Teaching Technology to Web-affected Computer-game-influenced Students in the Early 21st Century: Hopes and Despairs

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This paper reviews many of the observed characteristics and study habits of first-year students in Iowa State University's electrical engineering program. Based on students' behavior in studying and problem solving, dominate characteristics are identified, strengths and weaknesses are reviewed, and critical symptoms that can affect students' learning in technical fields (as well as life-long learning) are highlighted. We analyzed the effect that the Internet and the use of computer games have on students' thinking and problem-solving approaches. Contrary to what many technologists believe, these effects are not always glorious and wonderful. This paper identifies some important issues that can hinder a student's future progress in any technical field and recommends remedies. Finally, after reviewing many of the major symptoms, and identifying the above-mentioned potential weaknesses and strengths, we will propose solutions to help students overcome these potential hurdles.

Introduction

One of the main purposes of the freshman engineering classes is to teach the first year students how to deal with engineering problems—get them familiar with the type, the working, the tools, and the knowledge base required of such problems. Interestingly, most students do not have enough background in mathematics, logic, science, and engineering to be able to solve more realistic problems. Hence, the first class of engineering for the freshmen is the class where the students get the basics, attain some hands-on experience, and are trained to establish good thinking, working, and learning habits to last them their entire engineering carriers.

Based on the author's experience in teaching freshman engineering classes for electrical engineering students, the typical students have wonderful understanding of computer tools. In general they have been exposed to more technological tools than any students before them; however, many of them have developed certain habits and general attitudes that are unique to their age. These habits and attitudes can be their greatest assets and/or liabilities, depending on the way they mature during the first year, and especially during the first term, at the university.

Our observations show that some of their general characteristics are definitely related to the fact that all during their junior-high-school and high-school years they have experienced computers, games, e-mail, chats, Web browsing, and spending aimless hours searching what is new and exciting on the Web. Consequently, the author considers the

main characteristics of the students to be Web-affected and computer game-influenced. This paper will identify and discuss such characteristics and the critical issues concerning their behavior. Finally the paper provides ways to help the students overcome some of the unconstructive attitudes.

Freshman students and the university environment

Perhaps the most important change that the students go through when they enter the university classes is the difference between teaching and education. The universities are in the business of education, not necessarily teaching. The difference may not seem that great, but the slight change of focus makes a huge difference in perspective. Teaching is teacher or educator centric. The teacher is responsible for the students' knowledge, understanding, and practice. If the student does not perform in a teaching environment, most, if not all, of the blame is focused toward the teacher (the educator). In teaching environments, the educators are usually required to have certain types of certificates to teach. This premise by itself identifies the role and responsibilities of the teachers. In such environments, just by being in the class and doing the activities students will learn a great deal, and the bright ones may find they need very little out-of-class time to learn the material and get ready for the tests.

While there are great stories of success in such an environment, it should be noted that the universities are not in that business. Universities are in the business of education, which is learner centric. Teachers and educators try hard to provide the best environment with the best presentation and up-to-date information available, but it is the responsibility of the students to do the required reading and problem solving. The students are supposed to keep up with the class work, much more so out of class than in class, to read, learn, practice, and cooperate with others to make sure they understand the material. Such environments that exist in almost all of the universities are learner centric. It is the learners' (students') responsibility to make sure they work hard, ask questions, see reference material, do research, and get what they need to learn. If the students do not learn, it is really their own fault. Lack of systematic performance will result in bad grades in the few tests that the classes offer and eventually the final grades. The goal of the universities is to provide an environment that trains life-long learners—independent professionals who are self motivated and know how to learn new material.

It should be noted that the above point is the biggest problem that most of the university freshmen face. In the author's extensive interviews with a number of freshmen in engineering, they all mentioned that the teaching in the university is different. More than 90% of the students described the teaching as "bad," "not so good," "more complicated," "not understandable," "not at the right level," "chaotic," and "useless." Few of the better and challengeable students referred to the university-level teaching as "demanding," "too heavily loaded," and "really serious, with great expectations." Consequently, all of the students admit that the teaching in the university level is not the same and in general is not as clear as the high-school level.

Finally, a group of students who attended community colleges or other types of two-year college programs also indicated that the university-level teaching is not easy and not the same as the "colleges" that they have attended. After investigating the types of classes that they took in the community colleges, the author concluded that in all cases the community colleges were more inclined to a teaching-centric environment than a learner-centric one.

In the new and complicated university environment, the learners' behaviors, habits, and characteristics are of vital importance in making their university years fruitful, beneficial, and successful. The author feels that if each individual student understands the meaning of a learner-centric environment when they are exposed to it, then with a reasonable effort of the freshman engineering team, most of the students also identify their strengths and weaknesses for creating systematic learning habits in order to benefit fully from their college years and become successful. However, to find their way students need to work with more experienced groups to recognize and narrow down potential problematic habits and to develop constructive ones for a more beneficial learning experience of their own. In many schools a teaching team, consisting of advisors, professors, graduate students and undergraduate mentors help students with the challeng.

The students

Iowa State University is a land-grant school. In the Department of Electrical and Computer Engineering at ISU, we do not have any strict entrance requirement except passing grades from high school as well as reasonable interest in learning new material.

Consequently, ISU admits a wide variety of students with different backgrounds, interests habits, and behaviors. In general, a typical freshman class contains few national scholars, more than a few academic scholars, and the majority are the students who showed a reasonable understanding of science and math in high school. The most common trend between all of the students is the fact that they are all computer literate. They have experience with e-mails, chats, Web browsing, and, in particular, some type of computer-based games. Knowledge and comfort with the computer and using the computer for class projects is essential for the college life. So, one may look at the computer-based characteristics of the students and treat them as the most essential characteristics for success. It should be noted that due to the narrow, unsupervised nature of the students' computer utilization, some of the students have developed habits and characteristics that can hinder their progress in the university if they do not harness their talents correctly.

After careful observation of the students in the freshman class in electrical engineering, we can identify the following general characteristics that can be viewed as unfavorable for development of life-long learners. Please note that the identified characteristics are highly related and in many cases, by redirecting students' efforts, an unfavorable characteristic can become a great asset.

1. They are not challengeable.

In general, the students are not willing to accept challenges. When things are hard and the first sign of an unacceptable grade or class performance is seen, the first reaction of many students is to panic and quit. This usually manifests itself in a change of the field of study as well as dropping the class, changing schools, or just not working on classes any more and accepting the "defeat."

2. Students have no respect for any authority.

   Students do not have respect for or understand what an authority is. For them, an authority is one who constrains their activities and not someone who has more experience and is trying to help them deal with tough problems and mistakes. Consequently, they do not listen to the solutions, methods, and approaches that the teachers offer for their problems. One of the challenges of the freshman-year instructor is to establish him/herself as a trustworthy authority.

3. They have short attention spans.

   One of the most important symptoms of the Web-affected computer-game-influenced students is the fact that unless things are fun the students do not keep trying. So for a typical class, the continuous attention span is rarely more than 10 minutes. If the professor is not changing to another "interesting" item, approach, or presentation, the students don't follow the class.

4. They do not understand personal mastery.

   Perhaps the best definition of what is personal mastery was given by Peter Senge in *The Fifth Discipline*[1] and *The Schools that Learn*.[2] " Personal mastery is a set of practices that support people in keeping their dreams whole while cultivating an awareness of the current reality around them. This dual awareness of what you want and what you have often creates a state of tension that by its nature seeks resolution. The most natural desired resolution of their tension is for your reality to move closer to what you want. To do that an individual needs to develop a personal vision, the results one wants from life and the type of person one wants to be."[2] Then, through education, research, experience, and imagination, the vision changes and matures. Finally, as the person grows and creates a better reality in his/her mind in combination with his/her acquired skills (which includes the process of choice) the true nature of personal mastery is achieved. In general, except for a few students most students do not understand what this means. Unless guided through this by a more experienced person, they will not have much chance to practice having a vision, cultivating their resources, or working on and practicing their capabilities to become who they want to be—the person in their vision.

5. Students do not really understand the meaning of hard work.

Based on the effects of a computer-games mentality, what does hard work mean to the students? Hard work means the number of hours one spends on something. Generally, unless they thoroughly enjoy anything they do not engage in doing it. Consequently, they are not willing to do the routine, exercises, and practices in order to develop their skills. A typical student would say, "I played this game for 5 hours straight!" They do not have an understanding of practice to make perfect in real life, but are willing to do that in their computer games over and over. This is an interesting characteristic, and one that shows a dual behavior. If cultivated right, the capability is there to do a focused activity for a long time. They seem to have the attention span for things that they define as fun! However, the challenge is to make the learning, understanding, and practicing the basics fun!

6. They think that there is always someone better than them regardless of their efforts.

    One of the most interesting attitudes that most of the students have is this item. The fact that they have learned, from their experience on the Internet, that there is always someone out there who is better than them. In order for them to know about something, they just need to do the right thing and stumble on the right site. While most of them are interested in being number one, they have also accepted that there is always someone better. Some of the most competitive students can utilize this characteristic to learn more and become better; however, most of them use this knowledge for finding facts and sometimes utilizing the Web expert to solve their challenging homework. In a few cases, the authors' students have done Web chats or newsgroup postings to get difficult homework done. They spend a huge amount of time on the Web and solve the problem without really thinking about how they would go about solving similar problems. When the author asks for their reason, they mention that there is no point in working so hard when the answer is out there. They were sure someone had done it better than what they would be able to do, so they looked for the information and found it!

7. If they find it on the web, they can use it as it is.

    This is currently one of the most important problems hindering their understanding of learning and knowledge. For most of the students, based on their background, the belief is that learning is the process of getting information and remembering and repeating it. That has been reinforced in their high schools. Learning for them is remembering the facts, and tests are the practice of proving the retention of the facts that they have studied.

    When they are assigned a project for which they need to do research, most of them believe that if they have the information that is needed they are done. Some would mention, "Why should I really know if I know where to find it on the Web?" When they need to do a project, they surf the Internet and do enough searches to find what they think is "cool." Then, in most cases, they just copy the material from the site. This is done regardless of copyright issues (after all, the

Internet is free and public domain) and with a complete lack of understanding of issues regarding plagiarism.[3]

8. They think if they find it on the Web they know it.

    This is closely related to the previous point. Most students think once they find it on the Web they know it. They get their bookmarks organized and back them up—that is their knowledge base. When asked for the material, some will just bring you the printed version site or copy right off the site and include it in their reports. As the demand for their time and efforts increases, this problem will hunt them more. Unless dealt with correctly, with decisive action from the teacher in the freshman year, this great research tool (the Internet) will be wrongly utilized for the rest of their careers. One of the goals of the educators in the freshman year has to be giving the students guidelines and practices for efficient, ethical, and professional use of the Internet.

9. Students can waste time on e-mail and chats and not spend time studying.

    Perhaps the most threatening item for each individual student is not having parental supervision and wasting time with aimless socializing/e-mail/chats over the Internet. This is done instead of studying, working with peers, working on and identifying common problems they have in their classes, daily activities, homesickness, etc. The author's observations indicate that most of the students who did not achieve satisfactory results in their classes during the first two terms did not study systematically. In fact, the main item on their agenda of the day was doing e-mails and chats on their computers. They would engage in these activities for hours and sometime for whole weekends.

    In a few cases, when most of the chat group was in the same class, the students were encouraged to get together during the weekend. In all of the cases, experience showed that once they socialized on a face-to-face basis they planned study sessions as well as fun sessions. Consequently, in the electrical engineering freshman classes the emphasis is on teamwork to get students of the same interests and classes to socialize and organize their activities together—and the more get-togethers they have, the more the team gets successful results.

10. Students are getting used to half-done, telegraphic-communication-like e-mail and chats.

    Somehow, the students are getting used to incomplete work. They can do bullet point ideas and try to get the most important part of the information in their assignment as well as presentations. When asked to organize the material in a complete package, they resist and go through a real painful process, and most of them will not finish with a coherent work. While it may not seem important the author believe that this can result in future career problems when doing professional reports, technical papers, or social/political activities. The society

does expect the educated to have reasonable writing and communication still in a formal manner.

11. They do not know and nor do they respect classics.

They have developed strange views about the classics. They do not realize that the classics are the basis of most of our knowledge. When asked about the Declaration of Independence, instead of remembering the books and pages they have read they remember the cartoon (time squad). While this is always true for the new generations, the lack of systematic work, systematic reading, and respect for the authority and learning from the past is what these students are totally ignoring. As a result, they do not have any patience to understand the need for complex numbers and phasor theory, which are considered essentials for electrical engineering. Perhaps the best way to teach them the classics is an approach that is more application based, a story and case-study base. To teach them a complex number, they need to know why that is needed and perhaps be confused about how to handle a quadratic equation with negative numbers under the square root. It should be noted that in most cases the new generation stops and listens to the old generation when they are faced with problems that they cannot handle. When times get tough, and they need to get things done, they are more ready to listen.

12. Students do not know how to learn—they just know how fast and how fun things are.

One of the tasks of the educators of first-year students is to work with them and let them find the fun of learning. The issue for many of the educated people is that the process of learning is not easy—sometime it is hard and painful, especially when constraints, tests, social life, and lack of background interfere. However, we all engage in the process because we believe that it is fun to know, to seek, and to learn. The first class of engineering at the freshman level needs to bring this point to the students. This should be done with patience and great passion, knowing that most of the students are totally clueless about this point.

13. Students give up easily.

Another symptom is the give-up factor. While very related to the first point, this is a very unique characteristic that demands special attention. The students give up very easily when the going gets tough. Basically, in their background the worst that happens is that they need to change the game and get "three new lives!" They give up in the middle of the freshman engineering class and decide they do not want to study the particular engineering discipline that they are signed up for. In many cases, they talk to friends and change the field overnight, without enough knowledge about the new field. This is very similar to downloading another game and trying again.

In this mentality, the ones with a better background in math and science give up easier. They believe that they have proven their talent. Consequently, when they cannot get it, there is something wrong with the subject or presentation. However, instead of finding the problem, they change the problem and in many cases change classes, fields, or schools. This behavior reminds the author of a great, bright fellow down the street from our house. When my son downloaded a new game and it was hard, he asked this fellow to help with the new game. The bright fellow tried couple of minutes, made a few clicks at different points, and could not get anywhere. He said "This is worthless, too difficult. Even 'I' could not get through it after so many clicks. Here, let us download a better one."

14. Students do not seek to find.

   Most of the students have not been trained to seek and find. They do not like the confusion that exists during the learning process. However, this is the necessary condition to become lifetime learners. They need to be encouraged to seek and find. They need to be rewarded for their positive strides toward the goal. The author has found that the best way to help them is to try to catch them doing the right thing and let them know and reward them. This positive reinforcement is the best way for these students. In general, negative reinforcement has much less effect and sometimes an unsuccessful result on our current student population.

15. They cannot fail and do not know what to do to win.

   Another important item in their shortcoming is the process of learning from mistakes. Most of the students identify mistakes with failures. Since most of them have not been in real challenging positions, they have never understood what failure is and how to handle it and learn from it. Consequently, perhaps going through the first term of university classes with mathematics, chemistry, and physics is a good enough learning experience! In these classes it is hard to always do well. So we need to be there for them and, step by step, show them how to learn from bad tests and how to handle such unsuccessful attempts.

We should also remember that almost all of the above-mentioned items should be viewed from a constructive angle and used to help improve the students' habits and behaviors. At this point we should ask if there is any positive side to their habits, beliefs, and behaviors. Following are the points that the author believes are the positive aspects of Web-affected, computer-game-influenced students.

1. They have teamwork experience.

   In general they have done a considerable amount of teamwork and are comfortable with it. This was one of the most practiced aspects of their K-12 years.

2. They can do Web searches.

   They have a good understanding about how to search on the Web. They are not efficient and do not have the filters to know the good from the bad. One of the goals of the first classes in the university is to help students develop better search skills, help them know how to filter the good and not-so-good material, and help them learn from the Web and not just bookmark.

3. Students can learn computer-related tools really fast.

   They learn computer-related tools much faster than any other generation and are willing to spend hours on it. This can be and has been used by some educators to help some students learn through game-type lessons. While they do show some great success, that type of learning needs to be accompanied with maturity of working discipline and some traditional learning as well as development of reporting and working on their writing skills and expression.

4. They understand the value of communication.

   Strange as it may sound, the author believes that in general students have some very interesting notions about communication. They have their own favorite games. In almost all cases there are sites, magazines, and other sources of information where players write the tricks about the game. Kids of all ages are constantly looking for ways to get more points in the games and do more fun stuff. Such magazines and sites provide a way of communication with others with the same interests. This is a wonderful practice of communication, professionalism, and learning from others. However, it should be consciously explained to the students. Consequently, the students have a correct understanding of how to report their findings to focused/trade publications. If utilized right, the author believes this is the foundation of undergraduate research and the most important pillar that self-learners need to have.

5. They are natural in finding what they enjoy and what they are good at.

   They are much more suited to find what they are natural in. They claim that they do not want to work "hard." Meanwhile, they work hours on their favorite games and read sites and books that they are interested in. If explained and expanded correctly, this is the basis of the old saying "Find something you enjoy. Then your days of working are over. From then on you enjoy your life."

6. Students would like to be more independent and behave that way so they can be.

   They would like to be more independent. This is very interesting because it is one of the characteristics that we would like our life-long learners to have. The first-year class should help students gain their confidence to learn independently.

7. They have proven to be natural self learners.

   They have experience being a seeker in the Web and computer-game world. Educators just need to shift their activities to the right subject. There are some of our colleagues who believe the whole education in the high-technology area should be game-based because in that arena most students are self-learners.

A special group

Finally, there are some special students that show interesting behavior. This group of students seems to thrive in all environments and seems to overcome the problems, learn from their achievements, and do better constantly. The author has tried to study their major characteristics, and following are the findings.

Some students are by nature great competitors. They are usually from high-school teams with a competitive nature. This can be sports activities or science fairs as well as other academic competitions. Such students have previously built-in attitudes.
- They do not give up and they keep going. In general they strive to "win" and are challengeable. The tougher the time, the more worthwhile their efforts become.
- They work hard, understand practice, and want to be on the top. They have a good understanding about how to learn, act fast, and use their knowledge as well as develop their basics.
- They are usually not the best team members when the team is not filled with motivated people.

Almost all of the background and interest of this group is the same as the general student population. So they prove that once the striving mentality and belief that they are going to do what is takes to get the job done is brought into their systems, the students begin to show success. Consequently, their paths to becoming self-learners will be well defined.

Some ways to help students succeed

Class presentations and activities need to be altered. The new students will do well if they learn the challenges and the joy of learning. In each field we need to find exciting applications and present the math, physics, and all basics as hand-on. Schooling needs to be much more application oriented. Perhaps case-based teaching, where we start the subject with a real application case and whet their appetites regarding the problem to be solved, would help them respect the background of the problem as well as help them appreciate the beauty of the solution. Hands-on teaching is the best way to get the students ready to learn the tools needed. When a diode is seen in action, and students play around with the components before even knowing any math and physics, they become like sponges when the relative tools and mathematical constructs are presented to them.

We need to get them to start appreciating practice and doing certain things over and over. The best way is to engage students in frequent, well designed, and focused group activities. When they see their peers in the same boat and same situation they talk, reduce their frustration with the university environment, help each other get used to difficulties, and in many cases help each other solve the problems. In such groups they would be willing to do things over and over for the benefit of the others.

When the issues of the behaviors of the students are presented to them with good examples, they listen and start to alter their attitudes and behaviors. One of the most successful approaches that has worked well for the author's classes has been developing the awareness about the good and bad university habits by letting mentors (second-year students who were facing similar problems the year before) talk to the current freshman class. The mentors represent a group with the same problems but who have successfully solved them. At the Department of Electrical and Computer Engineering, the electrical engineering learning community for the freshman students has utilized this method for two successful years.

Working with mentors on hands-on projects, as well as social activities and fun get-togethers, has been the greatest resource for improving the students' habits. During the mentor sessions, mentors help students know what good study habits are and what the common problems are, and in many cases the mentors have been paid by the college to have study and help sessions for the freshman students.

In general any activity that helps the students work together, share common plans and activities, and have a chance to openly discuss ideas with their peers and mentors who have gone through similar experiences has helped improve the students' habits.

Final remarks

Finally, it should be mentioned that building habits takes a long time and needs repetition, patience, and positive rewards. It is the faculty's role to help students develop good habits and let go of the bad ones, while trying to catch them doing things right—not to be to harsh on their mistakes and help them use those mistakes as learning tools. If there is one important item about this group of students, it is that they are motivated with positive reinforcement.

Future work

We would like to expand this practice to cover the whole student population and help students even in their second year to develop more professional habits and points of view as the goal for the future. The other important item is to develop more analytical measurement processes to evaluate different approaches for habit correction and adaptations. The ultimate goal of this study is to look at the learning styles and developing processes for improvement of each individual student based on self-

evaluation as well as continuous measurement by well-designed tests. Finally, as the students grow into the program, it would be interesting to do a systematic study to see the effect of the freshman engineering learning on their future carriers.

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