2000s INTRODUCTION

SOME MENTIONS IN THE AUGHTS

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The aughts seem distinct as a decade by a changed emphasis: algorithms. Algorithms can be thought of as a sequence of steps, highly routine, that produce a desired result. For example, as a math student and teacher, I study and teach math with and without calculators and emphasize their use in various ways. I study mathematics and math education with a sense of speed through an algorithm and what is available for thoughtful reflection. This blend seems unique. Algorithms can also be thought of as a play between a teacher's craft and the effects of technology on a purposeful direction, our young people as students and learners. We also choose the value we bring to our classrooms and this also might be thought of as algorithmic. Indeed, this value forms our views of assessment that bridges what we have done and what we will do: the reasons for our craft.

The aughts uniquely position students within a changed view of algorithms. High school students in the early aughts most likely studied elementary numeracy with calculators—unseen algorithms. In my elementary years, to substitute calculators for mental arithmetic meant not learning. An appreciation for the beauty of number patterns and changing magnitude

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with ordered operations had limited development. In contrast, students entering secondary school in the aughts have a variety of experiences. And elementary students in the aughts learn multiple algorithms based on place value with manipulatives exposing certain number patterns, like friendly facts, through a variety of methods, tasks, and even games. A catalyst for this sort of emphasis seems to be technology. For example, during the same year early in the aughts I taught with a chalk board, complete with chalk holder, and with a dedicated math computer lab using Microsoft Excel's conditional statements to provide feedback about experiments, tables, and formulae students entered answering a sequence of questions, all automatically graded: a paperless finance unit. During those few weeks I asked the same questions differently. Students still experienced curricular algorithms in paced ways, but outside my direct and carefully controlled instruction. I programmed how their experience started and they experienced mathematics with unseen algorithms to expose and interpret other algorithms through an interpretation on Excel. Due to this interpretation, a selected algorithm became the point of questions in more ways than could be given on a chalk board.

Not surprisingly, ways of asking questions also changed. A previous pedagogic notion of developing a simple and elegant algorithm to learn and apply to various problems and then use in carefully constructed ways to explore its boundaries became an issue of repeating a teacher. This notion decreased in popularity, especially evident in the front matter of curriculum documents. Students, and their questions, became a focal point, and a craft emerged where prompts and starters initiated students' questions about portions of this simple and elegant algorithm. Initial student skills focused on ways of thinking, such as metaphors, with an emphasis on vernacular and reading comprehension through the use of short stories and longer word problems. More traditional arithmetic and algebraic practice for these simple and elegant algorithms became a topic of debate as technology revalued what was worth remembering. Indeed, formula sheets and question stems changed through the aughts to match these trends.

Just a few years before the aughts, grade 12 graduation became one of the measures of success. Questions about whether a student had the choice to fail within the purposeful design of a teacher's classroom guided professional development and matched a change in society's construction. Trends with students not graduating illustrated a consistent pattern of behaviours and were becoming unsustainable. In my grade school years, not graduating usually meant entering a trade, and many dropouts experienced success. For example, a common profile of a millionaire in the aughts is a small business owner providing a trade with low overhead and high productivity able to withstand harsh economic cycles, often without grade twelve and sometimes only grade eight credentials (starting their career twenty and more years earlier). Yet, in the aughts, the trades required a different teenage experience. Profoundly, education became focused towards asking questions from personal experience. Previous experiences and how students co-create classroom environments became crucial parts of Alberta's curricular experience. The teacher became responsible for a transparent design of inclusion and leadership. Indeed, in 2011, Alberta Education held an information meeting for superintendants and other curriculum leaders focusing curriculum interpretation towards transformation, journey, and experience. The skills of what is learned became aimed at the unknown future, not simply repeating algorithmic work of a past classroom.

Curriculum topics changed in the aughts and these were mixed with more changes of classroom culture and a mandated secondary school calculator. Multiple revisions of Math 30 and 33 changed to Pure and Applied, and this redefined secondary streaming. Bluntly and simply written, what was formerly understood to group academic or matriculation students became the course for many. For these students, streaming became somewhat of a moot issue. The mandated calculators enabled the completion of a Pure-level Diploma examination, and curriculum topics seemed split between those taught with more formal arithmetic and algebraic notations and those with calculators. For the first time in high school, an electronic calculator could check what were presumed to be high-level and calculator-less math questions. Profoundly, the mathematical notations that previously guided problem solving's reading and writing became a point of question, or more accurately, how a student internalized arithmetic-based algorithms for modeling and adjusting for errors. An appreciation for the beauty of mathematical modeling and errors, or applications, became an expectation of the classroom culture. This fundamentally changed a value of assessment; all students were expected to learn and demonstrate reading, writing, and arithmetic with a collection of unseen algorithms. Indeed, by the end of the aughts, another curriculum change brought Math 10 Common, with streaming pushed another year closer to graduation; instructional resources for modelling were multimedia, interactive, and widely available through the Internet; and pedagogy focused what students were capable of and teaching focused mathematical processes while students were engaged creatively.

Evidence for these math classrooms being changed can be understood in how teachers supplement resources. More evidence is technology. For example, elementary education journals from the 1980s suggest a variety of strategies for teaching arithmetic algorithms. These thoughts are reflected in current approved resources. Some secondary resources that expound calculator how-to's mimic a simple and elegant sequence for chunking, facilitating memory. Sometimes what continued were disconnections between a learner's thoughts and the symbols written. Elementary expectations of purposefully disconnecting formal thought from writing and later reconnecting these intentionally became contrasted with preparing students' demonstration on high-stakes exams. These students were prepared for a known and very immediate future unlike society's expectation. By the end of the aughts, technology continued to change and focus an unknown future. Learners experienced dynamic graphing and image-building software, knowledge-based search engines, and handwriting-recognition calculators. Answers became available through images, by asking questions, and by arithmetic done by writing formally (not memorizing calculator buttons). These tools focus an education of proofs, asking questions, and writing formally in different ways.

The aughts brought classroom questions that took student beliefs, expectations, and prior knowledge and exposed foundational math concepts by creating situations that required questions. For example, to explore a one-dimensional line, a string might hold clothes pins attached to recipe cards with fraction representations. Mathematical beauty occurs just before the third recipe card is hung. Hanging the second fraction suddenly creates unit relationships and definitions of "one." To attach the third recipe card accurately, a learner might use referent measures, measuring devices, proportions, and various formulaic representations. For younger or more immature learners, teachers can always define endpoints and proportions, focusing more ordinal concepts. Another question takes paper folding and constructs metric and imperial rulers helping learners with referents. Then, these learners might represent a repeating and non-terminating decimal and compare it to an irrational number. A final question example is a variety of stories related to a sort of number line bent in a circle with 50 tic marks where every third tic is erased as these are counted in a circular way. Modeling and predicting this situation can utilize concepts like logarithms. Assessing this kind of work and learning reevaluated what it meant to have fun and persevere. A teacher created a classroom culture of learning and students transformed from a collaborative skill set to functioning individually with confidence. These situations are intended to present a cross-section of how the aughts redefined questions answered with questions (from the definition of "one," to recollecting a historical perspective of mathematics based in measurement and wealth, to an expanding sense of number systems, to modeling with more advanced algorithms).

The aughts also brought many methods to add variety to address reading comprehension methods for more traditional and formal notations. For example, three solutions for multistep determinations of quadratic functions from a parabolic curve (general, vertex, and factored forms) can be cut up, piled, and reordered. Compared to copying notes from a chalkboard, students are required to be more sensitive as learners, wondering about where to start with a pile of paper "shredded into strips."

Over the past few years, the Education Act, amongst other items, has been questioned in Alberta. Mobile technology has progressed into personal education and mobile learning. In fact, in 2012, Alberta Education held a Math Digital Diploma Item Writing session where answers for these items were almost impossible to do by paper and pencil. If this sort of assessment changes, then it will match a growing sense of what is required of numeracy with seen and unseen algorithms, how knowledge is valued, and how we ask questions. In many ways, that is still to be decided. The aughts brought us students uniquely positioned with unseen algorithms and various experiences between knowing simple and elegant algorithms, their applications, and developing math skills that form ways of thinking and using words. It also brought us a changed value in graduation and classroom culture. How students access and use available technology will influence a value of knowledge. The value of these experiences should only increase. So, the questions we always had become used in ways to underpin a fact that mathematics is a collection of definitions because we say so...it helps us make sense of our world.

Mark Mercer currently teaches with Edmonton Public Schools. He enjoys teaching math and math education, and he is keenly interested in the value of a-teacher-in-the-classroom amongst vast amounts of technology and choices. For him, using imagination is the most valuable result of math education whether it is through reading, writing, or calculations.