Lessons from Socrates and the Online Classroom: Achieving Exceptional Performance in Project-Based Classroom

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ABSTRACT

Both Online teaching and Socratic pedagogy require excellent preparation, well thought out exercises, courteous and rapid responsiveness to student needs, and a belief that independent learning is the key to high achievement. As a result of importing these principles into his campus based classroom, the Author’s freshman programming novices now create complex software systems even though no examinations are required, no papers are submitted and traditional lectures are omitted. Even marginal students can have a transforming educational experience when Socratic and online principles are implemented prudently. We discuss why prestigious internships can be won, by historically weak students, as a result of participating in an educational method that values independent study, team work, rapid assimilation of knowledge and the immediate application of knowledge in creating “real world” complex systems.

1.0 INTRODUCTION

Small teams of freshman novice programmers [5, 9, 10] are capable of developing full commercial quality C++ or C# based multi-player client-server Gaming Systems. (Figure 1) We believe these achievements reveal that computer programming can be as compelling activity as game play for young people if the programming exercises imitate game play [4, 6] and the pedagogical method used in the classroom is Socratic in nature. [7, 8]

Programming exercises, called GM-Games are non-traditional exercises that were created by the author to develop the technical and software engineering foundations necessary to create complex game systems during the freshman year. These GM-Games appear to accelerate learning when used with an inquiry based, neo-Socratic educational method called the Game Motif method (GM-Method). The GM-Games are developed by students on an independent study basis.[8] Therefore, they are suitable for use in either an online classroom or a campus based classroom where Socratic methods are utilized by the instructor.

Figure 1
Multi-Game System with Account Management and Control

Since student success at developing GM-Games and complete complex game systems can be
accomplished on an entirely independent study basis we believe that exceptional student performance can be achieved in both the online and the traditional campus classroom where Socratic methods are utilized.

2.0 THE SOCRATIC METHOD

Major changes in pedagogy have taken place over the past three decades. Online education has become a dominant force on the educational landscape while Socratic pedagogy continues to be largely absent in the traditional classroom. We believe the success of online educational models will revive interest in Socratic methods. Consequently we briefly comment on the Socratic method. [22 ]

The Socratic Instructor

The Socratic instructor believes there is a body of truth external to student experience. The presupposition is that truth can be known. In the Socratic tradition, truth is discovered through discourse, otherwise known as the elenetic process. Socrates believed that through asking a series of directed questions his student could arrive at the truth. Thus, the main mission of the Socratic instructor is not to convey the truth but to help a student find the truth. The Socratic instructor plays the role of coach, mentor and guide. His primary gift is not that of a subject matter expert with exceptional communication skills. Rather he is skilled at guiding student discussion, exploration, observation and collaboration.

The Socratic instructor remains a rare species in the traditional campus classroom. However, we believe the explosive growth of online pedagogy will rekindle interest in Socratic methods on the college campus.

3.0 THE ONLINE CLASSROOM

The guiding coaching, mentoring and questioning skills of an ancient Socratic instructor are just as essential to the 21st Century online instructor. Both practitioners rely heavily on the use of stimulating and challenging questions to guide student dialogue that is often centered about the knowledge gained through independent study.

Independent Study

Virtually all of the knowledge and skills gained in the online classroom are developed through independent study. In the typical online classroom students are provided a written lecture, reading assignments and projects or homework assignments. Video lectures are increasingly rare though still used in some settings, such as the University of New England Medical School’s basic science course. Adjunct Professors, teach the majority of online classes, and they provide little in the way of supplementary materials. The primary student interface with the professor is through the asynchronous discussion forums and occasional synchronous seminars.

The Discussion Forum

In the case of the online classroom, dialogue with the professor takes place primarily through the asynchronous discussion forums which are a part of virtually all online classrooms. The dominant players in online education like DeVry, UMUC, ITT, Kaplan and the University of Phoenix all require frequent discussion forum posts from both faculty and students. Some require that the students create their first post within 48 hours of the session start time and they must post at least 3 times a week over several different days. The instructor is also held to similar performance standards. The quality of the student posts is important and is also assessed and graded.

Online educators believe that the both quantity and quality of student to student and student to faculty engagement are essential to the success of the online educational experience. The engagement however is not centered around knowledge transfer from faculty member to student, but it is centered
around the dialogue that comes out of simulating questions posed in the forum.

The asynchronous discussion forum is almost entirely Socratic in nature. Questions are used to kickoff the forum and faculty questions added throughout the week are designed to keep the students engaged. Collaborative problem solving in the forums is also common in mathematics classes, where student-to-student assistance is just as prevalent as faculty-to-student assistance.

The Synchronous Seminar

Synchronous online seminars are rare in the online college classroom. Finding a time that is convenient for the majority of students is difficult and online students do not like to feel bound to attend a seminar at a specific time. There are exceptions. Online college level mathematics classes (Kaplan) as well as high school online courses (Veritas Academy) often schedule synchronous seminars to enhance the online experience.

A one hour seminar can be extremely important in a low level mathematics class. Nevertheless, attendance seems to be mostly determined by a student’s personal lifestyle and work schedule. In addition, attendance is often dictated by an online instructor’s skill at using a single hour to clarify concepts found in an entire week’s lesson plan. This can be a daunting challenge. In a low level mathematics class we believe this time is best used by posing simple problems, waiting for each student to post an answer and then working through a step by step solution. By carefully increasing the difficulty of each new problem posed to the students, most students end the seminar with a real sense of accomplishment and self-confidence. Cheering (typed, of course) and student-to-student accolades are not uncommon and add a very rewarding dimension to online teaching.

Cooperative Learning

The distance education classroom might at first glance appear to prohibit team work and cooperative learning. This is not the case. Cooperative learning and teamwork is used in many online classrooms. In fact the University of Phoenix mandates that every course include some sort of team project.

The emphasis on teamwork should be no surprise. It is widely understood among online educators that student engagement through conferences, study groups, team projects and seminar participation are critical success factors. Students who remain isolated and unconnected drift away and invariably either fail the course or prematurely terminate their online educational journey.

In today’s world there are many ways to communicate besides in person. Student teams prefer to communicate through email and asynchronously conference links. Much less frequently they will use a WebEX or GoToMeeting tool to conduct synchronous conference.

4.0 SOCRATIC CAMPUS CLASSROOM

The Socratic campus classroom of the author has similarities to his online classroom. Use of the Socratic GM-Method, [8] developed by the author, begins in the freshman year during which students develop complex C++ or C# multi-game, multi-client, client-server gaming systems with centralized control and player asset management subsystems. (Figure 2) Almost all knowledge is gained through independent study much like it is in the online classroom. This presents enormous challenges in a highly technical field where a complex system project is undertaken. Since students know virtually nothing about programming at the beginning of the freshman year they must complete specialized programming exercises that develop basic programming skills at
an accelerated rate. Independent learning is the key to achieving this goal.

**Figure 2**
Casino DB and Floor Management Subsystem

Independent Learning

All GM-method exercises are designed for an independent learning environment whether that be in the classroom or online. The exercises foster a high work ethic, rapid absorption of knowledge and demand immediate application of advanced concepts. They are designed to appeal to the psyche of a generation of students who love computer games, are always searching for knowledge on the internet and are comfortable in collaborating with others as a result of their experiences playing multi-player games on the worldwide web.

Even the first week’s Hello World exercise (Figure 2) is utilized to motivate students to quickly reach beyond beginning concepts to find programming solutions that create more elegant and efficient solutions. In order to complete this first GM-method assignment students have to research, explore and master concepts that would normally be discussed six to seven weeks into a typical beginning programming class.

By Week 3, a console version of the Cellular Automaton (CA) exercise (Figure 4) is used to build self confidence, develop skill crafting algorithms, and experience searching for elegant solutions. For example, once a CA solution is found using two arrays students are encouraged to craft a solution using one single dimension array.

Under the GM-Method students are shown no faculty code solutions nor are faculty lectures given on any technical subject until the students have independently crafted their own solution.

Students are provided an executable which allows them to see what they must create. They can run the program as many times as they wish but no code is revealed.

**Figure 3:**
CS1 Hello World

A specification (Figure 3) is also provided which identifies sources for the knowledge they must acquire as well as a scoring rubric which is used for assessing student work and assigning a grade. High scores are based on functional completeness, on time delivery and technical sophistication. These, of course, are all the things that matter in the workplace.
The Laboratory

What role do faculty members then play when using the Socratic GM-Method in freshman courses? Faculty members work with students individually in a laboratory setting. Difficulties, code solutions, software engineering principles and problem solving are discussed mostly one on one. Students are also encouraged to collaborate with one another much as they do in online discussion boards. Students are allowed share code solutions with each other much as they would in the workplace. The faculty member, however, remains a knowledgeable inquisitor and questioner and thus, does not provide students with code solutions. Traditional lectures are inappropriate and incongruent with a Socratic modality. Students are never given “the answer” to a problem. It is very important that students learn that they must find a solution themselves. There are no professors in the workplace to provide answers. Links of interest, debugging ideas and innumerable other tidbits of knowledge can shared without violating Socratic principles. In this way students learn to be self-sufficient and they develop self-confidence quickly.

In many ways programming is one of the easiest disciplines to convert to a Socratic or online format. Young programmers are adept at web communication. Even in the traditional classroom they use online forums and web resources to search for answers, to engage experts and to seek the knowledge they need to succeed. Code examples are abundant on the web as are answers to innumerable problems and programming dilemmas. In a traditional classroom students are allowed to engage one another electronically as much and as often as they would do if they were enrolled in an entirely online course.

Teamwork

Teamwork seems to come naturally to the web generation. The feeling of awkwardness, or shyness experienced by many young people is much less evident in programming classes. Esteem and respect is based on competence and helpfulness not on personality, clothing or social status.

Figure 4
Cellular Automaton

Good teamwork, one of the fundamental requirements in a successful workplace, also seems to be one of those strategies which can lead to more meaningful student experiences as well as raise the self esteem of many students, especially those who are technically skilled but socially restrained. The positive interdependence that develops among GM-Game developers seems to be one of the primary reasons for student success. [15] The research literature also suggests that a student’s feeling that he/she is liked and accepted by fellow team members is also essential. [16] Performing well on a team is the best way to be accepted in a professional or academic setting. In fact, it is known that peer acceptance is so important that a student’s performance tends to gravitate toward the achievement levels of his or her close friends. [12, 15] Teamwork has been shown to foster energy, enthusiasm, commitment and content retention when students master the material in order to benefit others. [19, 20]

The Socratic classroom is an ideal environment to cultivate and harvest the benefits of teamwork. This is true in both online and traditional campus classrooms. We have found no barrier to team success when teaching online.
Even though GM-method projects can be very demanding (Figure 5), the Socratic GM-method is, thus, based upon a large body of academic research which supports the notion that non-traditional classroom methods can radically improve student performance and result in spectacular performance. [9, 11, 13, 14]

5.0 RESEARCH FOUNDATIONS

The manner in which GM-Games and the GM-Method are utilized in the classroom [6-9] simply represents another step in a long history of Socratic and active learning educational methods. The method is also an attempt to combine “game play” concepts and educational theory into the classroom experience.

The R. L. Moore Method

R.L. Moore was one of the 20th Century’s strongest and most successful proponents of a Socratic method called the discovery method. [13, 14] Well over 1600 PhD mathematician descendents have emerged to be a part of the enduring legacy of Professor Moore’s work. During the 40 year period 1915-1954 descendents of R. L. Moore were producing journal articles at a 50 to 150% higher rate than graduates from virtually every other educational institution. [13] How was this possible? Moore summarized very succinctly the philosophy leading to this amazing performance by his students: “That student is taught the best, who is told the least.” [3] Under the discovery method, “the instructor plays the role of coach, mentor, collaborator, guide, and occasional cheerleader”. [13] We have incorporated many these ideas into the GM-Method.

Similarly, we have incorporated the R.L. Moore philosophy of independent study for content mastery. We are not alone in this regard. Other educational researchers have confirmed that effective courses are those that are designed to enhance student self direction and self study. When faculty use GM-Games and GM-Method their ‘expertise in teaching lies not so much in … subject knowledge …as in her/his focus on student learning’ [1] We believe that instructors should participate in technical discussions with students, but almost never propose solutions. So we also have adopted R.L Moore perspective that “the instructor plays the role of coach, mentor, collaborator, guide, and occasional cheerleader”. [13]

6. A CASE STUDY

The impact on students with a mediocre record of academic performance is one of the most surprising and encouraging outcomes of using this variation of the Socratic method. We share two rather amazing cases.

In high school Peter S. was an undistinguished student who made his first foray into college with little idea of why he was there and decided to withdraw before his freshman classes even began. He subsequently worked in commercial retail for several years. This led to a life changing epiphany. He concluded he did not want to work in retail at $7.00 an hour for the rest of his life. He decided to return to college.

During his freshman year he began to study computer science under the GM-method. He immediately began performing at a remarkable level. He and his team develop a fully commercially releasable video casino system in C#.Net by the end of his freshman year (Figure 1). During his sophomore year he recreated the
German WWII ENIGMA encryption in assembly language. (Figure 6) As a result of this kind of work, Peter was offered a prestigious internship at the National Security Agency, which he declined.

He and another student created the 3-D ATTACK SLUG multi-player tank game (Figure 5) during his sophomore year as well.

During his junior year he did amazing work in the medical domain and presented a solution to the medicine reconciliation problem to MASS General hospital scientists. His solution used middleware tools to signal alarms and synchronize events and databases from disparate physicians offices. Peter went on to do an important internship at Phillips Medical and now is in full time employment at a hospital in the Greater Boston Area.

Corey B. had a similar background and experience. He also was an undistinguished high school student. His freshman team also completed a major systems project under the GM-method and Corey completed the ENIGMA encryption project 1 month into the computer architecture class. He exhibited super star characteristics immediately. He was accepted into a prestigious summer internship at Electronic Arts (EA) after his sophomore year. He will return to EA after his junior year and undoubtedly will join several of his student predecessors as an employee of one of the most highly coveted game development companies in the world.

7. CONCLUSION

The Socratic method, whether used online or in the traditional, classroom, can lead to exceptional student performance. Students love to learn and they love to help one another. They are not passive sponges. A strong work ethic emerges when the challenge is great, the project is interesting, and they have the freedom to be collaborate and be creative.

The demanding nature of game exercises and complete gaming system development is a great benefit. Strong problem solving skills and rapid absorption of advanced programming concepts are a pre-requisite to student success. Student have no choice; they must absorb massive amounts of knowledge on an accelerated basis. Nevertheless, novices seem to rise to the demands when gaming is involved. Many if not most students want to develop games. Our experience reveals that programming exercises based on banking, administrative or manufacturing applications simply do not create the energy or enthusiasm necessary for accelerated learning.

Finally, we believe that game themed exercises alone are not sufficient to cause accelerated learning and extraordinary outcomes. The work of researchers in non-traditional instructional methods has been critically important to our efforts. The GM-method requires a significant departure from tradition. The research of others encouraged us to believe in our student’s capacity to learn independently and at an accelerated rate.

8. REFERENCES


[19] Slavin, R., *Cooperative Learning and the Cooperative School, Educational Leadership, Nov 1987*
