

Teaching High School Math to Generation Z

Those born after the year 2000 are currently being labeled *Generation Z*. Today's high schoolers grew up in a post-9/11 world. They tend to be very conservative and insecure, worried about future jobs and how to pay for college, entrepreneurial in spirit, but—most importantly—77% of them have cell phones, and according to the Pew Research Center, “24% of teens go online ‘almost constantly.’”¹ Has the teaching of high school math adjusted to the needs of these tech savvy kids? Apparently not. A review of literature using the appropriate search criteria revealed less than a handful of articles. This paper therefore relied on more generally available information regarding making adjustments for generational differences and for the use of technology in teaching.

Kathleen Cushman's article² suggests that for Gen Zers to succeed at math they must have the expectation that the learning can be acquired with reasonable effort. She suggests that students appreciate teachers that function as coaches, encouraging them and helping them learn from mistakes. She also suggests that another motivator is review of what has already been accomplished. This shows students that they are succeeding. Other motivators cited were feeling safe, having a sense of future goals (planning), and knowing that the learning is important (such as the basis of a future course). Students need to feel that the learning at hand stretches them and is active. This latter motivator seems to encourage the efficacy of the hands-on, collaborative, *socially interactive* activities that are so important to Gen Zers.

ChanMin Kim et. al, in “Affective and motivational factors of learning in online mathematics courses,” review the wide use of online math courses. Their study set out to understand how motivation, emotion, and cognitive processes related to success, i.e., why do some students succeed and others do not? Surprisingly, self-efficacy failed to predict success

¹ Wikipedia contributors. "Generation Z." *Wikipedia, The Free Encyclopedia*. Wikipedia, The Free Encyclopedia, 3 Dec. 2016. Web. 3 Dec. 2016.

² Cushman, Kathleen. "8 Conditions For Motivated Learning." *Phi Delta Kappan* 95.8 (2014): 18-22. *Academic Search Complete*. Web. 2 Dec. 2016.

when emotional factors were involved.³ Ultimately, the authors suggest that in order to improve online courses, they needed to better mesh with the Gen Zers life; that is, they must be more socially oriented and more individualized.

Project KNect in North Carolina has applied the appropriate motivators to math learners, and their success rate demonstrates the effectiveness of understanding Gen Zers. The program has had “a measurable effect on students’ math achievement.”⁴ It uses project-supplied smart phones to encourage students to seek understanding and help via the internet, their peers, blogs, and their teachers. The phones can be used for video, internet, and instant messaging within the scholastic and the project environment, but *not* for chatting or talking amongst themselves. This project invites students to collaborate and produce materials on their own—and probably because they are Gen Zers—they thrive on it. Students in the project are “more likely” than those not in the program to demonstrate end of year proficiency in Algebra I and II. Additionally, 90% of those in the project said they were now “more comfortable” with math.⁵

The project has demonstrated an increase in math scores and actually changed the role of the teacher in the classroom. Use of computer technology and the phones changes the dynamic between the teacher and student;⁶ the teacher becomes more a facilitator and less a lecturer. This requires considerable more *tracking* abilities⁷, but KNect was up to the challenge with considerable monitoring applications. One student spent hours inappropriately texting a classmate in the wee hours of the morning, but when, the next morning, his teacher presented him with a printout, he knew not to do that again.

³ ChanMin, Kim, Park Seung Won, and Joe Cozart. "Affective And Motivational Factors Of Learning In Online Mathematics Courses." *British Journal Of Educational Technology* 45.1 (2014): 171-185. *Academic Search Complete*. Web. 2 Dec. 2016

⁴ Davis, Michelle R. "Solving Algebra On Smartphones." *Education Week* 29.26 (2010): 2023. *Academic Search Complete*. Web. 3 Dec. 2016.

⁵ Davis, Michelle R. "Making MATH Connections." *Education Week* (2011): 3840.

⁶ *Ibid.*, Davis, Michelle R.

⁷ Mobile Learning's Impact On Mathematics' Instruction And Achievement." *District Administration* 48.2 (2012): 59. *Academic Search Complete*. Web. 3 Dec. 2016.

Gen Zers don't just want and need online materials; they need input from various sources.⁸ They are not interested in nor can they learn from traditional "industrial model" school programs. In fact, the new world of the Gen Zers requires customization of their learning environment, and the multiplicity of information available today permits teachers to individualize instruction.⁹ Gen Zers are skill-based which has considerable implications for vocational schools especially as college becomes ever more expensive.

In "Today's Mathematics Students"—published just this year— Carmen M. Latterell raises another issue: the separate generation represented by teacher/student also includes a separate (different) skill set. It seems that algebra manipulation problems—an inherent part of college admission tests—are virtually absent from the SAT and ACT and other standardized tests. To bridge the experiential/generational gap, she suggests that

students want personal attention during the lecture. A mathematics professor...should try to use lots of examples, pace the lecture, have a relationship of trust with students, allow calculators to the degree that makes sense for a particular class (and even perhaps negotiate this with students), and, in general, should be checking with students on how it is all going.¹⁰

Abramovich's paper explores the use of technology to facilitate problem solving without directly providing *answers*. He suggests, for example, that instead of asking the student to solve a particular problem that is readily solved by computer, step-by-step, the teacher ask the student to predict the *rules* used to get from step to step. Math should be taught—not by drill and practice or with entertainment—but with constructivist learning environments that "measure learning...by one's ability to systematize, analyse [sic], guess and invent as a way of

⁸ Levit, Alexandra. "The Future Of Education According To Generation Z." *Time.Com* (2015): N.PAG. *Academic Search Complete*. Web. 3 Dec. 2016.

⁹ Wellner, Alison Stein "Generation Z." *American Demographics*, Sep 01, 2000; Vol. 22, No. 9, p. 60-64.

¹⁰ Latterell, Carmen M. "Today's Mathematics Students." *Montana Mathematics Enthusiast* Feb. 2007: 66+. *Academic Search Complete*. Web. 2 Dec. 2016.

wrestling with big ideas...This is problem-solving-oriented mathematics education, using technology for analysis, conjuring, and justification.”¹¹

Smith and Suzuki describe how *blended learning* (with a 30-79% utilization of online content delivery) achieved immensely better results than non-blended instruction in a California study.¹² The study compared two delivery methods of the same material by the same teacher. The online material was, then, unlike canned online courses. In this particular study, students had access to personal devices (like the KNet Project in North Carolina) that gave them access to the materials *created by their teacher*. Again as in the KNet Project, the teacher’s role—in the classroom—was as facilitator; she was available to each student to answer questions, so each student, essentially, had her all to himself; the blended delivery allowed the student to control his pace, place, and time in a way consistent with his cognitive ability.

In conclusion, material about teaching math to Generation Z is not readily available. This is probably not surprising given the short span of time in a generation and the rapidly changing technological environment. Happily, many of Gen Z characteristics resemble those of prior generations. It is therefore safe to say that, for best results, drill/practice/lecture will not work as well as a problem-solving use of technology. The California study and the North Carolina project clearly show the advantages of changing the classroom dynamic. The Gen Z teacher should be a facilitator, creating online materials and using technology to customize a student’s experience.

¹¹ Abramovich, S. "Revisiting Mathematical Problem Solving And Posing In The Digital Era: Toward Pedagogically Sound Uses Of Modern Technology." *International Journal Of Mathematical Education In Science & Technology* 45.7 (2014): 1034-1052. *Academic Search Complete*. Web. 3 Dec. 2016

¹² Smith, J.G., and S. Suzuki. "Embedded Blended Learning Within An Algebra Classroom: A Multimedia Capture Experiment." *Journal Of Computer Assisted Learning* 31.2 (2015): 133-147. *Academic Search Complete*. Web. 3 Dec. 2016.

Bibliography

- Mobile Learning's Impact On Mathematics' Instruction And Achievement." *District Administration* 48.2 (2012): 59. *Academic Search Complete*. Web. 3 Dec. 2016.
- Abramovich, S. "Revisiting Mathematical Problem Solving And Posing In The Digital Era: Toward Pedagogically Sound Uses Of Modern Technology." *International Journal Of Mathematical Education In Science & Technology* 45.7 (2014): 1034-1052. *Academic Search Complete*. Web. 3 Dec. 2016.
- Cardon, Lauren S. "Diagnosing And Treating Millennial Student Disillusionment." *Change* 46.6 (2014): 34-41. *Academic Search Complete*. Web. 2 Dec. 2016.
- Chang, Mido;Evans, Michael A.;Kim, Sunha;Norton, Anderson;Samur, Yavuz "Differential effects of learning games on mathematics proficiency." *Educational Media International*, Mar 01, 2015; Vol. 52, No. 1, p. 47-57.
- ChanMin, Kim, Park Seung Won, and Joe Cozart. "Affective And Motivational Factors Of Learning In Online Mathematics Courses." *British Journal Of Educational Technology* 45.1 (2014): 171-185. *Academic Search Complete*. Web. 2 Dec. 2016.
- Cushman, Kathleen. "8 Conditions For Motivated Learning." *Phi Delta Kappan* 95.8 (2014): 18-22. *Academic Search Complete*. Web. 2 Dec. 2016.
- Davis, Michelle R. "Making Math Connections." *Education Week* (2011): 3840. *Academic Search Complete*. Web. 3 Dec. 2016.
- Davis, Michelle R. "Solving Algebra On Smartphones." *Education Week*, Mar 18, 2010; Vol. 29, No. 26, p. 20-23.
- De Witte, K.; Haelermans, C.; Rogge, N. "The effectiveness of a computer-assisted math learning program." *Journal of Computer Assisted Learning*, Aug 01, 2015; Vol. 31, No. 4, p. 314-329.

- Erdem Keklik, Devrim, and İbrahim Keklik. "Motivation And Learning Strategies As Predictors Of High School Students' Math Achievement." *Cukurova University Faculty Of Education Journal* 42.1 (2013): 96-109. *Academic Search Complete*. Web. 2 Dec. 2016.
- Jones, Virginia R. "Essentials for Engaged." *Techniques: Connecting Education & Careers*, Oct 01, 2012; Vol. 87, No. 7, p. 16-19.
- Latterell, Carmen M. "Today's Mathematics Students." *Montana Mathematics Enthusiast* Feb. 2007: 66+. *Academic Search Complete*. Web. 2 Dec. 2016.
- Levit, Alexandra. "The Future Of Education According To Generation Z." *Time.Com* (2015): N.PAG. *Academic Search Complete*. Web. 3 Dec. 2016.
- Maltese, Adam V., Robert H. Tai, and Fan Xitao. "When Is Homework Worth The Time? Evaluating the Association between Homework and Achievement in High School Science and Math." *High School Journal* 96.1 (2012): 52-72. *Academic Search Complete*. Web. 2 Dec. 2016.
- McGlynn, Angela Provitera "Teaching Millenials, Our Newest Cultural Cohort." *Education Digest*, Dec 01, 2005; Vol. 71, No. 4, p. 12-16.
- Nikirk, Martin "Teaching STEM to Millennial Students." *Tech Directions*, Feb 01, 2012; Vol. 71, No. 7, p. 13-15.
- Plenty, Stephanie; Heubeck, Bernd G. "A multidimensional analysis of changes in mathematics motivation and engagement during high school." *Educational Psychology*, Jan 01, 2013; Vol. 33, No. 1, p. 14-30.
- Realí, Florencia; Jiménez-Leal, William; Maldonado-Carreño, Carolina; Devine. "Examining the Link between Math Anxiety and Math Performance in Colombian Students." *Revista Colombiana de Psicología*, Jul 01, 2016; Vol. 25, No. 2, p. 274-301.

Shaffer, David Williamson; Kaput, James J. "Mathematics and Virtual Culture: an Evolutionary Perspective on Technology and Mathematics Education." *Educational Studies in Mathematics*, Nov 01, 1998; Vol. 37, No. 2, p. 97-119.

Smith, J.G., and S. Suzuki. "Embedded Blended Learning Within An Algebra Classroom: A Multimedia Capture Experiment." *Journal Of Computer Assisted Learning* 31.2 (2015): 133-147. *Academic Search Complete*. Web. 3 Dec. 2016.

Sumpter, Lovisa "Recreational Mathematics – Only for Fun?" *Journal of Humanistic Mathematics*, Jan 01, 2015; Vol. 5, No. 1, p. 121-140.

Twenge, Jean M. "Generational changes and their impact in the classroom: teaching Generation Me." *Medical Education*, May 01, 2009; Vol. 43, No. 5, p. 398-405.

Wellner, Alison Stein "Generation Z." *American Demographics*, Sep 01, 2000; Vol. 22, No. 9, p. 60-64

Wikipedia contributors. "Generation Z." *Wikipedia, The Free Encyclopedia*. Wikipedia, The Free Encyclopedia, 3 Dec. 2016. Web. 3 Dec. 2016.

Wilson, Maureen E. "Teaching, learning, and millennial students." *New Directions for Student Services*, Jun 01, 2014; Vol. 2004, No. 106, p. 59-71.