to the test, you try to teach them [students] those life skills but you do begin to focus on the test."

Teachers had substantial concerns about consequential validity. When teachers were discussing their classroom-level decisions, concerns about validity and reliability were moderated as the test results could then be used in conjunction with other ways teachers have of knowing their students. Generally teachers

referred to the information in the Grow Reports as a starting point, as information balanced with their own assessments. However, when teachers talked about high stakes decisions made at levels of the system further distanced from the actual student, their concerns about the validity and reliability of the data increased.

Teachers' Reported Uses of Grow Reports

The teachers' synthesis of information from the Grow Reports into their understanding of the classroom, offered us a springboard from which to explore instructional decision-making. In the interviews teachers reported using the Grow Network in myriad ways to meet their own varied pedagogical needs, as well as their diverse students' academic needs. We grouped those different uses into three main categories: (1) planning - broad level planning such as setting class priorities, creating a pacing calendar, or doing weekly or yearly lesson plans; (2) differentiating instruction - strategies like grouping, IEP's, student conferencing or individualized assignments and materials; and (3) supporting conversations – discussions with parents, students, fellow teachers and administrators.

Planning

When asked how they use the Grow Reports, several teachers and school administrators reported using the Grow Reports and the instructional resources when doing broad level planning such as setting class priorities, creating a pacing calendar, or doing weekly or yearly lesson plans. Teachers reported that the Grow Reports help them decide on what standards to address and which skills to teach in daily lesson plans, mini-lessons, and even year-long pacing calendars. Many said that analyzing the information presented in the Grow Reports helped to show them where their overall class' strengths and weaknesses lie. For example, one teacher said that when looking at the reports, she asked herself, "Where is my class lacking?" and then, once identifying those skills, she developed a mini-lesson and/or integrated those skills into larger lessons and units for constant reinforcement. It was not uncommon for teachers to introduce a higher level of analysis of the Grow information before making a decision. "I spiral," one teacher reflected. "If they know something I will make it a homework assignment to see how much they remember and if I need to review or re-teach. I will spiral topics throughout the whole year."

The school context can play a key role in how teachers interpret and use the Grow Reports. For example, we spoke with teachers in a low-performing school under threat of take-over where the administration was tightly focused on test preparation. The teachers reported planning instructional activities solely around the test, even though this did not accord with their own view. A fourth grade teacher in this school commented that "teaching is 'not what I envisioned. I thought [the students] would be learning to know rather than take the test.'"

Many teachers also reported using the Grow Reports to plan instruction that would better meet the needs of individual students, especially those who are

struggling. By knowing an individual student's strengths and weaknesses, teachers claimed that they could better plan instruction tailored to specifically help that student, as well as provide him or her with materials appropriate to where he or she is.

Differentiating Instruction

Most teachers agreed that because the data represented on the Grow Reports reveal that individual students perform at various different levels, the tool helped them to differentiate instruction. Teachers reported different uses of the Grow Report depending on the differentiation strategies they sought to implement. Teachers said that sometimes individualized instruction to meet student needs by modifying lesson plans, by providing different materials so that students have multiple entry points into the content, by varying homework and assignments, and/or by teaching in small groups or one-on-one. For example, when modifying instructional materials or selecting resources, teachers said that knowing where students are in terms of the standards and skills could be beneficial. Some said they differentiate instruction by giving certain students' modified in-class and/or homework assignments according to their ability level. Others said they use entirely different textbooks or supplementary materials to work with different students. For example, one teacher used information found in the Grow Report to create different math homework calendars targeting specific weaknesses and strengths of students.

Many teachers said the Grow Reports could inform their grouping strategies by showing where students fell relative to each other. The grouping strategies took several different forms, and the relevance of Grow data varied by strategy. For instance, teachers might use Grow Reports for homogenous or heterogeneous ability grouping, but not for groups based on other criterion (i.e. behavior, interest, self selected). Furthermore, some teachers said that they regrouped students frequently and the Grow Report helped them make decisions when creating groups to work on a specific skill, but were less important in helping them group for a project-based learning activity. One sixth-grade teacher stated, "Oh sure, we do two periods a day of reading where we focus on the skill of the week. That's where I group them on the data. We have test prep books that focus on the skill, and Grow ties in nicely with that."

Another way that teachers reported differentiating instruction was by creating a peer tutoring situation in which a high performing student worked with a low performing student:

> Like for writing, we are doing a research project. Some kids are excelling. They have already done the outline and are ready to go on. Other kids don't know what to do with the outline, so I pair them – the strong and the weak to help each other.

Teachers also individualized instruction by working one-on-one with students. The data in Grow Reports could help identify students in need of special support in specific areas.

Supporting Conversations

Most of the teachers and school-building administrators with whom we spoke said the Grow Reports were useful in supporting conversations about students and learning. They spoke of using the Grow Reports in conversations with teachers, parents, administrators, and students. The respondents felt that the Grow Report provided a good starting point for conversations about student learning. For example, many teachers stated that the Grow Reports provided something "concrete" to show parents when discussing where the student was in his or her learning and where he or she needed to go. Some administrators said that when doing classroom visits, they ask teachers to explain how they use the Grow Report to inform their lessons.

The Grow Reports were also used to motivate students, set students' learning goals, and help shift responsibility to students in terms of their own learning. Many teachers reported using the information from the Grow Reports to conference with individual students about their performances. A few teachers informed us that they gave their students their own Grow Reports and had students create their own learning plans. One veteran teacher in a Harlem school worked with his eighth grade students to create a sort of IEP (Individualized Education Plan) of skills and competencies in which they excelled and on which they needed to improve. This process, he said, assisted him in giving students more ownership over their own learning.

Conclusions and Recommendations

The conceptual framework for understanding data-driven decision-making has proved effective. In this paper, we have attempted to use the framework to lay out the steps of transforming data into knowledge that can inform a decision, in addition to what the Grow Reports and what the educator brings at each step. The framework illuminates the interrelation between the data-tool and the educator in supporting decision-making. In understanding the role of the Grow Reports, the framework allows us to identify how the tool supports the creation of knowledge by collecting and organizing and summarizing the data. The ease with which most teachers were able to understand the reports perhaps indicates that the *data* are now at the level of *information*.

The framework also highlights the critical role the educator plays in the data-knowledge process and the wealth of practitioner knowledge in that respect. The transformation process identifies that the last few steps in generating knowledge are analyzing and synthesizing. In order to do this, teachers connect the information about test performance to their prior knowledge of teaching and their students, thereby shaping this connection by their pedagogy, their context and their level of understanding of the test. The decision being made from the Grow Reports were not driven by the data as much as by teachers' pedagogy. As

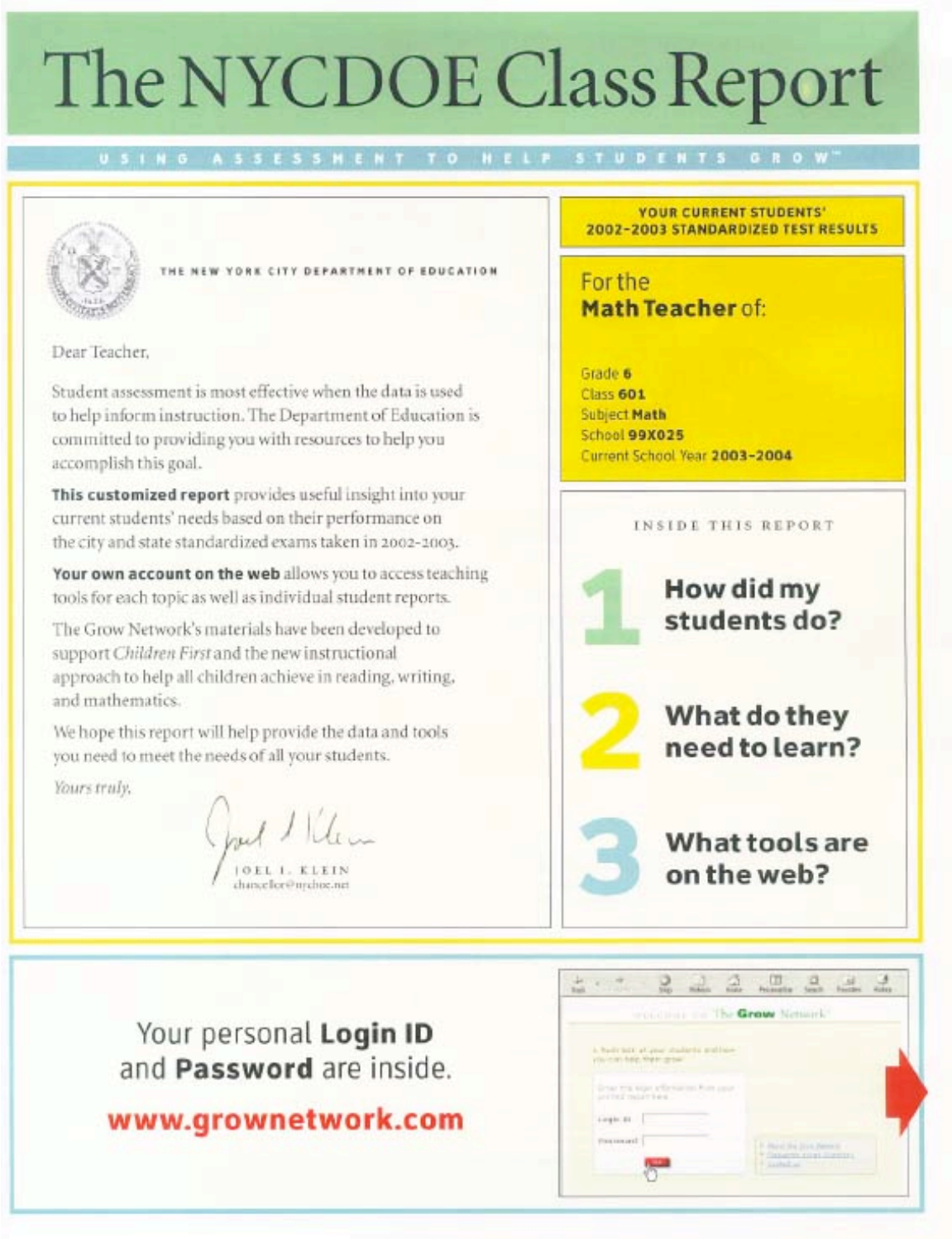
teachers stated, the data helped them develop a clearer picture of their students, but they still had to integrate this data into their broader understanding. In the final stages of the data-knowledge process, teachers rely more on their knowledge of teaching and learning than on their assessment literacy. This is perhaps the crux of the relationship between the data-tool and the educator where Grow has effectively transforms the test data so that the educator can use them when making classroom decisions.

We have tried to demonstrate the way in which the teacher shapes the final steps of transformation into knowledge. Therefore, keeping the role of practitioner knowledge in mind, our preliminary findings suggest that the information in the Grow Reports helps teachers know what their students could and could not do on one set of learning standards, but does not necessarily cause teachers to rethink their conceptions of teaching and learning. This supports the suggestion that, in order, for data-driven decision-making to change teaching and learning practices, the focus of professional development should be on teaching and learning, rather than just on data analysis.

A second recommendation is for further research into identifying the appropriate balance between what technology can offer and what practitioners need for different levels of decision-making. Our findings support the perception that the Grow Reports play a substantial role in creating useable information for teachers and required less assessment literacy from the teachers than other data-tools. This had certain benefits in terms of ease of use and comprehensibility and relevance to the classroom, but there are other possible combinations and formats. As data-driven decision-making becomes more prevalent in schools, we need to better understand how data technologies can best support the teaching and learning process.

Appendix A

Sample Grow Reports



The NYCDOE Class Report

USING ASSESSMENT TO HELP STUDENTS GROW™

THE NEW YORK CITY DEPARTMENT OF EDUCATION

Dear Teacher,

Student assessment is most effective when the data is used to help inform instruction. The Department of Education is committed to providing you with resources to help you accomplish this goal.

This customized report provides useful insight into your current students' needs based on their performance on the city and state standardized exams taken in 2002-2003.

Your own account on the web allows you to access teaching tools for each topic as well as individual student reports.

The Grow Network's materials have been developed to support *Children First* and the new instructional approach to help all children achieve in reading, writing, and mathematics.

We hope this report will help provide the data and tools you need to meet the needs of all your students.

Yours truly,

JOEL I. KLEIN
chancellor@nycboe.net

YOUR CURRENT STUDENTS' 2002-2003 STANDARDIZED TEST RESULTS

For the **Math Teacher** of:

Grade **6**
Class **601**
Subject **Math**
School **99X025**
Current School Year **2003-2004**

INSIDE THIS REPORT

1 How did my students do?

2 What do they need to learn?

3 What tools are on the web?

Your personal **Login ID** and **Password** are inside.

www.grownetwork.com

How did my students do?

OVERALL SCORES FOR GRADE 6 STUDENTS*

Far Below Standards LEVEL 1: 475-617	Scale Score	Below Standards LEVEL 2: 618-655	Scale Score	Above Standards LEVEL 3: 656-700	Scale Score	Far Above Standards LEVEL 4: 701-790	Scale Score
Adams, Anita	613	Gottlieb, Matt	655	Chester, Jane	692	Moses, Michael	714
Zuniga, Lluvia	610	Ormond, Nancy	655	Cavanaugh, Kate	692	Mitchell, John	706
Maxwell, Tyrell	608	Allen, John	655	Munoz, Maria	692		
Tucker, Michelle	608	Roberts, Mike	655	Navarez, Esteban	678		
Evans, Eric	580	Bochamps, Martin	655	Crowe, Amir	673		
		Martinez, Tom	651				
		Allsopp, Victoria	647				
		Davis, Latoyah	647				
		Cass, Arla	638				
		Cass, Mary	638				
		Ong, Mia	638				
		Reese, Nelson	634				
		Miller, James	630				
		Roebuck, Lila	625				

** The results and recommendations shown on the right are based on the 26 Grade 6 students listed above who took the Citywide Grade 5 test as Grade 5 students in the 2002-2003 school year.*

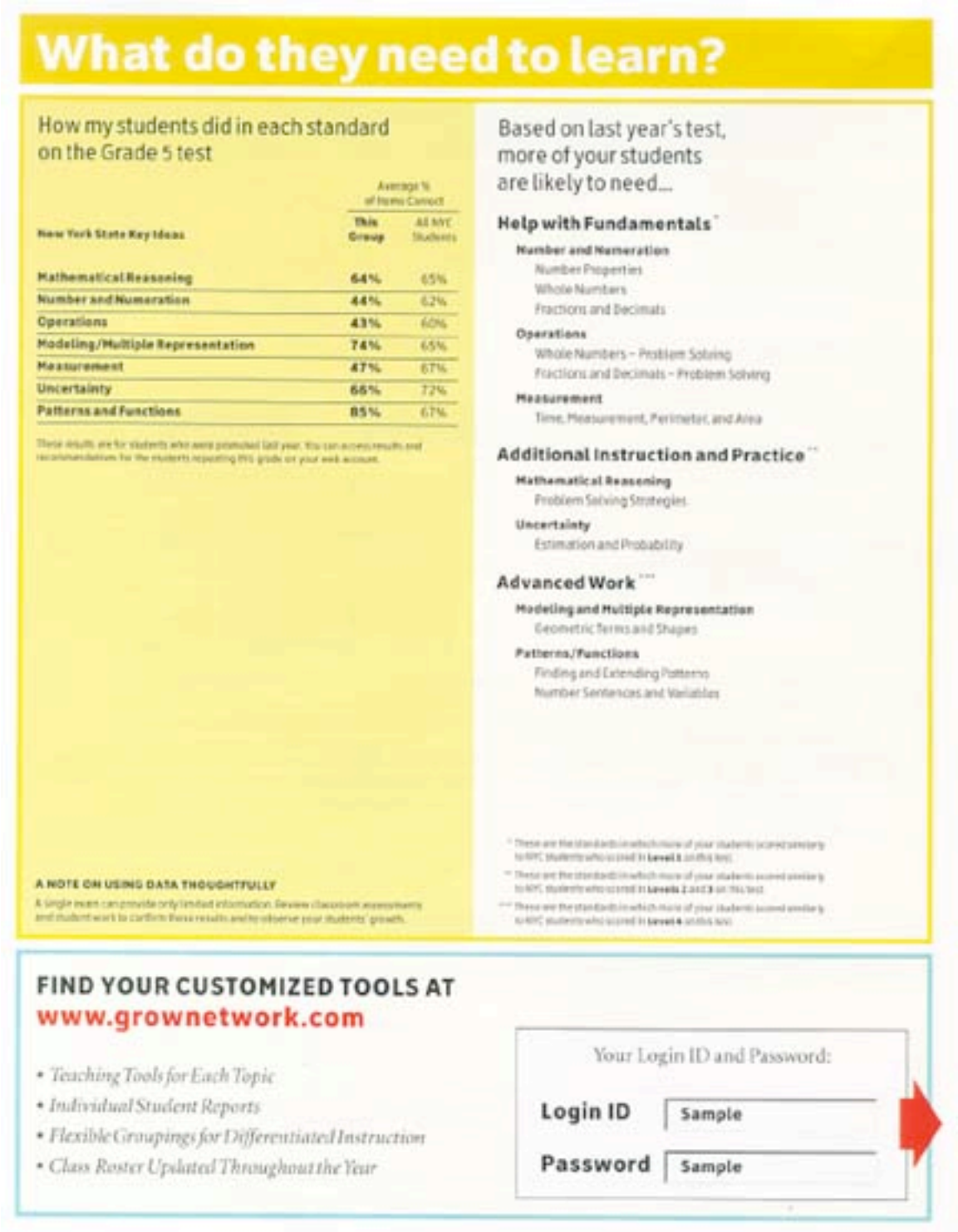
The table below shows results for other students in this class.

OVERALL SCORES FOR OTHER GRADE 6 STUDENTS

Name	Grade of Student in 2002-2003	Grade of Test Taken in 2002-2003	Scale Score	Performance Level	Name	Grade of Student in 2002-2003	Grade of Test Taken in 2002-2003	Scale Score	Performance Level
Barda, Willy	6	6	502	Level 1	Pryor, Peter	6	6	504	Level 2
Huband, Michael	5	4	680	Level 3	Moore, Jennifer	6	6	510	Level 1

NOTE: Scale score ranges for each performance level vary for each grade of test taken.

LEARN MORE ABOUT EACH STUDENT:
Your web account contains Individual Student Reports with results and recommendations broken down by topic.



What do they need to learn?

How my students did in each standard on the Grade 5 test

New York State Key Ideas	Average % of Items Correct: This Group	Average % of Items Correct: All NYC Students
Mathematical Reasoning	64%	65%
Number and Numeration	44%	62%
Operations	43%	60%
Modeling/Multiple Representation	74%	65%
Measurement	47%	67%
Uncertainty	66%	72%
Patterns and Functions	85%	67%

These results are for students who were promoted last year. You can access results and recommendations for the students repeating this grade on your web account.

A NOTE ON USING DATA THOUGHTFULLY

A single exam can provide only limited information. Review classroom assessments and student work to confirm these results and to observe your students' growth.

Based on last year's test, more of your students are likely to need...

Help with Fundamentals*

Number and Numeration
- Number Properties
- Whole Numbers
- Fractions and Decimals

Operations
- Whole Numbers – Problem Solving
- Fractions and Decimals – Problem Solving

Measurement
- Time, Measurement, Perimeter, and Area

Additional Instruction and Practice**

Mathematical Reasoning
- Problem Solving Strategies

Uncertainty
- Estimation and Probability

Advanced Work***

Modeling and Multiple Representation
- Geometric Terms and Shapes

Patterns/Functions
- Finding and Extending Patterns
- Number Sentences and Variables

* These are the standards in which more of your students scored similarly to NYC students who scored in **Level 1** on this test.

** These are the standards in which more of your students scored similarly to NYC students who scored in **Levels 2 and 3** on this test.

*** These are the standards in which more of your students scored similarly to NYC students who scored in **Level 4** on this test.

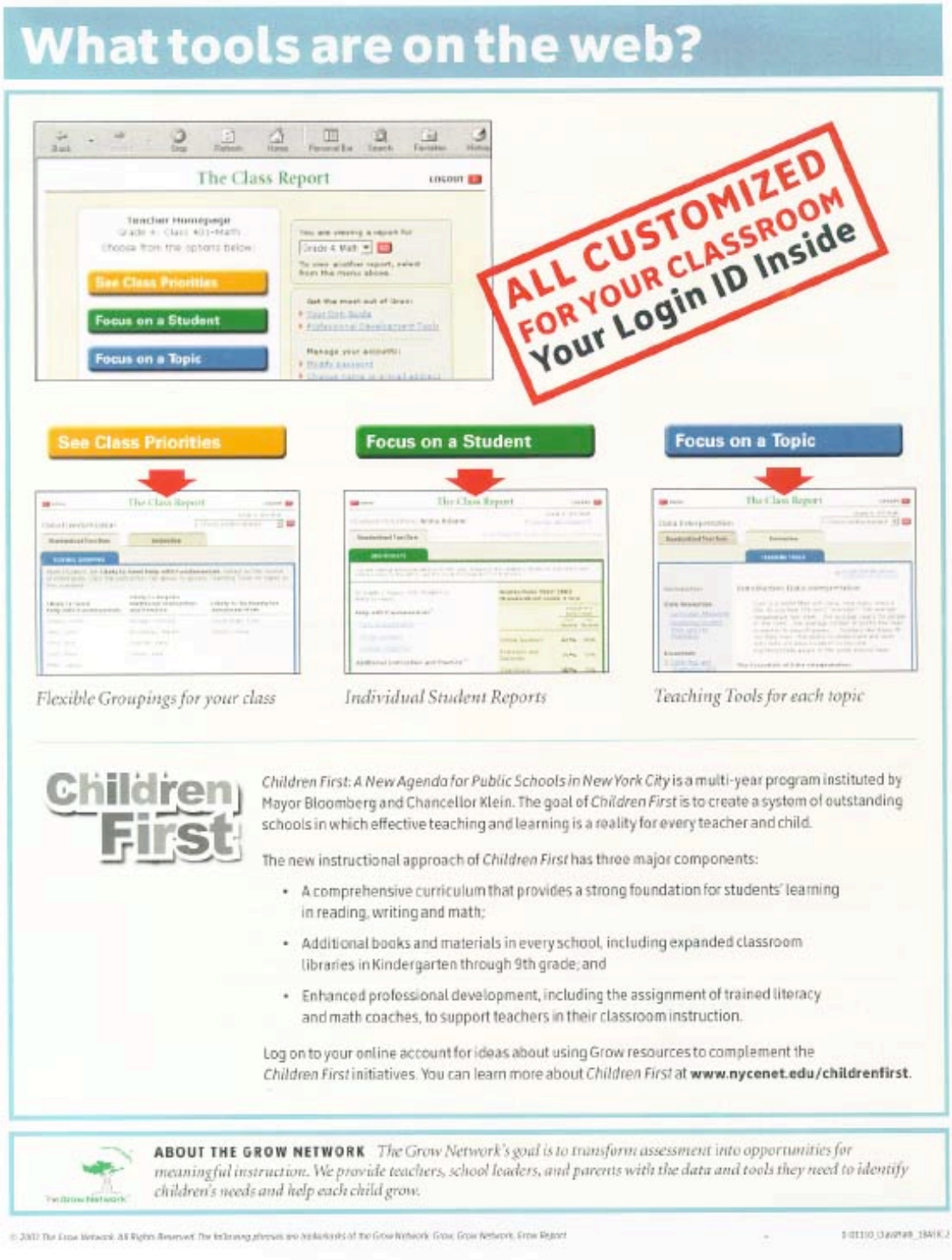
FIND YOUR CUSTOMIZED TOOLS AT www.grownetwork.com

- *Teaching Tools for Each Topic*
- *Individual Student Reports*
- *Flexible Groupings for Differentiated Instruction*
- *Class Roster Updated Throughout the Year*

Your Login ID and Password:

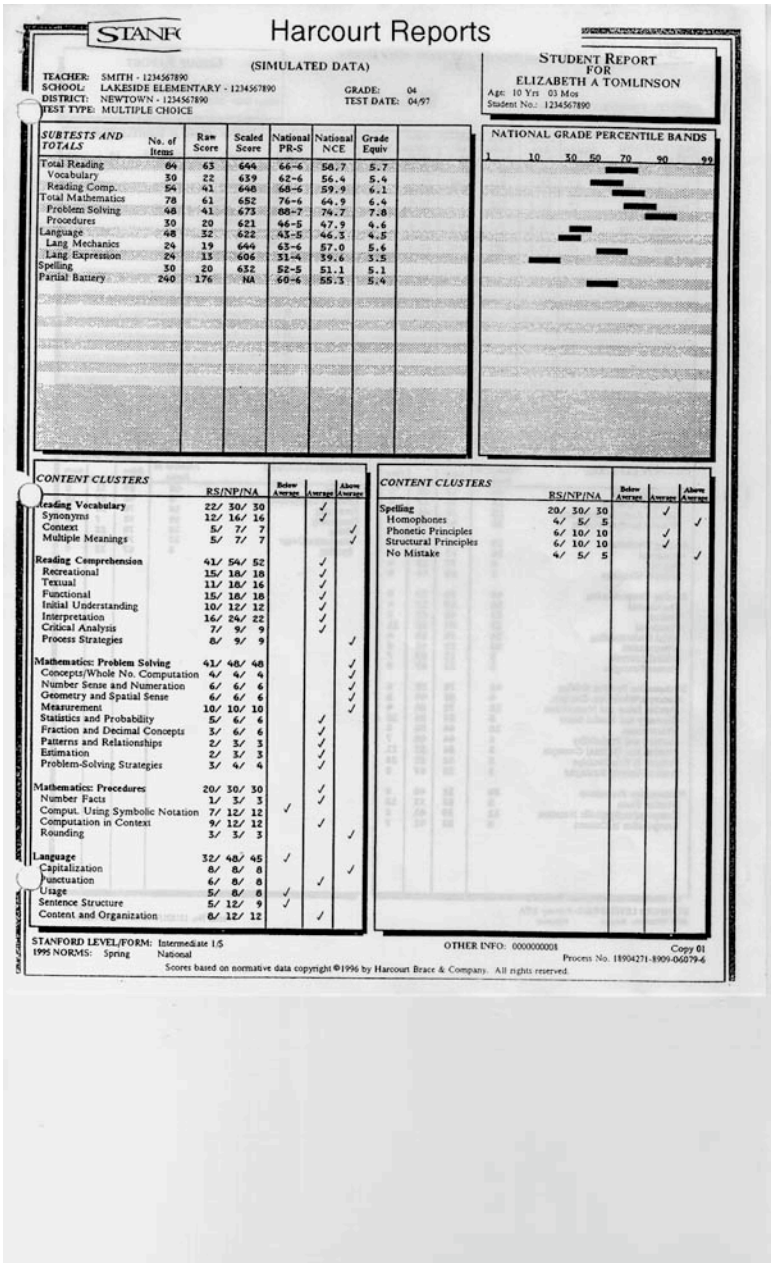
Login ID Sample

Password Sample


What tools are on the web?
The Class Report
LOGOUT
Teacher Homepage
See Class Priorities
Focus on a Student
Focus on a Topic
ALL CUSTOMIZED
FOR YOUR CLASSROOM
Your Login ID Inside
See Class Priorities
Focus on a Student
Focus on a Topic
Flexible Groupings for your class
Individual Student Reports
Teaching Tools for each topic
Children First
Children First: A New Agenda for Public Schools in New York City is a multi-year program instituted by Mayor Bloomberg and Chancellor Klein. The goal of Children First is to create a system of outstanding schools in which effective teaching and learning is a reality for every teacher and child.
The new instructional approach of Children First has three major components:
• A comprehensive curriculum that provides a strong foundation for students' learning in reading, writing and math;
• Additional books and materials in every school, including expanded classroom libraries in Kindergarten through 9th grade; and
• Enhanced professional development, including the assignment of trained literacy and math coaches, to support teachers in their classroom instruction.
Log on to your online account for ideas about using Grow resources to complement the Children First initiatives. You can learn more about Children First at www.nycenet.edu/childrenfirst.
ABOUT THE GROW NETWORK The Grow Network's goal is to transform assessment into opportunities for meaningful instruction. We provide teachers, school leaders, and parents with the data and tools they need to identify children's needs and help each child grow.

Appendix B

Copy of old version of teacher report of test data



STANF Harcourt Reports

(SIMULATED DATA)

TEACHER: SMITH - 1234567890
SCHOOL: LAKESIDE ELEMENTARY - 1234567890
DISTRICT: NEWTOWN - 1234567890
TEST TYPE: MULTIPLE CHOICE
GRADE: 04
TEST DATE: 04/97

STUDENT REPORT FOR ELIZABETH A TOMLINSON
Age: 10 Yrs 03 Mos
Student No.: 1234567890

SUBTESTS AND TOTALS	No. of Items	Raw Score	Scaled Score	National PR-S	National NCE	Grade Equiv
Total Reading	64	43	644	66-6	58.7	5.7
Vocabulary	30	22	639	62-6	56.4	5.4
Reading Comp.	54	41	648	68-6	59.9	6.1
Total Mathematics	78	61	652	76-6	64.9	6.4
Problem Solving	48	41	673	88-7	74.7	7.8
Procedures	30	20	621	46-5	47.9	4.6
Language	48	32	622	43-5	46.3	4.5
Lang Mechanics	24	19	644	63-6	57.0	5.6
Lang Expression	24	13	606	31-4	39.6	3.5
Spelling	30	20	632	52-5	51.1	5.1
Partial Battery	240	176	NA	60-6	55.3	5.4

NATIONAL GRADE PERCENTILE BANDS
1 10 30 50 70 90 99

CONTENT CLUSTERS	RS/NP/NA	Below Average	Average	Above Average
Reading Vocabulary	22/ 30/ 30		✓	
Synonyms	12/ 16/ 16		✓	
Context	5/ 7/ 7			✓
Multiple Meanings	5/ 7/ 7			✓
Reading Comprehension	41/ 54/ 52		✓	
Recreational	15/ 18/ 18		✓	
Textual	11/ 18/ 16		✓	
Functional	15/ 18/ 18		✓	
Initial Understanding	10/ 12/ 12		✓	
Interpretation	16/ 24/ 22		✓	
Critical Analysis	7/ 9/ 9		✓	
Process Strategies	8/ 9/ 9			✓
Mathematics: Problem Solving	41/ 48/ 48			✓
Concepts/Whole No. Computation	4/ 4/ 4			✓
Number Sense and Numeration	6/ 6/ 6			✓
Geometry and Spatial Sense	6/ 6/ 6			✓
Measurement	10/ 10/ 10			✓
Statistics and Probability	5/ 6/ 6		✓	
Fraction and Decimal Concepts	3/ 6/ 6		✓	
Patterns and Relationships	2/ 3/ 3		✓	
Estimation	2/ 3/ 3		✓	
Problem-Solving Strategies	3/ 4/ 4		✓	
Mathematics: Procedures	20/ 30/ 30		✓	
Number Facts	1/ 3/ 3		✓	
Comput. Using Symbolic Notation	7/ 12/ 12	✓		
Computation in Context	9/ 12/ 12		✓	
Rounding	3/ 3/ 3			✓
Language	32/ 48/ 45	✓		
Capitalization	8/ 8/ 8			✓
Punctuation	6/ 8/ 8		✓	
Usage	5/ 8/ 8	✓		
Sentence Structure	5/ 12/ 9	✓		
Content and Organization	8/ 12/ 12		✓	

CONTENT CLUSTERS	RS/NP/NA	Below Average	Average	Above Average
Spelling	20/ 30/ 30		✓	
Homophones	4/ 5/ 5			✓
Phonetic Principles	6/ 10/ 10		✓	
Structural Principles	6/ 10/ 10		✓	
No Mistake	4/ 5/ 5			✓

STANFORD LEVEL/FORM: Intermediate 1/S
1995 NORMS: Spring National
OTHER INFO: 0000000001
Copy 01
Process No. 18904271-8909-06079-6

References

Ackoff, R. L. (1989). From Data to Wisdom. *Journal of Applied Systems Analysis, 16*, 3-9.

Breiter, A. (2003). *Information - Knowledge - Sense-making A theoretical analysis from management / business literature.*Unpublished manuscript, Bremen, Germany.

Choo, C. W. (2002). *Information Management for an Intelligent Organization: The Art of Environmental Scanning. 3rd Edition.* Medford, NJ: Information Today.

Drucker, P. F. (1989). *The New Realities: In Government and Politics/In Economics and Business/In Society and World View*. New York, NY: Harper & Row.

Easton, J. Q., & Luppescu, S. (2004). *Teach and Principal Responses to the Grow Network: A Preliminary Evaluation of Use in Chicago Public Elementary Schools*. Chicago: Consortium on Chicago School Research. Research Data Brief.

Elmore, R., & Abelmann, C. (1999). *When accountability knocks, will anyone answer?* Philadelphia: Center for Policy Research in Education.

Fullan, M. (2000). The Three Stories of Education Reform. *Phi Delta Kappan, 81*(8), 581-584.

Fullan, M. (2001). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.

Grow Network. (2004). *About The Grow Network*. Retrieved April 1, 2004, from http://grownetwork.com/

Heistad, D., & Spicuzza, R. (2003). *Beyond zip code analyses: What good measurement has to offer and how it can enhance the instructional delivery to all students*. Paper presented at the American Educational Research Association, Chicago, IL.

Herman, J., & Gribbons, B. (2001). *Lessons learned in using data to support school inquiry and continuous improvement: Final report to the Stuart Foundation*. Los Angeles: UCLA Center for the Study of Evaluation.

Mitchell, D., & Lee, J. (1998). *Quality school portfolio: Reporting on school goals and student achievement*. Paper presented at the CRESST Conference, Los Angles, CA.

Nonaka, I., & Takeuchi, H. (1995). *The Knowledge Creating Company*. Oxford: Oxford University Press.

Princeton Review. (2002). *Testing the Testers 2002: An Annual Ranking of State Accountability Systems*. Princeton, NJ: Princeton Review.

Salpeter, J. (2004). Data: Mining with a Mission. *Technology and Learning, 24*(8), 30- 37.

Sarmiento, J. (n.d.). *Technology Tools for Analysis of Achievement Data: An Introductory Guide for Educational Leaders*. Retrieved March 7, 2004, from www.temple.edu/lss/

Secada, W. (2001, Spring). From the Director. *Newsletter of the Comprehensive Center-Region VI, 6,* 1-2.

Sharkey, N., & Murnane, R. (2003). *Helping K-12 Educators Learn from Student Assessment Data*. Paper presented at the AERA, Chicago.

Spielvogel, B., Brunner, C., Pasnik, S., Keane, J. T., Friedman, W., Jeffers, L., et al. (2001). *IBM Reinventing Education Grant Partnership Initiative - Individual Site Reports*. New York: EDC/Center for Children and Technology.

Spielvogel, B., & Pasnik, S. (1999). *From the School Room to the State House: Data Warehouse Solutions for Informed Decision-Making in Education.* New York: EDC/Center for Children and Technology.

Sveiby, K. E. (1997). *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*: Berrett Koehler.

Thorn, C. (2002). *Data Use in the Classroom: The Challenges of Implementing Data-based Decision-making at the School Level.* Madison: University of Wisconsin, Wisconsin Center for Education Research.

Wayman, J. C., Stringfield, S., & Yakimowski, M. (2004). *Software Enabling School Improvement throught Analysis of Student Data* (No. 67). Baltimore: Baltimore City Public School System.

Webb, N. (2002). *Assessment Literacy in a Standards-Based Urban Education Setting*. Paper presented at the AERA, New Orleans.