Session xxxx

HOT WHEELS®, BLACKBOARD AND LABVIEW – WHAT DO THEY HAVE IN COMMON?

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Abstract

After nine years of keeping away from freshmen, I taught an "Introduction to Engineering" course this year. Although I had undertaken the project with great trepidation, the course turned out to be one that I enjoyed teaching. In the lab, I introduced LabVIEW, a graphical programming language for data acquisition, analysis and presentation. The course was supplemented by the Blackboard Learning System on the web and Hot Wheels® incentives in the classroom. This paper reports on the introduction to LabVIEW in the lab, the enhancement that the Blackboard Learning System brought to the course and the effect of Hot Wheels® incentives on the class dynamics as well as the student design projects. It summarizes the programming topics I covered with LabVIEW and provides some examples of exercises in the lab. It also describes the activity that took place in the Blackboard site for the course, and concludes with a summary of the students' impressions of these new programming and learning environments.

I. Introduction

It started with a phone call: A department member was taking a sabbatical, one of the courses he was teaching could be covered by another professor if I could relieve this professor by teaching EGR 101: Introduction to Engineering. Anyone in academia would be familiar with this kind of a last minute course shuffle and I was not as surprised as I was horrified when I found out that my time had come. I, - teaching freshmen? I had done it in one of my previous lives, but had deliberately taught primarily upperclassmen for the last nine years. By the end of the summer, it was clear: I was teaching 101 whether I liked it or not. This paper will give an account of the new ideas I tried and the students' response to these enhancements.

One enhancement was the utilization of Blackboard, an online teaching platform which is an effective tool for web-based delivery of course material[1]. Although this platform is best suited for distance-education courses, traditional courses like EGR 101 also benefit from the use of this program.

The other change I initiated was the introduction of the students to LabVIEW, a graphical programming environment. LabVIEW is used in upper level courses that I teach: ELE 402 (Communication Systems), ELE 305 (Electromagnetics), EGR 316 (Control Systems). There is currently an ongoing project to convert introductory physics labs, which all engineers take, into a

LabVIEW-based environment. The "Solar Splash" project, Geneva's entry to a solar-energy driven boat competition, is monitored by LabVIEW. This wide use of the LabVIEW environment in the department justified the introduction of this program at the freshman level.

Another change (to the course as well as to my teaching style) was the introduction of an incentive system in which students received 1/64 scale die-cast cars as rewards for various achievements: for being the first to provide an answer, for 'going the extra mile' or for being the first to complete a lab activity. I had been introduced to the use of incentives in professional development seminars[2,3] in the form of treats, which never appealed to me. I preferred these incentives to reflect my personality. Diecast cars, on the other hand, have always fascinated me from the first time that I saw a Matchbox® Volkswagen 1500 Saloon in a shop window at Kadıköy, Istanbul, Turkey when I was in elementary school.

To achieve objectives 3 (engineering design process) and 8 (teamwork) listed below, a design project is part of the course requirement. In the previous offerings of this course, the students were allowed to form their own teams to but the project topic was assigned. This iteration of the course gave each team the freedom to choose its own design project.

A few weeks into the semester, I realized I was looking forward to meeting 'my' freshmen, especially in the lab. Midway through the semester, I started making mental notes on what to change the next time I offer this course – yes, I am willing to try again! This paper will concentrate on the changes introduced to the course and report on their effects. Section II will review the course and section III will summarize the level at which the Blackboard software was introduced. I will describe the initiation of freshmen to LabVIEW in section IV and introduce the student projects in section V. I will close with a reflection on the course and plans for future offerings.

II. EGR 101: Introduction to Engineering

Geneva College catalogue describes EGR 101 as follows:

> Introduction to engineering design and decision-making. Christian world-view applied to engineering. Use of logic, experimental data and design criteria. Project-oriented. First semester.

In line with this description and Geneva College's mission statement,

> [t]he mission of Geneva College is to glorify God by educating and ministering to a diverse community of students for the purpose of developing servant-leaders, transforming society for the kingdom of Christ. We accomplish this through biblically based programs and services marked by excellence and anchored by the historic, evangelical, and Reformed Christian faith. The curriculum is rooted in the liberal arts and sciences, vocationally focused and delivered through

traditional and specialized programs[,]

the objectives of the course, as listed in the syllabus are:

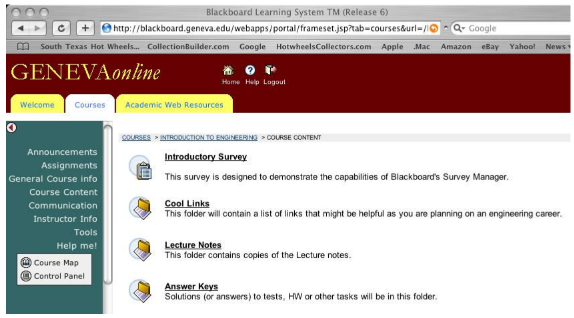
1. To introduce [the students] to a Christian perspective on engineering.
2. To develop a peer network to enhance [the students'] academic success.
3. To introduce [the students] to the engineering design process.
4. To develop and guide [the students'] creativity in the context of engineering design.
5. To introduce [the students] to the civil, mechanical, and electrical engineering professions and the associated professional organizations.
6. To develop an awareness of the current technical challenges and advances at the frontiers of engineering.
7. To help [the students] identify [their] gifts and abilities and begin to develop professional goals.
8. To learn how to work effectively as a team member.
9. To develop skills such as time management, study groups, and study techniques.
10. To understand and develop good communication skills (graphical, written, and oral) and recognize their importance in engineering.
11. To introduce selected topics in engineering science as related to specific design and research projects.
12. To develop skills in locating information resources (library and other).
13. To introduce some of the computer tools and laboratory equipment available in the department.

The list of objectives is a tall order for a course that meets for two "lectures" a week, on Mondays and Fridays and a three-hour lab period on Wednesdays. Traditionally, the lab periods have been used for special topics related to the design project in the beginning and to the planning and construction of the project in the latter part of the semester. The lectures are focused on the subjects from the textbooks[4-6] and some in-house papers. Topics covered in the lectures are: 1) Team Work, Personality Type, Conflict Resolution; 2) Keys to Success; 3) The Engineering Profession & Engineering Careers; 4) What is a Christian Engineer?; 5) The Engineering Design Process; 6) Needs Assessment; 7) Structuring the Search for the Problem; 8) KT Situation and Problem Analysis; 9) Acquiring and Applying Technical Knowledge; 10) Abstraction and Modeling; 11) Design Analysis; 12) Intellectual Property and Technical Information; 13) Basic Engineering Economics – Time Value of Money; 14) Ethics and Product Liability; 15) Hazards Analysis, Failure Analysis; 16) Engineering and Society.

III. Blackboard Learning System

Although the Blackboard Learning System is most effective in distance-education classes, I appreciate the organization and ease of communication the system brings to traditional classes.

Blackboard works with a regular web browser, enabling me to publish announcements, the syllabus, course notes, homework assignments and homework solutions as quickly as I can prepare them (see Fig. 1) and even from the comfort of my home. The system's e-mail utility enables me to communicate with the students and the students with each other from any web browser. The students can track their progress through the system's gradebook. I can give out surveys and even exams (though I did not use this feature), using the system and have out-of-class discussions through the system's bulletin board.



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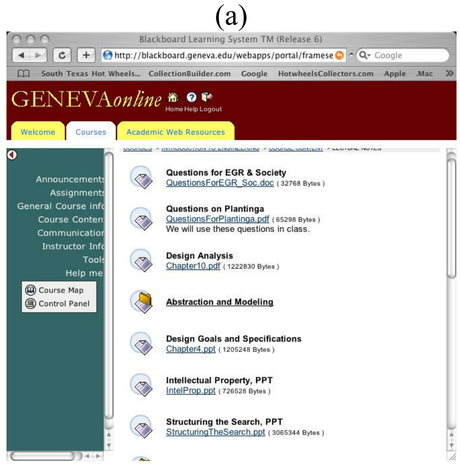

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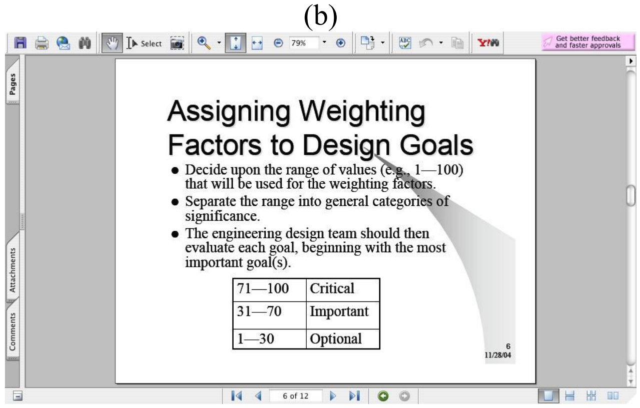

(c)

Figure 1:   The course content made available through Blackboard Learning System: a) Top level, b) Lecture Notes folder, c) Lecture Notes for Chapter 10 of Volan.

During the first week of classes, one lecture period was dedicated to Blackboard. The class met in a computer classroom and they logged into the Blackboard site for the course. The following activities were provided for them: Taking a sample survey, browsing internet links I had provided and sending me an e-mail message through Blackboard. Although the system has capabilities for electronic meetings and more powerful application sharing, I deemed this initial training sufficient at this level. After this session, the students were on their own to use the course site. In order to encourage them to check the Blackboard site regularly, a "question of the day was posted randomly as an announcement throughout the semester. The answer to the question was hidden in one of the folders of the course site. The student who got to the answer first and demonstrate this achievement earned a Hotwheels car.

IV. LabVIEW Exercises

LabVIEW is an acronym from the words "Laboratory Virtual Instrumentation Engineering Workbench." This software package is based on the concept of data flow programming and is particularly suited to test and measurement applications. The three important components of such applications are data acquisition, data analysis and data visualization. LabVIEW offers an environment which covers these vital components. One basic components of a LabVIEW *virtual instrument* (*VI* – LabVIEW's term for a program) is the *front panel*, which is a window for the user interface where exchange of data with the end user of the program occurs. The other is the *diagram*, which is another window that describes how inputs from the front panel are to be processed to achieve the outputs using a graphical language similar to block diagrams. LabVIEW front panels offer the user means of input in the shapes of knobs, sliders, switches, and other devices commonly found on laboratory instrumentation as well as means of output in the forms of gauges, meters, oscilloscope-screen type graphs, light emitting diodes and similar output tools, all contributing to a user interface that looks like a typical instrument panel. To introduce the freshmen to this powerful program, the class was divided into two groups of teams, who met in the engineering department's computer lab in alternate weeks. In their off-weeks, the teams worked on their design projects.

The topics covered were basic skills that would be the basis for further development in upper level courses. They were:

- **Introduction to LabVIEW**: The Front Panel, where students learned about the user interface.
- **The Block Diagram**, where they learned about the first steps in programming in this graphical environment
- **The Case Structure & Boolean Algebra**, where they learned about decision making in programs using LabVIEW's version of if...then statements and switches, as well as various Boolean functions such as AND, OR, NOR, NAND, XOR.

Graphical & Textual Formulae, where they learned about expressing mathematical functions both in a graphical setting and in special structure called the *Formula Node* that uses a C-like syntax.

Looping, where they learned about FOR loops and WHILE loops.

Each one of the topics was covered in one week except looping, which took two weeks. During each lab session, the first hour was dedicated to presentation of the topic on the projection screen with students following the instructor on their own computers. The last two hours were devoted to a mini project which the students completed under the supervision of the instructor. The student(s) who finished first earned a diecast car. The notes used were an electronic version of a past book aimed at freshmen[7] revised from a previous experience[8]. Figures 2 and 3 depict examples of student mini projects.

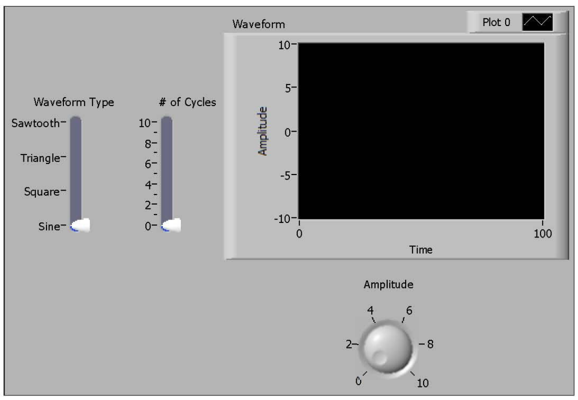

Figure 2: The front panel of a signal generator. The students designed this front panel in session 1.

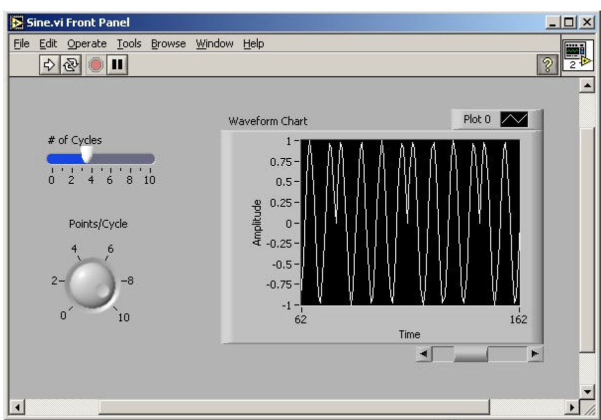

Figure 3: Front panel of a sine generator students implemented in session 5.

V. Student Projects:

Students were asked to adopt names for their teams. Some of the names they chose reflect the influence of diecast car incentives: π, *Dawtz*, *Group A*, ***Hot Seats*** (a Hot Wheels car inspired by a toilet), ***Hot Wheels*** (quite obvious connection), *King Tanyel's Engineers of the Round Table*, *Team Name*, ***The Audis*** (one of the team members had won an Audi TT for her unique answer), *The Odd Bunch*. After covering the topic of needs assessment, students were asked to pick a topic for their project. The topics chosen by the teams were: Self-Cooling Disposable Cup, Nonsmokers' Gazebo, Heated/Cooled Cupholder, Model Bridges, Sanitary Dispenser for Disposable Cup Lids, Catapult for the Dagorhir Club, The Jump Start (a shocking alarm clock), The Matchbox Autobahn, Side-Window Cleaner for SUVs. The freshman design experience followed the procedure for senior design projects: design proposal, mid-term design reviews and final oral presentations followed by final reports.

Figure 4: The presentations of The Jump Start (left) and The Matchbox Autobahn (right) projects.

The final design presentations were held during the last week of classes. The attitude varied from casual (Fig. 4, left) to semi-formal (Fig. 4, right) and the products varied from prototypes (Fig. 4, left) to hand drawings (Fig. 4, right).

Figure 5: Demonstration of the Sanitary Disposable Cup Lid Dispenser.

One project stood out among the rest: The Sanitary Dispenser for Disposable Cup Lids designed by the *Hot Wheels* team. This team chose a real need with a complexity level they could handle and did enough research and experimentation to produce a working prototype (Figures 5 & 6).

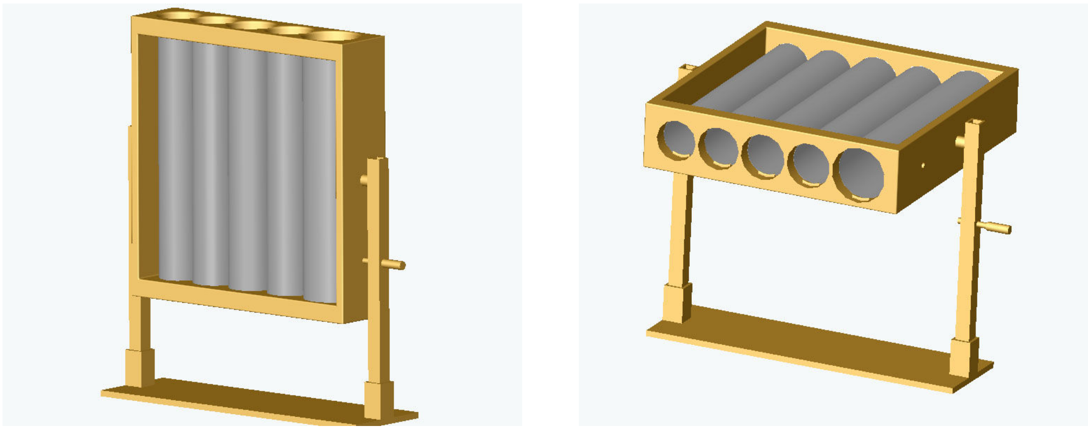

Figure 6: Solidworks 3-D drawings of the Sanitary Disposable Cup Lid Dispenser.

VI. Discussion

My initial trepidation to teach this course has been replaced by an enthusiastic planning for the next iteration of the course. To help with this planning, I prepared an on-line survey, which 15 students completed with the promise of a diecast car when they return to campus.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy working with computers.	20%	6.7%	20%	20%	33.3%
Before starting EGR 101, I enjoyed programming. *		6.7%	20%	13.3%	6.7%
Now that I've had an introduction to LabVIEW, I enjoy graphical programming.	6.7%	6.7%	33.3%	53.3%	0%
I feel confident that I can program simple engineering/scientific problems in LabVIEW.	0%	13.3%	13.3%	73.3%	0%
I appreciated the exposure to LabVIEW.	0%	0%	13.3%	60%	26.7%
I wish the LabVIEW sessions were every week, rather than every other week.	13.3%	6.7%	46.7%	20%	13.3%
I wish we could learn more features of LabVIEW ...	13.3%	6.7%	13.3%	60%	6.7%

*Table 1: Responses to questions on LabVIEW. *53.33 % of the responders had not had any programming. (n=15)*

Table 1 is a list of the statements probed and the responses obtained concerning LabVIEW. Before this course, 20% of the responders enjoyed programming while 53.3 % had not even been exposed to programming. After this brief exposure, 53.3 % enjoy graphical programming. I am pleased to find out that this brief exposure to LabVIEW has not turned them off. 73.3 % feel confident that they can program LabVIEW for simple technical calculations. It is my intention to increase this ratio in the future. 87 % of the responses indicated appreciation for the exposure to LabVIEW, while 13.3 % were neutral and none indicated disapproval. The results for the frequency and extent of LabVIEW coverage were interesting: only 33 % wanted to have LabVIEW sessions more frequently but 67 % wanted to learn more. On the surface these two responses seem to suggest they would like to cover material faster. However, the many remarks I got during lab time that I was going too fast for them weaken this reasoning.

Table 2 conveys the responders' attitude towards Blackboard and diecast cars. 80 % appreciated the exposure to Blackboard while none disliked it. 80 % thought Blackboard enhanced the course and 6.7 % thought it did not. 6.7 % thought Blackboard was more trouble than it was worth. 60 % thought the package could be used more effectively while 13 % thought it was just right. 27 % admitted to not having tried while 20 % thought they did. Surprisingly, 53 % wanted to learn more of its features. These results are consistent with my observations. The discussion boards had very few messages. Although each team had their own communication area, this feature was not used. In the future, I plan to emphasize the utilities that Blackboard has to offer to teamwork.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I appreciated the instructor's willingness to use Blackboard.	0%	0%	20%	26.7%	53.3%
The Blackboard site for EGR101 was an enhancement to the course.	0%	6.7%	13.3%	40%	40%
The Blackboard site could be used more effectively.	0%	13.3%	26.7%	46.7%	13.3%
Blackboard is more trouble than it's worth.	26.7%	46.7%	20%	6.7%	0%
I feel that I made use Blackboard to its full potential to the extent that it was made available to me.	6.7%	20%	53.3%	20%	0%
I wish we could incorporate Blackboard into the regular lectures - to learn more about its use and to experiment with its capabilities.	0%	13.3%	33.3%	53.3%	0%
The idea of giving out Hotwheels/Matchbox/Maisto model cars was a good one.	0%	0%	13.3%	66.7%	20%

Table 2: Responses to questions on Blackboard and Hot Wheels®. (n=15)

The last question on the survey revealed that none disliked receiving diecast cars, which is no surprise. Some of the comments on the subject summarize their role adequately:

> "I loved the class for the Hotwheels. They were great!!! … The cars were a great way to get over our anxiety…"

"The model cars were a great ice breaker and really relaxed the class. It also shows that the teacher cares."

"Hot Wheels are so much fun! And they sort of relate to engineering, too."

My plans for the course, should I be asked to teach it again, fall in two categories: tasks that I will definitely carry out and changes that I am hesitant about. I will definitely keep revising the LabVIEW notes and provide a more comprehensive package on a CD instead of the intranet. I plan to hold more of the regular class sessions in the computer lab and try out the electronic classroom environment of Blackboard. Although the electronic classroom is meant for distance learning, it is a good means to get students excited about the package to get them to visit the site outside of class time. I would also like to involve other members of the engineering department in design projects.

While I agree with students that more coverage in graphical programming will be helpful, I wonder, just like they do, whether this should be at the expense of time for team projects. Weekly exposure to LabVIEW would be helpful not only in the amount of material that can be covered, but also in the retention of it. On the other hand, weekly computer labs will also take away the free time during which teams can work on their projects.

However, I would continue to use the model cars as incentives. As the students observed, they were a great ice breaker. They enjoyed receiving the diecast cars and competed, on the Blackboard site and during the LabVIEW projects, to earn them. One third of the team names had a diecast car theme. One project was dedicated to diecast cars. The model cars also allowed the students to see their instructor not only as a professor, but also as person with passion for cars and as a father of two young children. Moreover, it was so much fun to shop for cars and it was fun sharing them!

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