A REVIEW OF THE BEST PRE-MADE
INTERACTIVE GEOGEBRA ACTIVITIES

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Abstract

By exploring objectives related to the new Common Core State Math Standards using GeoGebra software, students can learn about mathematics concepts in a meaningful and intriguing way. This paper will explore GeoGebra files that the authors found useful in teaching many math concepts to students K-12. Interactive technology like GeoGebra can help motivate learners to enjoy learning mathematics while connecting both mathematics to the real world. The paper will show educators how to access and use pre-made GeoGebra files. Math teachers need to realize that in an age of focusing on Science, Technology, Engineering, and Mathematics (STEM) fields, it is critical that we encourage and stimulate young people in mathematics classes through technology such as GeoGebra. Today there are thousands of pre-made GeoGebra ggb files that teachers can use to electrify, motivate, and teach with to help students better learn and understand mathematics concepts without reinventing the wheel.

Key Words: Teaching Mathematics, GeoGebra, Pre-made ggb files, Common Core Mathematics Standards

Introduction

When using GeoGebra, teachers can better connect and show our students how math is needed for our everyday lives. In today’s technologically-oriented world, students need to be accomplished in Science, Technology, Engineering, and Mathematics (STEM) fields. By the National Council of Teachers of Mathematics (NCTM, 2006 and 2000) endorsement and the new Common Core State Standards (CCSS, 2010) in Mathematics emphasis, it is necessary that we teach using technology to encourage connections with other disciplines and make math relevant and meaningful. Geometry is the main branch of mathematics that relates to the visual aspects of our surroundings. This paper looks at ideas for teaching mathematics with the use of technology, particularly using pre-made GeoGebra files to provide connections and motivation in learning mathematics. Math educators today do not need to go and reinvent the wheel, rather use what is effective to better reach young learners. There are many great ggb files in existence teachers can use to instruct and build concept development in math while motivating learner and also using the technology that exists.
GeoGebra

GeoGebra is considered a multi-platform dynamic software for doing and teaching mathematics created for all grade levels. GeoGebra dynamically connects algebra, geometry, measurement, graphing, spreadsheets, tables, statistics and even trigonometry and calculus in a straightforward software package (Hewson, 2009; Hohenwarter, Hohenwarter, & Lavicza, 2009). GeoGebra was created originally as an open-source dynamic mathematics software downloaded for free and its materials can be accessed at: http://www.geogebra.org/cms/en/info. With no licensing issues associated with the GeoGebra software, this allows students and teachers the freedom to use it both within the classroom and at home. Today GeoGebra has a large international user following and a developer community with users and contributors from 190 countries and is currently translated into as many as 55 languages.

Fahlberg-Stojanovska, & Stojanovski (2009) found that using GeoGebra for motivating students and through exploration and conjectures learn at a higher level. Originally, GeoGebra was largely intended for mathematics instruction at the secondary school levels. While GeoGebra certainly has uses in higher education math courses, it is now introduced in the elementary math levels. Online websites on resources related to GeoGebra are found in Appendix A of this paper.

Aydin & Monaghan (2011) in their research felt that by using GeoGebra, math teachers are allotted the potential for their students to see mathematics in the everyday life using such a dynamic geometry system in the classroom. Today’s teachers of math will find the videos on using GeoGebra useful (Mathematics and Multimedia, n.d.) as basic training for this software at: http://mathandmultimedia.com/2011/01/01/geogebra-essentials-series/ as they provide great resources for how to quickly use GeoGebra for instruction. GeoGebra allows one to input equations which can show how math can be applied to real-world applications in an extremely graphic manner by personalizing instruction and making learning more meaningful.

In their research, Thambi and Eu (2013) investigated student achievement with fractions using the software GeoGebra. Their quasi-experimental research design compared the achievement of two groups of fourth-grade students. The results showed significant difference between the mean scores of the control and experiment groups of students and illustrated that students in the experiment group performed exceptionally when using GeoGebra over the control group with more common learning method of teaching fractions without such software. The implications from this study were helpful in proposing other innovative way of teaching and learning fraction concepts as well as helping students in visualizing fraction concepts while using this software.
The authors as educators, believe that GeoGebra can provide the visual connection needed for real learning to occur. Through using interactive technology like GeoGebra, teachers help learners to connect and understand real-world problems in a more meaningful method. The authors feel that since GeoGebra allows for a variety of platforms and is free dynamic mathematics software for all levels of education that links many branches of mathematics into a simple package, many educational institutions and families can freely download it from [http://www.geogebra.org/cms/en/info](http://www.geogebra.org/cms/en/info). Teachers need to encourage our learners to connect geometry and shapes/mathematics to their daily activities.

**Research on Pre-made/Existing Math Software Tools to Teach Mathematics**

In their study, Zengin, Furkan, & Kutluca (2012) found that dynamic mathematics software like GeoGebra on student success in teaching of trigonometry had some major impacts on learning. Their sample size consisted of 51 students. Their experimental group were taught lessons with GeoGebra software in a computer-assisted teaching methodology and the control group was exposed to the lessons taught with a mostly constructivist format. The researchers collected data for a five-week period of application which showed a meaningful difference between experimental and control groups’ achievement in trigonometric learning. The researchers concluded that the difference was in favor of the experimental group which had pre-made materials using GeoGebra.

Hall and Chamblee (2013) concluded in their research that the main mechanism to improve how mathematics is taught and learned in middle grades/secondary classrooms is through the incorporation of GeoGebra software. They felt their personal experiences of utilizing GeoGebra-based teaching methodologies to pre-service and in-service middle grades/secondary mathematics teachers enhanced their mathematical thinking and had a great impact on the teachers’ instruction for encouraging pre-made math lesson activities for high student achievement levels.

The findings of Zakaria and Lee (2012) revealed that mathematics teachers in secondary schools have a positive attitude toward the use of GeoGebra. They conclude that mathematics is a subject that is abstract and that requires the collective imagination of students and teachers, particularly in the areas of geometry and transformations. The use of technology exposes students to learning without boundaries and also promotes student-centered learning, where the teacher acts as an enabler or facilitator even when using pre-made GeoGebra files. GeoGebra software is expected to help mathematics teachers diversify their teaching methods to facilitate students’ understanding of mathematics concepts through effective teaching and learning. In addition, it is expected that GeoGebra will be used as an alternative to encourage teachers to employ technology as a means of harnessing student potential in the teaching and learning of mathematics.

Based on the students' results in test results, questionnaire answers, and interviews, Takači, Stankov, and Milanovic (2015) determined that GeoGebra allowed for easier learning of the mathematics students. GeoGebra software allowed students using pre-made GeoGebra activities to verify each step in the process of solving a math problem. They concluded
that GeoGebra significantly helped all students and more so those who may struggled with learning math concepts. While drawing graphs and examining functions, the learning mastery of the students was greatly improved by working in cooperative groups. The research study summarized that GeoGebra promoted an effective-learning environment as an enhancement tool for examining functions and drawing their graphs.

In the research of Adams and Muilenburg (2012), they found that United States public school students in mathematics are underperforming in comparison to other industrialized nations globally. These researchers felt many students in mathematics classrooms across the country are expected to learn formulas and theorems with no premise for such math ideas and topics. They resolved our students are left with an understanding that lacks the depth required for true knowledge of mathematics for today. The authors contend that technology supports student learning by providing visual aids and dynamic tools to make meaningful discoveries about mathematics. They advocate the use of GeoGebra integrated into secondary math instruction improves student learning and understanding at a deeper level.

Arbain and Shukor (2015) in their research contend that learning and teaching of mathematics should not be focused on purely theoretical, but also a variety of learning approaches that involve the use of teaching aids proven to help stimulate students’ interest in mathematics. The mathematics software available in the market or even online has facilitated the task of the teacher to impart knowledge beneficial to the students. However, they feel that it depends on the teacher how they utilize existing materials without the need to allocate extra time to develop other teaching aids. Conclusively their study has shown that GeoGebra software has a positive impact on students’ achievement. The students also have positive perceptions on GeoGebra software in terms of enthusiasm, confidence, and motivation. This software should be introduced to mathematics educators so that students can explore the world of mathematics and make the students able to think critically and creatively as they use such dynamic software.

Ochkov and Bogomolova (2015) concluded in their research that computers could take over the routine math work, removing the tedious side of mathematics and thus allowing the teacher and students to create something more fascinating in the learning process. They summarized their findings with four major points about using pre-made or existing math software to teach math with as follows: A) software programs are innovative and appeal to young users’ senses; B) using animations and imagery teachers can increase students understanding of math concepts and related theorems; C) with technology, math problems and solutions can be made at a higher level for their students; and D) to advance the use of such software, math teachers should provide needed support to their students when using such pre-made software for teaching. Today teachers do not need to reinvent the wheel when they teach math. There exists many great pre-made technological tools that math teachers can use today to effectively teach math in this high-tech world we live in.

Although GeoGebra may not specifically be considered a Computer-Assisted Instruction (CAI) program, as the learner must know how to use it to access and use it to a large degree; however, some of the created pre-made activities and files under “Materials” on the
GeoGebra.org website may be more like CAI’s. GeoGebra and the pre-made existing files the authors refer to in this paper may be considered a method to improve learning outcomes for students, often created by educators to aid in instruction. De Witte, Haelermans, and Rogge (2015) in their paper believe that there is not very much information published about schools who use such CAI programs and the results when used for instruction. These researchers did a review of the current literature on such pre-made and existing CAI software and other technological tools to gauge the effectiveness of learners’ outcomes. Their paper and results suggested that teachers should use CAI programs to catch up on learning objectives. Given the involvement in the CAI program, students do more exercises leading to greater success. They concluded that working with CAI programs seems effective in the teaching of mathematics.

Dynamic geometry programs are not only used to make learning environment objective but also create a constructivist-teaching environment for learning mathematics. Technologies like GeoGebra can help students achieve a higher level of cognition. Ipek, Orhan, Akbasoglu, and Kaplan (2015) found in their research that software gives opportunities for students to create geometric shapes in a virtual environment, to find relationships between shapes, to scaffold theorem to proof this relationship and to change this scaffold according to the request or understanding. Math software like GeoGebra on this structure also allows for better understanding of measurement and comparisons. For these reasons, pre-made course materials prepared from software like GeoGebra can help both teachers and students. Teachers can explore to use software like GeoGebra and the activities found to better help their students learn. At the same time, teachers will be encouraged to use technology and to create new activities. Ipek, et al. feel that students will be able to explore and develop analytical and intuitive properties of mathematics. Teachers provides students to learn by trying, doing and exploring by integrating technologies like GeoGebra into their instruction.

While there has been a lot of support for using computer programs and software in teaching mathematics, not all studies support such approaches. This work in this paper specifically looks at GeoGebra software and more specifically GeoGebra ggb files pre-made to use as a form of instruction of concept development and practice. Other research above has supported the use of GeoGebra as an effective means of effectively teaching mathematics. One thing to mention in advocating this software as well is the fact that it is completely free and constantly being updated to enhance effectiveness for users.

In conclusion, research from Zengin, Furkan, & Kutluca (2012) has found that using GeoGebra to teach math has been proven to increase achievement scores in mathematics. The study findings show a significant difference between the average scores of the students’ on the posttest favoring the GeoGebra group when learning math concepts. Tatar (2012) also found a positive impact of utilizing dynamic mathematical learning software like GeoGebra thus enhancing students learning and understanding. More information and the free GeoGebra download can be found at [http://www.geogebra.org/cms/en/info](http://www.geogebra.org/cms/en/info)
“Of all of our inventions for mass communication, pictures still speak the most universally understood language.”  --- Walt Disney (n.d.)

GeoGebra makes the learning of mathematics visual and interactive. It helps to better communicate the language of mathematics to the learner. Like the quote above says, “pictures speak the most universally understood language.” This research with GeoGebra is advocating the use of imagery and premade existing GeoGebra files for teaching mathematics to motivate learners while teaching for understanding consistent with Jones (2012). Learners can insert all of these images into GeoGebra and then draw the mathematical relationships on top of the images. Today there are so many premade GeoGebra files, ggb’s, teachers have a wealth of material to use at their fingertips by just visiting the GeoGebra website to use:

- Pre-Made GeoGebra Activities for Teaching of Mathematics
- Files for many grades levels
- Files covering a wide variety of Mathematics Standards (CCSS)
- Files that are appealing and user-friendly for teachers and students

Along with Common Core Standards, this paper and presentation discusses how to access Pre-Made GeoGebra files on a multitude of mathematics topics. To access the pre-made GeoGebra files, teachers can go to:  http://www.geogebra.org/materials/

![GeoGebra Materials Website Page](image)

Teachers can see the featured and newest materials or search for other ggb files by search topic at the GeoGebra website. There are literally thousands of GeoGebra ggb files to use all contributed to the GeoGebra website. There are so many wonderful resources here. Teachers need to be cautious though as you need to use the ggb file and see how it works and often times you may discovery some flaw or issue with a file or that it is lacking a feature or something you may find to be needed. While they are all tried and tested and you
may contribute your own ggb file, it is important to test it out before using it to teach with or letting students use. You want to make sure it is not going to cause more confusion to the learner, so try them out first before using them.

Some criteria to consider when using pre-made GeoGebra ggb files include:

- Is it age and grade level appropriate?
- Does it help you cover state and/or the math CCSS?
- Is it user-friendly for both students and teachers?
- Is it motivating to the learner?
- Does it have any quirks that need to be addressed before using it?
- Does it lead to concept development?
- Is it corrective and provide feedback?
- Does it have errors that may create confusion for learners?

The above are just a simple list of possible criteria instructors need to take into account as they use such pre-made GeoGebra ggb files. While the researchers advocate the use of GeoGebra and the many resources found at their website, educators also need to use caution to review the files to make sure they meet some of the criteria listed above before using the ggb files for instruction purposes.

**Pre-made GeoGebra File Topics Explored in this Paper (See Appendix B):**

<table>
<thead>
<tr>
<th>Integers</th>
<th>Statistics</th>
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<tr>
<td>Decimals</td>
<td>Measures of Central Tendency</td>
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<td>Fractions</td>
<td>Similar Triangles</td>
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<td>Coordinate Geometry</td>
<td>Pythagorean Theorem</td>
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<td>Slope</td>
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<td>System of Equations</td>
<td>Parabolas</td>
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<td>Probability</td>
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The following are the Common Core State Mathematics Standards (National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO), 2010) covered as they relate to the above topics shared:

**CCSS.MATH.CONTENT.3.NF.A.3.B**
Recognize and generate simple equivalent fractions, e.g., \( \frac{1}{2} = \frac{2}{4}, \frac{4}{6} = \frac{2}{3} \). Explain why the fractions are equivalent, e.g., by using a visual fraction model.

**CCSS.MATH.CONTENT.4.G.A.1**
Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

**CCSS.MATH.CONTENT.4.NF.C.7**
Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to
the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model.

**CCSS.MATH.CONTENT.6.NS.C.6.A**
Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., \((-3) = 3\), and that 0 is its own opposite.

**CCSS.MATH.CONTENT.6.SP.B.5.C**
Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

**CCSS.MATH.CONTENT.6.SP.B.5.D**
Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

**CCSS.MATH.CONTENT.7.SP.C.7.A**
Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.

**CCSS.MATH.CONTENT.7.SP.C.8.B**
Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.

**CCSS.MATH.CONTENT.8.EE.B.5**
Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

**CCSS.MATH.CONTENT.8.F.A.3**
Interpret the equation \(y = mx + b\) as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function \(A = s^2\) giving the area of a square as a function of its side length is not linear because its graph contains the points \((1,1)\), \((2,4)\) and \((3,9)\), which are not on a straight line.

**CCSS.MATH.CONTENT.8.G.B.7**
Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

**CCSS.MATH.CONTENT.HSA.CED.A.2**
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

**CCSS.MATH.CONTENT.HSA.REI.C.6**
Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
**CCSS.MATH.CONTENT.HSF.TF.A.2**
Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

**CCSS.MATH.CONTENT.HSG.SRT.A.2**
Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. (pp. 1-93)

See Appendix B for all the Pre-made ggb files used for this paper/presentation and how they relate to the Common Core State Mathematics Standards.

**Summary**

Today many of our students are fascinated by using technology and will enjoy learning math better when using GeoGebra as they construct and investigate geometric shapes and other math ideas. Students using GeoGebra will start enjoying math and even see connections to other subject areas. By using technology like GeoGebra, our learners will become intrigued and maybe start liking and enjoying math more! Math teachers do not need to reinvent the wheel as today there are so many pre-made GeoGebra GGB files created to use for learner and teaching mathematics. This paper made the case for using such existing teaching materials.

Some of the reasons to use Pre-made GGB Files to teach with are to:

- Cover the CCSS by using technology
- Make connections and relationships between math concepts and real-world examples
- Employ emerging technologies in math with an emphasis to the real world in class
- Show practical applications to math in real-life situations
- Employ innovative teaching in the classroom
- Stimulate excitement through images to understanding mathematics
- Use existing materials that make it easier for the instructor to not have to create new material

Today math teachers can create or use a GGB pre-made GeoGebra file to teach with! Math teachers should consider creating GeoGebra files (ggb’s) to share on the GeoGebra Materials Webpage for other math educators to use for teaching and using with their students. As professionals, we can create and share files with each other for the sake of student learning. GeoGebra is free, the resources are free, and it is now one of the best mathematics teaching tool with our young people! Many great free resources for mathematics teachers of Grades K-12 can be found and downloaded from Appendix A.
References


### Appendix A: GeoGebra Websites and Resources for the Classroom

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</table>
Appendix B: Sample of Pre-made GeoGebra Files

Integers

Decimals

Fractions

Coordinate Geometry

Slope of a Line

System of Equations
To access the pre-made GeoGebra files, teachers can go to: http://www.geogebra.org/materials/