

## **Beta Testing a Web-Based Interactive Coaching System for Team Skill Development**

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### **Abstract**

The practice of engineering occurs in teams. Therefore, engineering educators must continue to construct and evaluate methods for helping engineering students learn how to work in teams. The development of TeamCoach occurred over a one-year period and was partially funded by NSF CCLI DUE -0088580. Beta testing was conducted during the Fall 2001 semester. Four different universities participated in the beta test for a total of approximately 140 users. The purpose of the project was to examine the potential of using a web-based system to teach team process skills to engineering students who were working on freshman and senior-level, semester long engineering design projects.

TeamCoach provided structured team process skills training and presented it to individual engineering students on design teams: 1) when needed based on the stage of team development and 2) customized for individuals based on individual styles. A database was used to store information on individual team members and capture reported team symptoms as the team developed over time.

Evaluation surveys were sent to all the students and faculty who used the TeamCoach system during the semester. This paper explains the basic TeamCoach design, describes the student and faculty evaluations of the TeamCoach system, and presents lessons learned and future development plans of TeamCoach.

### **Introduction**

Engineering students must learn to be effective team members. Teams are the way work gets done in industry. Engineers are required to design complex systems in a short amount of time and by necessity are required to work with others to accomplish these tasks. Recent engineering graduates reported that they spend an average of 32% of their time working in teams.<sup>1</sup>

With this large amount of teaming that occurs in industry, it comes as no surprise that industry leaders rate teamwork skills in the top three skills that they value in their

employees.<sup>2</sup> Leaders in industry repeatedly state the need for engineers who can work effectively in teams. Being an engineer means that you are technically competent. To set yourself apart and excel in the engineering profession, you have to develop good team skills. Fortunately, team skills can be learned; they just take practice. Learning to work in a team typically requires behavior changes, particularly because of the core values of individualism that we are raised with. We are accustomed to being measured and rewarded based on individual, not team, performance. Behavioral changes occur more readily in teams because teams are not as threatened by change as individuals.<sup>3</sup> Therefore, training in teamwork skills while students are participating in a design project appears to be an effective method for eliciting behavioral changes.

Where do engineering students learn how to work in teams? The typical scenario is that students are assigned to a group, told to work together to complete a task and then we as engineering educators stand back and wait to see what happens. Sometimes the team accomplishes the task and sometimes there are team fights taking place outside the faculty member's door. Even if the end product is satisfactory, are the students really learning to be effective team members? Since team skills must be taught with coaching, practice and feedback, the answer is typically no.

The ability to work well in a team does not just magically appear. Team skills need to be learned just like any other skill such as playing the piano, painting a picture, throwing a baseball or giving a speech.

This research project focuses on developing and evaluating an interactive web-based coaching system (TeamCoach) that helps engineering students develop team skills, while requiring minimal faculty intervention.

Faculty in the Department of Industrial and Manufacturing Engineering working with other specialists at WSU have developed TeamCoach to be used by students in semester-long engineering design courses. This software provides individually tailored team skill coaching to students based upon an assessment of their personal style and an assessment of the current functioning of their team as they develop a solution in a major design experience. Several of the unique attributes of this system are that it presents learning opportunities to students at times that the material is most relevant to their current experience, the information is tailored to each individual and each team, minimal intervention by a faculty member is required, the process requires only 20 minutes a week, and the material is easily accessed through an internet browser. Beta tests of the system were conducted during the Fall 2001 semester at San Jose State University, University of Arkansas, Clemson University, The University of Pittsburgh, and Wichita State University.

### **Description of the TeamCoach Model**

The TeamCoach model focuses on teaching team process skills to engineering students who are working on a team-based engineering design project. The TeamCoach model is used to present team process information to individual students on a weekly basis. The

TeamCoach model consists of three main parts: 1) Knowledge-based system 2) Database and 3) Team Process Modules as shown in Figure 1.

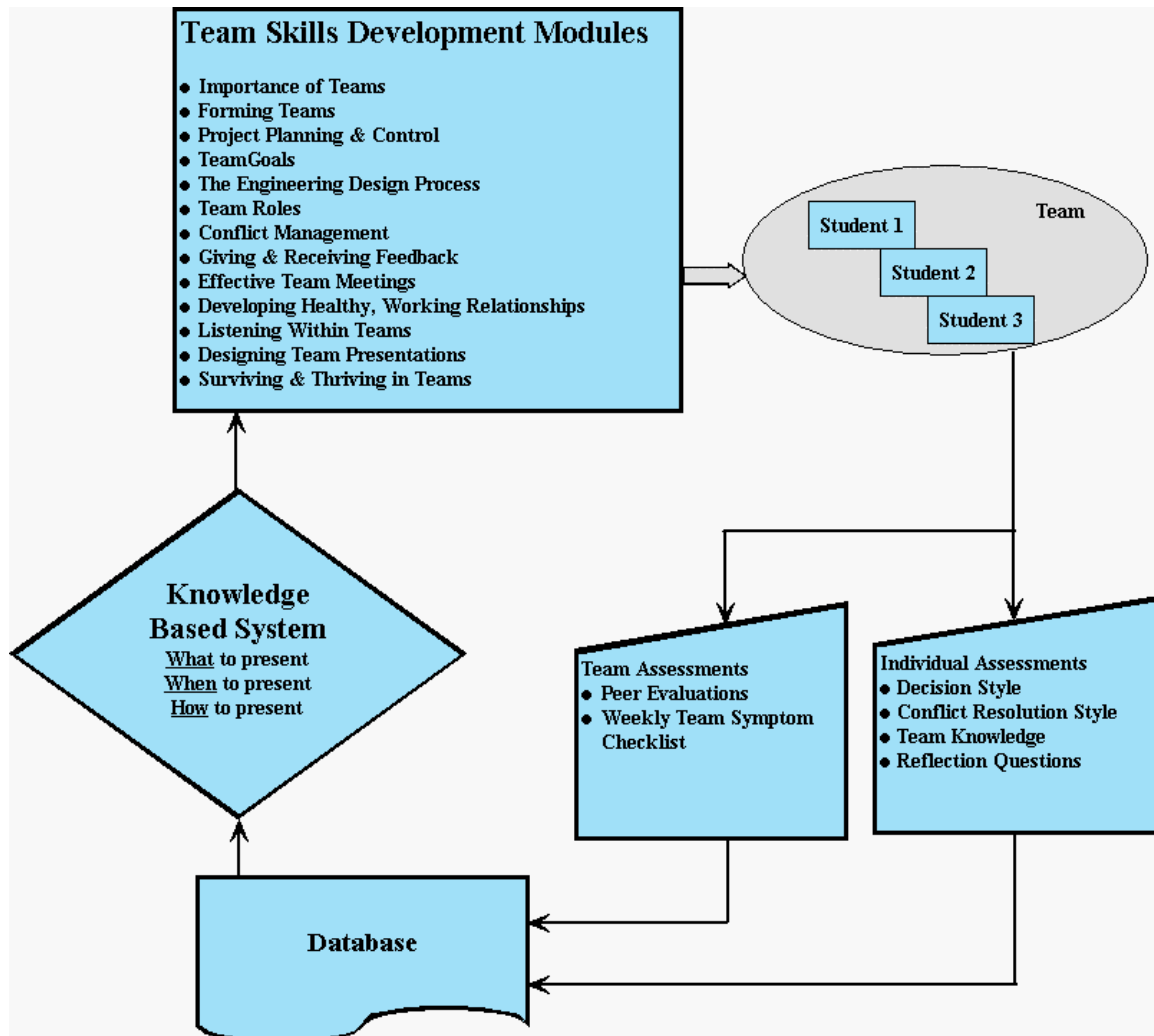


Figure 1: Model of TeamCoach System

The knowledge-based system serves as the supervisor of the system by determining: 1) what information to present 2) when to present the information and 3) how to present the information. The knowledge-based system determines what information to present based on the team's developmental stage, the specific team composition and the student's particular preferences related to decision and conflict resolution style. The knowledge-based system determines when to present information based on the team development stage, the week of the semester, and information supplied by the students through the weekly team symptom checklist and peer evaluations. The knowledge-based system determines how to present the information based on the individual's decision and/or conflict resolution style.

The second main component of TeamCoach is a database that is used to store all the responses obtained from the students. Students were surveyed initially to determine their

knowledge of team processes and their preferences related to decision and conflict resolution styles. Throughout the semester students were asked to reflect on questions concerning their team functioning, complete peer evaluations, and weekly team symptom checklists. All of this information is stored in the database and accessed as needed.

The third main component of TeamCoach is the team process modules that contain the actual learning material on team process skills. The modules are sequenced to follow the team life cycle developmental stages and to respond to problems reported on specific teams. Any module that has been previously viewed is available to students for later review.

### **TeamCoach Design Notes**

Teamcoach is implemented as a CGI application using the Perl programming language. The original implementation used a departmental Linux/Apache server as the platform; in 2001-2002 it was moved to a dedicated Windows NT/IIS server. It was hoped that this would allow more flexible administration of the system --however, the main result was attacks by Warez hackers.

The prototype system was developed without purchasing hardware or software. The database was implemented using directories, files and regular expression-based searches, the knowledge base was implemented using simple "if-then" logic, Perl hash structures, and the HTML::Template Perl module.

Portions of the TeamCoach software were implemented using object-oriented Perl, to provide for easier porting to more robust, scalable database systems.

We should also note that we considered converting TeamCoach to use ASP, however, we eventually decided this technology was too platform-specific and that the amount and quality of freely-available documentation and tools for Perl considerably exceeded that for ASP.

### **TeamCoach Modules**

The use of TeamCoach during an engineering student design project provides the students with specific team process knowledge and feedback in small, manageable chunks of information. The modules selected for TeamCoach consisted of transportable and team-contingent skills.<sup>4</sup> The decision to focus on transportable and team-contingent skills was made because engineering students could learn these skills by interacting with TeamCoach and then use them in a variety of different team contexts. Based on the research of the type of problems commonly experienced in engineering student design teams<sup>5-9</sup>, the literature on how to build effective teams<sup>7, 10-14</sup> and team stage development<sup>15-17</sup>, the modules shown in Table 1 are included in TeamCoach. The modules provide fundamental team process skills in a structured, disciplined approach to getting work done in teams.

Table 1: TeamCoach Modules

<b>Module</b>	<b>Learning Objective</b>	<b>Topics Presented</b>
Importance of Teams	To understand and be able to explain what makes a team and why team skills are important to an engineer.	<ul style="list-style-type: none"> <li>• Definition of a team</li> <li>• Why team skills are important in an engineering career</li> </ul>
Forming Teams	To explain the various stages of team development and to give a preview of what to expect on your team. Focus on getting to know other team members.	<ul style="list-style-type: none"> <li>• Sequential stages of team development</li> </ul>
Project Planning and Control	To be able to apply Project Planning and Control techniques to your team's projects.	<ul style="list-style-type: none"> <li>• Characteristics of projects</li> <li>• Project Planning and Control Process</li> </ul>
Team Goals	To understand why team goals are critical to the success of your team and to be able to set goals for your team.	<ul style="list-style-type: none"> <li>• Importance of team goals</li> <li>• Developing team goals using the SMART rule</li> </ul>
Engineering Design Process	To understand and be able to apply the Engineering Design Process to your team project.	<ul style="list-style-type: none"> <li>• Engineering Design Process</li> <li>• Defining the problem</li> <li>• Brainstorming</li> </ul>
Team Roles	To understand the three types of informal group roles and be able to identify specific roles of each type in actual group interactions.	<ul style="list-style-type: none"> <li>• Task roles</li> <li>• Maintenance roles</li> <li>• Individual roles</li> </ul>
Conflict Management	To understand what causes conflict in a team and to be able to effectively resolve conflicts.	<ul style="list-style-type: none"> <li>• Conflict handling styles</li> <li>• Using the appropriate conflict style based on the situation</li> </ul>
Giving and Receiving Feedback	To be able to recognize and accept feedback and use it to improve the project and further personal growth.	<ul style="list-style-type: none"> <li>• Benefits of giving and receiving feedback</li> <li>• Tips for giving and receiving feedback</li> </ul>
Effective Team Meetings	To be able to run effective, productive team meetings.	<ul style="list-style-type: none"> <li>• Why meetings are important</li> <li>• Steps for planning and running a meeting</li> </ul>
Developing Healthy, Working Relationships	To be able to work with all types of people; regardless of whether you like them or not.	<ul style="list-style-type: none"> <li>• Actions that promote healthy working relationships</li> <li>• Actions that could destroy working relationships</li> </ul>
Listening Within Teams	To understand the nature and importance of listening within teams and the three aspects of competent listening.	<ul style="list-style-type: none"> <li>• Importance of listening</li> <li>• Nature of listening</li> <li>• Guidelines for being a competent listener</li> </ul>
Designing Team Presentations	To prepare and present effective team presentations.	<ul style="list-style-type: none"> <li>• Organizing a team presentation</li> <li>• Practicing as a team</li> <li>• Using visuals effectively</li> </ul>
Surviving and Thriving in Teams	To keep the team focused on the task during the final weeks of the semester.	<ul style="list-style-type: none"> <li>• Suggestions for surviving and thriving in a team environment</li> </ul>

## Student Evaluations

At the end of the semester, the students were asked to evaluate their interactions with TeamCoach. A total of 68 students responded.

A majority of the users said that they were either very satisfied or satisfied with the Appearance of TeamCoach (67%) and the Information available on TeamCoach (64%). However, only 39% of the users were either very satisfied or satisfied with the Availability of TeamCoach.

The students were asked to indicate the most helpful module. The results are shown in Table 2.

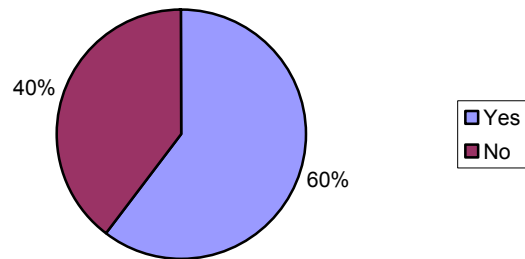
Table 2: Most Helpful Module

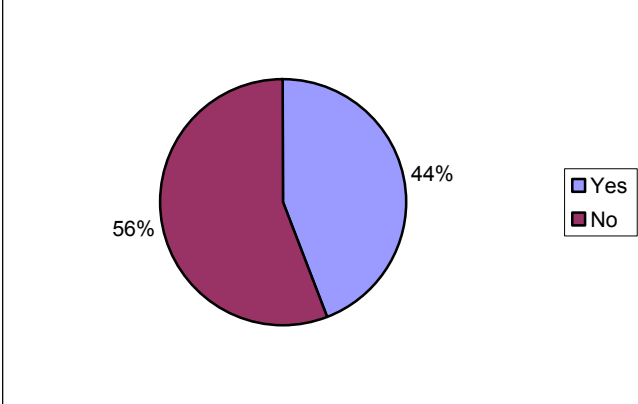
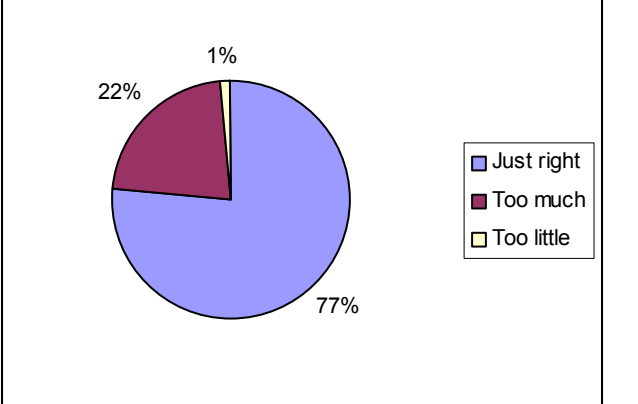
- Importance of Teams (26%, n=18)
- Project Planning and Control (25%, n=17)
- Team Goals (21%, n=14)
- Team Roles (10%, n=7)
- Forming Teams (10%, n=7)

Some of the modules contained videos of a real student design team modeling team behaviors. A total of 28 students (41%) watched the video segments with 9% (n=6) indicating that the videos were very beneficial, 24% (n= 16) indicating that the videos were of some benefit and 9% (n=6) indicating that the videos were of no benefit.

Overall, the students felt that Team Coach helped their team's performance, the students were not as positive about receiving the team skills information on the web as opposed to the classroom, and the majority agreed that the time required to use TeamCoach was just right.

I used the information from TeamCoach to help my team's performance.



<p>I prefer using TeamCoach to obtain information rather than receiving the information in a traditional classroom setting.</p>	 <p>A pie chart with two segments. The blue segment represents 'Yes' at 44%, and the maroon segment represents 'No' at 56%. A legend on the right shows a blue square for 'Yes' and a maroon square for 'No'.</p>
<p>The time required to use TeamCoach was:</p>	 <p>A pie chart with three segments. The blue segment represents 'Just right' at 77%, the maroon segment represents 'Too much' at 22%, and the white segment represents 'Too little' at 1%. A legend on the right shows a blue square for 'Just right', a maroon square for 'Too much', and a white square for 'Too little'.</p>

Several of the additional comments and suggestions from the students concerned their concern about the availability of TeamCoach and their ability to successfully view the videos. One student asked for a reminder e-mail each week so that he could remember to interact with TeamCoach. Two suggestions were made for additional content. One student requested additional information about professional management and managers and their team experiences. Another student requested information about how to talk to and interact with the industry representatives involved in the design projects.

### Faculty Evaluations

A survey was sent to all the faculty who participated in the beta-test. Listed below are the survey questions and a summary of the responses.

***1. Please share any comments about the appearance, ease of use, content and availability of TeamCoach.***

The faculty responses indicated that the appearance was professional. Some improvements could be made in the navigation of the site. The availability of the site did not meet the expectations. Suggestions for additional content were more streaming

videos depicting team roles and conflict resolutions, as well as more interaction required of the student.

*2. Please share what you would like to see added to TeamCoach (e.g. ability to group my own teams, ability to sequence my own lesson plans, ability to create additional TeamCoach modules, ability to see the information that students are putting into the system, instructor feedback as to how to work with teams)*

The faculty indicated that they would like to see enhancements to the reporting capabilities of TeamCoach and additional content available. The faculty would like to have the ability to see a progress or activity reporting system so that they can monitor what is happening in the teams. Also, there is a need for another level of depth in the modules allowing the teams to drill down deeper in their level of understanding of concepts to help them become a more effective team.

*3. Would you be willing to use TeamCoach again? (Please list any improvements that would need to be made.)*

All the faculty agreed that they would be willing to use the system again after more of the system problems are corrected and the system is more reliable. One faculty member thought that the content currently available is better suited for use by sophomores as opposed to seniors since the seniors commented that they had already been exposed to much of the content contained within TeamCoach.

*4. Please describe your students' reactions to TeamCoach.*

The students were highly frustrated throughout the semester due to the “unreliability” of the TeamCoach system. There were numerous server problems and the students commented that this resulted in them wasting quite a bit of time. Overall, the students seemed to react favorable to the content of TeamCoach.

*5. Do you think that the web-based team skill training was beneficial to the performance outcome of your student design teams?*

This was a difficult question for the faculty to answer because the impact of team training on performance is difficult to measure. There seemed to be a general feeling that the students were more conversant in team skills topics and aware of their roles in the team. The faculty believe that the concept of TeamCoach is useful and provides a very important resource.

*6. Please describe your level of support for further development of TeamCoach. (e.g. your support for using a revised version, interest in providing content material, interest in developing interactive modules)*

The faculty members were all interested in further development, testing and assessment of the system.



## Lessons Learned

The students told us in the survey very clearly that they encountered technical difficulties during the beta-test. The server used along with some programming difficulties resulted in less than ideal availability of TeamCoach. Also, the videos did not work well on older computer systems with slow download times. The server and videos proved to be the greatest sources of frustration to the students. The lesson learned from this is the necessity to have skilled programmers and system administrators to keep the system available. Even though this was a beta-test the users had high expectations for the technology to function properly. The technological glitches caused the students to lose faith in the system and we believe their frustration negatively impacted their impressions and use of the system. The students selected the '*Importance of Teams*' module as the most useful module. This module explains why teams are important in an engineering career. The other two top modules selected for usefulness were '*Project Planning and Control*' and '*Team Goals*'. Both of these modules were intended to help the students structure their team experience.

Overall, the faculty indicated a positive response to the overall concept of TeamCoach and have indicated their support for further development of the system. Additional content development with increasing levels of difficulty would enhance the system, along with an improved faculty interface.

## Future Development

Although TeamCoach is still in an early development stage, we are encouraged that with further development TeamCoach will be the preferred method for providing web-based team skill development with coaching, practice and feedback. Of course, there are many improvements to be made as the project proceeds. Specifically, further developments will include:

- Improved faculty interface with reporting capabilities
- More coaching
- More practice opportunities
- Additional team skill modules with increasing levels of difficulty

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## **TeamCoach**

Web-Based Team Skill Development

Providing *Coaching, Practice* and *Feedback*

TeamCoach Web Site: <http://teamcoach.wichita.edu>

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