

**Start with the Individual, not the mean.**

**Student Error Patterns are Very Personal.**

In the “Model Overview” paper, this statement was made about individualizing student error patterns:

Good assessment identifies the very personal individual disconnect between instruction and learning. The assessment system diagnoses the specific, personal error pattern of each individual. These personal error patterns exist because not all students learn alike.

The purpose of this paper is to provide empirical evidence that each individual does indeed have a “specific, personal error pattern” in math.

The table below shows the math error the “specific, personal” error patterns for 23 students in one fourth grade class.

	Highest Need	Second highest	Third	Fourth	Fifth	Sixth	Seventh
Group Mean	C03	A02	E02	C06	E03	D02	C01
Student 1	E03	A01	E02	C02	C05	C06	D01
Student 2	A02	C03	D02	E02	E03	C01	C02
Student 3	E02	C06	D02	A02	E01	E03	C02
Student 4	A02	D01	E03	C04	E02	C03	C05
Student 5	C01	C06	A02	E01	E02	C03	D02
Student 6	E02	C02	C04	C05	C06	D01	D02
Student 7	C03	R04	D02	A02	E03	C01	C02
Student 8	C06	D01	C03	C04	G01	A02	E02
Student 9	A02	C02	C03	C06	C01	D01	D02
Student 10	A02	C01	E03	C03	C06	D02	E01
Student 11	C01	A02	C03	C06	E02	G01	G02
Student 12	C06	D02	A02	E02	E03	C01	C04
Student 13	E02	C03	C06	A02	E03	C01	C04
Student 14	A02	E03	C02	C04	D04	R04	C04
Student 15	A02	C02	C06	E03	E02	C03	C05
Student 16	C03	A02	E02	E03	C04	C05	D01
Student 17	A02	C03	E02	D02	E03	E01	C01
Student 18	E02	D01	C03	G01	A02	E01	C01
Student 19	D02	E02	A02	E03	E05	C01	C02
Student 20	C03	E03	C06	D01	E01	E02	C01
Student 21	E03	E02	G01	R04	A02	C01	C05
Student 22	C02	E02	G01	R04	A02	C01	C05
Student 23	D02	C03	E01	E02	E03	D03	C05

First, let your eyes scan across the seven top error categories for each of the 23 students. No matter how you try to sort them, no two students have exactly the same error pattern. In fact, no two students have exactly the same seven top errors.

Individual instruction is difficult. What if the teacher declares, “I’ll take just a little time away from teaching the new curriculum to address at least the highest need category.” The top line of the table shows this is error category C03 Decimal is in the wrong place or one digit of could have easily been identified as incorrect. As it turns out, while C03 has the highest actual need, only three of the twenty-three students have C03 as THEIR highest need.

So what if the teachers say, “Well, I can cover the top two.” That would C03 plus A02 Error connecting a short verbal description of a relationship to its number sentence. For those highest two error categories, eight students will actually have C03 or A02 as one of their highest two. The table below shows the percent of errors covered

	Highest Need	Second highest	Third	Fourth	Fifth	Sixth	Seventh
Group Mean	C03	A02	E02	C06	E03	D02	C01
% of student errors covered	13	35	48	53	63	64	66

In English-Language Arts, the picture is about the same. Here is the pattern from a typical sixth grade class.

	Highest Need	Second highest	Third	Fourth	Fifth	Sixth	Seventh
Group mean	E17	E01	E05	E14	E03	E04	E26
Student 1	E05	E06	E24	E01	E03	E06	E14
Student 2	E01	E05	E25	E04	E14	E17	E14
Student 3	E01	E17	E03	E14	E04	E24	E25
Student 4	E01	E17	E14	E05	E26	E03	E04
Student 5	E05	E06	E03	E07	E14	E17	E19
Student 6	E03	E17	E14	E05	E06	E07	E12
Student 7	E26	E03	E05	E17	E01	E04	E06
Student 8	E17	E01	E14	E05	E04	E06	E11
Student 9	E17	E05	E03	E14	E25	E26	E11
Student 10	E01	E05	E17	E14	E03	E08	E11
Student 11	E04	E01	E03	E05	E17	E22	E06
Student 12	E01	E17	E04	E05	E19	E06	E14

	Highest Need	Second highest	Third	Fourth	Fifth	Sixth	Seventh
Group Mean	E17	E01	E05	E14	E03	E04	E26
% of Student errors	17	54	56	69	75	75	73

The group's greatest average need is E17 which was the highest personal error for only two of the students.

If the teacher had taken time to cover the group's highest three errors, then 56% of the 12 students' top three needs would have been addressed.

Those were just two examples. For four different districts, grades 3 to 8, from 2006 to 2011, here is a summary of coverage for ELA and Math.

% of Students	Highest Need	Second highest	Third	Fourth	Fifth	Sixth	Seventh
ELA	38	50	60	66	70	72	73
MATH	28	42	53	59	61	62	63

The table shows a little more personal variation among the 26 math error categories than among the 27 ELA error categories. The table shows that covering the top three would address just over half of the student error categories.

Why wouldn't the teacher just stop all instruction and take the time to cover all seven top categories? Think back to the two middle categories of levels of schooling.

The curriculum provides the basis for instructional planning. The teacher is expected to present to the students material which covers all of that grade's part of the overall curriculum,

Learning by the student. As instruction goes on, the teacher uses locally-developed measures to try to find out the extent to which the teaching has taken root as learning by the student.

The school year is fixed. The number of minutes of instruction is fixed.

The curriculum is fixed. The teacher is expected to assign all those minutes to the units of instruction so that, by the end of the year, the entire curriculum had been taught to the best of that teacher's ability. The author's personal experience is that teachers take that responsibility to cover the entire curriculum very seriously.

That is why error baggage exists

To expect "mastery learning" when the time available is limited is oxymoronic. Inevitably, when the teacher gives that last unit test, two outcomes can be expected.

- First, the level of learning will have a range. Not everyone will master everything.
- Second, the highest performer may have stumbled on the least challenging concept; the lowest performer overall may have easily mastered the most difficult concept. Each student will have a unique pattern of what she or he did not fully learn.

A popular psychometric technique, Rasch Analysis, has guided many people to a misunderstanding regarding the uniqueness of student error patterns. Rasch analysis, and many other models, assume that a low performer will have a 50:50 chance of getting very easy items correct. For a higher performer, the stakes are raised. The higher performer

has a 50:50 chance of getting a very difficult item right. The rules apply further: that low performer would be viewed as having much less than a 50% chance on a hard item while the high performer would be viewed as having much MORE than a 50% probability of getting the easy item right.

These data show that individual error patterns do not work that way. The individual error patterns are idiosyncratic. If the Rasch assumption strictly applied, then the difference among group data for classroom groups would depend only on average “ability” (a Rasch term and remarkably poor choice of terms for a system that measure performance, not ability) of the average student. After average performance is built in, the order of error categories should be the same for all groups if the Rasch assumption were strictly true.

That is why this article’s title reads, “Start with the individual, not the average.” The data shows the rareness of a student’s error pattern matching the group’s error pattern exactly. Look again at those two typical classroom examples, one in math and one in ELA. The student patterns are generally not consistent with the group’s pattern.

That concept of “individual first” also applies to student performance reporting.