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ABSTRACT

New Hampshire has adopted a standards-based statewide assessment, the New Hampshire Educational Improvement and Assessment Program (NHEIAP), which is designed to measure students' learning against proficiency standards at grades 3, 6, and 10. Because of the difficulty teachers had in interpreting the NHEIAP results, a custom-designed software program, the NHEIAP Data Interpreter, was developed to be a user-friendly, transparent means of examining district- or building-level groups of students. The NHEIAP Data Interpreter is a Windows program that displays the data for various groups in raw form or in frequency charts. The power of the program is in the subtlety with which it can select and compare groups of students, allowing educators to focus on the meaning of the data. Copies of the program on CD-ROM are available from the paper's authors. A sample NHEIAP mathematics problem is attached. (Contains six tables.) (SLD)

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# Helping Teachers Interpret Item-Level Data: The New Hampshire Statewide Assessment

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## Abstract

This paper is designed to accompany a technology-based roundtable at AERA (Montreal, 1999). The session demonstrates an original software program designed to help teachers, administrators, and other education policy-makers understand the item-level data provided by the NH Statewide Assessment (NHEIAP). This standards-based and mixed-format assessment is administered to all students in New Hampshire at the end of Grades 3, 6, and 10. The program includes data from each grade-level group (n=13,000 to 16,000). The NHEIAP Data Interpreter, a custom-designed software program, provides a user-friendly transparent means of examining district and/or building level groups of students. Copies of the program are available at minimal cost from the authors.

## Introduction

Like many states, New Hampshire adopted a standards-based state-wide assessment in this decade. The New Hampshire Educational Improvement and Assessment Program (NHEIAP) resulted in the composition of K-12 curriculum frameworks in four core academic content areas, mathematics, English language arts, science and social studies. The new state-wide assessment was designed to measure students' learning against proficiency standards at three tested grade levels (3, 6 & 10). The assessment included multiple choice items and open-response items (and additionally a longer writing sample as part of the English language arts assessment). The purported goal of the state-wide assessment was to help schools and districts improve student learning relative to the standards. Four score levels were defined: Novice, Basic, Proficient and Advanced with cut-points being determined primarily on the basis of performance on the open-ended items.

Despite this goal of helping school districts move local curriculum into alignment with the standards in the *Curriculum Frameworks*, a number of problems presented barriers to accomplishing this goal. First, New Hampshire had a sporadic history of state-wide assessment. Up to the present year (1999) 90% of school funding was derived from local property taxes and consequently there were highly variable levels of school finances since communities in New Hampshire range from very affluent small towns/suburbia in the southern tier of the state (near Massachusetts) to very small poor rural northern locales (near Vermont and Maine).

A second problem was that past state-wide assessment tended to be nationally normed achievement tests (e.g., the California Achievement Test or the Stanford). On such measures, (as well as on the SAT), New Hampshire students did very well. Since the majority of these students are relatively affluent and white, such a standing is easily understood. However, in many districts, these scores promoted the notion that NH schools were functioning well.

The third problem with meeting the goal of school improvement arose when the first assessment was administered (the first assessment was administered in 1995 to Grade 3 only). The *Curriculum Frameworks* had limited distribution at that point and the format of the test (especially the open-ended items) was unfamiliar, at best, to NH educators. As a consequence, scores on these first NHEIAP's were fairly low with a majority of students at the Basic and Novice levels in many districts and buildings. The poor scores were widely disseminated through the media (including the well-known *Union Leader* newspaper). The low scores, as well as the publicity, seemed to create a negative response among educators to the entire assessment and slow the reform efforts the assessment was to promote.

The final problem that interfered with the use of the state-wide assessment data being used to reform curriculum and instruction was the form in which data were sent back to local districts. Hard copies of students' responses to various items and state-wide percent correct were the most understandable forms, but this required arduous amounts of time to translate into meaningful guides for actions. Because of these problems, the NHEIAP Data Interpreter was developed. This custom-made software program allows decision-makers at the district and building levels to quickly identify those items (and the related standards) where local curricula and instructional practices are working well, needing minor attention and needing major improvement (such as curricular alignment).

## The NHEIAP Data Interpreter

The NHEIAP Interpreter is an IBM/PC Windows program, which displays NHEIAP data from various groups of New Hampshire students. Data can be displayed in raw form (for individual students) or shown in frequency charts to show the percentage of students giving each possible response to any desired question. The real power of the program lies in the subtlety with which it can select and compare different groups of students. Selection is a three-tier process. Initially the operator specifies a demographic group, including the grade tested and the year, followed by the district and/or school. The user can choose one school or all the schools in one district. It is also possible to choose all districts in NH, but this requires a fairly lengthy time to compile as there are approximately 13,000 to 16,000 student represented. The sample is now well enough defined that the user can choose either a raw data box ("Show Data') or an analysis box ("Analyze Data"), showing data or percentages for the entire sample.

After choosing the analysis box, the user must define two more parameters: content area (mathematics, English language arts, science or social studies) and format (multiple choice). Table 1 displays the initial results for the analysis box having chosen math multiple choice in Monadnock Regional High School. All the results in this paper are from the 1998 Grade 10 cohort at Monadnock, which is located in the southwest corner of New Hampshire. The school enrolls approximately 1300 students in Grades 7-12. The school district is primarily rural, in the top 1/3 of NH districts for educational need indices (e.g. free lunch eligibility), with the largest proportion of adults employed in blue

collar jobs. The first author recently spent 2 hours with the curriculum leaders at the school to explore the meaning of data generated by the Interpreter.

Table 1 – Math Multiple Choice – Monadnock Regional High School – all students (n=178)

| Item | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % + | 56 | 78 | 34 | 69 | 81 | 58 | 68 | 64 | 43 | 46 | 32 | 38 | 76 | 69 | 68 | 50 | 58 | 86 | 65 | 47 | 36 | 81 | 63 | 59 |
| % A | 11 | 1 | 5 | 0 | 13 | 0 | 11 | 0 | 5 | 10 | 0 | 8 | 0 | 13 | 2 | 12 | 13 | 0 | 0 | 5 | 24 | 2 | 31 | 1 |
| % B | 5 | 14 | 45 | 10 | 0 | 6 | 9 | 23 | 30 | 12 | 3 | 49 | 0 | 0 | 23 | 14 | 0 | 6 | 12 | 38 | 26 | 3 | 0 | 5 |
| % C | 0 | 5 | 0 | 9 | 3 | 31 | 10 | 10 | 19 | 0 | 60 | 0 | 22 | 14 | 0 | 0 | 13 | 2 | 17 | 0 | 11 | 0 | 2 | 0 |
| % D | 25 | 0 | 14 | 11 | 1 | 3 | 0 | 1 | 0 | 31 | 3 | 4 | 0 | 2 | 4 | 22 | 13 | 5 | 3 | 8 | 0 | 12 | 1 | 33 |

Above this table are options for further disaggregation of various student groups. The first options allow the selection of students at one or more score level. For example a user might choose only the "novice" students or he might combine "proficient" and "advanced" level students. (We typically recommend that combination since there are very few advanced students in any building/ district group.) The second set of options appears on the second line below the score level options. This line allow separation of students with and without disabilities ("coded" or "non-coded"). These options can also be mixed with the score level options – for example "novices who are coded" as opposed to "basic who are coded." By checking the appropriate boxes (and then "redisplaying'), the item results are quickly displayed.

The open-ended items on the NHEIAP are scored on a four-point scale using item-specific rubrics which are released with the items. Table 2 displays the results for the same building group in mathematics on the four open-response items.

Table 2 – Math Open-Response Items - Monadnock Regional High School - all students (N=178)

| Item | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| % 0 | 40 | 10 | 12 | 6 |
| % 1 point | 24 | 43 | 58 | 24 |
| % 2 points | 26 | 30 | 19 | 37 |
| % 3 points | 1 | 3 | 7 | 25 |
| % 4 points | 4 | 8 | 1 | 5 |

As with the multiple choice items the same disaggregation options are available.

## Changing Curriculum and Instruction

Once the user has chosen the sub-groups for analysis, (s)he can examine the behavior of these students to ascertain areas of positive practice, areas needing minor change and those needing major curriculum efforts. The first way to do this is by identifying items in three difficulty-based groups: [1] "floor" items where 80% or more of the specified group answers correctly or 3-4 points on the open-ended items; [2] "ceiling" items where less than 40% of the specified group answer correctly or 80% scored less than 2 on the open-ended items; and [3] items in the group's "zone of proximal development," those where the percent correct ranges between 40-80% (or the majority of students score 2-3 on the open-ended items). The use of the Vygotskian term of proximal development reinforces the idea that instruction should be grounded in what the group already can do (the floor items representing those skills) and should provide scaffolding until the group finds the skills represented in the zone to be "easy." Those skills represented by the ceiling items usually reflect areas where curricular decisions must be addressed as well. An interesting example of such a item was found in math at the Monadnock Regional High School.

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Table 3 – Sample ceiling item – Monadnock Regional High School (N=178)

#23. Jon wants his friends to guess what coins he has in his pockets. He gives them some clues:

He has 10 coins.
The coins are worth $1.60.
He has some nickels, some dimes and some quarters.

Al guesses that the coins are five quarters, three dimes, and one nickel. Al's guess is wrong because:

a. the value is less than $1.60.
b. the value is more than $1.60.
c. he used more than 10 coins
d. he used less than 10 coins

Results of sub-groups
Math Item 23

| | Whole Group | Novice | Basic | Proficient | Advanced * | "Coded" * |
|---|---|---|---|---|---|---|
| N | 178 | 76 | 68 | 29 | 5 | 2 |
| | | | | | | |
| + | 11 | 5 | 6 | 27 | 60 | 0 |
| A | 53 | 64 | 53 | 34 | 21 | 0 |
| B | 18 | 16 | 22 | 17 | 0 | 100 |
| C | 15 | 13 | 17 | 17 | 20 | 0 |
| D | 0 | 0 | 0 | 0 | 0 | 0 |

- Group too small to be reliable indicator.

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As a result of this pattern, the mathematics department discovered there were few opportunities in Monadnock's 7-10 curriculum to address such "logic" problems. The

math curriculum for lower level students tended to emphasize computation. The algebra/geometry cycle began for upper level students in Grade 8 and was fairly traditional in its focus.

Another problem in Monadnock's math curriculum was visible from the performance of subgroups on the open-ended items. Open-ended item 1 (labeled #18 in the attached sheet) required students to find the area of a isosceles triangle, draw a triangle of the same area that was not congruent with the first, and then find the area of another right triangle. All elements required the student to explain his work. This item shows a dramatically different scores for the students at the four basic score levels.

Table 4 – Open-Ended Math Item 1 (Item is attached at the end of this paper.)

| | Whole Group | Novice | Basic | Proficient | Advanced | "Coded" |
|---|---|---|---|---|---|---|
| N | 178 | 76 | 68 | 29 | 5 | 2 |
| | | | | | | |
| 0 pt. | 40 | 28 | 69 | 10 | 0 | 100 |
| 1 | 24 | 36 | 14 | 17 | 20 | 0 |
| 2 | 26 | 30 | 11 | 48 | 40 | 0 |
| 3 | 1 | 0 | 0 | 3 | 20 | 0 |
| 4 | 4 | 1 | 0 | 20 | 20 | 0 |

As can be seen by these data, students at the "proficient" level did far better at accurately completing the three tasks (represented by 2-3 point scores) and explaining their work (3-4 points).

Dramatic differences between score groups can also provide information about areas where curricular changes are needed. A good example of such an item appeared in the English Language Arts items for Monadnock:

Table 5 – English Language Arts Item 15

15. (Referring to a passage on biological classification schemes) What was the main problem with Aristotle's classification system?

a. He divided organisms into plants and animals.
b. He used the term "species" to mean similar life forms.
c. He chose to base his system on natural habitats. (Correct response)
d. He focused on similarities and differences in grouping organisms.

Sub-group responses

| | Whole Group | Novice | Basic | Proficient | Advanced | "Coded" |
|---|---|---|---|---|---|---|
| N | 178 | 55 | 116 | 6 | 2 | 2 |
| | | | | | | |
| + | 54 | 30 | 64 | 66 | 100 | 50 |
| A | 17 | 23 | 18 | 0 | 0 | 50 |
| B | 11 | 18 | 8 | 16 | 0 | 0 |
| C | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 15 | 27 | 10 | 16 | 0 | 0 |

In this case, English and science teachers agreed that lower track students were required to read far less non-fiction (in both science and English) than were their higher level peers. This lead to questions about reading across the curriculum and content area teachers' responsibilities for reading skills.

A final method of identifying areas for improvement through the Data Interpreter is through examination of error patterns. With a "guessing" pattern, equivalent percentages of the group choose 2-3 options which usually indicates need for curriculum alignment With "distractor pulls," large proportion of students choose 1 incorrect response. This usually indicates "naive understanding" and a need for more instructional time allocated to the standard associated with the item. A very interesting item with both a strong difference between groups and distractor pull error pattern appeared in the Social Studies Multiple Choice items in Monadnock.

Table 6 – Social Studies Item 5

A leader of the Russian Revolution who became the first head of the Soviet Union was

a. Gorbachev
b. Nicholas II
c. Lenin (Correct response)
d. Trotsky

Sub-group responses

| | Whole Group | Novice | Basic | Proficient | Advanced | "Coded" |
|---|---|---|---|---|---|---|
| N | 178 | 110 | 44 | 22 | 2 | 2 |
| | | | | | | |
| + | 14 | 6 | 15 | 45 | 100 | 0 |
| A | 56 | 68 | 59 | 40 | 0 | 50 |
| B | 0 | 11 | 6 | 0 | 0 | 50 |
| C | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 19 | 21 | 15 | 13 | 0 | 0 |

Again, the pattern here was explained by the differentiated social studies curriculum for upper and lower track students wherein the higher track students (where the majority were "proficient") were taught World History before the 10th grade assessment was administered.

## Conclusions

As can be seen from these examples, user-friendly high-level computer software can lessen the tedium of appropriate data analysis. The NHEIAP Interpreter program is transparent for most users. Its interface is simple and straightforward so the "computer literacy" demands are virtually nonexistent. The program allows educators to focus on the meaning of the data, rather than grappling with the computer to yield meaningful data. It is provided at no cost to NH school districts, while many commercial programs

are very expensive and oriented toward the needs and expertise of measurement professionals. These more sophisticated programs do not necessarily provide the information that many districts need to examine their curriculum against the data the statewide assessment provides as the Data Interpreter does. Use of the program in New Hampshire has been very successful. Many districts have used the interpreter to identify strengths and weaknesses in their own instructional programs. Because of the radically different financial needs in New Hampshire districts where 90% of school funding is based on local property taxes, poorer districts have little to no capacity within them to fund such a state-of-the-art computer program. The ease of use has also been a boon to these districts where there is not much of a technology base, either in hardware or in expertise.

Finally, the Interpreter illustrates how very simple, intuitively obvious, data analysis can be extremely powerful for educators seeking to analyze their local curriculum. Classroom teachers can examine what are the likely skills of a group dominated by 1-2 score levels; principals can examine the differences between cohorts within their buildings and district administrators can focus staff development and curriculum alignment efforts more precisely by use of the Interpreter.

Copies of the CD-ROM and documentation are available for $5.00 by contacting the authors of this paper:

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Helping Teachers
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Answer open-response questions 18 and 19. Be sure to

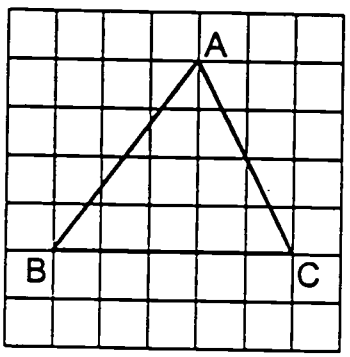
- show all your work, including diagrams, tables, and computations. If you do some of the work in your head, explain how you did your work with words or equations.
- answer ALL parts of each question and label them appropriately. (Some questions have more than one part, labeled a., b., c., etc.)
- make sure your answers are clear. If necessary, circle your final answers to set them off from other computations or words.

YOU MAY NOT USE A CALCULATOR ON THIS PART OF THE MATHEMATICS TEST.

CURRICULUM GOAL 4

STATE AVERAGE SCORE: 1.1

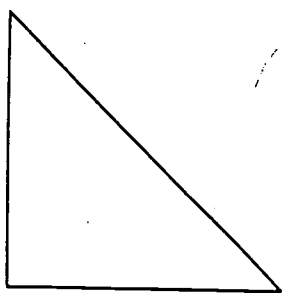
*Use the grid below to answer question 18.*




18. a. If the shaded square has an area of one square unit, what is the area of triangle ABC?

b. On the grid provided in your Student Response Booklet, draw another triangle that is not congruent to triangle ABC, but has the same area. Explain how you know the areas are the same.

c. The hypotenuse of the isosceles right triangle below has a length of 4 units. What is the area of that triangle? Show your work.



BE SURE TO LABEL YOUR RESPONSES (a), (b), AND (c).

Open-Ended Math Item #1
1998 NHEIAP - Grade 10

TM029852

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