



the fish question

When Math Is Required Reading

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On the first day of school, Nigel tells me that he is good at math. It's his favorite subject. Nigel is a good-looking young man with a round, almost chubby face that will probably thin out as puberty overtakes him. He is sitting straight in his seat in a way that makes me think of parochial schools. When he addresses me, his mouth widens in an enormous, tooth-filled smile as if he is angling to win me over. I can't help but wonder if he tells the English teacher the same thing. It turns out he's a little rusty from taking the summer off, but his computation skills are promising if not quite solid. On Thursday, he is handed the following word problem:

The Fish Question

I like to swim. It is my favorite form of exercise. This morning while I was swimming, it occurred to me that I swim a lot, but I never get anywhere. What if, instead of swimming back and forth doing laps, I swam the same distance in a straight line?

Now, the pool that I swim in isn't Olympic size. You have to swim 72 lengths of the pool to go one mile. I usually swim about 32 before I poop out. I swim an average of three times a week. At that rate, how long would it take me to swim to France?

Now, I know that I can't really swim to France in a pool, but I'm wondering how long it would take me to swim the distance it is from here to France. According to my atlas, the distance from Boston to the closest French beach is 3 and 3/4 inches. Boy, France is really close! I know, I know, it is a really bad joke. The distance on the map is obviously drawn to scale. The scale is that 1 inch on the map is the same as 960 miles.

Do not write on this page. Please explain your reasoning clearly and include all calculations on a separate sheet of paper. You may use a calculator if it helps (it may not), but you still need to walk me through all of the steps. Also, make sure you exercise regularly, eat your veggies, and floss your teeth (although none of these are necessary for this word problem).

I explain to the class that the goals of such word problems are threefold. First, I want them to be able to separate the wheat from the chaff, to extract the information relevant to solving the problem. Start by figuring out what the question is actually asking, then what is needed to answer that question. The second goal is to provide a chance to do some good problem solving. The road to a solution should not be obvious, is likely to involve multiple steps, and may require trying a number of strategies. Finally, I am interested in how *well-written* the response is. A good mathematician is able to explain his or her thinking clearly in words.

In fact, “The Fish Question” is not the best example of this genre. I usually open with it because it has a concrete answer and because I’m sentimental. It was one of the first word problems I wrote.

When I collect the homework the next day, several students have scrawled calculations on the bottom of the handout. I hand those back immediately. Nigel however has stapled his answer on a separate sheet. The full page of notebook paper has a proper heading: name, date, and subject. Underneath the heading he has written four question marks.

EXOATMOSPHERIC KILL VEHICLES

It is only partly a joke that I communicate to my classes by memo. They are subjected to idiosyncratic instructions, bad jokes, and constant reminders to maintain proper oral hygiene. While I’m sure there is some demarcation separating a language-rich environment from simply drowning in paper, I always have trouble seeing the line. I have begun to hand out fill-in-the-blank forms with my math problems in an effort to elicit longer responses. They have helped Nigel a little. Most weeks, I get reasonable answers to the questions that ask for concrete information, but little or nothing on the back where Nigel is supposed to explain his thinking or answer the question. When we discuss the solutions in class, he listens attentively and always says something like—*Oh, now I get it*. Maybe he does.

This week’s problem includes footnotes:

Rating Rates

Two items in the newspaper caught my attention recently. One, from an article on boredom, provided the interesting fact that “when Heinz ketchup leaves the bottle it travels at a rate of 25 miles per year.”¹ The other was from an editorial in a monthly intellectual paper I get, which included a

report on the recent test of an “Exoatmospheric Kill Vehicle,” a small missile designed to shoot down enemy missiles, which missed its target by six seconds.² The vehicle travels at 15,000 mph.

This question has two parts. Please do both.

- 1) How much faster is the missile than the ketchup?
- 2) How many miles did the missile miss its target by?

1. “Word for Word/Boredom.” *The New York Times* (Feb. 20, 2000).

2. Harris, Bob. “Defense Goes Ballistic.” *Funny Times* (Feb. 2000).

There are several problems with Nigel’s response. To begin with, he has only answered the first question. He provides the solution: 14, 975. As an explanation he writes: “I subtracted.” I ask him to sit down and go over the problem with me. “So, I see that you subtracted. Why those two numbers?”

“Those were the only two numbers in the problem.” OK. I point out that both of those numbers are rates, and we note that one is measured in years, the other in hours. Nigel looks thoughtful, but doesn’t immediately respond. Finally he looks up.

“So, should I have multiplied?”

REAL WRITERS AND POLENTA

Nigel ends up in my creative writing elective. I don’t like teaching electives. The only one I’ve taught that worked well was one on kite construction, and even then most of the kites fell apart when we tried to fly them. As a faculty we decided that the electives this term will be more academic. Since I am enrolled in a graduate program for writing, I volunteered to do a little seminar on my craft.

There are six students—two of whom are angry because they wanted the drama elective. I start by sharing a little bit about myself as a writer. I bring in my journal. I show them the doodles, the sloppy writing, talk a little bit about the topics I choose. Class time will be devoted to composing, revising, conferencing with a partner, and workshopping our pieces—all things real writers do. Then I hand out the so-called rules:

- All writing must emerge from your own personal experience. It may evolve from there, but it must be grounded in what you know.
- Poems may not rhyme. Rhyming is too easy to do poorly, very difficult to do well.
- You may not write poems about the following topics: rainbows, sunsets, the glories of nature, or puppy dogs. Poems about cats are acceptable.

Although I get the most complaints about the rhyming and the content restrictions, the first rule proves to be the most challenging for them and ethically questionable for me. Encouraging students to see themselves as writers is different than asking them to think like a scientist or an historian. I'm not sure I have the right to ask them to write something personal, but I can't stomach reading the fluff they produce when they don't. So I go for pushing the students to write about their real concerns.

Five of the students write about dating. Four of those ignore Rule Two and produce cute rhymes of iambic pentameter: easy to write, fast to read, and nothing memorable. The fifth dating poem has an angry edge that could be developed into something interesting. Nigel's poem is about a trip to Florida. The first stanza sounds like the opening paragraph of an essay that might have the title "What I did on my Summer Vacation." The second stanza, however, is full of short bursts of interesting images and sounds. He agrees to work some on the poem at home and workshop it next week.

His response to the next word problem is, unfortunately, more poetical than mathematical. We were up to The Polenta Problem, from the absolutely true adventures of Mr. Goldman series:

Still Life with Math

This is another true story. I was trying to cook some polenta. I copied the list of ingredients below. The recipe comes from a cookbook by Mollie Katzen called *Still Life with Menu*.¹ As you can tell, the recipe book calls for 1 1/4 cups of cornmeal. I poured the cornmeal into the measuring cup and I only had a one cup's worth. I still wanted to make polenta. It is a yucky winter night and so I am not going out to buy more cornmeal. I am bound and determined to make polenta with only a cup of cornmeal. How much of the other ingredients will I need to make sure that it comes out edible?

INGREDIENTS

3 1/2 cups of water
 1 1/4 cups of coarse cornmeal
 3/4 teaspoon salt
 1 1/4 cups (packed) grated provolone or fontina (optional)

DIRECTIONS

- 1) Place 2 1/2 cups of water in a medium-sized saucepan and bring to a boil. Meanwhile, combine the remaining cup of what with the cornmeal and salt in a small bowl.
- 2) Add the wet cornmeal to the boiling water, whisking constantly.
- 3) Cook over medium heat, stirring frequently, for 5 minutes, or until thick and smooth.
- 4) Stir in the cheese, if desired, and remove from heat.

1. Katzen, Mollie. *Still Life with Menu*. Berkeley, Cal.: Ten Speed Press, 1988.

This time Nigel didn't bother to fill out the form except for writing his name and the date. Under important information, he writes: "I don't know what polenta is."

"Polenta is cornmeal, Nigel," I explain when we meet to go over his homework. "Tell me why you needed to know that in order to do the problem."

Nigel proceeds through a small litany of gestures. He shrugs, he looks at the floor, he breathes out forcefully, then drops his arms to his side in defeat. "I never know where to start with these things."

We discuss strategies. I give him a highlighter, and he marks the key points as he reads. I have him circle the question and tell me what we are looking for in his own words. In his notebook I have him write a list of possible approaches that he can try when he has no idea of where to begin. As I watch him struggle to decode the list of ingredients, I have the sinking feeling that none of what I offer him will be much help. Nigel tells me his last teacher gave him a list of key words, and he could do all of *her* word problems fine. If the word "difference" appeared in the problem, he knew to subtract. If it said "more," he added. It was like a code, he says. Lots of textbook problems can be solved that way, I thought to myself, yet few real world questions are answered by deciding which of the four operations to apply to the numbers given.

HONEST ADVOCACY 101

I have now finished writing recommendation letters for my students. These one-page summaries are incredibly tricky undertakings. The competition to get into the seventh grade programs they are applying to is unbelievably fierce—often there are only one or two slots available. The schools know me by name, so I have to be honest to maintain any sense of credibility, but I also know that if I include anything that makes the students sound less than ideal that I have nixed their chances. So I go for honest advocacy. I like my students, or at least I try to like most of them, and I can usually find something about each of them that makes me feel comfortable recommending them.

In the special language of schools, words tend to lose their opposites. Students can be *smart*, but never *dumb*; *inquisitive* but not *dull*; *friendly* but not *mean*. I have lots of students who work *hard*, but not one who is *lazy*. Many find certain specific parts of the curriculum *challenging*, but they all are making *good progress*. Nothing is ever difficult, although sometimes students are still *developing a skill*.

I go through several drafts of Nigel's math recommendation. He has performed well on his problem sets, and his scores on tests and quizzes have all been in the top third of the class. Yet I know from the projects and the word problems that there is likely a serious issue with his ability to work abstractly. How well he will do when he leaves me will depend on what kind of a teacher he has next.

I focus on his work ethic:

Nigel is consistently well-prepared for class and responsible about his assignments. This steady approach works well for him because it gives him the practice he needs, and the time to develop his skills.

I talk a little about his test scores and how they correlate well with the results of the standardized testing. I can't, however, ignore the conceptual issues. I hypothesize that they are developmental.

Nigel is just beginning to make the leap to more abstract reasoning. He still is more comfortable with concrete, computation-oriented assignments, but he is learning to express his thinking more clearly.

I stare at the letter a long time. I've talked about his social skills, how well he has adapted to being in a new school this year. There are a few lines about the quality of his participation in class. But there is still something missing....

One student is absent, so there are only six of us gathered around the table when we workshop Nigel's poem. Everyone listens respectfully—writing workshops are serious business. Nigel takes an audible breath, and then reads his poem so quickly he sounds like he was recorded at the wrong speed. No pauses between words, at the ends of lines, not the slightest airhole between stanzas. If I had not already read the poem several times, I would have no idea what he is saying. I ask him to read it again, more slowly. Nigel nods gravely, composes himself for a moment, and then reads it again at the same speed, maybe even faster. From the look on Nigel's face it is clear that he is not up for a third go-round.

"Would you like someone else to read it for you?" I ask.

Nigel nods. "*You.*"

So I read the poem. The compliment round is unusually enthusiastic. Everyone really likes the way Nigel has portrayed the sounds of the beach and the go-carts and the miniature golf. We spend almost the whole period discussing how to convey noises in a poem. Nigel doesn't say much. He looks a little embarrassed by the attention, but he is smiling.

I append one final paragraph to my math recommendation.

Nigel is in my creative writing elective and was the only student willing to share his poem at a school-wide assembly at the end of the term. I was impressed by Nigel's willingness to revise the piece several times and incorporate criticism. It was a remarkable poem in its attention to details and the sophistication of its imagery.

Using abstract imagery in a poem is not the same as being able to work on a conceptual level in math. They are arguably separate intelligences. Word problems muddy those waters because they require both mathematical and verbal skills. Nigel suffered through the final term of my word problems without any appreciable improvement, but there was one substantial difference. While he never learned to appreciate the genre, after the elective he was willing to engage the problems again—to really try to sort through the language to find the meaning. When I think back on his smile that day, I realize that it was a different smile than the one he gave me when he boasted that he was good at math. Fewer teeth were visible, the spread wasn't quite as wide, but there was something more genuine happening on his face.