Project #: GFS 0707

# Visualizing the Bartlett Center Construction

An Interactive Qualifying Project Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by


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## Abstract

This project uses visualization techniques to improve the students' understanding of the construction process. Digital images of the recent construction of WPI's new admissions building, the Bartlett Center, have been used to create a website to aid engineering students who are particularly interested in learning how to schedule the construction of a building project. The website information is broken down into a five step process.

## Acknowledgements

We would like to thank Professor Salazar for all his help and Jim Monaco for his time and effort with the multi-media for our website. Also, we would like to thank Neil Benner for providing additional construction photos as well as John Wilkes for his learning style expertise.

# Table of Contents

# 1. Introduction

College students across the United States are being presented with learning material through various mediums. A teaching style proven to be most effective, learning through visualization, is not being fully utilized (2. Felder). Here at Worcester Polytechnic Institute we feel there is also a gap in visual learning. The majority of classes here and across the nation use lectures as the main source for presenting material to students. This is especially prevalent with civil engineering students where it is vital that they have a full comprehension of the construction process and understand how to apply what they learn beyond the classroom. Our project is unique because we use the term project in CE 3020 Project Management as a base to apply our visualization methods. There has been some previous research on learning through visualization at WPI with the Discovery project, which like ours uses a website to aid in classroom learning (7. Rathbun). However our project has a more specific focus. It was designed for the CE 3020 term project, and it breaks down the major steps of construction and exploits them visually. A timeline of activities is displayed as well so that the sequence of activities is emphasized. This website can be used as a learning tool and classroom aid to help students understand the construction process. Although we have focused our attention on a small field of learners, we hope that the benefits of visual learning will be recognized and ultimately out project will lead to an increase in visual learning tactics among professors here at WPI and eventually throughout the globe.

# 2. Background

There is a vast amount of information and people to talk to regarding visual learning and relating it back to a specific area of civil engineering at WPI. We used a book titled *Creativity in Education & Learning* to broaden our knowledge of how people learn (1. Cropley). We have reviewed a couple of papers written on the topic including, a paper written by Tomi Stefani for his IQP and *Learning and Teaching Styles in Engineering Education* (2. Felder).

## *2.1 Creativity in Education and Learning*

*Creativity in Education & Learning* rendered some key facts that were used to shape the project. First the book defines the differences between creativity and intelligence. The main difference between the two is that the function of intelligence is to acquire, recall, and memorize already known information, while Creativity is the skill to develop or invent new ways to utilize the already known information. We feel that many WPI students have the necessary intelligence and knowledge but lack the ability to apply the acquired intelligence toward specific projects in new and creative ways. In learning about civil engineering we have realized that visualizations trigger different parts of the brain than auditory learning. With this portion of the brain functioning, the student can link the two styles of learning together and apply them to arrive at more creative solutions to problems (1. Cropley).

## *2.2 Learning and Teaching Styles in Engineering Education*

*Learning and Teaching Styles in Engineering Education* by Richard Felder gave an in depth analysis of learning styles and related them to explicit engineering topics. Felder also shows how each learning style relates to its corresponding teaching style. It is stated that visual learners correspond with a presentation type teaching environment. The work recognizes that students can learn in a variety of ways; however it categorizes learning into three main methods. One method is teaching using visualization, although it is not the most widely used tactic in college, it has been proven to be highly effective. This method involves the use of pictures, diagrams, video, or other visual mediums that students can analyze and learn from. Another method is auditory learning where people use language in to order obtain knowledge. Both reading and listening to lectures are included in this category. The last technique is known as kinesthetic. In this form of learning people learn from physical feelings: taste, touch, and/or smell. (Felder 5)

## *2.3 The Stefani Paper*

Tomi Stefani states that a learning-style classifies individuals on a number of scales according to the way they receive and process information (6. Stefani). The better a teacher can realize his students individual learning styles the more effective his teaching may become. This way the teacher can tailor his/her lessons to the learning styles of the population of his/her students. Time

can be spent using the methods proven to be most effective for the highest number of students. To maximize efficiency students can be divided into classrooms based on their preferred learning styles. Using multiple methods to teach students in the classroom can promote creativity within students and give them a fuller understanding of the material and how it can be applied. When courses are taught focusing on only one teaching method the students' capacity for learning is limited.

A survey was carried out the first day of A term 1997 by Toni Stefani and it was distributed to civil engineering students who took CE 3010 and CE 3020, although it was not stated exactly how many responses were collected, it was noted that 87% of students were visual learners (6. Stefani). With such a high percentage it seems apparent that it would be beneficial to incorporate visual learning into classrooms across the nation. The survey isn't to say that students can't learn other ways as well but there should be a solid effort to bring more visualization into the classroom.

## *2.4 The Kolb Cycle*

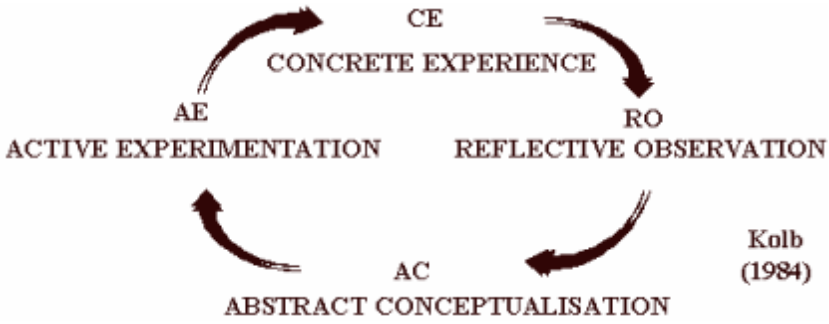
The main theory behind the Kolb learning cycle can be understood in the following line:

"Learning is the process whereby knowledge is created through the transformation of experience."

In 1984, David Kolby came up with a cycle consisting of four phases that best explain how people gain knowledge. The first phase is Concrete Experience (CE), where the student is educated by means of an example, video,

case study, or any experience where a learner can extract a piece of knowledge. After the student reviews the experience from multiple perspectives, they reflect upon what they have just obtained, they might ask themselves: What happened? What did I observe? Appropriately this phase is called Reflective Observation (RO). The third phase is called Abstract Conceptualization (AC), where the learners develop theories and look for patterns. Basically draw any conclusions from the experience, draw correlations between variables. For example, when A happens, B will result. The final phase is called Active Experimentation (AE), where the learners brainstorm ways of how to apply the information they have obtained in another example in the future. The overall concept of the Kolby Learning Cycle is to use information obtained from past experiences to learn new skills, facts, or ways of thinking and to apply them in the future.

Figure 2-4 shows how each phase flows into the next. Our website falls into the Concrete Experience (CE) phase, where the potential learner will view the video clips, read the correlating text, look at any other visualization on the web page and obtain information. After using our website and acquiring the concrete experience, the learner will then follow the Kolb cycle into the RO stage. After RO the learner will draw conclusions in the AC phase and then lead into AE where knowledge learned can be applied.




The Kolb Cycle
(Figure 2-4)

## *2.5 Myers-Briggs Learning Styles*

On October 11th, of 2006, we met with Professor John Wilkes discuss the break down of the different Myers/Briggs learning style types. Students are judged based on four different categories. The categories are broken down into extroversion/introversion, sensing/intuition, thinking/feeling, and judgment/perception.

Not all research with Professor John Wilkes proved to be valuable due to the fact that much of his data was referring to personality traits and not actually learning styles. Although we took what we could out of this research and attempted to understand the learner as an individual.

The difference between extroversion and introversion is that extroverted students feel they need to express themselves in an outward manner to the world. They are often more outgoing and enjoy sharing thoughts and ideas with others. Introverted people however tend to be much quieter and will often not

share a thought or idea with someone else until they rehearse what they are going to say in their head and they are sure that it makes perfect sense.

Sensing differs from intuition in that sensing people are very good at describing the way something looks or feels, while intuitive people on the other hand tend to relate something to another thing in order to describe it. Professor Wilkes helped us to understand this by telling a story of what happened in an experiment he participated in. In the experiment a group of sensing people was taken into a room to describe a leaf. The first thing the sensing group did was pass the leaf around the room to examine it. They all gave detailed descriptions of the way it looked and felt and were able to describe it quite well. A group of intuitive subjects was taken into another room and was also given a leaf to describe. In the intuitive group the leaf was not passed around the room. Instead they just looked at it from a distance and made a list of things that related to leafs in general. One notable example of a word that showed up on the list was *factory*. This was because the intuitive group saw the leaf as small factory for the tree in the process of photosynthesis.

The main difference between thinking and feeling is that people categorized into the thinking category tend to gather facts on a subject to find an objective truth. They try to be impersonal and fair. Feeling people on the other hand tend to take human emotion and feelings into account when making decisions or drawing conclusions.

The major difference in the final category of Judging/Perceiving is that people who are perceiving often prefer to be more spontaneous and flexible.

They do not like to make judgments on anything but would rather leave their opinion open because they realize they may learn new information later. Judging people however tend to take all the information they can on a subject and come to conclusions immediately without leaving the subject open for future analyzing.

While we find this information useful and intriguing, it would be difficult to incorporate it into our project. There is some statistical data on the performance of different types in class rooms structured a certain way, however none of the class rooms were focused specifically on visual, sensory or auditory learning. Rather they were structured in a way that related subjects to other subjects or described exactly what was happening at a very detailed level. Intuitive students were at the top of the class when subject material was related to other areas however when they were simply given more detailed descriptions they often found the material too abstract and themselves at the bottom of the grading curve. Because there is no statistical evidence showing that Civil Engineering students tend to be one type rather than another we can not tailor our website to just one type of student. If we were to structure our website so that it appealed to each type we would have to make a minimum of four different websites which would be too time consuming. We have realized that we may lose touch with our main focus of providing students with visual learning aids that may give them a better feel for what they are learning and allow them to understand it more fully.

## *2.6 The Felder Survey*

As we progressed with our learning style research we were suggested to take the Felder survey online by Professor Salazar. The survey was created by a professor of Chemical Engineering at North Carolina State University named Richard Felder. The survey is a series of about 44 questions; each question had two possible responses.

The responses were tallied up and analyzed by breaking the learning styles down into four different categories. The first category was Active vs. Reflective learners Active learners learn best by doing something and trying it out. Reflective learners prefer to think first and act secondary. The second group was Sensing vs. Intuitive learners. Sensors like to solve problems by using well-established methods and enjoy learning facts. Intuitive learners prefer to interpolate and extract information rather than memorizing facts. They prefer to look for a relationship that relates theories so they can try to find connections themselves. The third category was Visual vs. Verbal learners. Visual learners remember best what they see, whether its pictures, drawings, graphs, charts, timelines, or films. Verbal learners get more out of words and a lecture based class for example. This category was found to be most helpful in our project due to the fact that we were going on the theory that visual learning is needed as an additional supplement in the civil engineering studies. Civil Engineering is a unique major in that the processes of civil engineering and construction require a combination of common sense and the ability to make processes more tangible. Processes can be made more tangible through visualization. The final grouping of learning styles is Sequential vs. Global learners, where sequential learners

obtain information by means of logically ordered steps. Global learners happen to learn in bits and pieces and progress learning randomly with no connections then finally seeing the big picture at some point.

Felder states “In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts.” Felder goes on to say, “Unfortunately, most people are visual learners, which means that most students do not get nearly as much as they would if more visual presentation were used in class.”

The results from the surveys that we each took were consistent with Felder’s previous statement. With varying strengths we were both categorized as visual learners. We plan to have students take a brief questionnaire regarding the web site but also will suggest taking the Felder survey as well.

Although visual learning is underutilized there is still a need for verbal communication and learning. We have written a brief description for each visual clip of construction explaining what the viewer is watching. However the key component is the video clips. The goal as stated in section 2.2 is that when students read and listen to lectures in class they will picture in their head visually what they are learning, thus more effectively relating the classroom material to the real world.

# 3. Methodology

## *3.1 Sequential Timeline*

Listed below is a timeline of the intermediate schedule that was plan to accomplish in order to reach our ultimate goal.

1. 9/22/06 - Meet with Jim Monaco to see what images of the Bartlett Center construction process are available.
2. 10/11/06 - Meet with Professor John Wilkes to go over his data on students preferred learning techniques at WPI.
3. 10/25/06 - Construct a survey consisting of a series of questions that will help us determine which areas of study civil engineering students feel would be the most desirable and beneficial for us to apply visual learning techniques.
4. 10/30/06 - Revised approach in that we will design the web page first and create a survey second after our finished product can be tested.
5. 11/13/06 - Each of us take the Felder survey online and document results.
6. 11/20/06 - Present Pro. Salazar with preliminary sketch of webpage development.
7. 11/27/06 - Analyze and interpret the Stefani paper and any work submitted by Johnathan Rathbun. Find and document useful information that may be applied to our project.

8 11/6/06 - Research additional visual learning studies, such as Kolby Learning Cycle, and report findings from those as well as data found by Professor Wilkes.

9 11/13/06 - Learn how to operate Microsoft Publisher

10 11/20/06 to 12/13/06 - Add two or three more links to the website using visual learning techniques that pertain to civil engineering.

11 12/13/06 - Meet with Jim Monaco again to discuss what segmented clips we need to fit into each of our categories.

12 1/8/07 to 1/15/07 - Meet with Neil Benner to obtain additional interior pictures and finish up web page links.

13 2/15/07 – Send out survey and analyze responses.

14 2/22/07 – Measure the effectiveness of links we added to the website based on feedback from the professors and students who used the site through an online survey.

15 2/25/07 – Made changes to website from survey responses.

16 1/22/06 to 2/28/06 - Publish all findings in the form of a final paper.

## *3.2 Developmental process*

The process of creating the website was a trial and error procedure. We would try different things out analyze them while showing and asking the opinions of other Civil Engineering students as well as our advisor before making a final decision.

We looked at the Discovery project and tried to decide what we liked about it and what it was lacking. We wanted to make our website simple and

easy to use but at the same time have enough content to get the desired material across to the learner. To reiterate what we wanted to accomplish, our goal was to give the student a better understanding of the construction process and be able to picture it in ones head rather than just the text related to it on a paper. Figure 3-2 is a preliminary sketch of the website that turned out to be very similar to our final design.

**(**Figure 3-2)

**The Bartlett Center**: From Start to Finish

Pictures showing:
Owner, Architect, Construction Manager Relationship

| Video Clips: |
| --- |

Excavation

Steel Frame

Exterior (Wall)

Windows & Doors

Roofing

Site work

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(New page: once you click on one of the above links)

Example: Excavation

-text explaining each video clip

| Streaming Video<br><br>(side by side) |
| --- |

Before even putting the website up on the computer we sketched out on paper different formats for the site before finally arriving at the different steps listed as each activity. As displayed below the main page of our website graphically demonstrates the relationship between the owner: WPI, the construction manager: Gilbane, and the architects: CBT.

We decided that there should be a brief caption explaining the video clip as well as a timeline visually showing the sequential activities. The web site really came together with time and trial and error. The figure below shows the page that opens up when you click one of the steps listed on the main page.

To begin working on our website we first needed to see what images of The Bartlett Center could be made available to us. Professor Salazar, our advisor, referred us to David Taranto who possessed these files. After we emailed David Taranto he set up a meeting for us with a media specialist Jim Monaco. We met with Jim multiple times he proved to be most helpful. The media worked very much like a flip book as the quickly changing still images resembled actual video. The media he showed us used one photograph for each week of construction. He informed us that he had pictures available from every fifteen seconds of construction at two different angles. These pictures were taken by automated cameras, web cams, set up on either side of the site. The web cams were placed on adjacent buildings with the purpose to show all sides of the building under construction. If only one camera were used, images would be

captured from just one side of the building and only half of the entire process would be visible.

Jim said that he could tailor the video clips that he had to our specifications. We specified the range of dates and the time elapsed between each image we wanted displayed for each clip. Originally we chose to show a picture of the construction each day at noon at a rate of six slides per second having a separate link for each view. We ended up evolving to 1 slide per second to give the viewer more time to absorb what exactly is happening as well as putting both views side by side simultaneously playing to show a full 360 degrees of the construction.

To add to the media that Monaco possessed, we met with Neil Benner, the project manager for the construction of the Bartlett Center. We were interested in obtaining additional interior photos to display on our site since this data was not available to us through the images of the web cams. Unfortunately he did not have many interior pictures and we could not show the steps of any interior construction activities as we had hoped. However we were able to add a link to the main page with the interior pictures of the Bartlett Center that we received.

After having seen the media available to us we began thinking of ways to structure the website. We decided to break down the clips into smaller clips to explain each step individually. They were divided into different categories according to the CSI format commonly used in Civil Engineering. The phases we chose were; Excavation/Foundation, Steel Frame, Exterior (Walls), Doors &

Windows, Roofing, and Site work. Each category has its individual link and when clicked it opens a page where both views, Higgins and Harrington, play the clips corresponding with the construction of that step. In addition we have text that goes along with each clip giving a broad explanation of the category stated and giving a specific explanation of what is happening in each step.

### *3.3 Feedback Loop (Implementing and Obtaining)*

After designing the preliminary website, we wanted to gain feedback on our work. It was decided that the best way to do this would be to contact a list of all students that have taken CE3020 in the last four years as well as a list of Civil Engineering professors sending them both a link to our website and a survey of corresponding questions. Survey questions were formulated by first thinking about what information we wished to obtain from students and then deciding which questions we should ask to gain the specific advice and opinions we desired. We wanted to know if students thought that the content, appearance, and function ability of our website was adequate. Also, we wanted to figure out ways that the site could be improved and see if respondents thought that the site would be helpful to any other classes they had taken besides CE3020. A number of background questions were included in the survey so that we could obtain information on the respondent's civil engineering experience. The data we received would be used to make improvements to our website.

We began making the survey with Microsoft Publisher. The survey would be available online and results were to be emailed back to us. In making the survey we ran into some trouble. Because of our limited background in computer

programming we found it was difficult to create questions in a format other than open response. Looking to the CCC for help, we were informed about a website called SurveyMonkey.com that specialized in creating online surveys. (survey link http://www.surveymonkey.com/s.asp?u=838053255728)

Using this website we were able build the survey asking questions in a variety of different formats including open-ended response, list selection, matrix, and multiple choice. We received 46 responses after emailing the students and professors and asking them to test and evaluate the website using the survey.

## 4. Results & Recommendations

We received 45 responses from the student population of civil engineering majors who took CE 3020 Project Management in the last 4 years. We expected roughly 10% of the students to respond, and with the 45 responses collected this was about 15%. Over 90% of the respondents were Civil Engineering students. Many of the responses were similar. The most informative question, how can the site be improved, gave valuable answers. Most of the suggestions were related to cosmetic issues, involving the attractiveness of the site regarding its looks. It was stated by more than one student, as you can see in Appendix B, that the white background should be changed to make the website more appealing. We considered changed the background to a color or to have a relevant picture in the background but we did not want to distract the students attention from learning with fancy graphics.

Another main suggestion was regarding a navigation issue in browsing the website. Instead of having to go back to the previous page to navigate from each step it was suggested that we include links in each steps page to navigate from step to step without having to go back. In this case the survey proved most helpful and important because the changes made the site much more efficient.

A 95.6% response rate of yes was tallied when asked if the site could be helpful for its intended purposes which are to help students get a better understanding of the construction process as a whole. (See Appendix A) From the majority of the answers received it looked as if each student who took the survey actually browsed thoroughly through the site. Their responses were

relevant and taken into serious consideration for revising the site.

Another intriguing statistic from the survey was the response given to the question: Do you feel the use of this site would be beneficial in any classes other than CE 3020?. Common responses to this question were CE 3021 Cost Estimating and CE 1030 Introduction to Civil Engineering. See Appendix B for all open-responses from students. A good point was brought up by one student saying that, although many of the civil engineering courses focus on a specific area of construction such as foundation engineering or structural analysis the site could still be useful to help the student understand where and how the specific class they are in plays an intricate role in construction. The students might understand how to use the formulas and equations to come up with the correct answer for stresses in a beam, but if they are lost in the understanding of the how, what, when, where, and whys of the construction process then the gained knowledge is pointless.

This concept can be demonstrated in the Felder survey where the sequential and global learner category separates individuals into two different types of learners. One student may understand how to come up with the solution but not know how to apply it. Another student may understand exactly how and why the solution fits into the big picture but has no idea how to arrive at the solution. One without the other is useless; you need to know how to arrive at the correct answer and how to apply it in the big picture.

Appendix A shows all survey responses with the addition of graphs to graphically represent our collected responses. Question 5 asks what part of the

term project was found to be most difficult. The most common answer was to create the sequential schedule of activities. This answer showed the need for our website. It proved to us that students really did not understand the process. We hope that through the use of our website that many of these areas of trouble would be no longer difficult but understood by the student.

The overall response to the website from the collected surveys was positive. 95.6% of respondents indicated that in their opinion the site could be used for its intended purposes. Based on the results we obtained we are optimistic that our site will prove to be valuable to future CE 3020 students.

In one professor's survey we received, it was stated that if the website was to be used toward another class it should be fine tuned to fit that classes syllabus like this website is geared toward the CE 3020 Project Management course. For example not all classes have a term project where they need to manage every aspect of the construction process and instead may need more detail on one individual step of the process such as foundation.

In future work done on this topic, it is suggested researchers should survey the students that used the site for the CE 3020 term project. The survey should gauge the effectiveness of the site and ask the respondents to make suggestions for improvement. This will give us a better idea of the benefit visual learning is capable of providing and how it can be improved.

The major item we have tried to accomplish is helping students understand the construction process through visualization. Our website was designed for a classroom setting for CE 3020 Project Management, to give the

students a broader knowledge of all the activities involved in construction. Not to replace any of the lectures based learning in classrooms, but to incorporate an additional aid.

Visualization should be used more in classrooms because using multiple forms of learning gives students a better and fuller understanding of course material. This ultimately promotes creativity as it results in the ability of students to apply learned knowledge in new ways. If our project is successful we hope that our idea to incorporate more visual learning into the classroom will catch on and eventually an appropriate amount of visual learning will be used in education around the globe.

# 5. Bibliography

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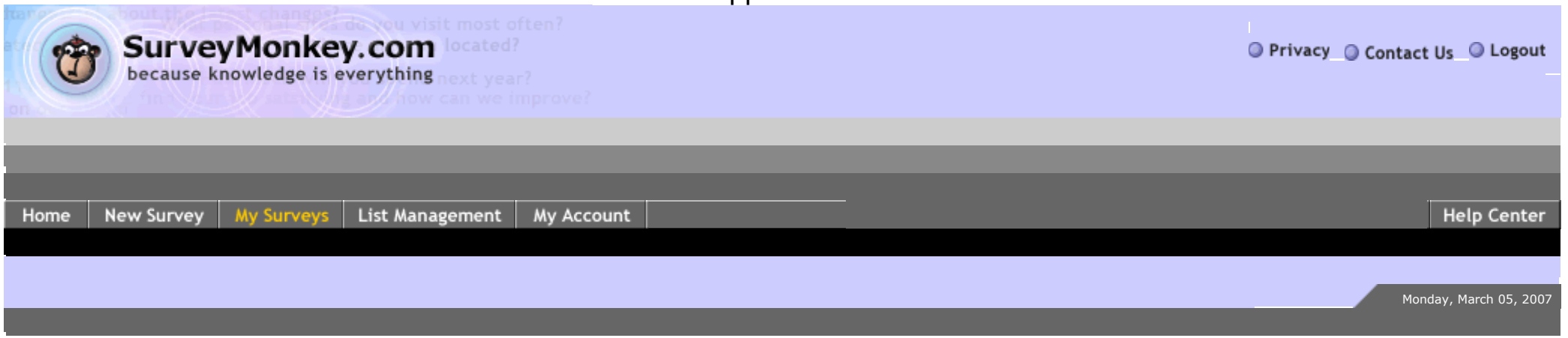
# 6. Appendices

Appendix A - Student Responses
Appendix B - Student Open-Ended Responses
Appendix C - Professor Response (including open- ended)
Appendix D - Felder Questionnaire
Appendix E - Learning-Styles & Strategies (Felder)
Appendix F - Preliminary Sketch of Website
Appendix G - Main Page of Website
Appendix H – Example of step (Excavation)

# Appendix A




## Results Summary

Show All Pages and Questions

Export... View Detail >>

### Filter Results

To analyze a subset of your data, you can create one or more filters.

Add Filter...

**Total:** 45
**Visible:** 45

### Share Results

Your results can be shared with others, without giving access to your account.

Configure...

**Status:** Enabled
**Reports:** Summary and Detail

**1. From Start to Finish**

1. Name (optional)

View **Total Respondents** **16**

| | |
|---|---|
| (skipped this question) | 29 |

2. What is your major?

| | Response Percent | Response Total |
|---|---|---|
| **CEE** | **91.1%** | **41** |
| CM | 4.4% | 2 |
| MGE | 0% | 0 |
| OIE | 0% | 0 |
| View Other (please specify) | 4.4% | 2 |
| **Total Respondents** | | **45** |
| (skipped this question) | | 0 |

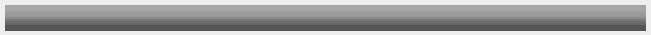
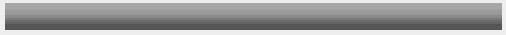
3. What term did you take CE3020

| | Response Percent | Response Total |
|---|---|---|
| A04 | 4.4% | 2 |
| A05 | 40% | 18 |
| **A06** | **51.1%** | **23** |
| View Other (please specify) | 4.4% | 2 |
| **Total Respondents** | | **45** |
| (skipped this question) | | 0 |

4. What was your construction experience prior to CE3020?

| | | Response Percent | Response Total |
|---|---|---|---|
| None |  | 42.2% | 19 |
| **Some** |  | **48.9**% | **22** |
| Extensive |  | 8.9% | 4 |
| | **Total Respondents** | | **45** |
| | **(skipped this question)** | | **0** |

5. Which areas of the term project did you find to be difficult?

| | | Response Percent | Response Total |
|---|---|---|---|
| Developing a list of activities |  | 24.4% | 11 |
| **Creating a sequential schedule (critical path method)** |  | **40**% | **18** |
| Types of costs (overhead, variable, wages, materials, etc.) |  | 26.7% | 12 |
| Cost risk analysis |  | 31.1% | 14 |
| Comprehension of activities |  | 15.6% | 7 |
| Visualizing the logical process sequence |  | 33.3% | 15 |
| Formulating an estimate of final costs |  | 31.1% | 14 |
| View Other (please specify) |  | 11.1% | 5 |
| | **Total Respondents** | | **45** |
| | **(skipped this question)** | | **0** |

nk this site could be helpful for the intended purposes?

| | |
|---|---|
| **Yes** |  |
| No |  |

7. Please, rate (1=poor, 5=excellent) this site on each of these categories.

| | 1 | 2 | 3 | 4 | 5 | Response Average |
|---|---|---|---|---|---|---|
| Content (information: text & graphics) | 0% (0) | 7% (3) | 20% (9) | **44% (20)** | 29% (13) | **3.96** |
| Appearance (looks) | 2% (1) | 11% (5) | 16% (7) | **47% (21)** | 24% (11) | **3.80** |
| Functionability (ease of navigation) | 2% (1) | 2% (1) | 24% (11) | **42% (19)** | 29% (13) | **3.93** |
| | | | | | **Total Respondents** | **45** |
| | | | | | **(skipped this question)** | **0** |

8. How could the site be improved?

| | |
|---|---|
| View **Total Respondents** | **19** |
| **(skipped this question)** | **26** |

9. Do you think that this website could be helpful in any other civil engineering courses? IF so which ones?

| | |
|---|---|
| View **Total Respondents** | **20** |
| **(skipped this question)** | **25** |

# Appendix B

| | How could the site be improved? |
|---|---|
| 1. | More info dealing with the class. |
| 2. | It could use a bit more detail when explaining the activities, and perhaps a further breakdown. |
| 3. | One thing that I would improve about this site is the lack of links on the second pages. For instance, after following the excavation link there is no immediate way to go to the steel frame page. You must go back and then use the steel fram link. This would create easier navigation for the web page users. |
| 4. | Its perfect |
| 5. | links back to the main page from pages within the site |
| 6. | It would b e a lot easier if you could navigate from one step to the next instead of having to go back to the original link and then forward to the next. If this is a educational site, then maybe you could add a little more instructional text about each step of the process. The last step, site work, it is too long. You could probably skip some of the pictures. Also the fact that there are so many different light (sun, cloud, rain, snow, different part of the day and so on) makes it hard to look at the long last video. And finally I would like to have a longer time setting on each slide, so that I have time to look at the details. Now you probably wished you never asked me to comment..... Overall a very good site though!! |
| 7. | Better Graphics |
| 8. | Not all of the links worked, like "the first step" etc. That sould be fixed. |
| 9. | Nice website, it will help people see the process from start to finish. A bit more professional looking would make it outstanding, but great job! |
| 10. | I think it needs to be a little more attractive. Also, check for typos; I found a couple. I think navigating was not very easy because you have to return to the main page before visiting another section. |
| 11. | it looks too amaturish. The white background should be something else. More images on homepage and in nagivation links. |
| 12. | More information relating to the class would be more helpful. |
| 13. | Different text styles, more visually appealing. |
| 14. | Maybe a little more in depth about the smaller events that take place as a part of each activity |
| 15. | Add a background to make the site more visually stimulating. Some of the links also do not appear to work in the text. |
| 16. | looks good for the need |
| 17. | use some pictures to show construction don't ask the same question twice in a survey |
| 18. | If you allow navigation to all of the categories on all of the separate pages it would be a great help so you dont need to keep going back. |
| 19. | Better functionability, just cosmetic fix-ups. |

| Do you think that this website could be helpful in any other civil engineering courses? IF so which ones? | |
|---|---|
| 1. | CE3026--steel structures design and cost analysis process |
| 2. | Any CM class could use it. |
| 3. | Yes, giving the students a better idea of what is expected for the class and how to earn better grades. |
| 4. | There might be some application in Cost Estimating as well as architectural engineering systems (CE3023) |
| 5. | Cost Estimating |
| 6. | I think that this website could also be helpful in the concrete course as well as design courses. The videos are good resources to show the process of putting up a building. This would be helpful in any course relating to the construction of buildings. |
| 7. | I think it would depend on the class, classes like the 2000 series would not gain anything from a website but a class like materials of construction might. It is best for someone with no construction experience to be able to visualize circumstances. |
| 8. | This is by far the best class for this site. But im sure most classes could be helped, none that i have taken however. |
| 9. | possibly cost estimating |
| 10. | CE 1030 |
| 11. | CE 3021 - Cost Estimating and Project Control |
| 12. | Probably cost estimating or other project management classes |
| 13. | Cost Estimating |
| 14. | Yes, for the introduction to CE class, 1030 |
| 15. | Yes, any course that has to do with constuction. Foundation Eng, Cost estimating, Intro to Civil Eng |
| 16. | I don't really think so. |
| 17. | I mean, outside of CE3020, not really. And only if CE3020 contiunes to do their term project on the bartlet center. Otherwise, not so much. |
| 18. | Maybe, any other CM classes. |
| 19. | I think it could be helpful in any course that relates to construction, especially steel, foundations, and the project cost class. |
| 20. | CE 3021 and CE 1030 |

# Appendix C

## 1. From Start to Finish

| 1. Name | |
|---|---|
| **Total Respondents** | **0** |
| **(skipped this question)** | **1** |

2. Please, rate (1=poor, 5=excellent) this site on each of these categories.

| | 1 | 2 | 3 | 4 | 5 | Response Average |
|---|---|---|---|---|---|---|
| Content (information: text and graphics) | 0% (0) | **100% (1)** | 0% (0) | 0% (0) | 0% (0) | **2.00** |
| Appearance (looks) | 0% (0) | 0% (0) | **100% (1)** | 0% (0) | 0% (0) | **3.00** |
| Functionality (ease of navigation) | 0% (0) | 0% (0) | 0% (0) | **100% (1)** | 0% (0) | **4.00** |

How could this site be improved?

| | |
|---|---|
| **1.** | the video clips that i reviewed are closer to a collection of photos or a powerpoint slide show than a true video stream of an onsite process. the videos would also benefit from the addition of narration so that if the material is assigned for review outside of class, the important learning elements are established for the students. |

Do you think that this website would be helpful for use in any other couses? If so which ones?

| | |
|---|---|
| **1.** | steel design, foundation engineering, cost estimating may all gain some benefit from the site if the specific learning elements for the students can be determined. |

Appendix D

NC STATE UNIVERSITY

# Index of Learning Styles Questionnaire

**Barbara A. Soloman**
**First-Year College**
**North Carolina State University**
**Raleigh, North Carolina 27695**

**Richard M. Felder**
**Department of Chemical Engineering**
**North Carolina State University**
**Raleigh, NC 27695-7905**

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**Directions**

Please provide us with your full name. Your name will be printed on the information that is returned to you.

**Full Name**

For each of the 44 questions below select either "a" or "b" to indicate your answer. Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

1. I understand something better after I
   - **(a)** try it out.
   - **(b)** think it through.

2. I would rather be considered
   - **(a)** realistic.
   - **(b)** innovative.
3. When I think about what I did yesterday, I am most likely to get
   - **(a)** a picture.
   - **(b)** words.
4. I tend to
   - **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - **(b)** understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   - **(a)** talk about it.
   - **(b)** think about it.
6. If I were a teacher, I would rather teach a course
   - **(a)** that deals with facts and real life situations.
   - **(b)** that deals with ideas and theories.
7. I prefer to get new information in
   - **(a)** pictures, diagrams, graphs, or maps.
   - **(b)** written directions or verbal information.
8. Once I understand
   - **(a)** all the parts, I understand the whole thing.
   - **(b)** the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   - **(a)** jump in and contribute ideas.
   - **(b)** sit back and listen.
10. I find it easier
    - **(a)** to learn facts.
    - **(b)** to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
    - **(a)** look over the pictures and charts carefully.
    - **(b)** focus on the written text.
12. When I solve math problems
    - **(a)** I usually work my way to the solutions one step at a time.
    - **(b)** I often just see the solutions but then have to struggle to figure

out the steps to get to them.

13. In classes I have taken
    - **(a)** I have usually gotten to know many of the students.
    - **(b)** I have rarely gotten to know many of the students.
14. In reading nonfiction, I prefer
    - **(a)** something that teaches me new facts or tells me how to do something.
    - **(b)** something that gives me new ideas to think about.
15. I like teachers
    - **(a)** who put a lot of diagrams on the board.
    - **(b)** who spend a lot of time explaining.
16. When I'm analyzing a story or a novel
    - **(a)** I think of the incidents and try to put them together to figure out the themes.
    - **(b)** I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
    - **(a)** start working on the solution immediately.
    - **(b)** try to fully understand the problem first.
18. I prefer the idea of
    - **(a)** certainty.
    - **(b)** theory.
19. I remember best
    - **(a)** what I see.
    - **(b)** what I hear.
20. It is more important to me that an instructor
    - **(a)** lay out the material in clear sequential steps.
    - **(b)** give me an overall picture and relate the material to other subjects.
21. I prefer to study
    - **(a)** in a study group.
    - **(b)** alone.
22. I am more likely to be considered
    - **(a)** careful about the details of my work.
    - **(b)** creative about how to do my work.
23. When I get directions to a new place, I prefer

- **(a)** a map.
- **(b)** written instructions.

24. I learn
    - **(a)** at a fairly regular pace. If I study hard, I'll "get it."
    - **(b)** in fits and starts. I'll be totally confused and then suddenly it all "clicks."
25. I would rather first
    - **(a)** try things out.
    - **(b)** think about how I'm going to do it.
26. When I am reading for enjoyment, I like writers to
    - **(a)** clearly say what they mean.
    - **(b)** say things in creative, interesting ways.
27. When I see a diagram or sketch in class, I am most likely to remember
    - **(a)** the picture.
    - **(b)** what the instructor said about it.
28. When considering a body of information, I am more likely to
    - **(a)** focus on details and miss the big picture.
    - **(b)** try to understand the big picture before getting into the details.
29. I more easily remember
    - **(a)** something I have done.
    - **(b)** something I have thought a lot about.
30. When I have to perform a task, I prefer to
    - **(a)** master one way of doing it.
    - **(b)** come up with new ways of doing it.
31. When someone is showing me data, I prefer
    - **(a)** charts or graphs.
    - **(b)** text summarizing the results.
32. When writing a paper, I am more likely to
    - **(a)** work on (think about or write) the beginning of the paper and progress forward.
    - **(b)** work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
    - **(a)** have "group brainstorming" where everyone contributes ideas.
    - **(b)** brainstorm individually and then come together as a group to

compare ideas.

34. I consider it higher praise to call someone
    - **(a)** sensible.
    - **(b)** imaginative.
35. When I meet people at a party, I am more likely to remember
    - **(a)** what they looked like.
    - **(b)** what they said about themselves.
36. When I am learning a new subject, I prefer to
    - **(a)** stay focused on that subject, learning as much about it as I can.
    - **(b)** try to make connections between that subject and related subjects.
37. I am more likely to be considered
    - **(a)** outgoing.
    - **(b)** reserved.
38. I prefer courses that emphasize
    - **(a)** concrete material (facts, data).
    - **(b)** abstract material (concepts, theories).
39. For entertainment, I would rather
    - **(a)** watch television.
    - **(b)** read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
    - **(a)** somewhat helpful to me.
    - **(b)** very helpful to me.
41. The idea of doing homework in groups, with one grade for the entire group,
    - **(a)** appeals to me.
    - **(b)** does not appeal to me.
42. When I am doing long calculations,
    - **(a)** I tend to repeat all my steps and check my work carefully.
    - **(b)** I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
    - **(a)** easily and fairly accurately.
    - **(b)** with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to

○ **(a)** think of the steps in the solution process.

○ **(b)** think of possible consequences or applications of the solution in a wide range of areas.

When you have completed filling out the above form please click on the Submit button below. Your results will be returned to you. If you are not satisified with your answers above please click on Reset to clear the form.

Submit Reset

---

*Dr. Richard Felder, felder@ncsu.edu*

# Appendix E

## LEARNING STYLES AND STRATEGIES

Richard M. Felder
Hoechst Celanese Professor of Chemical Engineering
North Carolina State University

Barbara A. Soloman
Coordinator of Advising, First Year College
North Carolina State University

## ACTIVE AND REFLECTIVE LEARNERS

- Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.
- "Let's try it out and see how it works" is an active learner's phrase; "Let's think it through first" is the reflective learner's response.
- Active learners tend to like group work more than reflective learners, who prefer working alone.
- Sitting through lectures without getting to do anything physical but take notes is hard for both learning types, but particularly hard for active learners.

*Everybody is active sometimes and reflective sometimes.* Your preference for one category or the other may be strong, moderate, or mild. A balance of the two is desirable. If you always act before reflecting you can jump into things prematurely and get into trouble, while if you spend too much time reflecting you may never get anything done.

### How can active learners help themselves?

If you are an active learner in a class that allows little or no class time for discussion or problem-solving activities, you should try to compensate for these lacks when you study. Study in a group in which the members take turns explaining different topics to each other. Work with others to guess what you will be asked on the next test and figure out how you will answer. You will always retain information better if you find ways to do something with it.

### How can reflective learners help themselves?

If you are a reflective learner in a class that allows little or no class time for thinking about new information, you should try to compensate for this lack when you study. Don't simply read or memorize the material; stop periodically to review what you have read and to think of possible questions or applications. You might find it helpful to write short summaries of readings or class notes in your own words. Doing so may take extra time but will enable you to retain the material more effectively.

## SENSING AND INTUITIVE LEARNERS

- Sensing learners tend to like learning facts, intuitive learners often prefer discovering possibilities and relationships.
- Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitors like innovation and dislike repetition. Sensors are more likely than intuitors to resent being tested on material that has not been explicitly covered in class.
- Sensors tend to be patient with details and good at memorizing facts and doing hands-on (laboratory) work; intuitors may be better at grasping new concepts and are often more comfortable than sensors with abstractions and mathematical formulations.
- Sensors tend to be more practical and careful than intuitors; intuitors tend to work faster and to be more innovative than sensors.
- Sensors don't like courses that have no apparent connection to the real world; intuitors don't like "plug-and-chug" courses that involve a lot of memorization and routine calculations.

*Everybody is sensing sometimes and intuitive sometimes.* Your preference for one or the other may be strong, moderate, or mild. To be effective as a learner and problem solver, you need to be able to function both ways. If you overemphasize intuition, you may miss important details or make careless mistakes in calculations or hands-on work; if you overemphasize sensing, you may rely too much on memorization and familiar methods and not concentrate enough on understanding and innovative thinking.

### How can sensing learners help themselves?

Sensors remember and understand information best if they can see how it connects to the real world. If you are in a class where most of the material is abstract and theoretical, you may have difficulty. Ask your instructor for specific examples of concepts and procedures, and find out how the concepts apply in practice. If the teacher does not provide enough specifics, try to find some in your course text or other references or by brainstorming with friends or classmates.

### How can intuitive learners help themselves?

Many college lecture classes are aimed at intuitors. However, if you are an intuitor and you happen to be in a class that deals primarily with memorization and rote substitution in formulas, you may have trouble with boredom. Ask your instructor for interpretations or theories that link the facts, or try to find the connections yourself. You may also be prone to careless mistakes on test because you are impatient with details and don't like repetition (as in checking your completed solutions). Take time to read the entire question before you start answering and be sure to check your results

## VISUAL AND VERBAL LEARNERS

Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words--written and spoken explanations. Everyone learns more when information is presented both visually and verbally.

In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners, which means that most students do not get nearly as much as they would if more visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.

**How can visual learners help themselves?**

If you are a visual learner, try to find diagrams, sketches, schematics, photographs, flow charts, or any other visual representation of course material that is predominantly verbal. Ask your instructor, consult reference books, and see if any videotapes or CD-ROM displays of the course material are available. Prepare a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections. Color-code your notes with a highlighter so that everything relating to one topic is the same color.

**How can verbal learners help themselves?**

Write summaries or outlines of course material in your own words. Working in groups can be particularly effective: you gain understanding of material by hearing classmates' explanations and you learn even more when you do the explaining.

**SEQUENTIAL AND GLOBAL LEARNERS**

- Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."
- Sequential learners tend to follow logical stepwise paths in finding solutions; global learners may be able to solve complex problems quickly or put things together in novel ways once they have grasped the big picture, but they may have difficulty explaining how they did it.

Many people who read this description may conclude incorrectly that they are global, since everyone has experienced bewilderment followed by a sudden flash of understanding. What makes you global or not is what happens before the light bulb goes on. Sequential learners may not fully understand the material but they can nevertheless do something with it (like solve the homework problems or pass the test) since the pieces they have absorbed are logically connected. Strongly global learners who lack good sequential thinking abilities, on the other hand, may have serious difficulties until they have the big picture. Even after they have it, they may be fuzzy about the details of the

subject, while sequential learners may know a lot about specific aspects of a subject but may have trouble relating them to different aspects of the same subject or to different subjects.

**How can sequential learners help themselves?**

Most college courses are taught in a sequential manner. However, if you are a sequential learner and you have an instructor who jumps around from topic to topic or skips steps, you may have difficulty following and remembering. Ask the instructor to fill in the skipped steps, or fill them in yourself by consulting references. When you are studying, take the time to outline the lecture material for yourself in logical order. In the long run doing so will save you time. You might also try to strengthen your global thinking skills by relating each new topic you study to things you already know. The more you can do so, the deeper your understanding of the topic is likely to be.

**How can global learners help themselves?**

If you are a global learner, it can be helpful for you to realize that you need the big picture of a subject before you can master details. If your instructor plunges directly into new topics without bothering to explain how they relate to what you already know, it can cause problems for you. Fortunately, there are steps you can take that may help you get the big picture more rapidly. Before you begin to study the first section of a chapter in a text, skim through the entire chapter to get an overview. Doing so may be time-consuming initially but it may save you from going over and over individual parts later. Instead of spending a short time on every subject every night, you might find it more productive to immerse yourself in individual subjects for large blocks. Try to relate the subject to things you already know, either by asking the instructor to help you see connections or by consulting references. Above all, don't lose faith in yourself; you will eventually understand the new material, and once you do your understanding of how it connects to other topics and disciplines may enable you to apply it in ways that most sequential thinkers would never dream of.


- Click here for more information about the learning styles model and implications of learning styles for instructors and students.
- Click here to return to Richard Felder's home page.

Appendix F

# **The Bartlett Center**: From Start to Finish

Pictures showing:
Owner, Architect, Construction Manager relationship

| Video Clips: |
| --- |

Excavation

Steel Frame

Exterior (Wall)

Windows & Doors

Roofing

Sitework

---

(new page: once you click on one of the above links)

Example: Excavation

-text explaining each video clip

| Streaming Video<br><br>(side by side) |
| --- |

# Web site links not working

## 11/2008

## IQP/MQP Archiving PROJECT


George C. Gordon Library
WORCESTER POLYTECHNIC INSTITUTE

Appendix G

# The Bartlett Center: From Start to Finish

Excavation

Foundation

Steel Frame

Exterior (Wall)

Windows & Doors

Roofing

Site Work


WPI

(Owner)

Gilbane

(Construction Manager)

CBT

(Architect)

# Web site links not working

## 11/2008

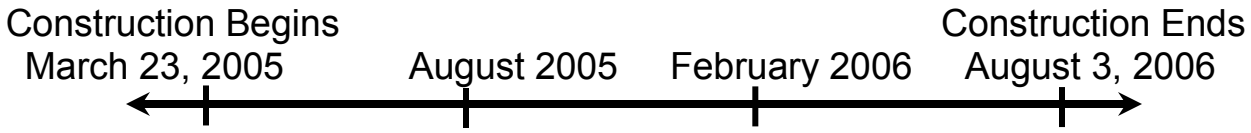
## IQP/MQP Archiving PROJECT


George C. Gordon Library
WORCESTER POLYTECHNIC INSTITUTE

# EXCAVATION

Excavation is one of the first major construction activities in a new project following surveying and site preparation. The Excavation in the Bartlett Center had many obstacles due to the restricted space on the site, especially with the large excavation equipment and machinery. This stage is vital to the rest of construction and the final quality of the finished project because this is where the foundation will be laid and will withhold with weight of the entire building. Before breaking ground with the excavation stage it is necessary to check plans, specs., and any other drawings describing the site, there could be pipes, conduits containing live electricity, the type of soil to be excavated which will determine the type of excavation machinery to be used. Once a hole is successfully dug, often times temporary shoring is needed to provide stability. Excavation equipment is very costly, so when making an estimate and choosing which type of equipment is needed it is important to chose wisely. Ordering excavation equipment that is not designed for such tough excavating will slow down the production rate or even result in the need for a more capable machine.

Video Clip: Excavation




3/23/05-5/12/05 **EXCAVATION**
3/30/05-5/3/05 FOUNDATION
5/31/05-6/14/05 STEEL FRAME
6/11/05-7/11/05 ROUGH ROOFING
7/11/05-9/12/05 EXTERIOR (WALLS)
9/3/05-10/6/05 FINISH ROOFING
10/28/05-11/20/05 WINDOWS & DOORS
3/23/05-8/3/06 SITEWORK ——— SITEWORK

Excavation

Foundation

Steel Frame

Exterior (Wall)

Windows & Doors

Roofing

Site Work

# Web site links not working

## 11/2008

## IQP/MQP Archiving PROJECT


George C. Gordon Library
WORCESTER POLYTECHNIC INSTITUTE