

Online STEM Course at the Pinellas Virtual School

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THE PINELLAS VIRTUAL SCHOOL

Pinellas County Schools is a school district in southwest Florida in the Tampa Bay area that includes the major cities of St. Petersburg and Clearwater. The district has over 104,000 K-12 students (Florida Department of Education, 2011). In 2008 the Florida State Legislature passed a law requiring all school districts to institute a district Virtual Instruction Program that would provide K-8 education at a distance to students who were enrolled in public school the prior year and wanted to transition to a full-time virtual education program. Pinellas district staff received presentations from approved providers and piloted one of the approved commercial options for distance education with a small group of K-8 students. Based on the pilot, internal capacity, and the widespread use of distance education tools in traditional classrooms through Pinellas (such as *Moodle* and *Illuminate Live*), superintendent Julie M. Janssen decided to have district staff create their own virtual school. Pinellas currently has one of the largest active instances of Moodle in the world, with over 70,000 active profiles (Moodle, 2011). Pinellas has used a combination of *Illuminate Live* and Moodle for over 3 years to provide online professional development for teachers and as online tools for classroom technology integration.

After obtaining permission and guidance from the Florida Department of Edu-

cation, the school district began work on a model that could be used not only for full-time virtual instruction but also courses like middle school health on a part-time basis for students who already have a full schedule due to being involved with special programs. This flexibility was a key factor in deciding to start a new virtual school so Pinellas students could enroll in courses not currently available from providers like the Florida Virtual School, and the district could retain the funding for such classes. At the beginning of the 2010-11 school year, Pinellas expanded the Pinellas Virtual School to include ninth- and 10th-grade full-time and assist with state class-size overflow as needed. In its second year, the Pinellas Virtual School served 339 students in Grades 6 through 10, with a combination of full-time and part-time enrollments.

DISTANCE EDUCATION TOOLS UTILIZED IN PINELLAS

Pinellas County Schools has used Moodle as a course management system for over four years as a platform online professional development of teachers training. Moodle is a free and open source web-based course management system that is similar to WebCT, Blackboard, or Angel (Maikish, 2006; Martin-Blas & Serrano-Fernandez, 2009). For the last three years teachers have also been using Moodle with their students to post resources and partic-

ipate in activities such as wikis, blogs, discussion forums, and more. Designed for distance education, Moodle has been used for teaching at a distance and has become popular for classroom use due to its ease of use for teachers (Cole & Foster, 2007). School district leaders felt confident from this experience of using Moodle for building professional development and use in the K-12 classrooms in building a virtual school using Moodle as an asynchronous platform for instruction.

School district personnel also had experience with the synchronous distance education tool, Elluminate Live. Elluminate Live is a web-based learning environment that provides instructors and students with chat, voice, whiteboard, and screen-sharing tools for real-time interaction (Karabulut & Correia, 2008). Elluminate Live had been used in Pinellas County Schools for professional development and in very limited interactions with students, including world language instruction for students at different schools. When Lakewood High School in St. Petersburg had trouble finding a German IV teacher after an abrupt resignation, the district recommended using *Elluminate Live* to connect with a teacher at Largo High School nearly 20 miles away. Building on these small successes with this synchronous tool for distance education also provided the experience needed to employ Elluminate Live in the Pinellas Virtual School program.

The school district's new Student Information System at the time of the opening of the Pinellas Virtual School, Focus SIS, integrates with Moodle, allowing teachers and students to login through the portal feature. This integration allows for seamless transfer of roles and grades with no intervention from the teacher between Moodle and the course history/transcripts. The district programming staff also created integration with this portal interface and Elluminate Live to provide single sign-on capability for staff and students to encour-

age easier utilization. All of these tools are available to the virtual school teachers and students—and to all traditional classrooms throughout the district.

ENHANCING EDUCATION THROUGH TECHNOLOGY STEM GRANT

In the spring of 2009 Pinellas was awarded a competitive Enhancing Education Through Technology grant through the Florida Department of Education to promote science, technology, engineering, and mathematics (STEM) in secondary schools. The Pinellas proposal included training science, math, and technology teachers at socioeconomically challenged schools about the distance education tools available in Pinellas, virtual school best practices, and STEM content. At the conclusion of the training, Pinellas purposed to have the teachers building a STEM virtual course that could be used to teach virtually and as a supplement to traditional classroom instruction available to all classes. The course that was selected was computer applications in science and engineering. Students would receive a half-credit toward graduation after completing and a quality point toward their grade point average. The course would be offered through the Pinellas Virtual School to students that the targeted schools in need of improvement.

As part of the proposal, the target schools also received extra technology in the form of computers and mobile devices to assist students in need with access to the course before and after school. Socioeconomically disadvantaged students who often fall on the wrong side of the digital divide may not have access to online tools at home and thus are cut out from as many virtual school opportunities as compared to other groups (Watson, 2007). Table 1 lists the target schools along with student the number of students enrolled in the program, recent school grades, free and reduced lunch rates, and graduation rates

Table 1. Home Schools of Students Enrolled in Pinellas Virtual STEM Course

School Name	<i>N</i>	2009-10 School Grade	Free and Reduced Lunch Percentage	2009-10 NGA Graduation Rate
Bay Point MS	36	B	63.99	N/A
Chi Chi Rodriguez Acad	4	N/A	55.68	N/A
Dunedin HS	17	B	40.69	84
Dunedin Highland MS	1	C	60.83	N/A
Lealman Intermediate	2	C	83.51	N/A
Pinellas Park MS	39	C	73.94	N/A
Tarpon Spring MS	1	B	30.97	92
Thurgood Marshal Fund MS	27	B	35.02	N/A
Total	127			

for the high schools involved (Florida Department of Education, 2011).

The computer applications in science and engineering course was previously only offered at the national recognized Center for Advanced Technologies program at Lakewood High School in Pinellas. This grant significantly increased the opportunity for this type of instruction and content to students who would otherwise not have the opportunity to take this course. It also provides successful completing students with a half-credit toward graduation (many of them before they even arrive at high school) and extra points on their weighted grade point average. The grant proposal specified that this rigorous course would be built with engaging technologies, incorporating the latest research in STEM and online education in order to provide the best completion rate for these students who may not have had the opportunity for online instruction in the past. The students would work through the semester's material using a combination of school and take-home computers to complete the entire curriculum posted in Moodle. Students would be regularly assessed and meet in synchronous lessons and help sessions via Elluminate Live. The Enhancing Education Through Technology grant would cover

the costs for the first year of training, creation, and implementation but the course could be taught afterward along with all of the materials created being shared with other STEM teachers across the district. The teachers who participated in the grant program were to also share with their schools the information they learned through the process in the hopes that others would become engaging in wanting to integrate STEM concepts and lessons into their classrooms.

CREATION OF THE COMPUTER APPLICATIONS IN SCIENCE AND ENGINEERING

The targeted schools were assembled to discuss the planning and implementation of the online STEM class. Students need an education with a solid foundation in STEM areas so that they are prepared to both work and live in the twenty-first century. Since the 1960s, the demand for skills has changed significantly—the demand for routine manual task skills have decreased, while the demand for nonroutine interactive task skills have increased significantly. Workforce projections for 2014 by the U.S. Department of Labor show that 15 of the 20 fastest growing occupations require significant science or mathematics training to

successfully compete for a job. According to the U.S. Bureau of Labor Statistics, professional information technology jobs will increase 24% between 2006 and 2016 (Kuenzi, 2008). However, as jobs requiring a solid background in science, technology, engineering, and mathematics are growing, fewer students are choosing to major in these areas. If students continue to pursue degrees and careers in fields other than STEM-related areas, the United States will find it difficult to compete in the global economy. Further, the United States will not be able to meet its future workforce needs. The United States needs 400,000 new graduates in STEM fields by 2015. After discussing this research about STEM and knowing the demographics of the schools that were targeted, the planning of the class began.

The discussion with the targeted schools was directed on first of how the online class would be developed. Each of the targeted schools sent four to six representatives to help plan and write the class. The ASSURE (analyze learners, state standards and objectives, select strategies, utilize technology, require learner participation, evaluate) model, according to is helpful for designing courses utilizing different kinds of media (Smaldino, Lowther, & Russell 2008). Since this was a STEM course, the decision was made to use the ASSURE model for outlining the overall course. The teachers had to focus on educational technology and student engagement when designing the course. The ASSURE model uses a step-by-step process to create lessons that effectively integrate the use of technology and media to improve student learning. The goal of the course was to effectively integrate technology and media to engage and improve student learning.

The first part of the ASSURE model was to identify and analyze the learner characteristics. The students targeted were low socioeconomic students that had high absence rates from school, and many of

these students were at a low reading level. The need to have a course that had high student engagement at the very beginning was important. The teachers knew if there was a lot of reading and not much interaction, that the audience would be lost right away. Hauden (2008) stated, "People work because they have to. That is why it is called work. But people engage because they want to" (p. 29). When students are disengaged, it is just work and the goal of the class was to have the students want to be there and work.

The next step was the state standards and learning objectives. The Florida Next Generation state standards for math and science were used. The teachers discussed and chose the standards that were the most frequently used—not only on state testing, but for our end-of-course exams. The teachers also made sure that literacy standards to our course were added because of the high number of students who were lacking in that area.

Once the teachers analyzed our learners and knew what standards were going to be used, we had to build that bridge so our students would achieve success. The decision was to use eight modules with eight different concepts. The number eight was picked because of the way Pinellas County District has set its courses. The course would be completed in 18 weeks so that each student would have two weeks to work on each module with a week in front of the class so the teacher could connect to his or her students and a week after the class for reflection. The first module was titled "You make me sick" and was about bacteria. The student learns how bacteria are transferred, how to collect evidence, how to use exponents to calculate, and how to graph the exponential growth of a cell. The second module was titled "Game designing and Programming." Its objectives were to teach the students how to make simple games on the computer. The student would look at different game programs and how they were created and,

along with that information, design their own game. The third module was titled "Modern Design," in which students learn the four phases of architectural design, learn how math and CAD affect design, and uses Google Sketch-up to design their own ergonomic chair. The fourth module was titled "Design Focus," in which the student studies the design process of building a bridge, researches the different types of bridges, and uses a program to build a virtual bridge. The fifth module was titled "CSI," based on a popular television program. The students act as investigators who are presented a crime scene. The students gather data and use the data to solve the crime. The sixth module researched was renewable energy and titled "Charge it up." At the end of this module the student learns the value of energy supply systems based on renewable and nonrenewable sources, discusses problems related with fossil fuel energy use, and suggests new alternatives. The seventh module was titled "Why oil and water do not mix." The students research the best way to clean after an oil spill, learn about the processes organizations use to clean affected ecosystems, learn about the lasting effects of these types of disasters, and prepare a presentation that communicates their findings. The eighth module was titled "Space—Mission Possible or Impossible." In this module the student explores the characteristics of Mars, reviews past expeditions to Mars, researches theories for colonizing Mars, investigates reasons for or against continued space exploration, and then prepares a presentation that communicates findings that supports their reasons for and against continued space exploration.

In each of these modules the content was arranged using the 5E (engage, explore, explain, elaborate, and evaluate) model. The 5E model is important for teachers to use to properly implement the inquiry process (Bybee et al., 1989). The teachers made sure the first part of their

module was engaging and something that would catch the student's interest. This gives the student the need to know and helps define a question or problem that relates to the real world. This came in a form of a game, a discussion, or a simulation. The students then had an activity to explore the concept they were studying. The student gathers, organizes, interprets and analyzes data about the exploring activity. The concept was then explained by the teacher in a variety of ways such as Youtube, Elluminate Live, or an article that was written on the concept. The teacher offers feedback to the students so they may reach conclusions or generalizations and communicate this in many forms (podcast, PowerPoint, or webcast) back to the teacher. The teachers had the students go the extra step and elaborate on the concept. This was done by the students making presentations, an actual product, or an online simulation. The students had to apply what they learned to solve problems, perform tasks, or resolve conflicts. At the end of each module there was an evaluation. The evaluation might be a final presentation, a quiz, or a product that was designed. At the end of all the modules the students were presented with a final challenge that was called "Mythbuster." The students take a possibly mythical concept and try to prove or disprove it. For example, regarding the folklore about cow-tipping, the students might have to research to see if this could be really done. They might use math, articles, and video to prove or disprove this myth.

The next part of the ASSURE model was to utilize technology, media, and materials. The teachers decided what kinds of media and materials were needed to help the students obtain their objectives in this course. The course media were picked following the "5 P's" process: preview the technology; prepare the technology, media or materials; prepare the environment; prepare the learners; and provide the learning experience (Smaldino et al., 2008). The

teachers designing this course were very careful to make sure that all the technology used by the student was readily assessable. Anything that needed to be downloaded and used by the student was demonstrated by the teacher in video and writing. The students were given a checklist at the beginning of each module that assured they knew of all items that needed to be submitted and what programs were needed to accomplish the tasks in the module.

The R in the ASSURE model was to require learner participation. As Smaldino et al. (2008) note, "to be effective, instruction should require learner's active mental engagement" (p. 28). There were activities in place in the modules under the explore and elaborate pieces of the 5 E's model that required each student submit work that was evaluated by not just the teacher, but the other students in the class. The students were provided constant feedback before final projects were submitted.

The last part of this course was the evaluation. This part of each module not only evaluated the student's progress but also gave the teachers valuable feedback, which was shared with other teachers so this course could be modified in the future. The evaluation of the course will be developed based on standards from other online courses.

IMPLEMENTATION OF THE COURSE

The course was offered to all the middle and high schools in the county in the spring semester of 2011, but with more emphasis on the targeted schools that had actually created the course. The course started out with 300 students, with about half dropping out in the first two weeks during the "grace period." The main reason students gave for dropping out was they were not sure what they had signed up for. Many students had been told by their guidance counselor to take the course and the counselor did not tell them it was

an online course taken at your home on your own time. Problems like these will be easily corrected in the future with more training for the guidance counselors.

The course is a half credit with a grade point average quality point, so students taking the course would get a bigger percentage on their grade point average for taking this course. Students in seventh and eighth grades would receive a high school credit for passing this course. It is crucial that the students targeted in the middle school as potential dropouts come into high school ahead of the game.

The United States is not producing enough students, teachers, and practitioners in the fields of science and mathematics. A large majority of the students in our county fail to reach proficiency in science and math. The course in computer application in science and engineering is Pinellas County's method to remedy this serious situation.

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