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A Distance-education Model for Project and Lab-based Courses

Dr. Suresh Kumar Jayaraman, School of Chemical Engineering, Oklahoma State University, Stillwater, OK 74074

Suresh Kumar Jayaraman completed his Bachelor of Technology degree in Chemical Engineering from SSN College of Engineering (Anna University) in 2009. He completed his Masters in Environmental Engineering at the University of Houston in Spring 2011. He is graduating with a PhD in Chemical Engineering from OSU in Fall 2015. His areas of specialization include process modeling, optimization and advanced process control. He also taught Engineering Computer Programming course for the past 4 years. After his PhD he wants to gain insights and first-hand experience in the industry and then make a switch to academe. He is really passionate about teaching and thinks teaching can bring about massive changes in this world.

Dr. Jennifer Robinson Glenn, School of Industrial Engineering and Management, Oklahoma State University

Dr. Jennifer Glenn is currently a Lecturer in the School of Industrial Engineering and Management (IEM) at OSU. She attended Oklahoma State University, earning bachelor's and master's degrees in IEM. After graduating from OSU, Jennifer continued her education at the Georgia Institute of Technology where she earned her M.S. in Statistics and a Ph.D. in Industrial and Systems Engineering. She currently teaches IEM courses at the undergraduate and graduate level in the areas of quality leadership, engineering economics, Visual Basic and service systems. In 2012, she was named the CEAT Diversity Faculty of the Year, and she is currently advisor to the Society of Women Engineers.

Dr. Karen A High, Clemson University

Karen High is the Associate Dean for undergraduate studies in the College of Engineering and Science at Clemson University. She also holds an academic appointment in the Engineering Science and Education department and joint appointments in the Chemical and Biomolecular Engineering department as well as the Environmental Engineering and Earth Sciences department. Prior to this Dr. Karen was at Oklahoma State University where she was a professor for 24 years and served as the Director of Student Services as well as the Women in Engineering Coordinator. She received her B.S. in chemical engineering from University of Michigan in 1985 and she received her M.S. in 1988 and her Ph.D. in 1991 in chemical engineering both from Pennsylvania State University. Dr. Karen's educational emphasis includes: critical thinking, enhancing mathematics, engineering entrepreneurship in education, communication skills, K-12 engineering education, and promoting women in engineering. Her technical work and research focuses on sustainable chemical process design, computer aided design, mixed integer nonlinear programing, and multicriteria decision making.

A distance-education model for project and lab-based courses

Abstract

Recent increases in engineering enrollments have spurred interest in developing course structures that can increase both the efficiency and effectiveness of course delivery. This need is particularly acute in project and lab-based courses. One potential model is to convert the traditional learning environment to an internet-based e-learning system. Such an e-learning system can be structured to be essentially independent of class-size, time, and geographic location. Online courses also mimic the realities of industrial projects in that teams of global multidiscipline engineers interact via the internet. Universities are engaged with trying to replicate this online, multidisciplinary experience for their students.

In the project described here, a beginning multidisciplinary engineering course, the e-learning concept was applied to "Engineering Computer Programming" (ENGR 1412) at Oklahoma State University. This course is a 2-credit course, with a lecture session to introduce programming and engineering concepts, and a lab session to give hands on experience for programming to the students. Help sessions were conducted by Graduate Teaching Assistants (GTAs) to assist students on projects, quizzes, and exams. The course projects were designed to introduce principles from various engineering disciplines to the students. Every problem in the course project focused on a specific component of the engineering design cycle, such as researching, modeling, implementing, measuring, and communicating. Herein, we address the transition of a project-based course, ENGR 1412, from traditional methods to internet based e-learning systems, where lectures and lab sessions are video recorded, and exams, assignments and help sessions are handled online. This transition was done in step-by-step fashion in order to gauge student response and performance in incremental fashion. We also address the challenges faced during the transition of this course, recommendations to overcome those challenges, and suggestions on how to implement a distance education program for any project-based or lab-based engineering course.

Exam scores and student surveys were used to evaluate the effectiveness of this internet-based e-learning system. The transition from paper-based examinations to online examinations has increased the class average on exams by 6% for a class of 310 students. Further, the students have taken surveys twice during the course, and both the midterm and final course evaluations favored the online exams and video lectures. In particular, students found the video lectures to be extremely helpful, as they can review the lecture content, as needed, to understand the concepts.

Keywords: E-learning, project based courses, distance education, engineering

1. Introduction

Multidisciplinary projects pave a way for students to interact with others and learn to work on real-world problems as a team.[1] Olsen et al., have elaborated on the evolution of interdisciplinary curriculum strategies as a part of integrated design experience.[2] Reeves et al., have discussed various student engagement techniques to multidisciplinary online engineering laboratories.[3] Interdisciplinary projects are important to develop communication and interpersonal skills in students.[4] ABET accreditation requires that students work in multidisciplinary teams.

Online learning has received great visibility since its inception. It is an excellent way to provide students with course content in multidiscipline classes. Online courses have experienced increased student enrollment from 10% to 29% over the last decade.[5] The advantages of online learning include: increased flexibility in working time, reduction of cost and time of commuting, accommodation of more students, efficient way of learning and testing, and decreased student to teacher ratios. The literature reports outcomes of various online course, specifically the meta-analyses comparing online and face-to-face courses reveal that there isn't any difference between the overall structures in the two types of courses, but there is a difference in the outcomes of the courses. Various authors have reported both the best and worst outcomes of various online courses compared to face-to-face courses, where positive outcomes are strong compared to the negative ones.

The positive outcomes of online courses have led educators and researchers in engineering education to continue expansion of online learning from K – 12 educations to higher education. A series of technology-based classroom initiatives such as Carnegie Mellon's Open Learning Initiative, Western Governors University, and National Center for Academic Transformation has received attention from postsecondary educators.[6] In addition to classroom initiatives, various private institutions like KhanAcademy, Lynda, Coursera, EDX, Datacamp, CodeAcademy are offering Massive Open Online Courses (MOOC) in the form of websites for both undergraduates and graduate level students. KhanAcademy, Coursera and EDX have MOOCs from various universities and offer courses on various topics not limited to arts, math, science, social science, economics, and finance. Lynda, DataCamp and CodeAcademy mainly focus on various programming languages. Some of these MOOC also offer practice sessions for students to familiarize themselves with the content.

Jaggar discusses how underprepared and low-income students could benefit from the online education, in terms of academic outcomes like student's course enrollment, completion of the course, and performance.[6] Allen and Seaman use the term "online" for completely online courses and "hybrid" for partially online courses.[5] A hybrid course is also referred as a blended or flipped course. Frolik et al., discuss how multiple universities can collaborate to develop portable and adaptable online course content to cater to a large volume of students.[7] Bozkurt et al., have developed a framework to structure methodology for the design, development and delivery of either a brand new online course or one modified from an existing face-to-face course.[8] Smith and Mitry concluded that e-learning will never reach its true potential if course administrators dilute the academic standards.[9] Berry presented research to compare the efficiency of offering an electrical systems course online compared to the regular course structure.[10]

Most of the online courses reported in the literature are limited to theory courses in Science, Technology, Engineering, and Math (STEM) fields. This paper discusses the transformation of a project and lab-based course from completely face-to-face to a hybrid (or blended) to a completely online structure, and reports various findings and struggles faced during the process. Detailed description of the engineering course chosen for the study and multi-disciplinary nature of the course with respect to projects, team work and departments is explained in the

methodology section. Outcomes of various assessments and surveys conducted during the course transformation are discussed in the results and discussion section. Recommendation and implications of online e-learning system in engineering education are included in Section 5.

2. Methodology

Transition of a project-based course from traditional methods to hybrid to Internet based e-learning systems is discussed in this paper. "Engineering Computer Programming" (ENGR 1412) is a multi-disciplinary 2-credit course offered to a wide range of engineering students from various departments like Chemical Engineering, Electrical Engineering, Industrial Engineering & Management, Mechanical & Aerospace Engineering, Biosystems & Agricultural Engineering, Civil Engineering, Petroleum Engineering, and Fire Protection & Safety Engineering at Oklahoma State University. The course mainly focuses on Microsoft Excel and Visual Basic for Applications (VBA) with a lecture session to introduce programming and engineering concepts, and a lab session to give hands on experience for programming to the students.

The course instructor handles the lecture sessions and lab sessions are handled by the Graduate Teaching Assistants (GTAs). The course enrollment number varies from semester to semester, anywhere in between 300 to 500 students. Based on the enrollment number, the count of GTAs varies from 10 to 16. The class is divided into sections of 20 students each with 2 GTAs per lab session, where a primary GTA runs the lab and a secondary GTA helps the students. Help sessions are conducted by GTAs at least for 20 hours a week, to assist students on projects, quizzes, and exams. In addition to help sessions, Structured Learning Assistants (SLAs) hold after hour help sessions for any additional help. SLAs are undergraduate students who enrolled and excelled in this course in the past are hired to run help sessions to assist students with their projects and quizzes. Interactive online discussion forums are set up on Desire2Learn (D2L) site for any quick help on the projects. D2L is a learning management system used at Oklahoma State University. The course schedule from Fall 2014 is attached in Appendix A.

Students are assigned a final grade based on their attendance and performance on projects, quizzes, midterm and a final exam. Being a multi-disciplinary course, projects and quizzes are designed to introduce principles from various engineering disciplines to the students. Some of

the concepts from the past include, Reynolds number, stress – strain curve, parallel and series electric circuits, binary and decimal conversions, friction factor, vapor pressure models, model development using population balance modeling and dimensionless numbers. Projects are worth 50 or 100 points based on the difficulty level and content. Quizzes are worth 50 points, the midterm is worth 100 points and the final exam is worth 200 points. A group project is assigned towards the end of the semester, where students are encouraged to work as a group of 2 or 3. This group project helps students from various departments to interact and brainstorm on a problem, which reveals another dimension to the multi-disciplinary nature of this course.

Figure 1 shows the design cycle structure developed by Dr. Alan Cheville. Every problem in the course project focused on a specific component of the engineering design cycle, such as researching, modeling, implementing, measuring, and communicating. Researching is the process of exploring, understanding, or learning about the problem. The second step modeling, is to describe the problem using either quantitative or representational method. Implementing is the process of turning ideas, models, or concepts to a physical realization. Finally measuring is done to determine the performance of the system or design, followed by communicating the results so others can understand. The design cycle helped students to learn how to solve various engineering problems and communicate the results.

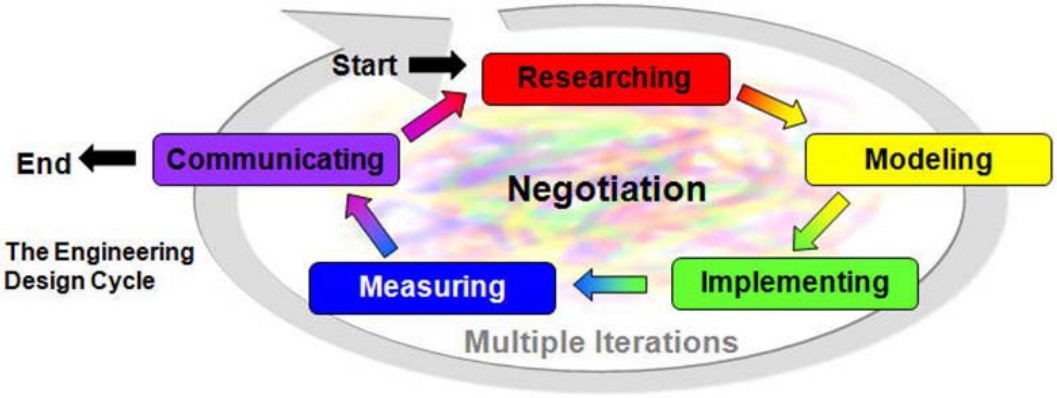

Figure 1: Design cycle developed by Dr. Alan Cheville

Table 1 shows the transition of ENGR 1412 from regular to hybrid to a completely online course structure. This paper uses the term “regular” when both lecture and lab sessions are face-to-face

and exams are conducted on paper, "hybrid" when the lab session is face-to-face, lecture is combination of both in class and online videos and exams are conducted completely online, and "online" when both lecture and lab sessions and exams are completely online. This transition was done in step-by-step fashion in order to gauge student response and performance in incremental fashion. There was a change of instructor in Fall 2014. The course was offered in a regular way until Fall 2014 along with posting a few short YouTube type videos demonstrating various components of MS Excel and VBA programming. These videos were welcomed by students, mainly because they were able to watch them again and again and use these videos as a reference when preparing for their quizzes and exams. As a result, these videos were repeatedly used every semester and students gave positive reviews as well.

Table 1: Transition of the course from regular to online structure

	Spring 13	Fall 13	Spring 14	Fall 14	Spring 15	Summer 15	Fall 15
Lecture	in class	in class	in class	in class	in class	online	online/in class
Lab session	in class	in class	in class	in class	in class	online	in class
Help session	in person	in person	in person	in person	in person	online	in person
SLAs	no	yes	yes	yes	yes	yes	yes
Videos	no	yes	yes	yes	yes	yes	yes
Exam	on paper	on paper	on paper	on paper/OMR	online	online	online
Surveys	no	online	online	online	online	online	online

Online
Hybrid
Regular

The enrollment number increased to 500 during Fall 2014, when grading and maintaining midterm scores for all 500 students became cumbersome. In order to make the system efficient, the final exam during the Fall of 2014 was conducted in the form of multiple-choice questions (MCQs) using Optical Mark Recognition (OMR) sheets. Grading and maintaining scores are automated when the exam was taken using OMR sheets. When the exam is done in the form of MCQs, it is difficult to assess student's capability in computer programming. So both the midterm and final exam were taken online during Spring 2015 using the D2L online quiz feature. The exam was made of MCQs, long answer programming questions, and true or false in order to test student's programming abilities and conceptual knowledge. Thus, we were more able to assess the students' programming knowledge.

Conducting exams online and the student's response to short videos gave enough merit for us to offer this course completely online for the Summer of 2015. Offering a lab-based course online isn't as common as any other theory course. But recent increases in engineering enrollments have spurred interest in offering lab-based courses online, so students can complete these courses while interning during the summer. Since the course was offered online for the first time, the enrollment for the course was capped to 20 students. Both lecture and lab sessions were recorded as a series of short videos and posted online every Monday. The research shows that the short videos are effective compared to the long videos. Students were able to watch all the videos and practice programming at their own pace. Since the course was offered for 8 weeks, a few changes like canceling the midterm and conducting finals for 100 points were made in the syllabus to fit the schedule, and projects were broken into smaller assignments. Students had assignments and assessments due every week to ensure they were keeping up with the pace of the course. Both lab and lecture videos were made short, typically less than 12 minutes to maintain student's attention. Help sessions were conducted using the Skype for Business tool, where students had face-to-face interaction and shared project documents with the GTAs. D2L features like the online quiz, discussion board, and drop-box were utilized completely for the course.

3. Results & Discussion

Table 2 shows the enrollment and average scores of projects, quizzes, midterms and finals in percentage from Spring 2013 to Summer 2015. The average midterm score from Spring 2015 is 5% higher than the midterm score of Fall 2014, this shows that the online exam is a better way of testing student's programming ability, compared to on paper exams. When programming questions on the exam are taken on paper, students tend to make spelling errors on syntaxes, and miss other steps such as necessary parentheses since they have no way to debug their program. But these mistakes can be avoided and debugging gets really easy, when the programming questions are taken on the computer. This way students get to execute their programs and check for the desired output. The online exams showed a positive impact on the midterm, but the average remained the same for finals indicating that exams taken using the OMR sheet were similar to the online exam. The online exams also help in mitigating paper waste, making

grading and maintaining scores time efficient and error free. The downside of conducting online exams includes technical glitches like server breakdown, poor internet service and logistics problems like exam proctor scheduling, and limited spots in testing centers.

Table 2: Average scores of projects, quizzes, midterms and finals from Spring 2013 to Summer 2015

Avg scores (%)	Spring 13	Fall 13	Spring 14	Fall 14	Spring 15	Summer 15
Enrollment	265	284	302	530	300	18
Project#1	93.89	92.52	94.44	91.60	89.01	90.21
Project#2	92.11	90.38	92.37	92.57	89.67	89.38
Project#3	89.86	86.89	87.41	90.04	90.32	87.92
Project#4	82.56	82.49	78.98	90.67	87.96	73.96
Project#5	83.99	85.64	84.49	89.26	92.18	69.43
Project#6	88.72	88.75	85.86	93.34	N/A	77.78
Quiz#1	91.16	94.89	94.18	92.22	92.27	81.48
Quiz#2	91.37	93.45	91.71	89.30	88.73	91.67
Quiz#3	92.19	87.90	92.64	88.50	90.97	81.85
Quiz#4	95.54	80.12	89.43	79.90	89.44	71.11
Quiz#5	N/A	N/A	N/A	N/A	73.08	85.00
Midterm	72.48	73.89	68.47	68.85	74.56	N/A
Finals	73.73	75.65	73.68	65.39	65.27	88.74

Table 3 shows the comparison of midterm scores of Fall 2014 and Spring 2015 using a single factor ANOVA test with 0.05 as significance limit. The null hypothesis is there is no change in average between online and on paper exams. The average of midterm scores increased by 5%. With a F-score of 25.01, the p-value of 6.96E-07, a score that formed the basis to reject the null hypothesis and conclude that the online exam made a statistically significant difference on the performance of the students in the course.

Table 3: Influence of online exam on student's performance in the midterm exam

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Midterm(Fall14)	530	36283	68.8482	218.6366
Midterm(Spring15)	300	22367	74.55667	302.5762

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	6229.679	1	6229.679	25.01293	**6.96E-07**	3.852755
Within Groups	205473.2	825	249.0584			
Total	211702.8	826				

Table 4 shows the comparison of final scores of Fall 2014 and Spring 2015 using a single factor ANOVA test with 0.05 as the significance limit. The null hypothesis is there is no change in average between online and on paper exams. The average of final scores remained the same. With a F-score of 0.708, and a resulting p-value of 0.7082, this formed the basis to accept the null hypothesis (state null hypothesis before this) and conclude that the online exam did not make a statistically significant difference on the performance of the students in the course compared to the exams taken using OMR sheet. However, the online exam is a better way of testing student's programming ability, whereas only conceptual knowledge can be tested in exams taken using the OMR sheet.

Table 4: Influence of online exam on student's performance in the finals exam

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Finals(Fall 2014)	530	34657	65.39423	236.1468
Finals(Spring 2015)	300	19575	65.25	272.0243

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	176.4087	1	176.4087	0.708177	0.400293	3.852714
Within Groups	206256.9	828	249.1026			
Total	206433.4	829				

Table 5 shows the percentage of final grades obtained by students from Spring 2013 to Fall 2015. The results reveal that the number of Cs, Ds, Fs and Ws have decreased in the hybrid and completely online course structures suggesting that students were more effectively to able to attain course content in the online format, thus earning higher grades.

Table 5: Percentage of final grade obtained by students from Spring 2013 to Fall 2015.

Percentage	Spring 13	Fall 13	Spring 14	Fall 14	Spring 15	Summer 15	Fall 15
Initial enrollment	295	320	320	578	329	20	470
Final enrollment	265	284	302	532	299	18	434
A	41.69	42.81	57.50	40.80	56.36	40.00	44.68
B	26.78	25.00	19.06	31.77	19.39	35.00	32.55
C	12.20	11.25	12.19	11.46	7.27	10.00	9.79
DFW	19.32	20.94	11.25	15.97	16.97	15.00	12.98

DFW – Students received either a D or an F in the course or withdrew from the course after the drop date.

In addition to the average scores, online surveys taken during the semester favored the short video lectures. Table 6 show that students used the videos on D2L quite often, mostly for their preparation for quizzes and exams. Students also used the sample projects, and other sample documents on D2L over the past semesters. These two pieces of feedback from the students

strongly suggested that this course can be moved completely online with the help of short videos and features on D2L. The result was seen in Summer 2015, when students used the videos and documents on D2L extensively.

Table 6: Percentage of students used online videos and documents on D2L

Question	Choices	Spring 13	Fall 13	Spring 14	Fall 14	Spring 15	Summer 15	Fall 15
How much did you use the videos on D2L	Extensively	24.74	17.89	18.15	7.02	20.26	60.00	5.85
	A lot	45.79	27.98	25.48	10.53	48.45	26.67	31.38
	Some	25.79	27.06	32.05	33.99	20.45	13.33	41.49
	Not at all	3.68	27.06	24.32	48.46	10.84	0.00	21.28
How much did you use the sample project memo and other sample documents on D2L?	Extensively	48.42	56.42	59.85	59.65	63.23	26.67	56.38
	A lot	41.05	31.19	33.20	29.82	26.54	33.33	32.98
	Some	9.47	10.09	6.56	9.65	9.45	33.33	9.04
	Not at all	1.05	2.29	0.39	0.88	0.78	6.67	1.60

Table 7 shows students' response regarding effectiveness of video lectures compared to in-class lectures and their liking toward online exams. The recent survey taken during Fall of 2015 shows that the students prefer video lectures compared to in-class lectures because of the fact that they can watch it any time and any number of times as well. Students were quizzed on video lectures to make sure that they watch the video and understand the concepts. The survey also shows that students like online exams compared to on paper exams mainly because they are accustomed to programming and debugging on the computer and not on paper.

Table 7: Students' survey response on video lectures and online exams

Question	Choices	Fall 15
Rate the video lectures on a scale of 1 to 5 - was it better compared to the in-class lecture? (1 being low and 5 being high)	1	6.38
	2	7.98
	3	17.55
	4	25.00
	5	43.09
How did you like the online exams on a scale of 1 to 5 - was it better than paper based exams? (1 being low and 5 being high)	1	3.72
	2	5.32
	3	17.55
	4	23.40
	5	50.00

Table 8 shows students' response on their choice of course structure based on their experience during the Fall of 2015. The survey indicates that students like the hybrid course structure better than completely online one. They prefer video lectures and online exams, but they also prefer face to face lab and help sessions.

Table 8: Students' response on online and hybrid course structures

I'd prefer this course to be	completely online	5.85	5.85
	partially online (lecture and lab videos) but with face to face help sessions	12.23	12.23
	partially online (lecture videos) but with face to face lab and help sessions	61.70	61.70
	as such without any change	20.21	20.21

A list of student comments from the online survey is attached in Appendix B. The comments reveal students liking the online class and video lectures more.

4. Conclusion

The process of transitioning a lab based course from a regular to online course structure is demonstrated in this paper. Exam scores, grades and student surveys are used to evaluate the effectiveness of the online learning system. The transition from paper-based examinations to online examinations has increased the class average on an exam by 5% for a class of 310 students. The number of Cs, Ds and Fs has decreased when the course followed a hybrid course structure. The students' opinion of online exams and video based lectures are recorded over a period of time, which indicates a positive impact on both online exams and video lectures. The students find the video lectures extremely helpful, as they can review the lecture content as needed to understand the concepts. Finally, students registered their opinion on online and hybrid course structures. Students found video lectures and online exams more rewarding and would prefer lab and help sessions to be face-to-face sessions.

5. Implications for Engineering Education

The demonstration of a step-by-step transition of ENGR 1412 from a regular course structure to online as discussed in this paper, can be implemented to any lab based project course. The fact this methodology worked for a class of 300 – 400 students affirms that this will work in other

large courses at other universities. The online learning system is a potential solution for problems like increasing engineering enrollment, and limited spots in computer labs. When implementing the online course, a few things like timed online quizzes and randomized questions should be followed to maintain the academic integrity of the course. Help sessions can be made possible using group video conferencing tools like Skype, Google Hangout, or WebEx. Different time zones should be considered before scheduling help sessions. A well-prepared schedule will help in conducting the course smoothly by avoiding any last minute surprises. Frequent online quizzes will help in evaluating student's progress in the course.

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Appendix A: Course schedule from Fall 2014

ENGR 1412 Course Schedule - Fall 2014

Week		Date (Mon-Fri)	Due: Programming Assignment	Lecture: Engineering and Lecture Topic	Lab Section: Programming Quiz	Lab Section: Programming Topics	Reading
August	#1	18-22	Log Into D2L	Introduction, Course Overview		Desire2Learn, Excel and Validation	Ch 1: Pgs 1-32
	#2	25-29		All About Excel, Project 1, Spring 2013 Project 1		More On Graphing and Advanced Excel Features (Built in Functions & Solver)	Ch 1: Pgs 33-44 Ch 2: Pgs 57-84 App Pg 377-386
September	#3	1-5	Project #1 Spreadsheets and Charts	Variables, Flowcharts and Functions, Quiz 1		Function Programming, Flowcharts	Ch 3: Pgs 87-105 Ch 5: Pgs 119-128
	#4	8-12		Problem Solving, SUB Programs, Project 2, Spring 2013 Project 2	Quiz #1 Cell Referencing Styles, Functions, Spreadsheet Design, Charts	Sub Programs; Cell I/O, Input Box, MsgBox	Ch 6: Pgs 141-162
	#5	15-19	Project #2 Function Programs	Decisions, Quiz 2		Decision Statements & Debugging	Ch 7: Pgs 163-174; Ch 10 Pgs 257-270
	#6	22-26		Loops, Numerical Methods, Group Quiz 1, Project 3, Spring 2013 Project 3	Quiz #2 GPP, Run Button, Variables, Functions, Sub Programs, Decisions	FOR-NEXT Loops, Root Finding and Integration Methods	Ch 8: Pgs 179-189; 193-200
	#7	29-3	Project #3 Sub Programs IF Statements and Making Decisions	Mid Term Rules and Material	Group Quiz # 1	Option Explicit, Random Numbers, Review For Midterm	
October	#8	6-10		Mid Term Exam Functions, SUB Programs, Decisions and Debugging	No Labs	No Labs	
	#9	13-17		Loops, Arrays, Sorting, Project 4, Spring 2013 Project 4		Nested Loop, Arrays and Sorting	Ch 8: Pgs 215-242
	#10	20-24		Simulation and Design, Project 5, Quiz 3		Modular Programming & Evolving Programs, Do Loops	Ch 9: Pgs 201-214 Ch 11: Pgs 283-296
	#11	27-31	Project #4 Root Methods, Loops, Arrays and Games	IOGA, File I/O, Project 4		Modeling, IOGA and File I/O	Ch 9: Pgs 243-251 Ch 10: Pgs 275-280
November	#12	3-7		Simulation and Design, Project 5, Spring 2013 Project 5		File I/O, User Forms	Ch 12: Pgs 299-338
	#13	10-14	Project #5 IOGA, File I/O	Ethics, Business and Engineering, Project 6, Quiz 4	Quiz #3 GPP, Loops, Arrays, File I/O	Workbook & Worksheet Events, Forms, Scope	Ch 12: Pgs 338-366 Ch 13: Pgs 367-373
	#14	17-21	25 Point Quiz # 2	Ethics, Business and Engineering, Project 6, Spring 2013 Project 6, 25 Point Quiz	Quiz #4 Forms and Events	Review For Final	
	#15	24-28		No Lecture	No Labs	No Labs	
December	#16	1-5	Project #6 Software, Sales Manual, Brochure	Course Review and Evaluation		Review For Final	
	#17	8-12	Final Exam Week		See Syllabus for Your Exam Time		

† Course Notes From the Fall 2012 Edition (used again for Fall 2014)

Assignments / Projects

Projects 1-2 are 50 Pts each

Projects 3-6 are 100 Pts each

Quizzes & Exams

Quizzes are 50 Pts Each (drop lowest)

Midterm is 100 Pts

Final is 200 Pts

Appendix B: Student comments from online survey

The instructor was great! I especially liked the online lectures because I could watch them at my convenience and re-watch them if I needed more clarification on a specific subject.

I thought your idea of the video teaching was pretty cool and successful, it opened up my schedule to accomplish more and I still learned from you.

I preferred the video lectures to the actual lectures, I found that a quick 15-minute video better introduced subjects than a 50-minute lecture. I also greatly appreciated the weekly email updates, I found them very helpful.

The information was presented well and organized, no complaints. If the videos were watched then the quizzes were straightforward and easy to accomplish.

The instruction was very helpful and in-depth. The combination of lecture videos and lectures notes was especially helpful because I could reference one if I did not understand the other.

I really enjoy the online lectures because I am able to watch them at home and if I do not understand something then I go back and watch it again.

They are effective because I can pause and re-watch a part that I would have a harder time or be slow on.

The online lectures are effective and easy to follow, also they are not long and drawn out, but get right to the main idea.

I like the online lectures much more than coming to class because I can pause it and replay it as I need to.

Online lectures are great and it gives an insight as to what we will be working on in the next lab.

Online lectures are helpful and convenient.