

## Keynote Debate 1: Calculator vs. No Calculator May 24<sup>th</sup>, 2017

Calculator use in our mathematics classes has always had a “war” aspect to it. Calculators are a fact of life, and increasingly so with all the devices that are readily at hand. They can solve equations and factor quadratics along with calculate square roots or multiplication questions. Shouldn't they be a given in all college math classes? On the other hand, colleges work with employability skills like numeracy. Students come to college and have no idea how to do long division or multiply two numbers together without a calculating device. Isn't this important in numeracy development? All this and more will be covered in a debating clash in this keynote! Join in with your own comments!

Initial vote:

- Calculator: 30
- No Calculator: 25

Calculator: Fred (Ontario Association of Mathematics Educators), Don (Lambton College)

- Calculators off the power of visualization
- Teaching trigonometry/logarithms using tables and interpolation without calculators was very time consuming
- Use graphing calculators for CAS, analytic geometry, statistics and functions for visualization
- Get with the times
  - Students have been using calculators since grade 5
  - Aren't we supposed to focus on concepts/problem solving at the college level, not calculations?
- Calculators are the way to provide access to more complicated math
  - Maxima/minima
  - Tables of values around a point
  - Tables of values as a graph approaches a limit
- Calculators are easily available on any job anywhere
- Calculators fill the gap and give more confidence for students with numeracy problems
- Focus on concepts and meet the objectives of the course

No Calculator: Tracy (Conestoga), Maksim (Seneca)

- We all face similar challenges as college educators in terms of students with weak foundational skills, math anxieties/phobias and disengagement
  - Calculators contribute to the above
- Calculator is a tool that needs extension of previous knowledge
  - Facility and arithmetic, place value, estimate/check, evaluate: be numerate
  - Educators need to recognize when calculators are appropriate
  - Using calculators enable bad habits
    - Calculating without thinking
    - Unable to estimate
    - Trial and error methods for solving problems
    - Abuse calculators at expense of understanding

- Need to focus on numeracy, process and skills
  - Calculators shouldn't be used here
  - Calculators may be used for more complex problem solving
- Calculator becomes a problem when it replaces knowledge
  - Students don't gain understanding of the structure of the phenomenon
  - Anxiety raises
  - Erroneous beliefs towards mathematics as a black box adherence to strict rules
  - Negative beliefs toward own mathematical ability isn't addressed
  - Not enjoying problem solving/creativity
  - Not ready for professional exams restricting calculators
  - No foundation to continue quantitative education

#### 2<sup>nd</sup> Vote

- Calculator: 25
- No calculator: 34

#### Comments from the floor

- Calculator
  - People will have access to them in the workplace, but assigning marks for right answer AND showing how to get the answer
  - Using a calculator isn't a "giveaway," but it's "icing on the cake" – a way to check your answer
  - We can encourage numeracy and framing with a calculator
    - Define questions that get to the heart of numeracy with a calculator
    - Word problems/interpretive language
    - Test for codependence on a calculator
  - Learning to use a calculator appropriately is one of college educators' responsibility
  - Employment isn't based on how quickly someone can mentally do a calculation
  - Calculators aren't meant to take our jobs as educators, but to enhance what students already know
  - Teach concepts without wasting time on computations
  - Students were just as anxious without calculators back in the day as they are now
  - Not using calculators don't allow students to focus on problem solving
  - We need to teach the problem solving, not computation
  - Students getting high grades in Business math, but can't do any calculations on the job
  - Use the tools that are of most use for the fields into which our students are going
- No Calculator
  - People won't have them in all workplaces (e.g. Emergency Room, Aviation)
  - Certain vocational experts need to have mental mathematics skills
  - Early learning of mathematics without a calculator is critical
    - When students start learning fundamental concepts they hadn't learned before (e.g. prime factorization), they ask why they haven't learned this before because now they understand
    - People give back double the amount of change

- A problem when students do 60 divided by 2 with a calculator
  - A private school in California bans technology from day 1 even though they have the money and means to do whatever they want
  - High school students can't be employed because they can't do basic math
  - Can't teach a student to factor if they don't know their times tables
  - Mental calculations are quicker and more reliable (less reliant on cell/wi fi service)
  - Confidence fallacy in believing that the calculator must be right
  - Students think calculators make math easier, but they really do the repetitive/easy stuff for you
    - Replace easy stuff with more difficult stuff
  - Employability tests require quick thinking mental calculation/estimation
  - How much does it cost colleges to teach the math that ought to be taught in secondary schools?
  - What happened to College Math Project/College Student Achievement Projects regarding Grade 12 Mathematics for College Technology (MCT4C)
    - Most secondary schools can't offer it due to low enrollment and contractual obligations at the school districts
  - Calculator is meaningless if the base of logic isn't there. We encourage being able to read before college, why not being able to do basic calculations?
- Both?
  - Either/or fallacy (only a Sith deals in absolutes)
  - Once someone has mastered dividing decimals long-hand, why keep doing it?
  - Probably situationally dependent
    - Before college basic mental skills are key
    - Once in college classroom, it depends on program and certification tests
  - Current technology spits out answers to verbal questions so calculator use even becomes obsolete. Maybe will have implanted "brain meshes."
  - Logic systems need to be built in students' minds before giving a calculator
  - Elementary mathematics teaching is alarming. Teachers are asked to teach everything (not just math). By grade 4, they have a specific science teacher, but homeroom teacher teaches the math. Focus on basics before giving a calculator.
  - First-year college students are learning elementary math skills.

#### Closing statements

- No calculator
  - Not arguing to eliminate calculators in all math classes
    - Calculate  $6 \times 7$ ,  $6 \times 0.7$ ,  $6.2 \times 7.5$ 
      - At which point above do students feel uncomfortable without a calculator?
      - At which point above should students feel uncomfortable without a calculator?
      - Would you be comfortable flying on an airplane built by someone who doesn't know how it flies?

- Would you invest with someone who doesn't understand how financials work?
    - Calculators are a tool, but mathematics is a field causing deep thought. Calculators detract from that.
- Calculator
  - We work at the college level and a lot of that is reiteration of elementary and high school mathematics. Leave computation to them. Let's do colleges' job and teach at our level.
  - People keep saying that computation without a calculator is a base of knowledge, but mathematics is WAY bigger than that.
    - Mathematics isn't a linear process
    - We can jump in at many different levels and delve in some very deep mathematics
  - Only one good reason for using a calculator: helps students learn mathematics better
    - Never substitute using of skills for learning mathematics
    - Focus on the process using the calculator, then summarize it with an algebraic process

Final vote:

- Calculator: 29
- No calculator: 35