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Online Tutorials for Design of Machinery Software

An Interactive Qualifying Project Report
submitted to the faculty of
Worcester Polytechnic Institute
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by

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Abstract

The goal of this project was to create an online tutorial for a cam-design program called Dynacam. Research determined that students had difficulty navigating the program and understanding how to translate problem statements into design parameters; this tutorial guides the students through this process. The tutorial was created using web-authoring software and animation software. In total, seven animations were created to guide students through specific areas of Dynacam. The project resulted in students being able to learn the program without help from their instructor as well as begin to understand the principles of cam design.

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Introduction

Today Internet usage is increasing substantially. According to a Nielsen/Net Ratings study, in October 2001 there were 115.2 million Internet users in the United States alone (Nielson/NetRating, 2001). That means that 62% of Americans are using the Internet. Since computer usage likely to, more companies and organizations are moving towards Internet related means of communication. Consequently, the Internet is becoming an everyday fact of life for many Americans.

Another result of this growth is the prevalence of the Internet in schools. The Internet has the unique capability to link children in rural Nebraska with pen pals in Japan for instant communication and learning. For older students it provides access to information around the world without having to leave their hometowns; this is particularly relevant for research projects that high school students must do. Most colleges and universities now require all students, faculty, and staff to have email addresses in order to provide better interaction within their community. In fact, some colleges are now offering courses taught partially, or in full, on the Internet.

Internet-based classes as well as traditionally taught courses often depend heavily on Internet tutorials to convey information to the students. Not only do Internet-based classes free the students from buying textbooks for the plethora of information covered in the class but it can be accessed from any online computer. The online tutorial is especially effective for teaching software because students have access to the latest information and software upgrades.

This project will demonstrate the need for an online tutorial of for software programs used in undergraduate machine design courses, specifically the program Dynacam, as well as to make such a tutorial for one of the programs and analyze its effectiveness. These programs help students to understand and design mechanisms by using animations, charts and graphs of the forces involved. There are over 110 schools in the nation that use Design of Machinery by Robert L. Norton. This text comes with student versions of programs Dynacam, Fourbar, Fivebar, Sixbar, Slider, Engine, and Matrix. However, of the schools surveyed by the author, only 17% reported that they require the students to use the programs (Norton, 2001). One reason for this might be that the instructors for this course do not themselves know how to use the programs and

therefore cannot teach the students. Thus, students may choose not to use the accompanying software that could aid their understanding of machinery design. Another reason for not teaching the software to the students might be that the instructor does not want to interrupt class time to explain the programs. Thus, students may not choose to use the accompanying software, which could aid their understanding of machinery design. Both of these problems might be solved by an online tutorial that could be accessed by students and teachers across the country.

The goal of this project is to create an online tutorial for program Dynacam. This project will also examine the effectiveness of this tutorial for learning these programs.

The next section of this paper will further explore the uses and effects of online-tutorials. In addition, personal learning styles and how different styles can benefit from using online-tutorials will be studied. Assessment methods and web-authoring tools will also be discussed.

Background

Educational Use of Computers

As technology becomes more advanced and less expensive, its use and relevance are expanding. One area in which it is most valuable is in the classroom. Computers are now common in the classroom. Many, children are introduced to computers during grade school and continue to use them throughout their school years. In fact, the United States' Census Bureau reported in the year 2000 that while 2 in 3 children had a computer at home, 4 in 5 used a computer at school (United States Census Bureau, 2001). Since most children learn how to use computers at an early age they are comfortable using them at the university level. This is beneficial since many professors assume that their students have knowledge of computers and so use them in their courses. Since computers are so widely used, many studies have been done to determine the best ways to incorporate them into the classroom.

There are many studies about computer and Internet use in teaching. One study about student -usage of the Internet by Donovan and Nakhleh (2001) examined the effectiveness of using a website to supplement an introductory chemistry course. The website that was used in the study was made specifically for the course and contained information and graphics of subjects covered in the course. The students were given homework assignments that made it necessary for them to use the website, beyond that, its use was not required. The study found that students used the website to further their knowledge of chemistry and clear up confusion on difficult subjects. The study also found that the students who did not to the homework assignment that required them to use the website, felt that viewing the site might have benefited their understanding of the subject through visualization and reinforcement. Students who didn't use the website reported that they didn't use it because they either didn't know about it or forgot about it. The overall response to the tutorial was positive with only 7% of the students reporting that the website was a bad idea. The authors make the point that viewing the website should be made an assignment by the instructor so that all students are exposed to the website (Donovan and Nakhleh, 2001).

Another study of distance learning conducted by King and Hildreth (2001) investigates the effectiveness of an Internet course. In the study, one group of students was taught in the traditional lecture format while the other group was taught using the course's online tutorial. The two groups came together at examination time. The study found that students who learned the course entirely via the Internet became more active learners by forcing them to keep up with the material. Said one student, "'This class has been more helpful to me than any other class, because it required me to be organized and responsible'" (114). The Internet students in this study communicated with their instructor via the Internet to clarify misunderstandings about the subject. The study found that these students did not feel disadvantaged because they communicated with the instructor by email rather than in person. However, the authors make the point that as class size increases, the ability of the instructor to communicate regularly with each student is diminished, which decreases the effectiveness of the distance learning. (King and Hildreth, 2001). This is the same as in the classroom – the more students there are, the harder it is for the instructor to work with each student one on one.

There are many benefits to online classrooms. A study by Carswell *et al.* (2000) examines the student experience in web-based course. The course was taught at Great Britain's Open University. Open University is a distance education facility. This course was a pilot to see if running courses on the Internet is superior to running them by mail. A portion of the class took the class course on the Internet while the remaining students worked by mail. This is a true distance learning environment. The students never met their professor, but they were able to complete the course by using the means available to them. Open University's success demonstrates that a professor does not have to teach the course in person for the subject to be understood by the students. The authors of this study found that the Internet course had increased interaction between students, provided good reliability, quick feedback, and exposed students to the Internet if they had not already been. The authors concluded that the Internet provides effective learning because the students reported that the experience was favorable and that they would take another Internet-based class.

For all projects there are positive and negative aspects. Ross *et al.* (1999) lists the advantages and disadvantages to using the Internet in the classroom. Some of the

advantages are that the Internet has the potential to meet all students' individual learning needs. Also, once developed, online resources can save the instructor time, and using the Internet can enhance the meaning and richness of the course. King and Hildreth found many students whose opinions supported this idea, "... [the instructor] gave us a CD to help us, along with additional biology websites, so I used a lot more information than just the textbook" (King and Hildreth, 2001). Electronic material can help improve teaching by presenting the material in many ways. Finally the Internet can improve student willingness and motivation to learn. One student said, "...The structure of this Internet course made it imperative that students work through the textbook in order to complete the weekly assignments" (King and Hildreth, 2001). Some drawbacks to using the Internet are that the students or instructor may not have sufficient knowledge of computers and that developing the material can be time consuming. The biggest disadvantage may be that some material may be difficult for students with slow Internet connections to access. The instructor should decide on an individual basis if the positive aspects of using the Internet in the course outweigh the negative aspects.

Learning Styles and Teaching Methods

Within the past few decades the idea of teaching to different learning styles has become more prevalent. There have been many studies done to identify different types of learning styles and how to teach using them. According to Ross *et al.* (1999), there are four main types of learning styles. They are: visual, auditory, kinesthetic, and social. Visual learners learn best by seeing information like text or diagrams. They enjoy tasks that involve reading, recitation, note taking, and watching videos. Auditory learners process information best by hearing it such as they would in a lecture format. They benefit from tasks that require active listening, communication, and narration. Kinesthetic learners learn by doing things such as conducting experiments. They enjoy acting, building, manipulating, designing, and experiencing. Social learners learn best by working in groups, and discussing ideas with other students. They enjoy debates, interviewing, and interactive discussions. Lately, many ways have been developed to teach to students with these different learning styles.

The Internet is a good tool for teaching students with a diverse range of learning styles. Animations, hypertext, and diagrams can be employed to help visual learners learn. Recorded lectures or lecture summaries as well as recorded explanations help the auditory learners. For kinesthetic learners, small interactive programs can aid in their learning. Finally, the Internet may be used as a chat-room for social learners to gather and discuss topics (Ross *et al.*, 1999). A study by Truell (2001) found that all types of learners had a positive response to Internet-assisted instruction.

Tutorials and Site Design

Many of the articles reviewed gave suggestions on creating a successful online tutorial. The suggestions detailed below look at how other tutorials have been created and the useful techniques the studies' tutorials employed.

Visualization

One of the greatest advantages that tutorials have over general lectures is the fact that they are visual. Tutorials have text that can be read aloud for more auditory learners, silently for the more visual learners and there is hypertext (when the user clicks on this text it brings them to a different part of the website) for both. Donovan and Nakhleh (2001) found that students went back and reviewed information on the course website. Said one student " 'It's better than just going through lecture again because you actually get to focus more energy and time on things you don't understand and you can skip over the things that you do' "(Donovan and Nakhleh, 2001). Pictures and graphics can also be presented easily on a website. Another useful thing about pictures used on a website is that they can be saved on the computer and viewed later without having to return to the tutorial.

Animation

A computer-based tutorial is superior among tutorials because it can make use of animations, something that textbooks cannot do. Animations are useful tools in learning because they can present a moving demonstration of the concept. This is often extremely useful when trying to describe a particularly difficult concept such as mechanisms. Eick and Burgholzer (2000) found that in a study that utilized online tutorials to supplement an

introductory soil science class, students understood "some of the more difficult concepts from clay mineralogy… [that were displayed] in a three-dimensional, rotating, interactive format" (149). This study also utilized QuickTime virtual reality movies to illustrate concepts to the students. This study helps illustrate the point that animation and movies greatly added to the quality of a tutorial.

Johnson *et al.* (2002) developed a tutorial for teaching CAD to undergraduate level students. The tutorial covered orthographic projection, solid modeling, and dimensioning fundamentals. The authors came to the conclusion that people learn well when taught by animations rather than by still pictures and they used this in their tutorial.

Design Strategies

One article that was reviewed described the methods used in creating an online tutorial for MatLab and what was successful. Tilbury and Messner (1997) designed the tutorials to be run in tandem with MatLab. The tutorial had pictures and explanatory text and the students were encouraged to copy lines of code from the tutorial and input them into MatLab. The authors decided on this approach for many reasons: One, cutting and pasting eliminates the mistakes that occur when typing text, it reduces the amount of time spent learning the program and finally students can compare their outputs with that of the tutorial. Tilbury and Messner found that this approach to the tutorial was very successful with 84% of the students responding that the tutorial was useful or very useful.

A tutorial developed by Crown (1999) uses lecture notes in the form of slide shows, movies, games and quizzes to teach the fundamentals of engineering graphics to undergraduate level students. In a survey done by Crown, 66% of the students felt that the tutorial movies were the most helpful. Crown utilized games and quizzes because it gives students immediate feedback about the topic they just covered. Crown found that having the lecture notes available to students on the computer meant that students were less likely to go to live lectures. Crown encouraged students to utilize this and attend class when they were unsure of the material. In Crown's class the reduced class size meant that the students and teacher have more interaction. This format also benefits students who are ill and cannot attend class. A survey conducted by Crown found that there was a 16% increase in understanding of the material by students who used the

tutorial compared to those who were taught using the traditional lecture format. This indicates that the students not only use the tutorial to learn on their own but also that they understand the tutorial without needing much, if any, assistance from an instructor. One more finding of this study is that 80% of students in the class favor the tutorial (available on CD-ROM) to the textbook. Crown concludes that the interactive learning of the tutorial greatly benefits most students.

Example Tutorials Reviewed by the Author

A number of software and instructional tutorials were examined to help determine what makes a good tutorial. Graphics Interactive (Lieu, 1997), which teaches general drafting techniques, PRO/Engineer (Toogood, 2001), which teaches PRO/Engineer 2001 (a CAD software), and Engineering Graphics (Crown, 1999), which teaches introductory CAD and three-dimensional object manipulation were all reviewed.

Graphics Interactive (Lieu, 1997) incorporates sound into the tutorial. A voice reads the text so that the viewer can study the graphics and animations. Some viewers may find it distracting that the sound is not consistent throughout the tutorial. That is, some screens are read for the viewer and others aren't. Also, the navigation buttons for the tutorial sometimes cover up graphics and text. Another observation is that some of the animations were so fast the viewer could not decipher what was happening.

The Pro/ENGINEER (Toogood, 2001) tutorial had good quality graphics but the animation moved around the screen with no indication to the viewer of where to move next. Since this animation ran with no user interaction it could not be rewound and could potentially lose the viewer.

Engineering Graphics (Crown, 1999) presents the viewer with a webpage user-interface. The tutorial operates by using lecture notes, animated CAD tutorials, games and quizzes. The viewer may look at lecture notes in PowerPoint (Microsoft ®) which are also presented with video and audio. The games and quizzes correspond to each lecture. This provides the user with immediate feedback about their understanding of the information. The games lack instructions though, making the viewer guess what to do. Also, incorrectly answering a question will bring the user back to the beginning of the game which frustrates the user. The games, quizzes, and lecture all have different

backgrounds and fonts. While all the components in each category are consistent within that category, there is no consistency between categories.

Aesthetics

Flanders and Willis (1998) emphasizes that the designer should be consistent with color, font, and font and graphics size for the entire website. This makes it easier for the viewer to concentrate on what is being delivered rather than distracted by how it is delivered. The authors also make the point that the web pages should be short, that is, they should not be more than two screen-loads long. The longer it is, the more the viewer has to scroll through and the higher the potential for the user to get bored and leave the site.

Web Site Assessment

All of the articles about computer use in the classroom used surveys as their means of gathering information. The study by King and Hildreth (2001) used anonymous opinion surveys distributed to the Internet class to gather information on the Internet-based course. Questions included asking the students why they took the Internet course as well as asking if they thought they were learning the material as well as students in the lecture class. The study also conducted limited interviews with the students enrolled in the Internet course. This served to get information on specific topics about the Internet-class. This is beneficial as the questions are open ended and students can convey their exact feelings. Truell (2001) used a response scale in his study. The Donovan and Nakhleh (2001) study also used a scaled response survey as well as limited interviews. Questions in this study ranged from asking the students to rate using the Internet for the course to what the students felt about particular aspects of the site. The scaled response is a valuable tool because the answer must fall into a category and this makes comparison easier. The Carswell *et al.* (2000) study used questionnaires to establish the students' background in computing experience, and questionnaires to compare learning styles so that the group composition could be determined. A final assessment was made comparing the final grades of the Internet class and the traditionally taught class. The

grade comparison is useful because it can show if students in the Internet class fared better or worse than their peers. Researchers can use this method to determine if the Internet class reached its goals.

Web-Authoring Tools

Websites are most commonly written in a language called Hypertext Markup Language (HTML). When the web-browser goes to a particular website, it reads the HTML code and displays the user interface. There are several options for creating the HTML code. The first method is to simply open a text-editor on the computer and start writing the code. This is a great way to for the designer to become intimately familiar with HTML code. The downfall to this method is that the user must know the HTML language. Another disadvantage to using a text editor to create a webpage is that it is very difficult to debug an error because a location for the error is not given. A second option is to use a WYSIWYG (What You See Is What You Get) program such as FrontPage, which was created by Microsoft. This program is specifically made to create web pages. Instead of writing the code, the designer uses a visual method to create the web page. For example, a drag and drop method can be used to position text and graphics, while the HTML code is created by the software as opposed to writing the lines of code required to do the same operation. This method can be used to create a framework for the website while the details can be added in the HTML, which can be altered while in FrontPage. This program has obvious advantages to beginner web-designers. One disadvantage to this program is that it sometimes embeds proprietary code which makes viewing the website with non-Microsoft browsers, such as Netscape Navigator, difficult; however, this proprietary code can be removed from the HTML. There are two other programs that work in the same manner as FrontPage: Dreamweaver by Macromedia and GoLive by Adobe. Both of these programs have a good user-interface like FrontPage and they avoid the problem of adding proprietary code that will only enable the site to work on a Microsoft specific browser. Below is a list of the elements that a website might have. Any web-authoring tool must have the capability to deal with these.

- animation
- graphics
- text
- hyperlinks
- hit counters
- frames
- sound
- search engines
- advertisements
- navigation bar
- pictures
- buttons
- check boxes
- drop down menus/lists
- text box
- scrolling
- output box
- mouse-overs (when the mouse hovers of a particular item a specific event can be triggered like pop-up menus and color changing, etc.)
- tables
- style sheets (a template for all color, font, alignment etc)

All the WYSIWYG programs like FrontPage, Dreamweaver and GoLive have the ability to handle all of the above listed elements because these programs are just ways to organize and navigate through the material that is created in external programs like Flash.

Animation Tools

There are a several ways to make computer animations. Depending on what the author wishes to do there are some options as to the tool s/he uses. If a "flip-book" type movie is desired it is possible to make .gif files that act like movies. Programs like Adobe ImageReady can do this. Another animation tool is a Macromedia program called Flash. This is a very powerful tool. Flash makes it possible to synchronize sound and

picture. Flash will accept any type of picture file (.jpg, .gif, etc.) but once saved, it will become a Flash file. This will require the user to download the Flash plug-in which is freely available at the Macromedia website (Macromedia, 2002). Through animation, both of these programs can help students visualize the written instructions or understand a difficult concept.

Student User Survey

To determine student opinions of programs Fourbar and Dynacam a survey was sent to three schools; Clemson University, University of Delaware, and Worcester Polytechnic Institute. One hundred forty-two students were polled in this survey. There was a 21.1% response rate. Of the 30 students who did respond, 70% thought that it would be a good idea to have a tutorial for these programs. When asked how they preferred to learn programs 89% responded that they explored the program on their own. The next most preferred method (14%) was to have a one-on-one demonstration. Also, students were asked which program was more difficult to learn. Fifty-three percent of the students responded that Dynacam was a more difficult program to learn than Fourbar. Six percent thought that Fourbar was the more difficult of the two. The remaining 38% thought that both programs were equally easy or equally difficult while 3% did not respond fully and their opinion could not be determined. The majority of the students felt that Dynacam was a less intuitive program. This information was used as part of the rational for choosing Dynacam as the program for which to make the tutorial. A more complete analysis of this survey can be found in Appendix C.

Five professors from various schools were also interviewed to determine their opinion of the programs. All to the instructors interviewed said that a tutorial for either Fourbar or Dynacam would be useful to their students either as a reference or as a teaching tool. A full analysis of these interviews can be found in Appendix D.

Assessment of the Tutorial

Once the tutorial is made it remains to assess its effectiveness to see if it helps the students learn the programs. There are several ways to do this. A formative assessment can be done. This type of assessment seeks potential problems and identifies possible

solutions. One way to do this type of assessment in this project would be to have the user answer questions as they proceed through the tutorial. This is useful because the user does not forget about aspects of the topic. This could be done by having a small quiz at the end of each section. The user would go into Dynacam and work through the problem using the techniques they just learned. If they gave the correct answer they would be allowed to proceed to a new topic, if they answered incorrectly they would be directed to another example explaining the topic. This technique could be used to track how many students gave the correct answer and how many needed to relearn the information. This would help analyze whether the tutorial had done a good job at teaching the information. The downfall to this method will be its implementation. This is a very time consuming and difficult element to add to a website and may not be feasible for the given timeframe.

A summative assessment could also be done. This produces a summary of the effectiveness and is done at the end of the project. This is beneficial because it could be structured to contain either free response questions or structured answers. If used, the choice between a formative or summative assessment will have to be made depending on the number of students who review the tutorial for assessment since free response questions can be difficult to analyze in large numbers. (Fitz-Gibbon, and Morris, (1987). Another way to evaluate the tutorial would be to have instructors review the website and give feedback. Another way to evaluate the effectiveness of the site would be to set up a long-term study with a control group. Such a study could be over the course of a year and involve two classes. One class would learn the programs without using the tutorial and then be asked to take a quiz. The second class would learn the programs using the tutorial and then take the quiz. The grades from these two classes could be compared to see if students who used the tutorial had a better understanding of the programs.

Methodology

Many decisions were made for this project; things like which web development software to use, which topics to cover and how to present the information. The following is a detailed account of the decisions and their rationales.

Software Selection

The first task for this project was to decide on the software that would be used. The types of software needed fall into three different categories: web page authoring tools, animation tools, and graphics editing tools. Web page authoring tools were looked at first. The options for this were writing the HTML or using a What You See Is What You Get (WYSIWYG) program. The deciding factor between these two types was the ease of use for the time allotted to this project. Once the decision was made to use a WYSIWYG program it was necessary to decide which one to use. There are three main programs: FrontPage by Microsoft, GoLive by Adobe, and Dreamweaver by Macromedia. All of these programs have the same webpage making capabilities. They can make websites with multiple pages, contain frames, and accept any type of animation. The advantages and disadvantages for each program were weighed. The advantages for FrontPage are that Worcester Polytechnic Institute currently has a student license for Microsoft products, which means that it was not necessary to purchase web authoring software. Next, the author was familiar with FrontPage and since the timeframe of this project was so condensed there was little time to learn new software. Additionally, there was a support network for FrontPage available to the author. The only disadvantage to using FrontPage is that certain components of FrontPage websites are not compatible with web-browsers other than Internet Explorer. Since these options were not used in this website, this was not an issue. The advantage to GoLive is that the software does not embed Microsoft proprietary code into the HTML. The disadvantages to GoLive are that there is no support network readily available for the program, the program would have to be purchased, and in a trial of the program, the author found it very confusing to use. The purchasing of the program was a big consideration because if the site was ever to be updated in the future it would be necessary to buy another copy of

the program since WPI does not have a license for it. The advantage to Dreamweaver is that it does not embed proprietary code. However, its disadvantages are very similar to those of GoLive: there is no support network, it would require purchasing the program, and there is no available support network. For these reasons, the decision was made to use FrontPage.

The second group of software is animation tools. Macromedia's Flash was used because it is the one of the most capable animation tools on the market and after research it was determined to have all the functions necessary for this project; specifically, the ability to create animations that could run continuously, run and stop at specified frames, coordinate sound files with frames and accept various file types. Since it was not clear how the tutorial would be created when the software was ordered it was necessary to purchase software that had a wide range of abilities.

The final category, graphics editing, was not considered at the onset of this project but once the animations began to develop it became clear that it was necessary to have a graphics editing program because it was not possible to resize the .jpg files from the screen captures without loosing a lot of quality. For this reason Jasc Software's Paint Shop Pro 7 was used. Paint Shop Pro 7 allows the user to take screen shots and change the width and height without loosing much quality.

Appearance

Once the tools to create the tutorial had been selected it remained to create the website. The author decided to use frames in the site so that the navigation links and title would always be available. Originally the site contained four frames: top, left side, bottom, and middle. The middle frame was where the tutorial was presented. The top contained the title, the bottom, the contact information, and the left side, the navigation links. Space became an issue and the left side frame was eliminated and the links moved to the top frame. However, further space was needed and the bottom frame was removed and the contact information was moved into the top frame. The final layout for the site can be seen below in Figure 1.

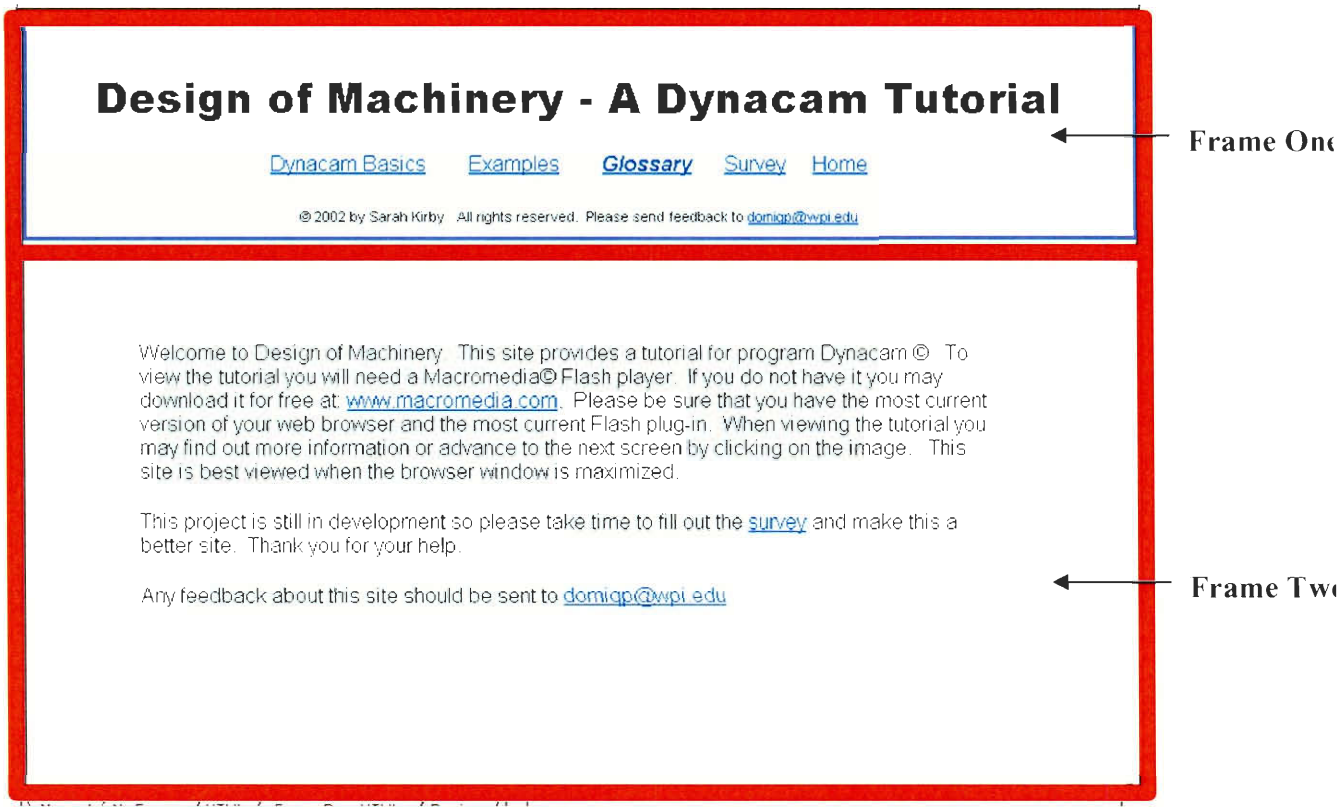


Figure 1: Page layout for Home page. All pages have the two frames in the same positions.

Navigation in the site was a very important part of this project. The flow chart below (Figure 2) is a graphical representation of the site navigation.

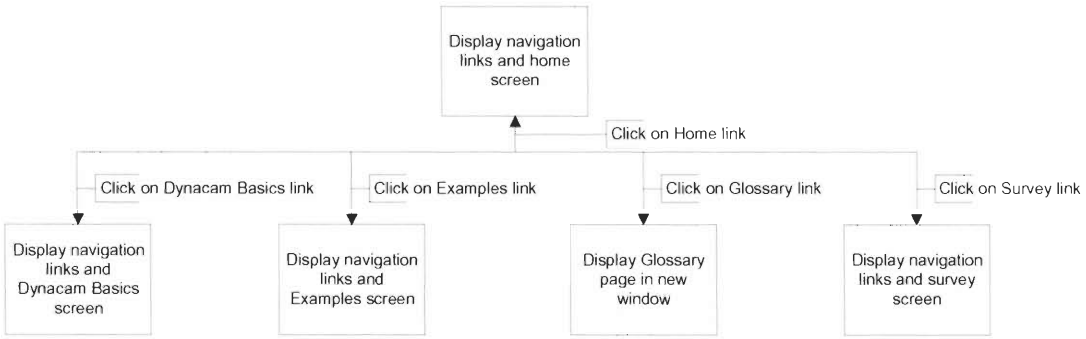


Figure 2: Website Navigation

The next decision was the color of the background. Black was also not considered because it strains the viewers' eyes on the computer (Wilson, 1998). A light

blue (Hex code = #CCFFFF) is used because is provides high contrast with black letters and provides a little color to an otherwise plain site. The font used is Arial because it is a Sans Serif font. Studies have shown that Sans Serif font is a better font for text that is read on a computer (Access to Australia's Culture and Recreation, 2002).

Preliminary Decisions

Another decision in this project is which program (Dynacam and Fourbar) and which parts of that program to cover. Through a survey conducted in December 2001 it was determined that students had more difficulty understanding program Dynacam and subsequently Dynacam was chosen as the program for which to make the tutorial. Initially there was a broad range of topics to be covered. A flow chart for these can be seen in Figure 3.

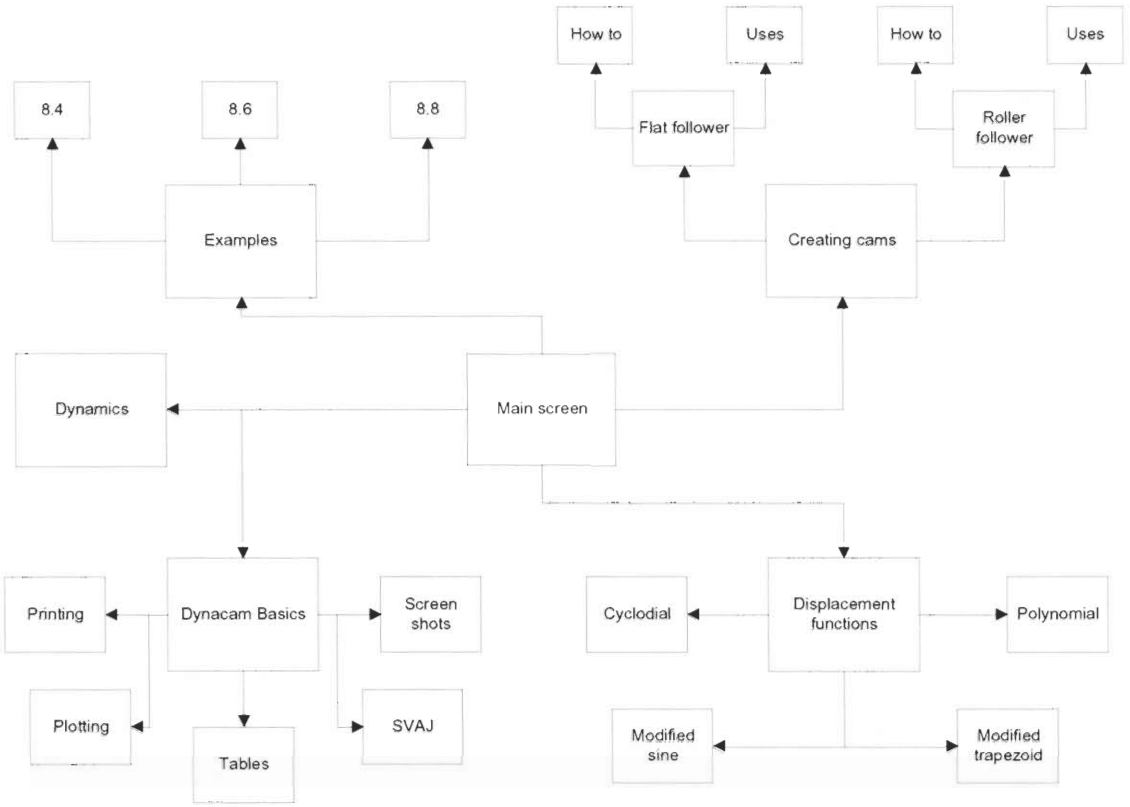


Figure 3: Initial website layout

Since there was a time constraint on this project it was decided that the tutorial should cover all the basics for the program which are as follows:

- S-V-A-J input
- Plotting
- Printing
- Size cam
- Screen shots

Also, to help students understand cam design three examples were chosen and are as follows:

- Double-dwell standard function
- Single-dwell standard function
- Single-dwell polynomial function.

Creating Animations

All of the animations for the Dynacam website were created using Macromedia's Flash 5. The strategy for this tutorial was to make the animations as similar to the Dyncacam as possible. The user must click on the proper data entry field or button (rather than enter a value) to make the animation proceed. The boxes and buttons only become available for use in the tutorial once the preceding actions have been performed. In Dynacam there are specific actions that occur when certain information has been entered. For example, in the SVAJ input screen, once the number of segments desired is entered, the screen appears with the appropriate number of rows where the user inputs the correct information; see Figure 4 for an example of the SVAJ input screen. In Dynacam there is little order for the way information needs to be entered, however, there is a suggested sequence which is how the tutorial guides the user through the program.

In Flash animations are created using layers and frames. Frames display the images in a time sequence to create an animation, and layers stack images on top of one another so that pictures can have additional graphics on top of them. An example of this is having a screen shot from Dynacam on layer one and having a highlighted box on a certain area (layer two). If these were not on separate layers the box could not be seen. In general each screen shot from Dynacam used had two layers and used one frame. The first layer contains only the screen shot. The second layer contains the mouse-over buttons and any graphics that correspond to the screen shot. An example of the mouse-over buttons is seen in Figure 4. In this case, the highlighted box appears when the mouse hovers over that area indicated by note 3, the orange highlighted box appears and when it does, information about that box input field appears off to the side. Although there are four other input fields on this screen, only clicking on the highlighted box will advance the user to the next screen. Once this step has been completed the user can then hover over the number four box area on the screen and repeat the same process. Using balloons helps guide the user through the proper input sequence. There are also green forward and backward arrow buttons that appear on all screens. Clicking on these will move the user to the appropriate screen.

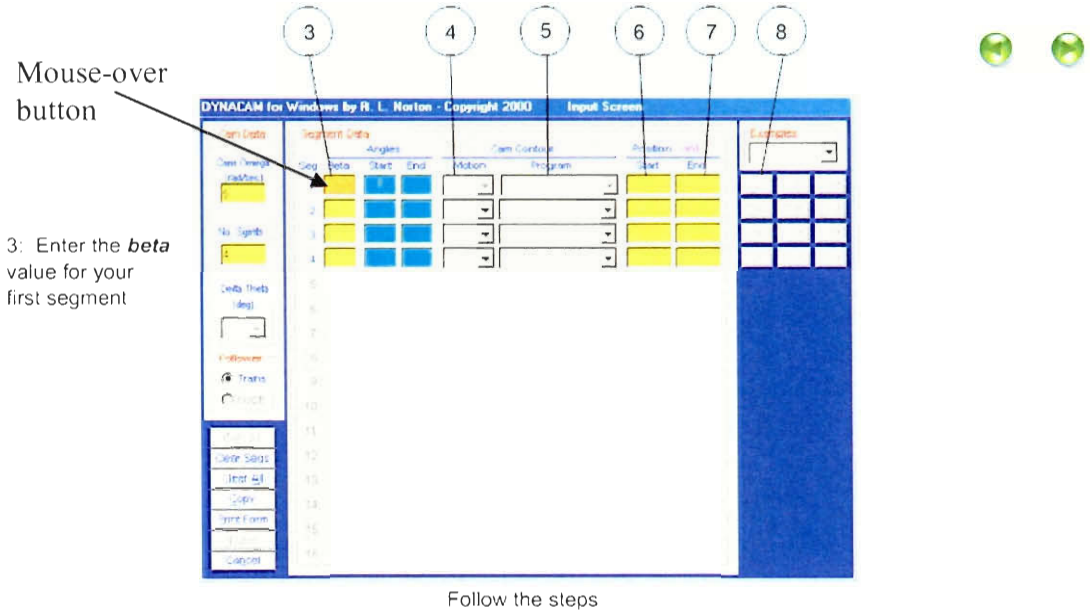


Figure 4: Screen shot with mouse-over button

The buttons were created by drawing a box at the correct area and then converting it to a button symbol. The button was then edited. The button itself has four different frames: up, over, down, and hit. Anything in the up frame will appear wherever the mouse is on the screen. When the mouse moves over the button what ever is in the over frame will appear, the same is true for the down, which occurs when the mouse is clicked. The hit frame decides exactly where the button is active. Examples of what happens in the up and over positions of the mouse are shown in Figures 5 and 6.

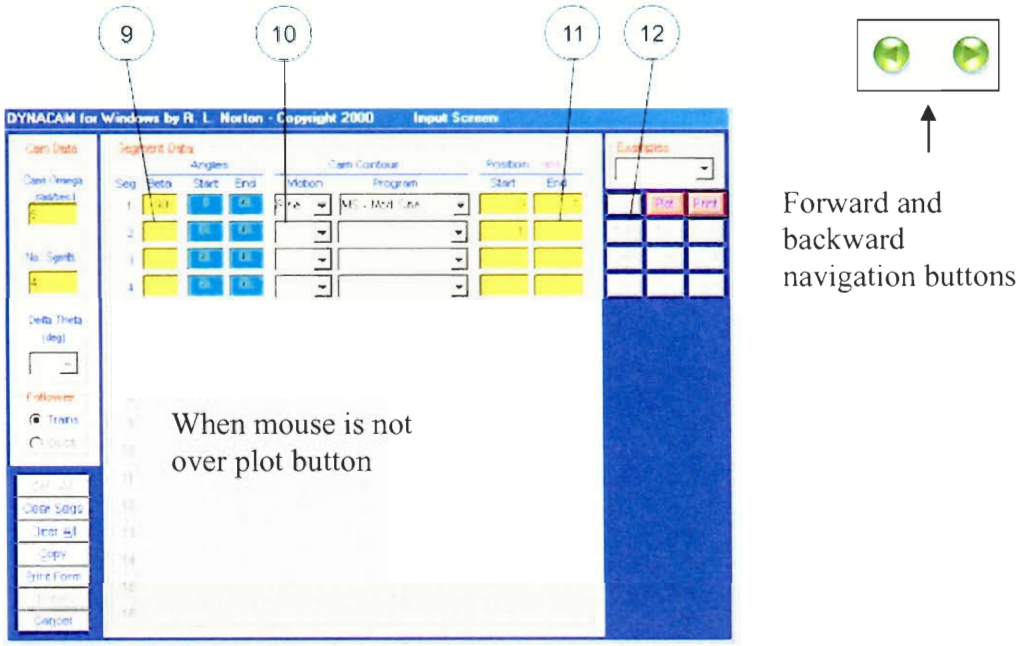


Figure 5: When mouse is not over plot button (up frame of button)

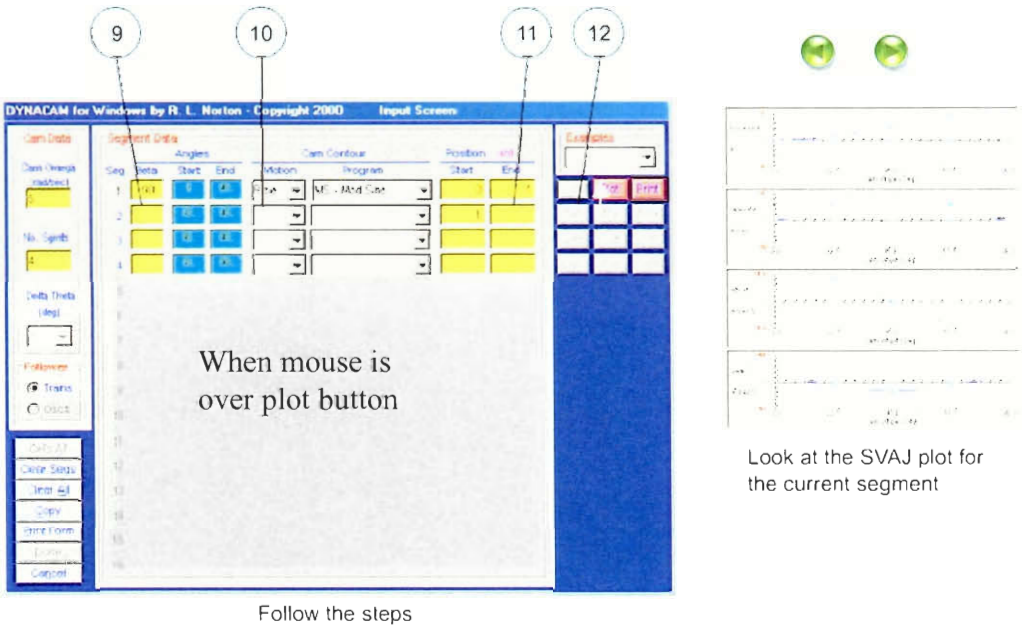


Figure 6: When mouse is over the plot button (over frame of button)

The buttons were used primarily to move to the next screen and convey additional information but they were also used to show different screens. This was employed so that as the mouse moved over different radio buttons, among other things, the appropriate screens would appear just as they would in Dynacam; additionally, the tutorial displays thumbnails pull down menus or input fields that are associated with the radio buttons.

In certain parts of the tutorials it was necessary to have balloons appear on multiple frames. Rather than creating the balloons on each individual screen a single layer was created for the balloons and was set for the frames needed. A graphic from Flash showing how a single layer lasts for multiple frames is shown in Figure 7. Images on each layer only appear in frames of that layer that are grey. For example the images in layers 6 and 39 are also displayed in frame 5 and images from layers 7 and 40 are displayed in frame 6. The circle and rectangle symbols in Figure 7 are part of Flash and represent the beginning and ending of the frames where the image is displayed. For images that only exist in one frame, only the circle symbol is shown. Here the image on layer 68 is displayed from frame 5 to frame 11 and the image contained in layer 68 will appear on all the boxed layers.

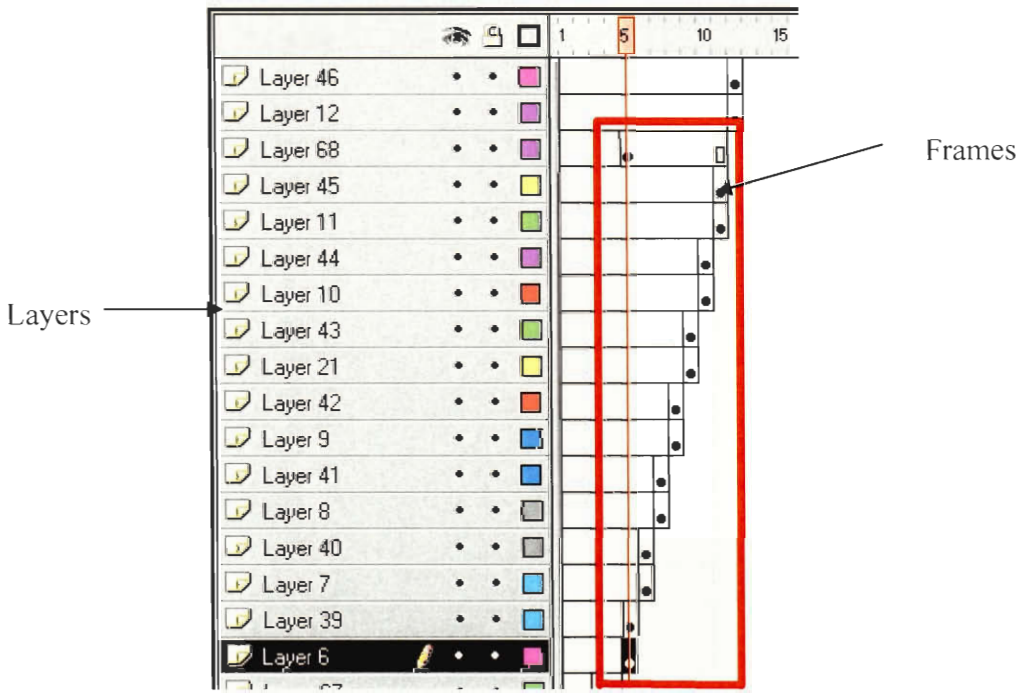


Figure 7: Layers lasting for multiple frames

Results

The following flow charts describe how the tutorials work.

Flow Charts for Tutorial Animation

All of the animations made for this tutorial were created so that they guide the user through the tutorial the way Dynacam should be operated. All of the animations contain explanations and instructions for the user.

S-V-A-J Input

The S-V-A-J input part of Dynacam is vital to understand but also one of the most difficult because there are many options that the user may choose. The goal of this animation is to teach the users how to properly input the data as well as introduce them to the different screens they will encounter. This was done by guiding users through the input screens and explaining each of the different options. The repetitive operations familiarize the user with the input procedure and the interactivity reinforces this. Interactivity in tutorials has been shown to increase student understanding (Eick and Burgholzer, 2000). A screen from the SVAJ tutorial is shown in Figure 8.

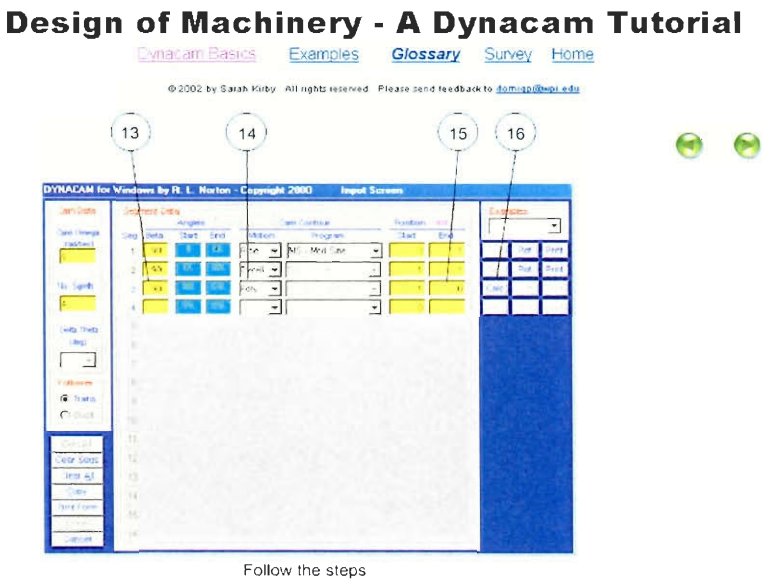


Figure 8: Typical Dynacam input screen shown in the SVAJ tutorial

The animation in this tutorial attempted to cover the broad range of choices the user might use. The flow chart for this animation can be seen in Figure 9.

Figure 9 Part 1: Flow Chart for S-V-A-J Input

Figure 9 Part 2: Flow Chart for S-V-A-J Input

Plotting

The plotting section of program Dynacam has four options to that can be used to plot. Since the numerous options may confuse users about the best choice, the animation allows the user to explore all the different types of plots. This was deemed necessary because users may use any of the four options and they need to be familiar with how to use all of them. The plot types' selection screen can be seen in Figure 10. In Dynacam the user chooses the type of plot by clicking on the radio button and choosing the Done button or by double-clicking the plot type icon. In the tutorial, the user clicks on the type of plot they want and this brings them to the same screen as they would see in Dynacam.

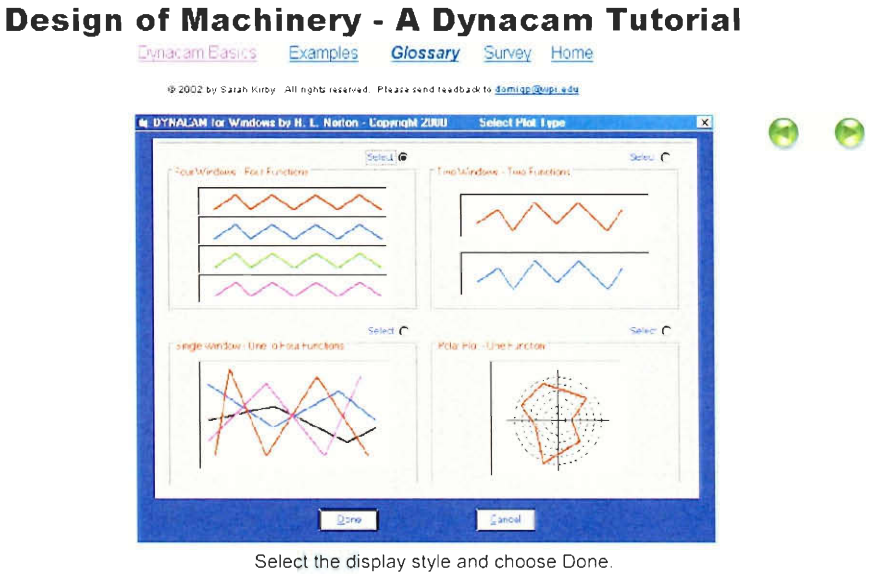


Figure 10: Plot types selection screen

Within each type of plot there are many choices the user can make. An example of the four functions plot type data screen is shown in Figure11.

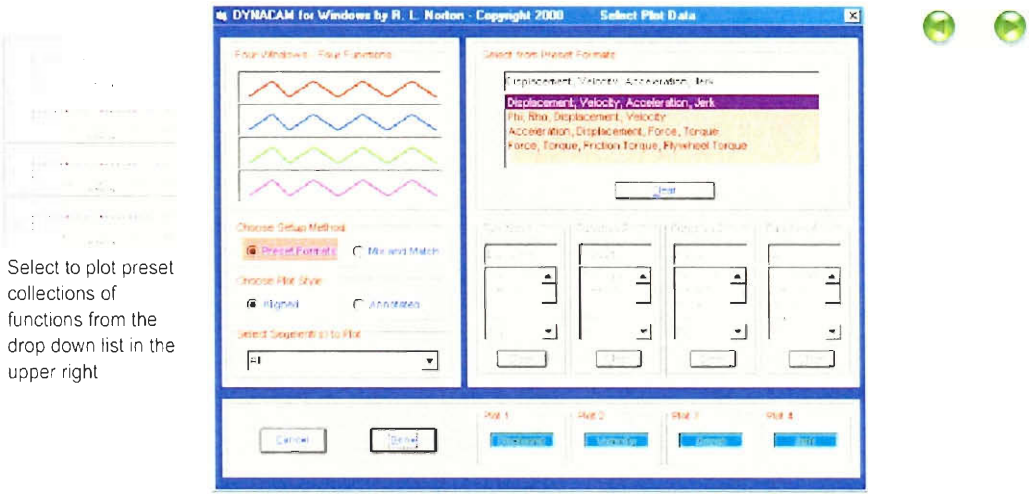


Figure 11: Typical select plot data screen. There are mouse-overs similar to the one shown, for the Mix and Match, Aligned, Annotated, and Segments choices.

By presenting an explanation and a graphic to the left of the screen shot when the user hovers over the desired radio button, the user can read the description as well as looking at the picture to understand what that option will do. The same presentation of explanation accompanied by a graphic happens when the mouse hovers over the Mix and Match, Aligned, Annotated and Segments choices. The flow chart for this animation is in Figure 12.

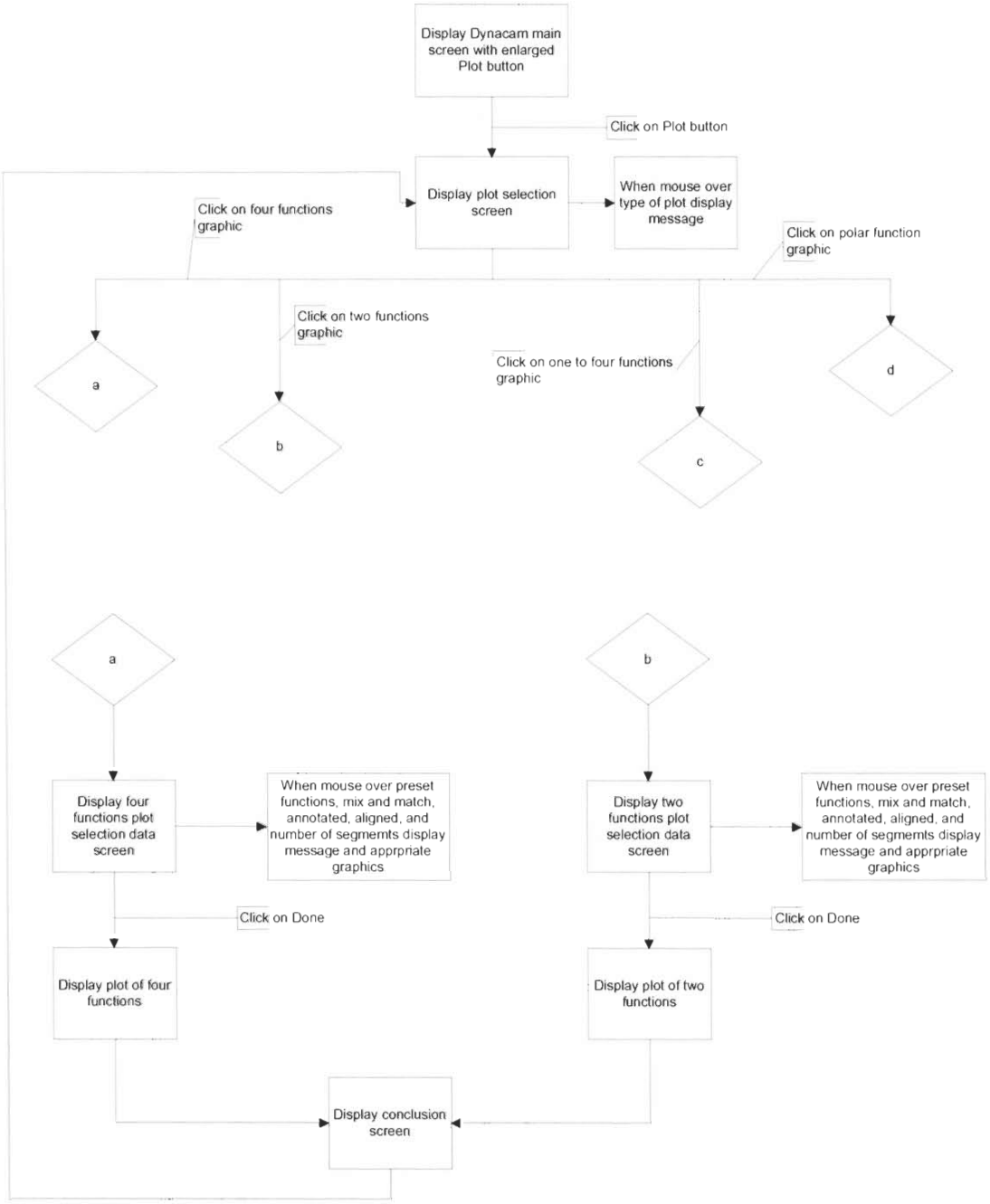


Figure 12: Part 1 -Flow Chart of Plotting

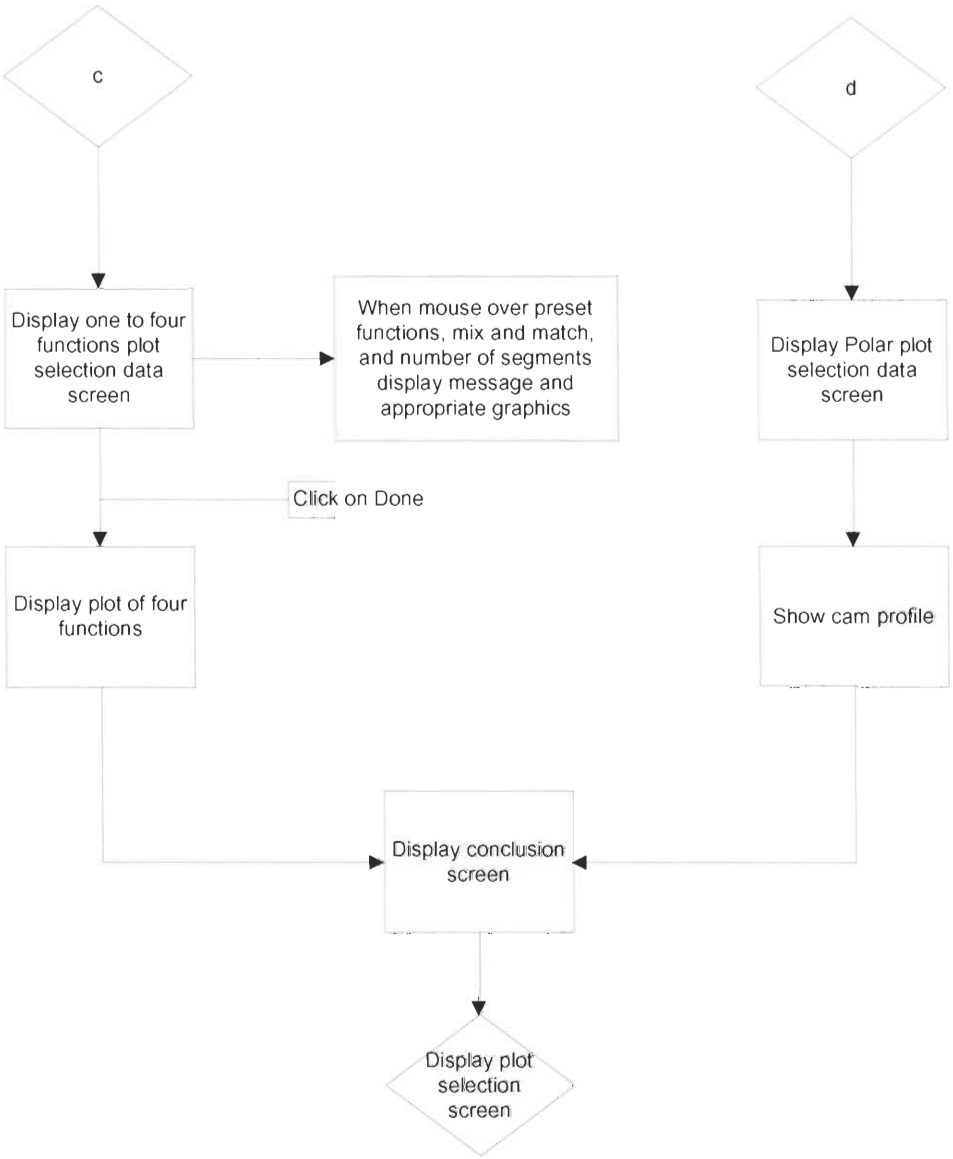
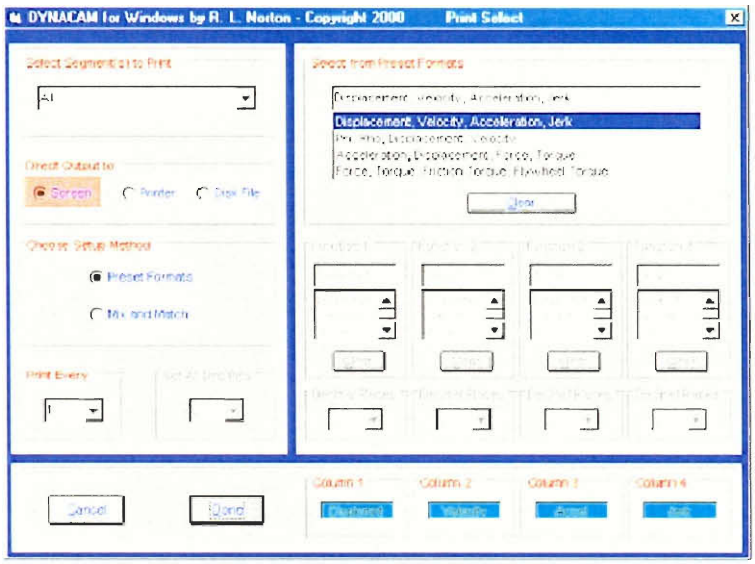


Figure 12: Part 2 – Flow Chart of Plotting

Printing

One of the most common comments on the initial survey (Appendix B) was that it was unclear how to print. Printing tabular data is often necessary for users to do because it is where they find the extremes of position and its derivatives as well as all intermediate data. This is vital in cam design since the extremes are the worst cases and designs are created so that the extremes are within given limits. Figure 13 shows the print selection screen.



Select this to print the information to your screen

Choose where you want to print to. Next, using either the mix and match method or the preset method, choose the functions to plot.

Figure 13: Print selection screen

Users can print to the screen, printer, or disk. They can also choose from the preset or mix and match formats, as well as choose the increment of the numbers to print. As in the previous animations this animation involves interactivity which helps users learn and reinforce what they've seen. The flow chart in Figure 14 illustrates that animation.

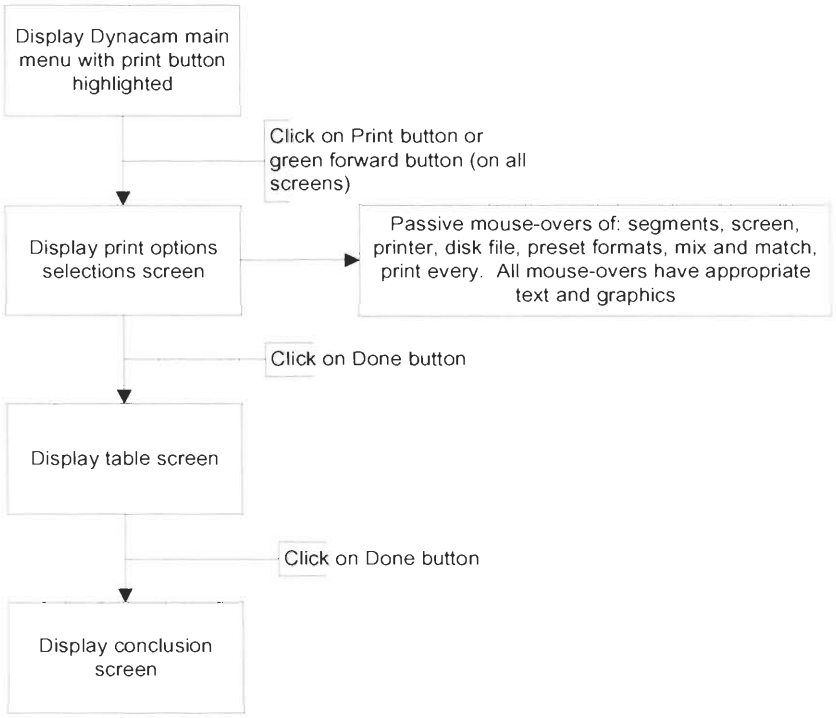
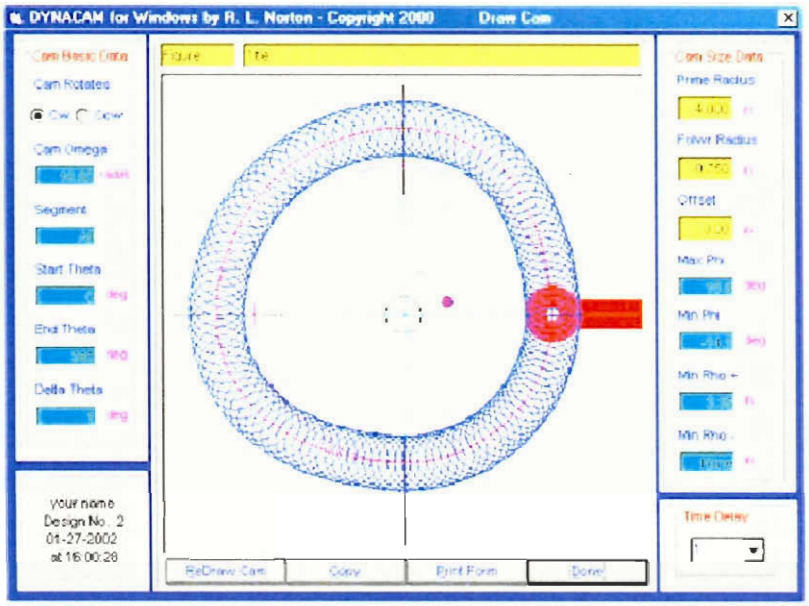


Figure 14: Flow Chart of Printing

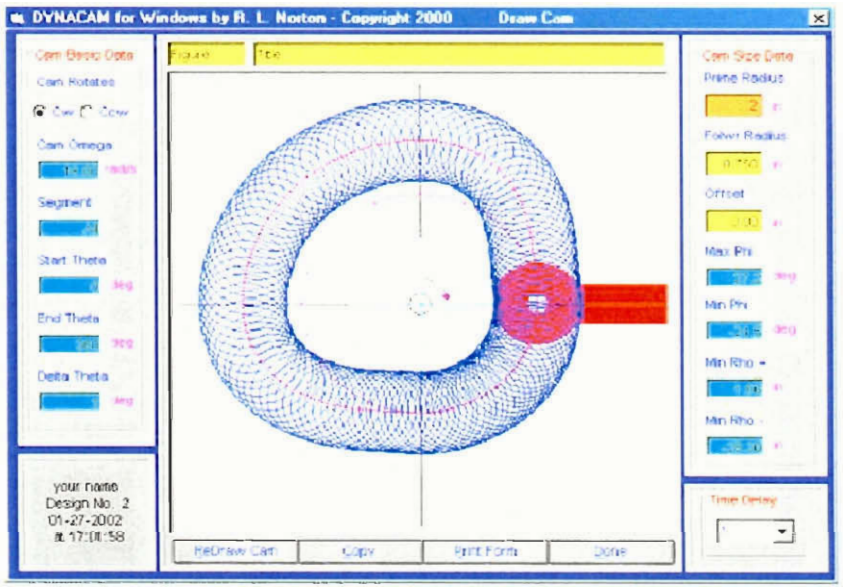
Size Cam

This is one of the most difficult parts of program Dynacam because there are many different options and users are often confused how to use them to optimize their design. The goal of this animation was to teach the users about the different options. Figure 15 shows a screen where a roller follower type cam has been chosen and Figure 16 shows what happens to the cam when the prime radius is reduced.



Make changes to the Prime Radius, Follower Radius, Offset, and the direction of cam rotation or choose Done when finished.

Figure 15: A roller-follower type cam with a prime radius of 4 inches



Change the prime radius of the cam

Make changes to the Prime Radius, Follower Radius, Offset, and the direction of cam rotation or choose Done when finished.

Figure 16: The same cam as in Figure 15 but with a prime radius of 2 inches

By showing the users the effect of changing values they learn what each option does and in the process learn more about cam design. The flow chart in Figure 17 shows the process that the users are guided thorough in this animation.

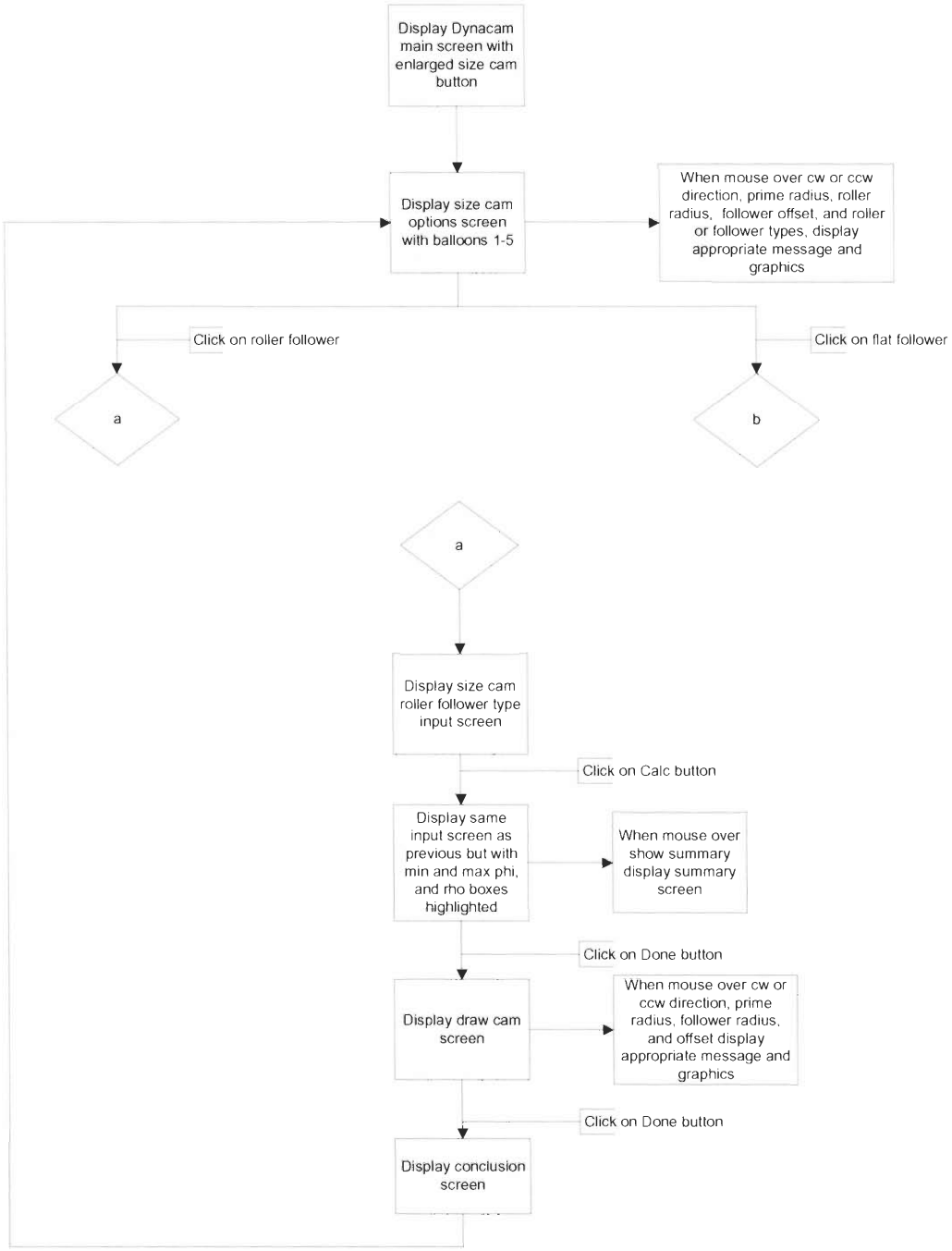


Figure 17: Part 1-Flow Chart for Size Cam

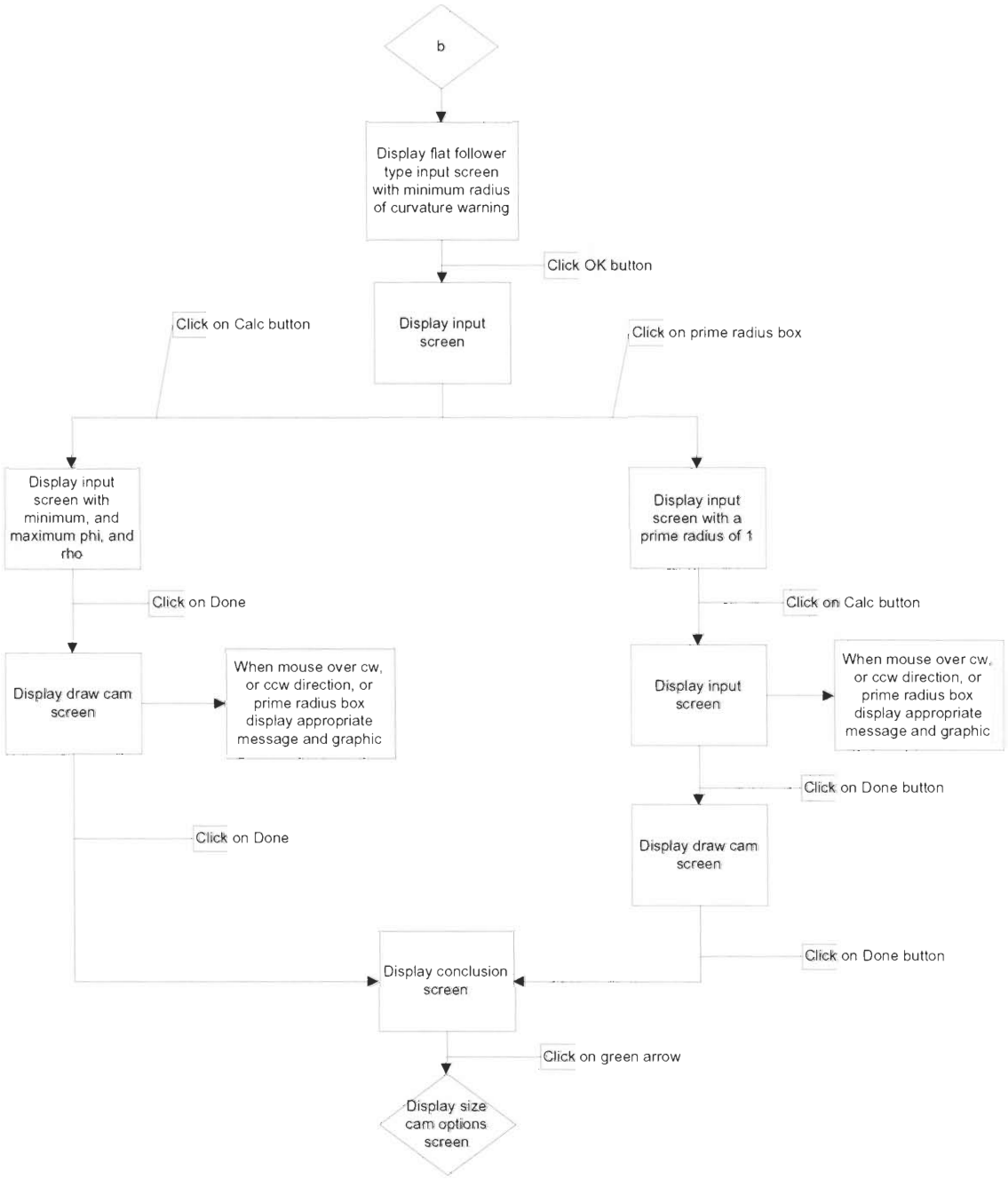


Figure 17: Part 2 – Flow Chart of Size Cam

Screen Shots

Although taking capturing screen shots images is a simple procedure, users are often confused about the difference between screen shots and printing. This animation is less of a tutorial and more of a reference of how to take screen shots. It provides no significant interaction for the user. The introductory screen is shown in Figure18.

Figure 18: How to take screen shots

Figure19 shows the flow chart for this animation.

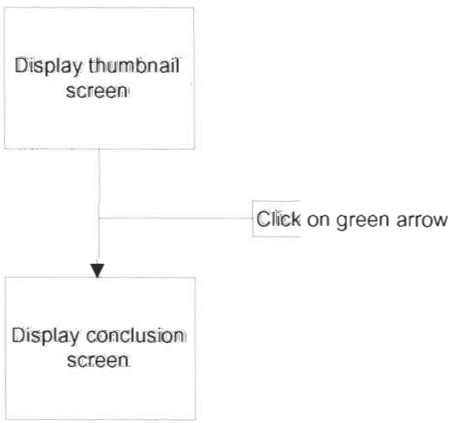


Figure 19: Flow Chart for Screen Shots

Double-Dwell Standard Function Example

In addition to understanding how to operate the program it was also necessary that users understand how to use the program to design a cam for a given problem statement. In this each example the users is shown how to convert a text-based description of the cam specifications to the proper input needed in Dynacam. In the double-dwell example users are walked through a problem that has a double-dwell and compares two standard functions. The comparison of the two standard functions is important because users see the difference the functions make in the position, velocity, acceleration, and jerk functions. Once they understand the properties of each function they will be better at designing cams. Figure 20 shows the final screen where the two graphs are compared side by side.

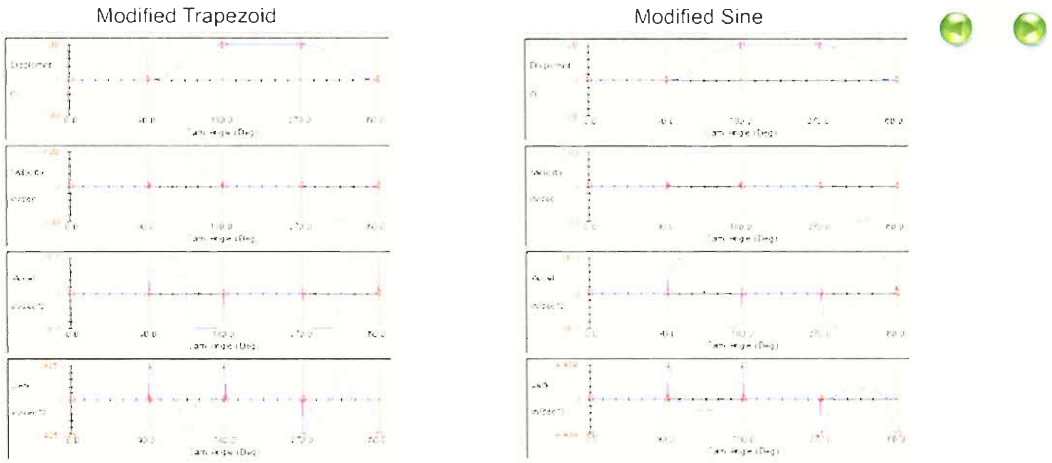


Figure 20: Comparison of the two standard functions in the double-dwell example

Figure 21 shows the flow chart for this example.

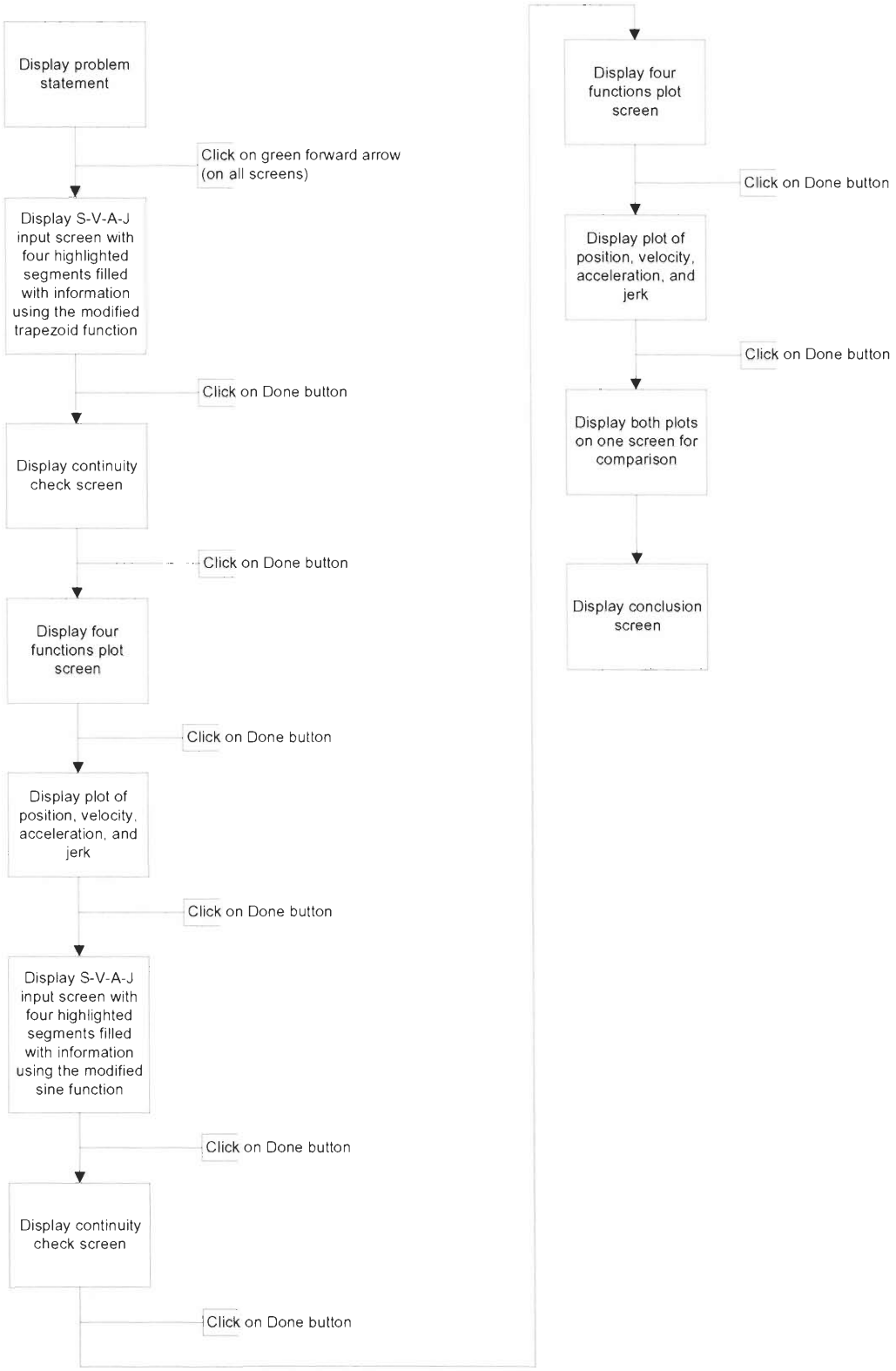


Figure 21: Flow Chart for Double-Dwell Standard Function Example

Single-Dwell Standard Function Example

The single-dwell standard function example also walks users through an example. This time they are shown a single dwell cam that uses standard functions; two different functions are compared so that users begin to understand the effect of certain functions. The tutorial graphically highlights certain features of the output screens. An example of this is seen in Figure 22. Notice the pink circle in the middle of the screen, which highlights the return to zero in the acceleration function noted in the comment on the left side of the screen. The student's attention is thus directed to the important feature on the plot. By seeing the good and bad points about these functions users will learn more about which type of standard function to choose to do a particular job.

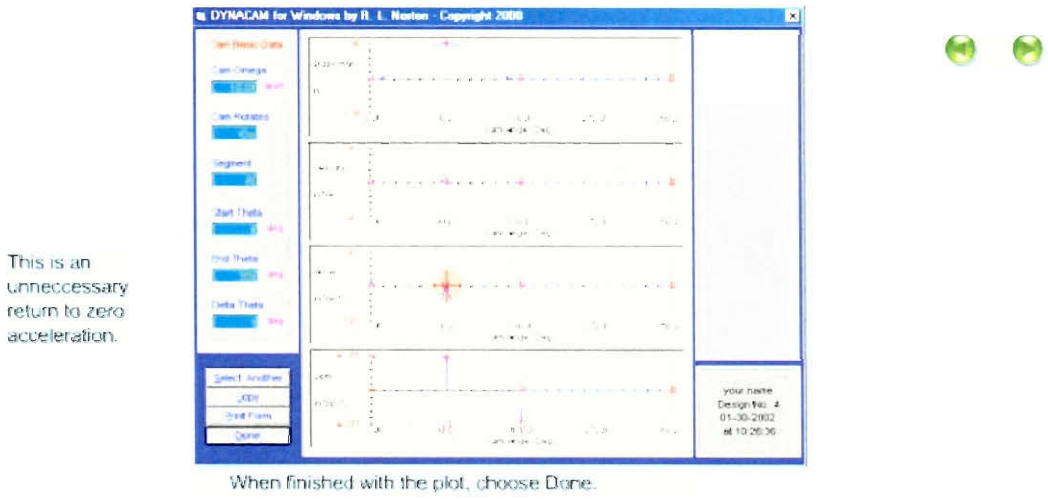


Figure 22: Screen shot from single-dwell example showing a highlighted feature

Figure 23 shows the flow chart for this example.

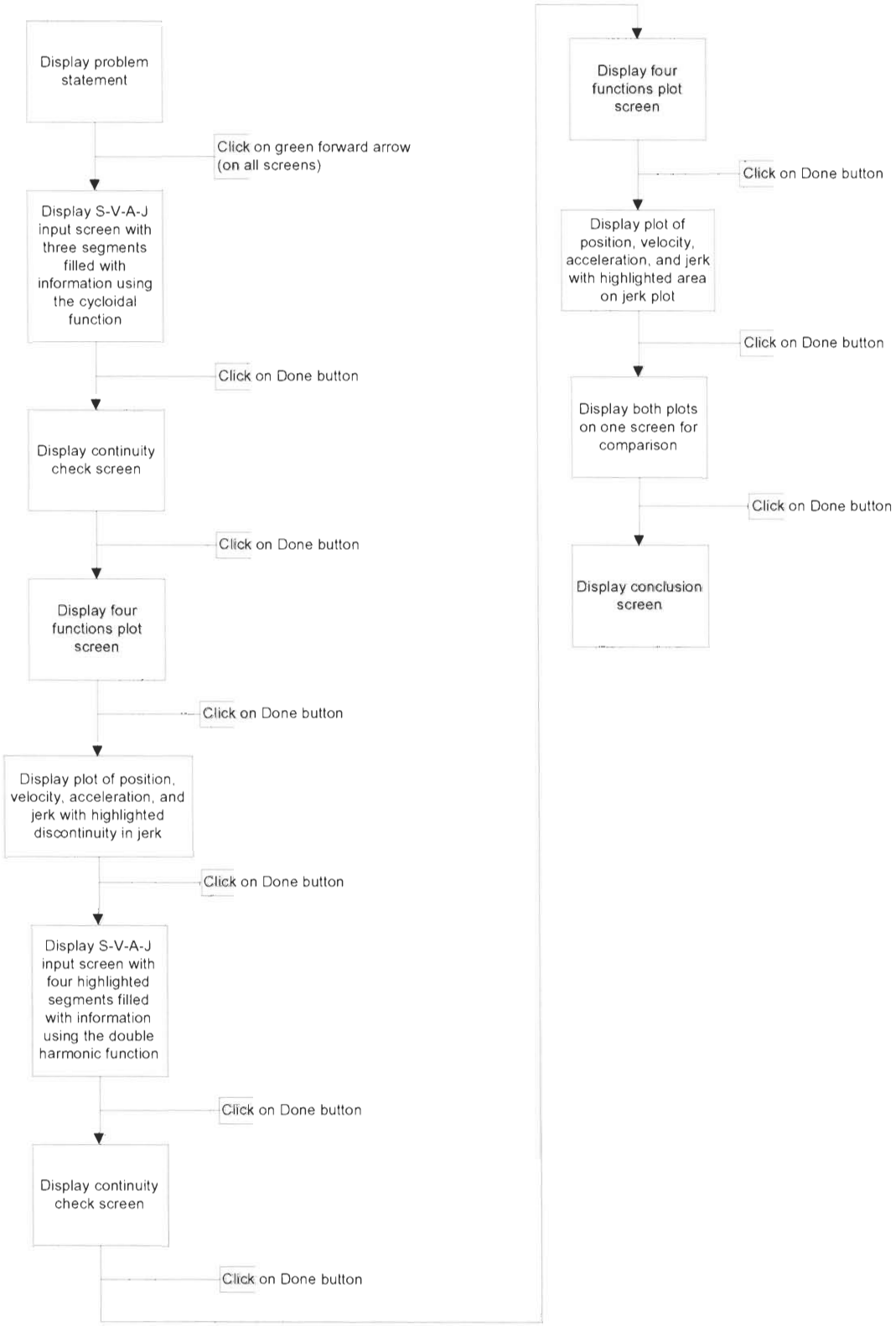


Figure 23: Flow Chart for Single-Dwell Standard Function Example

One of the most difficult things to understand in cam design is the use of polynomial functions because they require more input than standard functions and therefore the user must know in advance of using the polynomial function which parts of the function will be explicitly defined in the program. The single-dwell polynomial function example guides the user through an example that uses a polynomial function since it provides a better solution than a standard function. This example also helps the student take the text-based specifications of the cam and input it into the S-V-A-J input screen as well as boundary condition input screen. The final screen which contains the plot and an explanation is shown in Figure 24.

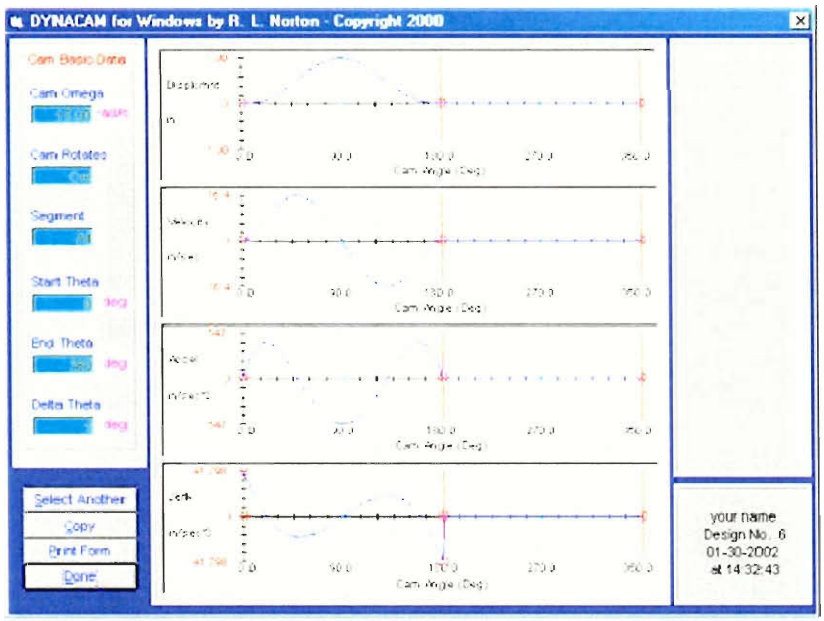


Figure 24: Explanation of the polynomial function in the single-dwell polynomial example

While this example does not provide a comparison to another plot it provides the user with an explanation of why this polynomial is a good design. In future development of this project adding a comparison between this polynomial solution and the single-dwell standard function example might be beneficial since the problem statements for both the examples are similar. The flow chart for the polynomial example is shown in Figure 25.

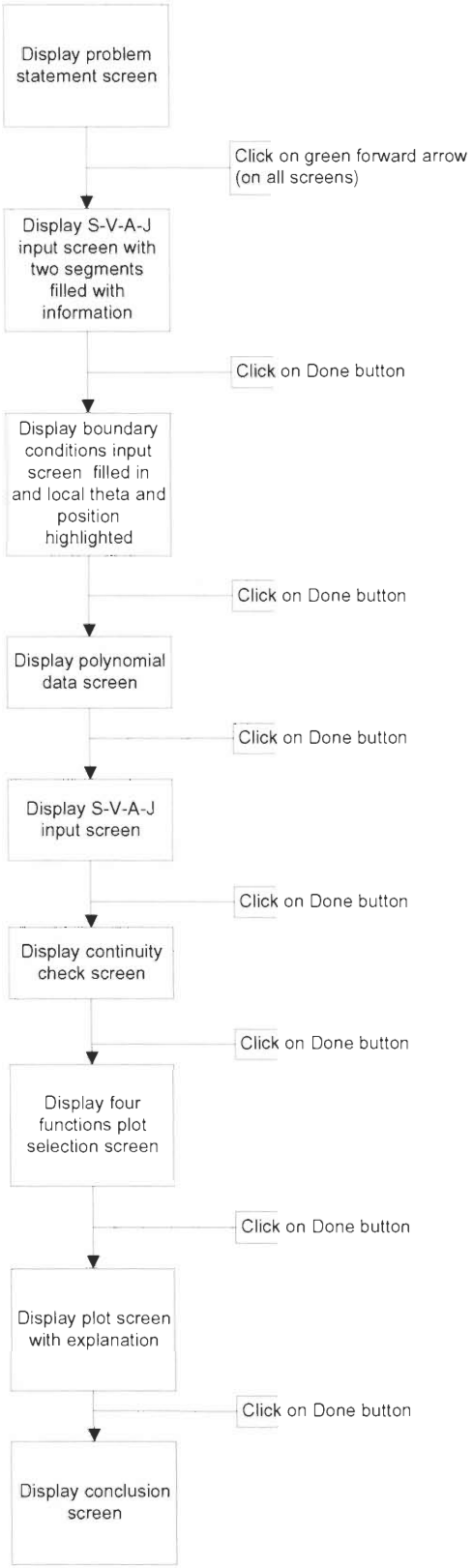


Figure 25: Flow Chart for Single-Dwell Polynomial Example

Additional Discussion

This project was created to teach students how to operate Dynacam and in the process to better understand cam design. Research from the Background chapter of this paper indicated that the most effective tutorials are interactive and involve many different features. The tutorials created for this project are interactive – the user can only advance to the next screen by interacting with the tutorial. This program also employs strategies for different types of learners. The tutorials are completely guided by text which benefits visual learners and the interactivity of the tutorials address the kinesthetic learners' needs. Audio was not added to this tutorial for technical reasons. Adding audio to the tutorial would have made the Flash files extremely large and would take up more than the allowed percentage of bandwidth (as described in WPI's acceptable use policy) of the WPI server if more than one person tried to access at a time. If more than three percent of the bandwidth is used by one webpage the author is warned and given one week to correct the problem. If the webpage uses more than 5% of the bandwidth the page will automatically be shutdown. Audio could be added to the tutorial in the future if it was on a CD-ROM.

Analysis

After the site was created, a survey was created to determine how useful it was in aiding student understanding of cam design and program Dynacam. People were requested to fill out the survey after they had viewed the site. There were 32 responses in total. Twenty-nine were from a kinematics class at Worcester Polytechnic Institute, one respondent was a former student of that class, another was a graduate student who is the teaching assistant for the kinematics class and one respondent was from a professional at the Gillette Company. The survey questions are shown below.

Survey Questions

Please rate on a scale of 1 to 5 where 1 is poor and 5 is excellent

1. Did the tutorial help you understand cam design? (1 2 3 4 5)
2. How well did you learn the following program functions?
   - SVAJ (1 2 3 4 5)
   - Plotting (1 2 3 4 5)
   - Printing (1 2 3 4 5)
   - Sizing Cams (1 2 3 4 5)
   - Single Dwell Example (1 2 3 4 5)
   - Double Dwell Example (1 2 3 4 5)
   - Polynomial Example (1 2 3 4 5)
3. Was the site easy to navigate? (1 2 3 4 5)
4. Please rate the quality of the explanations (1 2 3 4 5)
5. Did you use the glossary? If so, was it helpful?
6. Which parts of the tutorial were the most helpful/informative?
7. Please rate the following: (1 2 3 4 5)
   - color scheme
   - font size

graphics quality

overall appearance

8. What improvements would you make to this site?
9. Would you recommend this site to a friend? If no, why not?
10. Who are you?

    student

    professional

    instructor

11. Was viewing this site an assignment?
12. Did you have a demonstration of Dynacam before using the tutorial?
13. Did you use the tutorial to learn the program or as a reminder of how to do things?
14. How many cams have you designed since using this tutorial?
15. What type of browser are you using?

Responses to the Survey

While some people did not answer every question on the survey, there was still enough data to provide good analysis. In the questions that respondents were asked to rate the scale is as follows: one means poor, two means fair, three means average, four means good, and five means excellent. The first question that was asked was about understanding cam design. Figure 26 shows the chart of responses.

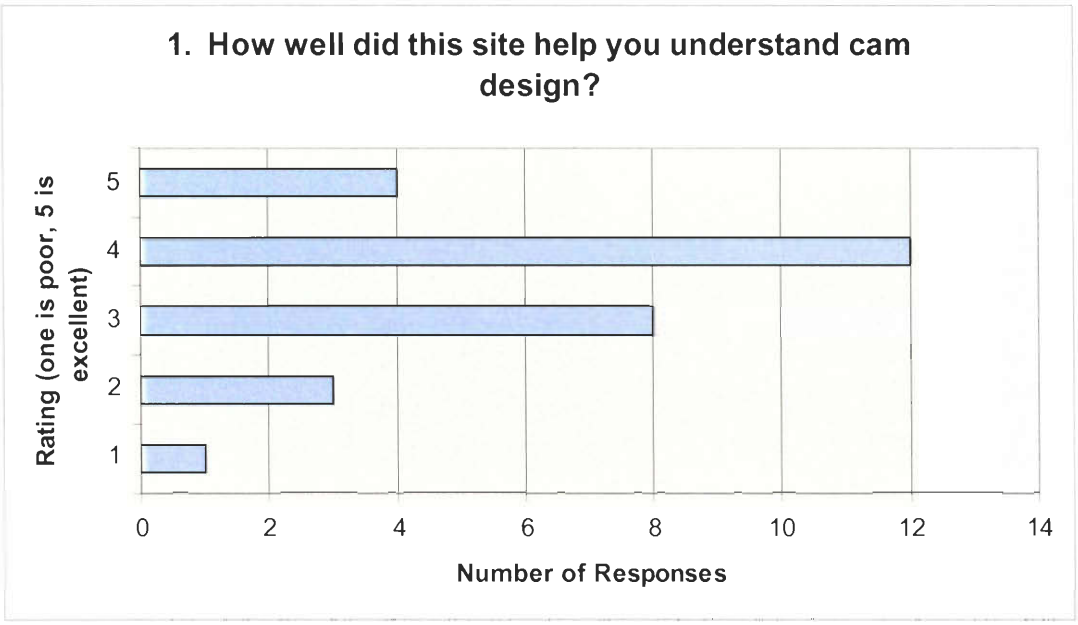


Figure 26: Graph of cam design understanding

This graph helps illustrate that two thirds of the students gained an average to good understanding of cam design from using this tutorial. This shows that the project did accomplish one of its goals which was to help in the understanding of cam design.

The second question asked the user to rate the different sections of the tutorials. The responses are graphed in Figures 27 and 28.

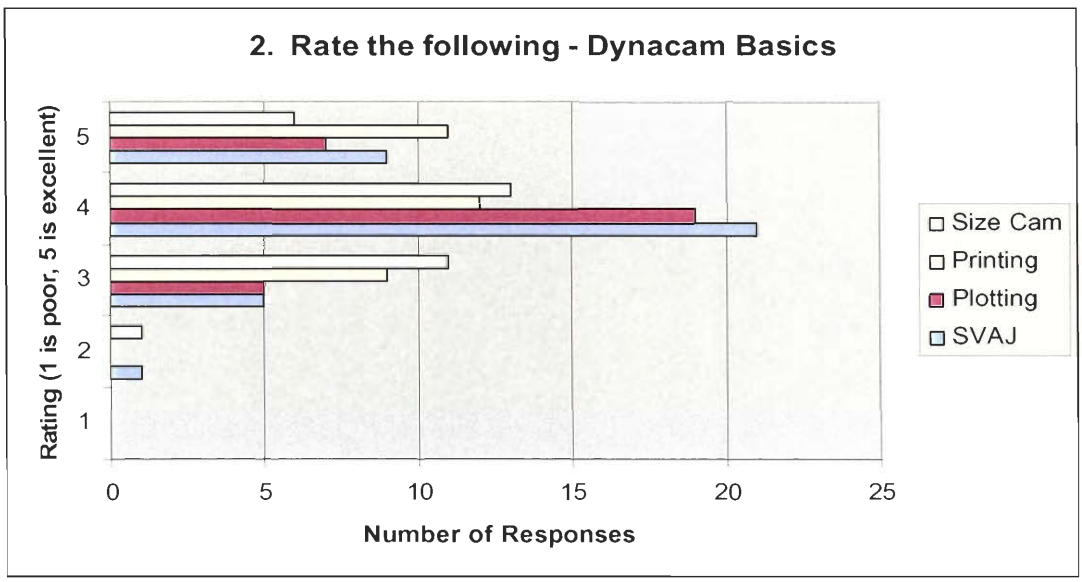


Figure 27: Graph of understanding for Dynacam Basics tutorials

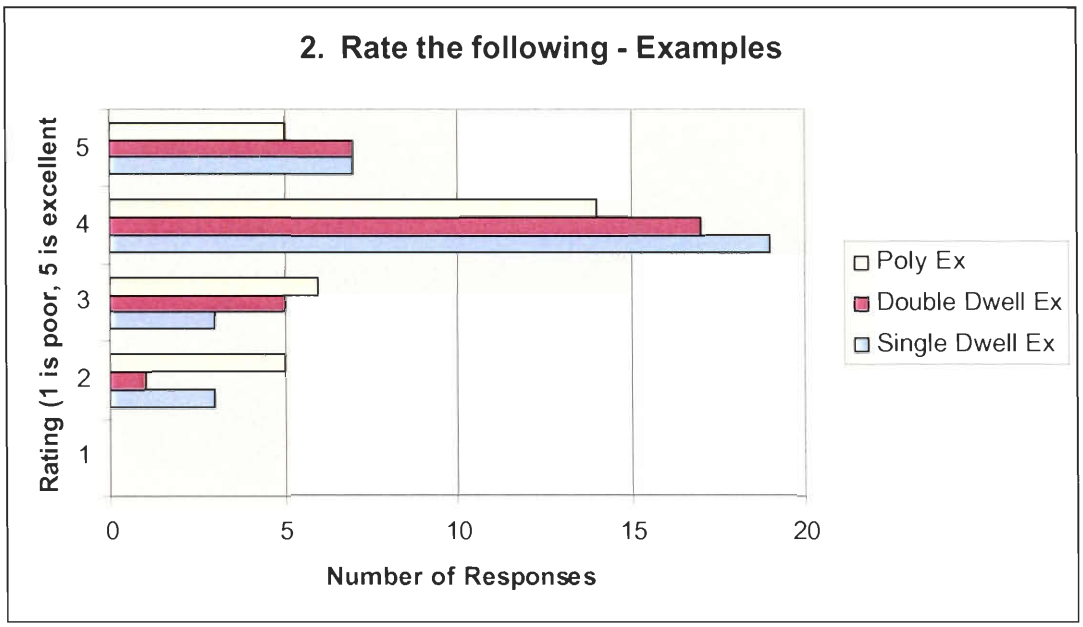


Figure 28: Graph of understanding for Examples tutorials

The responses indicate that the users have a good understanding of all the tutorials since a rating of four was the most popular for all of the seven options. The polynomial example tutorial had the broadest response of all the tutorials with 16% responding that they gained a fair understanding, with a rating of two, of using polynomials and 16% responding that they gained an excellent understanding, a rating of five. Forty-seven percent of the respondents said they gained a good understanding of using polynomials.

The next question that users were asked was to rate the quality of explanations. Figure 29 shows their responses.

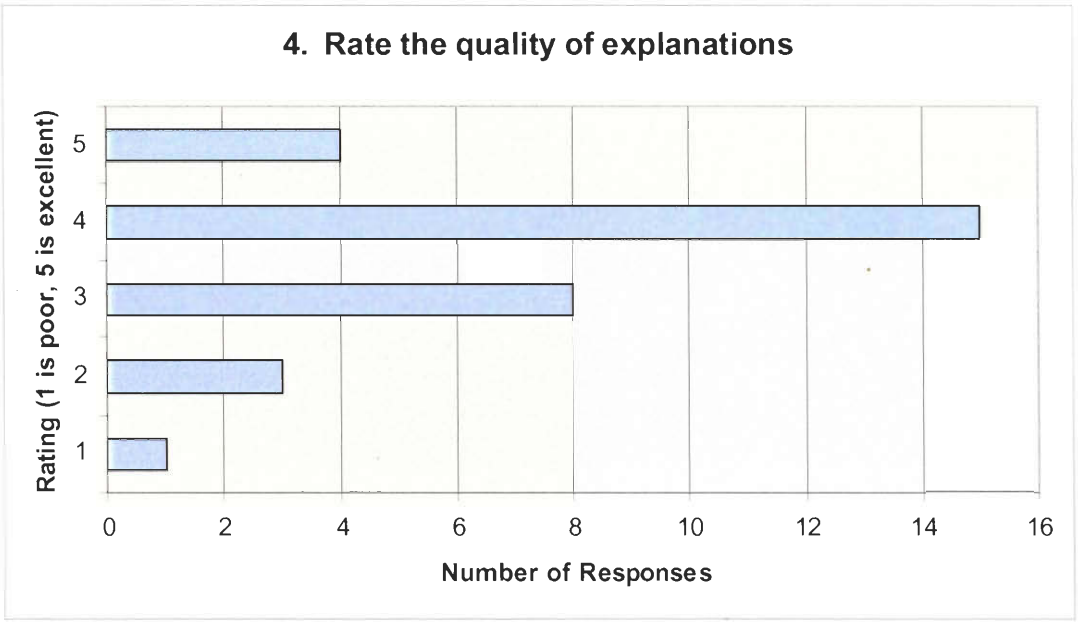


Figure 29: Graph of quality of explanations' responses

Nearly 50% of the users responded that the site had good explanations. Another 26% said that the site had average quality explanations. While three users gave the site a fair rating and one user gave poor rating, most people felt that the explanations helped them understand the program. Since this was not a free response question it was not possible to find out what the four users who gave low ratings did not like about the explanations.

The users were next asked to indicate which parts of the tutorial were the most helpful. Their responses are shown in Figure 30.

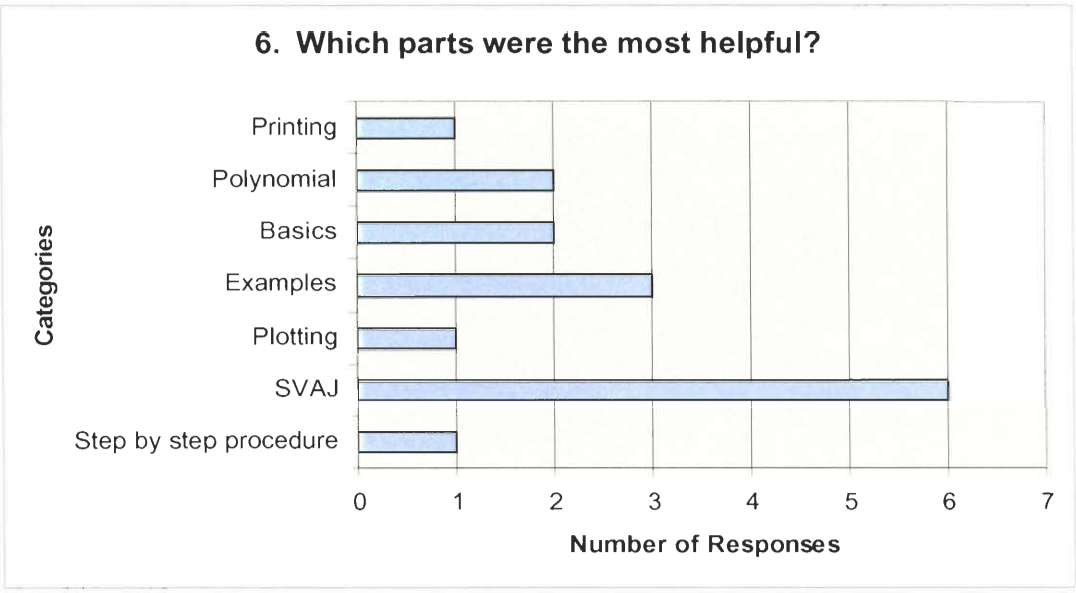


Figure 30: Graph of helpful parts in tutorial

While most people did not answer the useful parts of the tutorial question there were enough responses to draw some conclusions about. The most popular response was the SVAJ tutorial with 38% which was followed by the examples with 19%. There was a mean response of 2.29 with a standard deviation of 1.80 to this question. The fact that the most useful tutorial was the SVAJ is good because it is the first part of the program and no other option can be used unless the SVAJ information has been inputted correctly. The preliminary survey for this project found that students were unclear about the basic operation of Dynacam. The high rating of the SVAJ tutorial suggests that the problem may have been addressed. Results from the preliminary survey can be found in Appendix B.

The survey also asked users to indicate what improvements they would make to the site. The responses are shown in Figure 31.

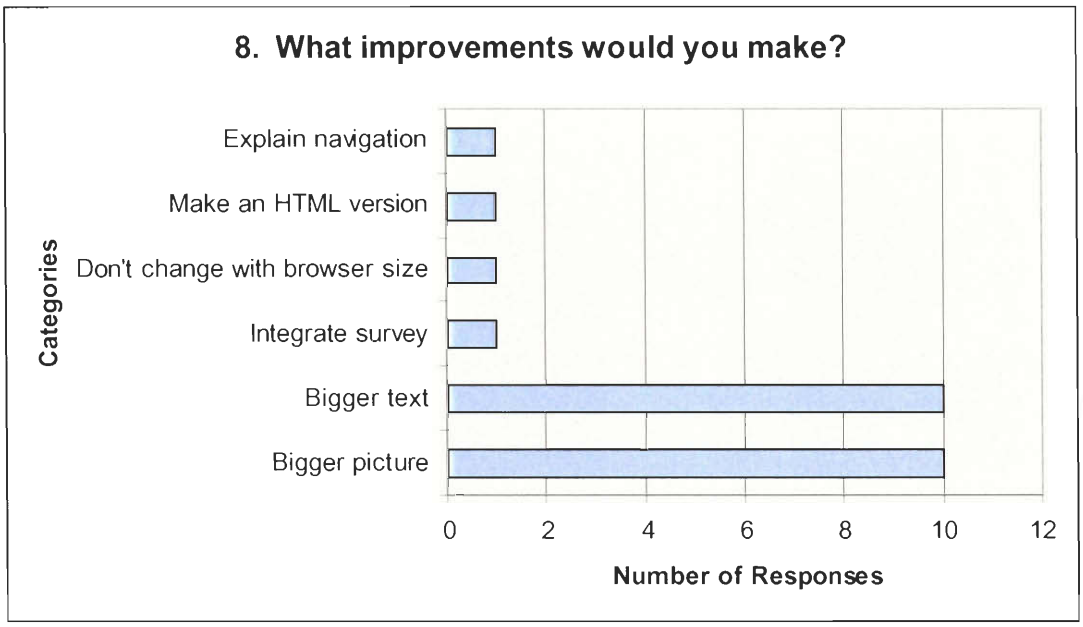


Figure 31: Graph of improvement suggestions

The overwhelming responses to this question were that the graphics and the text should both be larger. The other responses on this question were given by one person and while some may be valid ideas for improvement, using these suggestions will not greatly improve people's response to the site.

Site navigation is an important part of this project since poor site navigation can lead to limited use of the site. Figure 32 shows the responses to survey question three.

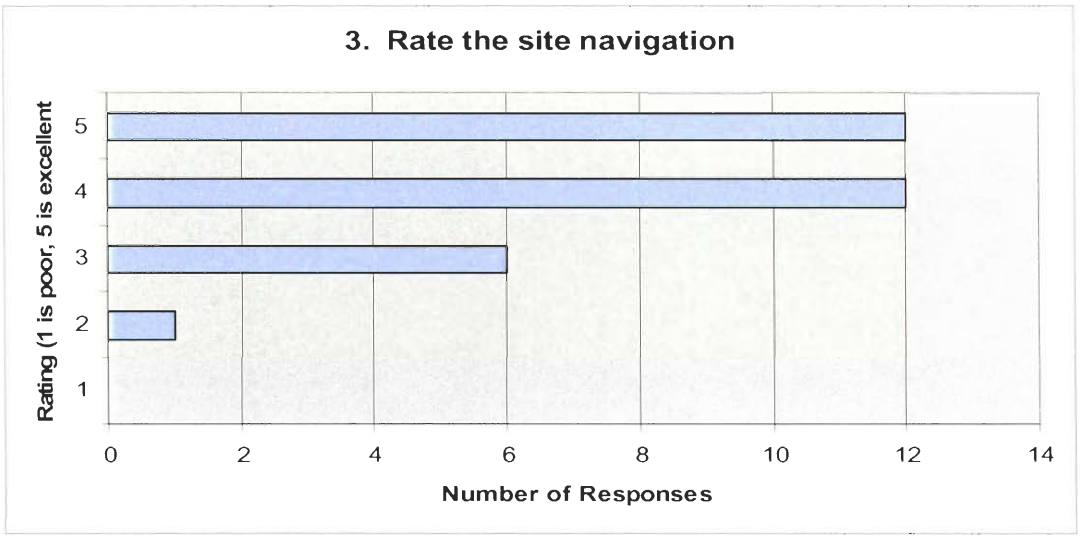


Figure 32: Graph of site navigation responses

The responses here indicated that the site navigation is good or excellent since three quarters of users rated the site navigation with a four or five. Nineteen percent rated the site as having acceptable navigation. The responses indicate that most users are happy with the site navigation and it does not need to be altered much, if at all.

Next, the users rated the overall appearance, graphics and font quality and the color scheme. Their responses are shown in Figure 33.

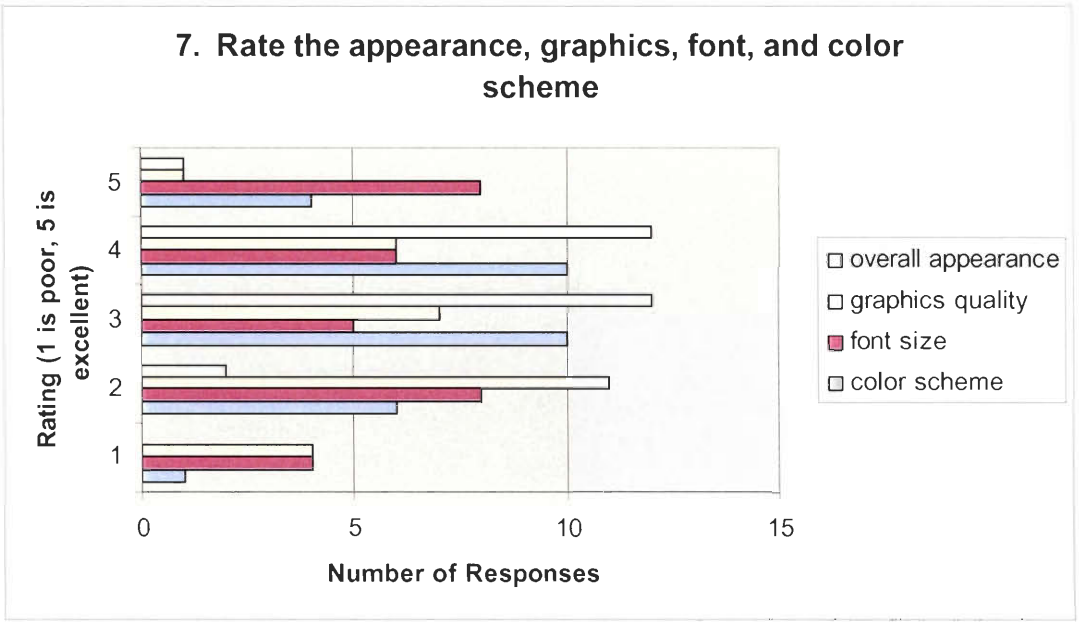


Figure 33: Graph of appearance, color and quality ratings

Approximately forty-five percent of the users gave the overall appearance an acceptable to good rating. The two most important categories in this question were the graphics quality and the font size. The largest response to the graphics quality was a rating of two (fair) with 38% of the respondents giving this rating. The most common response for font size was also a rating of two with 26% of respondents giving this rating. Thirty-two percent of the respondents gave the color scheme a rating of average and 32% also gave it a rating of good.

Users were next asked about the glossary – if they used it and if so, did they like it. Their responses are shown in Figure 34.

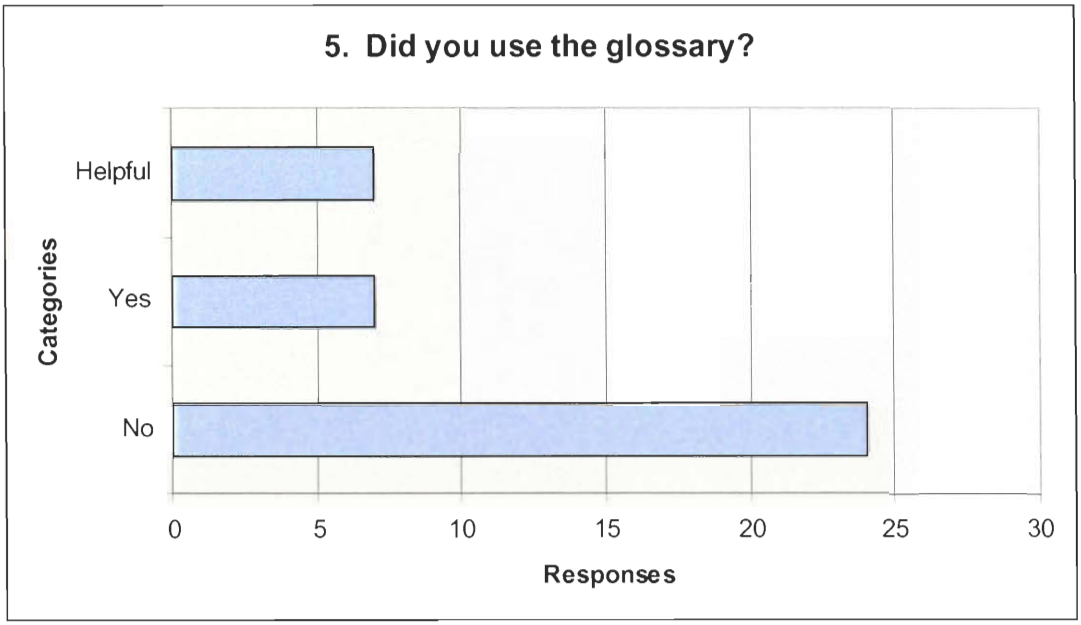


Figure 34: Graph of glossary usage

Seven people looked at the glossary and all seven said that it was useful. Some of the respondents said that they knew the terms before looking at the glossary but that the definitions were good. Seventy-seven percent of the users did not look at the glossary.

Twenty five people said that they would recommend this site to a friend. Four people said they would not. Of those four, two people said they wouldn't because their friends do not need to learn the program and one person said that the program was too simple to need a tutorial. Since 87% of the users said they would recommend this site this is a positive rating for the site.

Another important consideration in the analysis of the surveys is the source the data comes from. The majority of the respondents to this survey were students who were required to view the website as part of an assignment. Since replying to the survey was an assignment, students many not have spent much time looking at the tutorials and therefore may not have gained all the knowledge they could from it. Also, two thirds of the people who answered the survey had not designed any cams since viewing the tutorial and therefore may not have an accurate idea what they did or did not learn from the tutorial.

A table with all the information from the survey can be found in Appendix A.

Recommendations

Based on the survey results there are several areas that could be further developed. The biggest complaint in the survey was that the graphics were too small and fuzzy to be very legible. This obstacle was noticed very early in the development of the tutorial and steps were made to improve it. However, since there was a design constraint that the website should never scroll, the size was limited. One option that was explored was to have the tutorials open in separate windows and be the only thing in that window. Making the tutorial in that manner utilizes more screen area but also eliminates the site navigation and was not used for this reason. With the current technology there is no way to create shaper images with the current version of Dynacam. The current version of Dynacam uses text colors that do not have a high contrast with the background. At the regular size this is not a problem, but as the image is shrunk so that it fits into the animation screen, the colors blend because there is low contrast. The recommendation for this problem is to update the tutorial when the color scheme of Dynacam changes so that there is more contrast and the color blending problem has less of an impact. When this changes, existing screen images will need to be discarded. New screen shots will have to be captured and edited again but since the frame work is laid out for the animations already, it will just be a matter of replacing them in the correct animations.

The next recommendation is to make changes to the website itself. One comment on the survey was that the site lacks interest. This might be improved by adding animations, graphics, or word art. The fact that this is an educational website and not a personal or business website should be kept in mind when making changes.

Another recommendation is to create a more in-depth tutorial for choosing cam functions and polynomials. This would provide an experienced user with more understanding of what each function does and when to use each one. This would then make the site more of a tutorial for cam design in addition to how to operate Dynacam.

A final recommendation is that another survey be done to see which parts of the tutorials students are still unclear on. While 61% of users said that the site had good or excellent quality explanations there are still some people who did not understand them. A survey that determines what the students don't understand should be done so that these parts can be improved and the site can be used by students to learn Dynacam.

Conclusions

This project did many things. It set up the framework for a website, created seven animations, worked out many publishing obstacles, and created and analyzed a survey so that the site's pedagogical value could be assessed. The two goals of this project were one, to create a site that taught the user how to use Dynacam and second, to give the user an understanding of cam design. The survey results indicate that both of these goals were accomplished. While further development is needed to polish up the site, the project proves that using the Internet is an effective way to teach and learn. This concept can now be expanded to teach all the programs on the Design of Machinery CD-ROM: Fourbar, Fivebar, Sixbar, Slider, Matrix, and Engine. It might even be extended to Working Model. Once these tutorials are created they can be included in the textbook CD-ROM or as a website that users navigate to. Overall, this project has served its purpose in developing an initial tutorial for Dynacam and in proving that an interactive tutorial is an effective pedagogical method.

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Appendix A – Survey About Dynacam Tutorial

1. Rate your understanding of cam design

	1	2	3	4	5
	1	3	8	12	4

2. Rate your understanding of the following:

	1	2	3	4	5
SVAJ	0	1	5	21	9
Plotting	0	0	5	19	7
Printing	0	0	9	12	11
Size Cam	0	1	11	13	6
Single Dwell Ex	0	3	3	19	7
Double Dwell Ex	0	1	5	17	7
Poly Ex	0	5	6	14	5

3. Rate the site navigation

1	2	3	4	5
0	1	6	12	12

4. Rate the quality of explanations

1	2	3	4	5
1	3	8	15	4

5. Did you use the glossary?

No	24
Yes	7
Helpful	7

6. Which parts most helpful?

Step by step procedure	1
SVAJ	6
Plotting	1
Examples	3
Basics	2
Polynomial	2
Printing	1

7. Rate the following:

	1	2	3	4	5
color scheme	1	6	10	10	4

font size	4	8	5	6	8
graphics quality	4	11	7	6	1
overall appearance	0	2	12	12	1

8. What improvements would you make?

Bigger picture	10
Bigger text	10
Integrate survey	1
Don't change with browser size	1
Make an HTML version	1
Explain navigation	1

9. Would you recommend this site to a friend?

Yes	**25**
No	**4**
Why	1 - program to simple to need one 2 - friends don't need to learn it

10. Who are you?

student	29
professional	2
instructor	0

11. Was viewing this site an assignment?

Yes	27
No	3

12. Did you have a demonstration before using the tutorial?

Yes	7
No	24

13. How did you use this site?

Learn	24
Remind	6

14. How many cams have you designed since viewing the site?

0	18
1	3
2	3
more than 2	6

15. What type of web-browser are you using?

IE	27
Netscape	3

Figure 35: Table of second survey responses

Appendix B – Student Survey Responses

Thirty students responded to the survey, which was sent to three schools: Worcester Polytechnic Institute, Clemson University, and University of Delaware. One hundred and forty-two students were polled. Ninety-seven percent of the students learned program Fourbar first. The students commented that the easiest part for the programs was entering in values. The most difficult things were making tables and using units. The table below shows the responses to certain questions

Which program is more difficult to learn?

Fourbar	Dynacam	Both-Easy	Both-Difficult	Undetermined
2	16	8	2	3

Techniques used (rate always)

Online tutorial	Reading manual	Exploring	One on one	Demonstration	None
2	2	24	4	4	2

Techniques used for Fourbar

Online tutorial	Reading manual	Exploring	One on one	Demonstration	None
0	2	25	3	8	1

Techniques used for Dynacam

Online tutorial	Reading manual	Exploring	One on one	Demonstration	None
0	3	27	3	11	0

Figure 36: Table of initial survey responses

Seventy percent of the students responded that a tutorial would be useful. The most common requests for the tutorial were examples and basic navigation of the programs. Ten students rated themselves as excellent student engineers while 14 rated themselves as good engineers. Three students rated themselves as poor engineers. Only four students rated themselves as excellent computer users. Seventeen rated themselves as good computer users.

Student Survey on Programs Fourbar and Dynacam

This survey is part of a project to determine student opinions of programs Fourbar and Dynacam. You have been selected to be surveyed because you recently took a class that used these programs. Your response is confidential and only aggregate data will be reported. Please reply to this email by December 3rd. Responses should be sent to domiqp@wpi.edu. Please answer all questions, for those that do not apply write N/A. Thank you for your time and cooperation.

1. Which program did you learn first (Fourbar or Dynacam)?

2. What did you find easiest to learn in this program?

3. What did you find most difficult to learn in this program?

4. How difficult was it to learn Fourbar?

Very Easy 1 2 3 4 Very Difficult

5. How difficult was it to learn Dynacam?

Very Easy 1 2 3 4 Very Difficult

6. What techniques do you usually use to learn software?

Always 1 2 3 4 Never

a) online tutorial _____
b) reading the manual _____
c) exploring the program on your own _____
d) having someone teach you (one on one) _____
e) attending a demonstration _____
f) other (please fill in your answer) _____

7. Which of the above methods did you use to learn Fourbar?

8. Which of the above methods did you use to learn Dynacam?

9. Have you ever used an online software tutorial? If so, for what topics/programs? did you like them and why or why not? Please be as specific as possible.

10. Do you think that an online tutorial for Fourbar and Dynacam would be useful?

11. If there was a tutorial for Fourbar and Dynacam, what sorts of things would you like to see included?

12. On a scale of 0 to 4 (0=not applicable, 1=excellent, 4=poor), how do you rate yourself in the following?
    a) as a student engineer
    b) as a computer user

Appendix C- Professor Interviews

Professor Survey

1. How long have you been teaching using the Design of Machinery text? What topics do you cover in the course?

2a. How do you use the programs Fourbar and Dynacam in your class?
(how do you teach the programs?)

2b. How many hours do the students spend using the programs?)

3. What to you perceive as the needs of the students with respect to the Design of Machinery software?
(do students have difficulty learning the programs or using them?)

4a. Do you think a tutorial for programs Fourbar and Dynacam would be useful to your students? Why/not?

4b. Do the students read Appendix A (program tutorial)?

4c. What's good about the chapter?

5. Are there any things that you perceive as necessary for this tutorial?

6. Are there any things that you would **not** want to see in a tutorial?

7. Do you use any other supplementary material in your class?

8. What other online/computer tutorials have you used and do you think they helped? If so, how? (interactive, animation)

Professor Keefe of University of Delaware

Interviewed December 5, 2001 at 9:30am

Professor Keefe has been using the Design of Machinery textbook since 1993. In his course he covers chapters 1-7 and parts of 8-11 of the DOM textbook. He does not provide a demonstration of programs Fourbar and Dynacam in his class. The students learn the software on their own and from the appendix in the textbook. The students use the programs in their homework and projects. He estimates that the students spend approximately 25 hours in a semester working with the programs. Professor Keefe feels that some students cannot just sit down and learn the program – that they need some hand-holding. He feels that an online tutorial for these programs would be a good idea because it would save class time. Professor Keefe likes the appendix in the textbook because it is straightforward and has good graphics and explanations. In a tutorial for Fourbar and Dynacam he would like to see a step by step explanation of how to run the program as well as some problems solved in the book. He also mentioned that having different levels in the tutorial for the beginner and the more advanced users would be a good idea. The other program that he uses in the class is MAPLE to explain synthesis. The only software tutorial the Professor Keefe used was for Pro/Engineer and he followed an example.

Professor Jalili of Clemson University

Interviewed December 5, 2001 at 9:15am

Professor Jalili has been using the Design of Machinery textbook for three semesters and covers chapters 1,2,4,5,8, and 9. He gives a 30 minute presentation on programs Fourbar and Dynacam. The students use the programs in their homework and in two projects. He estimates that the students use the programs for about 15 hours in a semester. The students also read the appendix in the textbook and Professor Jalili finds that it has good

graphics and explanations. He feels that a tutorial for Fourbar or Dynacam would be useful. Professor Jalili would like to see demonstrations of examples from the book and some practice problems. He also mentioned having the tutorial broken into sections of different levels. Finally, he would like to see a glossary of terms and a trouble shooting page.

Professor Wang of North Carolina Agricultural and Technical State University

Interviewed on November 30, 2001 at 1:00pm

Professor Wang has been using the Design of Machinery software for five years. His course covers chapters 1,2,3,4,6,7,8, and 9. He demonstrates the programs in class and the students use it for their homework. Professor Wang says that he uses the programs to compliment MatLab. It should be noted that Professor Wang developed the MatLab supplement for Design of Machinery. The students are not assigned to read the appendix in the textbook. Professor Wang feels that a tutorial for programs Fourbar and Dynacam would be useful to some students. He said that he would like to see screen captures of the program to help illustrate the point. He also said that hyperlinks within the site would be a good idea. Professor Wang has used tutorials for Visual Basic because they have good examples.

Professor Iskander of University of Tennessee

Interviewed by email on December 10, 2001

Professor Iskander has taught using Design of Machinery textbook for one semester. He covers most of the book in his course. The students use the programs to facilitate their homework. He discusses the programs with the students in class and many come to his office for extra help. Professor Iskander estimates that the students spend 10 hours using the programs. He believes that a "live" tutorial would be a great help to many of his students. The students are not required to read the appendix although some of them do. The good points in the appendix are the general directions for all programs. Professor

Iskander would like to see step by step instructions for the programs and perhaps some student interaction with the tutorial.

Professor Norton of Worcester Polytechnic Institute

Interviewed on November 29, 2001 at 3:30pm

Professor Norton is the author of Design of Machinery. He believes that a tutorial for programs Fourbar and Dynacam would help students "get over the learning curve" for these programs. He feels that students need a step by step guide. Professor Norton would like to see examples in the tutorial that have already been solved in the textbook, as well as animation and interaction with the tutorial.