

Elizabeth Martha Palena Hall. The Plant Information Center Database Interface: A Usability Study. A Master's Paper for the M.S. in I.S. degree. April, 2001. 45 pages. Advisor: Jane Greenberg.

The Plant Information Center (PIC) database contains images of plant specimens and corresponding metadata and was designed to facilitate plant identification. While operational since Fall 2000, there has been little research on the overall design and the effectiveness of the interface. This investigation was an exploratory study that evaluated user perceptions of the PIC database with an emphasis on the interface. A test instrument containing questions and tasks was administered to sixteen undergraduate botany students from the University of North Carolina during the Spring 2001 semester. Responses to the questions were mainly positive. Eighty percent (80%) of the participants knew they were searching a database and ten of fifteen participants (66.6%) viewed the database in a positive manner. Although responses to the questions were supportive of the database, user comments suggest that improvements could be implemented to make the database, particularly the interface, more user friendly.

Headings:

Database

Interface

Usability

Java

Plants

Botany

THE PLANT INFORMATION CENTER DATABASE INTERFACE: A USABILITY STUDY

by

Elizabeth Martha Palena Hall

A Masters' paper submitted to the faculty of the
School of Information and Library Science of the
University of North Carolina at Chapel Hill in partial
fulfillment of the requirements for the degree of
Master of Science in Information Science.

Chapel Hill, North Carolina

April, 2001

Approved by:

Advisor

INTRODUCTION.....	1
LITERATURE REVIEW.....	3
PROBLEM DESCRIPTION.....	10
METHODOLOGY	11
Design of the Test Instrument	11
Test Procedures	11
RESULTS.....	13
DISCUSSION OF RESULTS	19
SUMMARY AND CONCLUSION	21
REFERENCES	23
APPENDIX A: CONSENT FORM.....	24
APPENDIX B: QUESTIONS AND TASKS	26
APPENDIX B.2: SAMPLE QUESTIONNAIRE SCREEN SHOTS	29
APPENDIX B.3: CODE FOR QUESTIONS AND TASKS	32
Intro.html	32
Controller.jsp.....	34
Demographic.jsp.....	36
Questions.jsp	37
Final. jsp	39
LizThesis.java (Java Bean).....	40

INTRODUCTION

This study investigates the usability of the Plant Information Center (PIC) database, focusing mainly on the user interface. The Plant Information Center search site (<http://dbserv.ils.unc.edu/projects/botnet/asp/plantsearch.asp>) utilizes an Access database as its information source. It is the interface components and the display of the information from the database that will be the primary focus of this master's thesis. The PIC search database is part of the larger Plant Information Center web site, which is "a web based center being developed that links digital images of herbarium specimens, associated data, and outreach programs of the North Carolina Botanical Garden"(Plant Information Center, 2001). "The intent of the project is to connect the research community and the general public (including school children) so that primary research materials owned by the university can be made available to these new audiences and that expert knowledge may also be shared" (Daniel, White, Greenberg, & Massey, 2000). In order to evaluate the success of the PIC, three areas of research have been identified. These include: 1. image access and use, 2. metadata effectiveness, and 3. electronic access to subject expertise (Greenberg, Daniel, Massey, & White, 2000). The focus of this research paper will be electronic access as it relates to the PIC database interface. Since no usability testing has been performed to date on the PIC search database, it was the goal of the researcher to determine if one of the principal user groups, undergraduate biology students, could use the current interface to locate desired information. The results of this study provide information intended to assist in the revision of the web interface and improve user satisfaction when performing searches on this site. This evaluation was performed using a test instrument that stored responses in a database housed at the School of Information and Library Science. For the purpose of this research study the term

“on-line questionnaire” will be used to refer to a test instrument containing both tasks and questions.

The goals of this project were to:

- Identify which interface elements were confusing or unclear to botany undergraduates
- Establish a list of suggestions for future interface revisions
- Identify what users viewed as the leading reason to use the site
- Identify if the content provided on the page was satisfactory for the needs of botany undergraduates

While this project focused specifically on an undergraduate user population, further investigation should be performed involving other known user groups, such as researchers, amateur botanists, students (elementary through higher education), and other communities interested in botanical science.

LITERATURE REVIEW

The literature gives an overall picture of case studies by researchers in the field, highlights design techniques used on other web database interfaces, and reviews lessons learned from other studies and interfaces that have been implemented.

One of the environmental web databases mentioned in the literature was the Environmental Change Network (ECN) database described by Rennie, Lane and Wilson (2000). The goal of this database was to provide a broad amount of environmental information relevant to current conditions in the UK. The database has links to Arc/Info and Arc View Geographical Information Systems (GIS). In addition, the ECN website at <http://www.nmw.ac.uk/ecn/> has links to pages which have database interpreted data such as graphs and tabulations. The system uses Active Server Pages and an Open Database Connectivity (ODBC) connection to an Oracle database. In the future, ECN will be evaluating ways of continuing the incorporation of integrity rules, presenting data together with important meta-data, and providing access to analytical and modeling tools. A database such as ECN is exciting because it utilizes a database to generate dynamic graphs and charts, allowing their user population to visualize environmental trends. This kind of graphical representation could, in the future, be utilized to enhance the information that PIC currently presents in its 'White Card' and 'Plant of the Month' features. For example, information regarding long-leaf pine and its decline and comeback in North Carolina could be displayed in a graph representation (Daniel et al., 2000). Such information could help achieve the goal outlined by Daniel et al. (2000) of "helping people observe nature more closely and more knowledgeably."

Another database described in the literature was the UnCover database, a bibliographic document delivery database by Galpern and Albert (1997). The authors described some of the characteristics of the database that were incorporated into the interface design and discussed some of the shortcomings of the interface. The emphasis of the database is on science and social science, and can be used for the location of articles on a particular topic, bibliographic

verification, or lists of journals concerning a specific subject area. Radio buttons are present to allow the user to select searches by keyword, name/author, journal title or type term(s) into a search box. Users can select the number of records they wish to view on a screen by using the “more records” button. Search results are shown in reverse chronological order; however, if over 300 references are retrieved, results are displayed in random order, a clear drawback. Other problematic features outlined by the authors included a single line for entering search statements and no option to add or modify the statement that was valuable when attempting multiple searches. Another source of frustration for professional searchers was the lack of a controlled vocabulary assigned to individual articles, and thus the possibility for “false drops”. The Galpern and Albert (1997) study is valuable because it outlines positive interface characteristics, such as the modification of search via selection of different fields and provision for user control of displayed results, while also describing areas of weakness, such the lack of a controlled vocabulary. While the PIC database interface has a controlled vocabulary drop down menu, it is unclear if the vocabulary can be used effectively by all user groups, and if those user groups would use the search box or the help options. Further research would be required to determine whether or not including a means of controlling the display of the results would be as useful to the PIC database interface as it was to the Galpern and Albert study.

Shneiderman, Byrd, and Croft (1997) presented a study that proposed the following four-phase search process: 1. *Formulation*: what happens before a user starts a search, 2. *Action*: starting the search, 3. *Review the results*: what the user sees resulting from the search, 4. *Refinement*: what happens after review of and before the user goes back to formulation with the same information need. A process such as the one outlined by Shneiderman et al. (1997) is an asset when evaluating interfaces such as the PIC database because it outlines the stages where a breakdown might occur; thus enabling investigation of user interaction at each level.

The first and second step of the process can be applied to Belkin and Henninger (1996), who assert that interfaces need to accommodate the information seeking behavior of users. The

authors state that information retrieval systems can be divided into system-based and user-based views. The system-based view “is concerned with efficient search techniques to match query and document representation, while the user-based view must account for the cognitive state of the searcher and the problem solving context”. The authors emphasize that “the information retrieval system must not only provide efficient retrieval, but also assist the user in defining a problem or fulfilling a perceived lack of knowledge.” BrightPlanet.com (2001) suggests that “often too little time is spent on search and query formulation and any improvements one can make toward more precise and accurate queries will lead to fewer documents to review.” Xie and Cool (2000, p 110.) also report, “that it is very difficult for users to figure out not only how to solve their problems but also how to characterize and label their problems”. Belkin and Henninger (1996) further assert that designers must understand that a problem evolves as intermediate queries are performed. The authors state, “queries provide a means of direct search, but often rely on the user understanding complex query language and proper vocabulary to be effective” (Belkin & Henninger, 1996). Nielson (1997) also mentions that every page should have a “strong sense of structure and navigation support” to assist different types of searchers since “half of all users are search-dominant, about a fifth of the users are link-dominant, and the rest exhibit mixed behavior”. Since “people’s information seeking behavior needs to be analyzed in the problem solving context in which their information needs arise,” (Belkin & Henninger, 1996) questions such as the following should be asked when designing or evaluating interfaces for web databases:

What are the common associations people make?
What information is closely related?
What different perspectives can a piece of information be viewed from?
(Belkin & Henninger, 1996)

Therefore, the research is clear in recommending that interfaces need to provide a number of interactive styles, such as querying and browsing, to support the differing user search needs as well as a concise system view, which facilitates problem solving by searchers. Questions such as

those listed by Belkin and Henninger (1996) also provoke analysis and could be used in the formulation of questions for evaluating the PIC database interface.

Shneiderman et al. (1997) offers eight golden rules that can be of use in designing the interface to a database system. These include: 1. strive for consistency, 2. provide shortcuts for skilled users, 3. offer informative feedback, 4. design for closure, 5. offer simple error handling, 6. permit easy reversal of actions, 7. support user control, 8. reduce short-term memory load. Shneiderman et al. (1997) also suggests allowing plenty of space in text-entry boxes because longer search text helps increase precision and recall. One final recommendation was to provide a sense of control to the user by giving a broad overview of the entire database (Albert & Shneiderman, 1994). This point is also supported by the study described below by Xie and Cool (2000).

Similarly, Lopes de Oliveira (1994) identified a number of desired features that came about as a result of the user interface literature as well as discoveries during the development of graphical interfaces. Some of the recommendations include: transparency and feedback, concision and presentation quality, adaptability and tutorial ability, coherence and integrity, functional completeness, automatic display generation, support for different abstraction levels, data access via database management system (DBMS). These rules and recommendations have implications for the design of the PIC database interface because they provide a framework from which to evaluate current features and analyze ambiguous or missing features. In addition, such features can then be explored in future testing.

In order to clarify the four-phase framework and eight guidelines outlined, Shneiderman et al. (1997) performed two case studies. The first study evaluated the search page of the Library of Congress's THOMAS system (at the time of the study) and identified features that were potential problems, such as not grouping attributes together for search modification, not providing date ranges, not managing case-sensitivity or variants, and allowing multiple search/clear buttons on one screen.

The revised interface organized the results, and included valid dates for the 104th Congress, radio buttons to select fields for search, a drop down list for choosing a member of Congress and a date range selector for date selection. Additionally, variants allowed in the search were described for the user, a maximum number of returned results were specified, and sorting functionality was added.

The second case study involved the redesign of the time INQUIRY program; an X-Windows based system supported by a single database back end. Some of the problems with the original interface included: a non-meaningful bar graph which gave document scores, appearance of query and result in a single window allowing for an “out of sync” error (a query with the wrong result set on the same page), limited document visualization, query history limited to the current session, unclear error messaging, and unclear relevance feedback.

The revised version of X-INQUIRY included changes such as: a bar graph representation of search words in the document extending to the left of the document title, the possibility of viewing a numerical representation of the bar graph, a descriptive summary at the top of the results (e.g. Query 1. raw food business) to confirm query/result correspondence, the status of stemming, display of stop and case sensitivity (stopping: yes stemming: yes match case: no), display of multiple documents, a history of queries issued in a session, clearer error messaging, and, a caption when relevance feedback was used.

The functionality of the two sites before and after the case study was the same; however, it was believed that the interface changes would “shorten learning times, improve user effectiveness, reduce errors, increase retention and raise satisfaction” (Shneiderman et al., 1997). These two case studies have implications for the PIC database because they provide clear examples of how guidelines such as user control and informative feedback were implemented on two different interfaces.

The final study reviewed was by Xie and Cool (2000), and described an investigation comparing two groups of graduate students in an Advanced Database Searching Course and

contrasted experiences of Web versus non-Web interfaces to on-line databases. The researchers reported that reactions to Web interfaces vs. non-Web interfaces were mixed, since Web interfaces were intuitive and easy to use for novices, but may be less efficient to control for expert users. The report cited that “almost every searcher agreed that easy access was one of the distinctive features for Web interfaces”(Xie & Cool, 2000). The identified advantages of the Web interfaces were browsing features, search assistance, relevance feedback, and the ability to view search histories, which allowed for search strategy formulation and reformulation. In addition, context-specific help was mentioned as being advantageous, but could be improved with details related to the cause of user faults. Three kinds of help were deemed useful, including a hyper linked hierarchical table of contents, help buttons next to search boxes, and help directly associated with the page. Users tended to prefer multiple display choices, various organizational features offered via ranking and sorting, and evaluation facilitation provided by various document formats and highlighted search terms. Reported disadvantages of the web database interfaces included slow connection speed, especially at certain times of day, and being disconnected from the system entirely.

The principle findings of this study were that searchers want both greater control and greater ease of use, though greater control was often associated with greater complexity and effort. To address the issue of how to accommodate the needs of the novice as well as the expert user, the authors suggest that the both command and guided search may be appropriate. The researchers suggestions for further research include examining how novice users evaluate an on-line interface differently than more experienced users. Again, this information is important because it reiterates the common theme of user control, but also identifies the dichotomy that exists between novice and professional users, clearly showing the need for ongoing research.

Overall, the reviewed research evaluates several case studies and points out many suggestions for the improvements that can be made when designing or revising a database portal. The first step, however, in revising the PIC search database interface was a usability study to

analyze where users perceive breakdowns as well as confirming useful interface features. The methodology explains further how the usability study was designed and implemented.

PROBLEM DESCRIPTION

The Plant Information Center (PIC) database contains images of plant specimens and corresponding metadata and was designed to facilitate plant identification. While operational since Fall 2000, there has been little research into the overall design and effectiveness of the interface. The features which require evaluation include: the hierarchical drop down menus, the clarity of terminology (i.e. scientific names), the clarity and functionality of the buttons, links and their labels, the clarity of the help options, and the perceived value of content, specifically information on the 'View Specimens' pages. Two-thirds to three-quarters of all users cite the inability to find the information they seek as one of their primary frustrations (second only in frustration due to slowness of response) (BrightPlanet.com, 2000). Since it is unclear whether the PIC database interface facilitates or impedes searching, it is the goal of this usability study to identify both potential pitfalls and helpful features.

METHODOLOGY

The methodology underlying this study utilized a multi-method approach. Questions and assigned tasks (Appendix B) were used to evaluate user perceptions of interface features, as well as to collect demographic information. A test instrument containing questions and tasks was administered to sixteen undergraduate botany students from the University of North Carolina during the Spring 2001 semester during a regularly scheduled class.

Design of the Test Instrument

The on-line questionnaire was programmed using Java Server Pages (JSP) and Java Beans, and the pages were served using the Apache Tomcat server on the researcher's Unix account. The questions, as well as user responses, were stored in a MySQL database, and a Java Database Connection (JDBC) was used by the Java code to access it there. Java was the programming language chosen because it is almost totally platform independent, and has no expenses associated with its use. The source code for the on-line form can be found in Appendix B.3. Prior to the actual implementation of the on-line questionnaire two test cases were performed; one included four testers reporting on programming bugs and the clarity of questions/tasks while a second test case involved seven testers on an Internet relay chat (IRC) to test browser compatibility, database performance with concurrent usage, and potential problems with the Tomcat server.

Test Procedures

There were sixteen participants who completed the questions and tasks, including four males and twelve females. All participants were undergraduate students enrolled in a Local Flora biology class. First, UNC undergraduates were recruited from the biology class and asked to come to the SILS computer laboratory where they met with a proctor who described the basic framework for the study and the consent form. Those who still wished to participate signed the consent form, while others were free to use the time as needed. Second, printed subject identification codes were randomly distributed. The subject identification codes consisted of a

combination of letters and numbers created by the researcher to ensure that multiple entries were not inserted into the database. The proctor was a member of the PIC staff, and was chosen to attend the session to help remove any bias that might be introduced by the researcher's presence. Third, participants opened a browser window to the first page of the on-line questionnaire using the URL provided by the proctor. The first page contained a brief description of the study and a hyperlink that opened a second browser window containing the Plant Information Center database page (<http://dbserv.ils.unc.edu/projects/botnet/asp/plantsearch.asp>). This allowed participants to read questions in one browser window and perform tasks and analyze interface elements in another browser window. The only text box that the participants were required to enter was the subject identification code on the second page. While participants were encouraged to answer questions and perform tasks to the best of their ability, they were able to skip to the next page at any time. In addition, participants were able to go back and change or update an answer. Finally, when the last screen was reached, users were thanked for their time and provided with a link to close the browser window.

RESULTS

The results from the on-line questionnaire were gathered for the sixteen participants who completed it. Fifteen participants (93.75%) used a computer daily. One user (6.25%) reported weekly usage. There were twelve female (75%) and four male (25%) users who responded. There was one amateur botanist (6.25%), fourteen undergraduates (87.5%), and one PhD student (6.25%). Frequencies were performed on the yes/no questions, and open-ended questions were coded. There were ten positive responses to the first question, “What is your first impression of the PIC database search site?” Adjectives used to describe the site included: hopeful, good, pleasingly simple, simple, useful, easy to use, easy to access, well organized, novel, and knew it was a database. Two participants either left the question blank or provided an ambiguous answer, while three participants provided negative responses. These comments were:

Table 1

Negative Comments
“Very sparse. Lacks statement of purpose & explanation of what exactly it is that you're searching. Needs some informative text! (& pizzazz.) The layout is a bit difficult to work with.”
“I have no idea - it looks like a blank page that I don't know how to use.”
“Wouldn't have known what it was, since there doesn't seem to be much there yet.”

In response to the second question, “*Is it clear you are searching a database? Why or Why Not?*” there were twelve participants (80%) who answered “yes”, two “no” responses (13.33%), and one “maybe” response (6.66%). There were two participants who did not answer. Some of the explanations provided by the participants are shown below.

Table 2

Positive Comments	Negative Comments
“Yes, because the name is plant information center”	“No, it's just a white screen.”
“It is clear that I am searching a database because there is nothing to distract me from the search mechanisms. No fancy pictures, etc.”	“I suppose. But I have no orientation as to what kind of database it is, what I would be able to search for..”
“You can browse and/or search”	“No. You need to write something about the database itself & its purposes.”

For the task requesting users to use the hierarchical buttons to retrieve information on Magnolia (Appendix B, question #3), the correct number of results was six. The range of answers provided is shown below. Two answers provided for this question were thrown out because they had no relationship to the question.

Table 3

Answers	Number of Participants
6	7 participants(46.6%)
19	3 participants(20%)
1	3 participants(20%)
47	1 participants(6.6%)
3	1 participant(6.6%)

Less than fifty percent of participants entered the correct answer for this question. It is interesting to note that nineteen is the number of species returned for the species *Magnolia acuminata* (Linnaeus) Linnaeus. Participants did report in question #13 that the synonyms and the varieties of plants became confusing when analyzing the results. Participants may not have been able to clearly identify the major groups on the page for Magnolia; especially since this result set contained more species and common names than the search using the search box. Clarity of the question could also have been a factor in the low score.

For the task requesting users to use the search box to retrieve information on the Eastern Red Cedar (Appendix B, question #8), the correct number of results returned was two. Answers provided by participants are shown below.

Table 4

Answers	Number of Participants
2	15 participants (93.75%)
1	1 participant (6.25%)

In response to the question, “*If you needed help with your search, where do you think you would find further help on this screen?*” eleven participants reported the link at the top of the page. Other responses included typing help in the search box, clicking on the view specimens or genus info button, USDA specimens, see specimens, and the help icon button. Lastly, some participants made recommendations such as colored columns by category and adding a picture to the help link. Below are responses to some of the yes/no questions.

Table 5

Question#	Question	Response No	Response Yes	N/A
7.	Click on the ‘ListMajorGroups’ button again at the top of the page. Do you like the fact that pressing this button clears the results?	4 (25%)	12(75%)	0(0%)
4.	Are the button labels clear?	0(0%)	15(94%)	1(6%)
5.	Would you like to see the common and scientific terms for the drop down options?	7(44%)	8(50%)	1(6%)
9.	Are the display of the results for ‘Eastern Red Cedar’ clear?	3(19%)	13(81%)	0(0%)
11.	Click the link ‘View Specimens’ for the results with the species name ‘Juniperus virginiana Linnaeus’. Does this link give you the information you were looking for?	0(0%)	16(100%)	0(0%)

Comments regarding the clarity of the interface display are listed in table 6 and 7.

Table 6

Participant Comments: Are the display of the results for ‘Eastern Red Cedar’ clear?
“The white cedar also comes up, and it could be confusing that it comes up even though I don't think it's really what I was supposed to find.”
“If the common name were more obviously grouped with the scientific name that precedes it (eg with a double line separating entries); as it is displayed, it is up to the searcher to interpret whether the common name text box goes with the text box (scientific name) above or below it.”
“I had to look at it a while to figure out it was two different plants and not two different plants with the same common name”

Table 7

Participant Comments: “Click the 'Browse' link for the second entry in the results. Is the function of the browse link what you expected? Please explain.”
“I expected more of a parousal/browse option. This screen does not look much different than the one before it.”
“It was confusing that it switched the one on the bottom to being on top, I hit the back button and tried it again before I realized that they had switch and then it took me a while to see that anything had changed. Once I understood that, it all made sense.”
“I would expect all the possible synonyms and related links (more).”
“All it did was switch the order of the names around. what's the point?”
“I thought it will lead me to a specific website but it did not”
“I would have expected more detailed info. on that particular species instead of going back from whence I came.”

Comments to the question related to user search experience are listed below.

The main categories derived from the responses were that participants liked the simplicity of the site; pictures were cited as being a great asset as well as the ability to enlarge pictures and the availability of more than one specimen. Two participants mentioned they liked the ability to revise the search via the hierarchical listing.

Table 8

Participant Comments: What did you like about your search experience?
“It seems like it will be an incredibly useful database. I hope that when it comes out, it's publicized enough that can find it and be able to benefit from it. With any new program, it takes a while to get used to, but after that it can be very useful.”
“Straightforward and helpful to be able to see the plants after finding information about them”
“I liked that this survey taught me how to use the PIC Database Search Page. I also liked that I was able to revise the search rather than erasing it entirely by clicking on something lower in the hierarchy than 'list major groups”
“Having access to plant figures and herbarium specimens is great!”
“It was easy and much faster than a book it gives clear concise information”
“The hierarchical listing is good because at any time you can go back to previous steps instead of having to start all over again.”
“I could look up common names or scientific names, common by using the search mechanism, and scientific by using the search mechanism or the drop down screen. I also didn't find that I was directed to info I didn't want to be directed to, sort of distractions built in.”

The main categories of responses related to disliked features on the PIC database interface were:

- synonyms vs. variety distinction unclear in the results
- browse link was unclear
- the interface was not interactive
- drop down menus and buttons were too close together
- instructions for search options not available
- tutorial not available

- history of previous searches not available
- more color definition/better spacing suggested
- more pictures needed (some not available)

Below are selected comment examples regarding user interface dislikes.

Table 9

Participant Comments: What did you dislike about your search experience?
“Wasn't sure what all the synonyms for the species were at first so couldn't tell if those were varieties of one species or synonyms-a bit overwhelming to have a list of fifteen and not be quite sure what they were”
“The fact that if I click on one entry (browse) it doesn't clear the first entry; this was a bit confusing”
“Some of the features are not so clearly stated on the buttons, like the browse button and clearing the screen by clicking on the major groups button. I also think that maybe it would be better to name the major groups button plant groups, because I think that would be clearer.”
“I wouldn't have known how to use it without the survey to guide me.”
“Maybe just a little more color definition, or spacing a little more fluid, but that is all.”

Participant ranking of Likert scale questions results are reported below.

Table 10

Statement	1	2	3	4	5
Ease of Use (1 = not easy to use 5 = easy to use)	0	1(6.25%)	2(12.5%)	5(31.25%)	8(50%)
Clarity of the information (1 = unclear 5 = clear)	0	1(6.25%)	4(25%)	8(50%)	3(18.75%)
Page Layout (1 = disorganized 5 = organized)	0	0	2(12.5%)	9(56.25%)	5(31.25%)

Lastly, when asked, “*Is this a site you would come back to in the future? Why or Why not?*” fourteen participants (93.3%) responded “yes” and one (6.6%) “maybe”. Selected comments are listed.

Table 11

Participant Comments: Is this a site you would come back to in the future? Why or Why not?
Sure:-to see actual pictures of plants I was investigating; especially useful if I didn't have access to an herbarium
Oh, yes. What a treasure this would have been throughout this semester. May we use it again?
Yes, I would. Once I know how to use it, its usefulness is clear!
yes because it is useful, although frustrating.
Definitely. By the time it's complete, it will have an incredible amount of info
I would definitely come back because the site is easy to use to find very direct, specific, and helpful information.

DISCUSSION OF RESULTS

The results from the on-line questionnaire represent a usability study evaluating the clarity of the interface elements present on the current PIC database search page. Responses to the questions were generally positive. Eighty percent of the participants knew they were searching a database. When asked about their first impression, ten of fifteen participants used positive adjectives to describe the site. The three who reported flaws with the site all indicated not knowing what the page's purpose was, or lack of "a statement of purpose". This can be remedied in the future with some informative text about searching on the PIC site.

In regard to the two searches performed, subjects overwhelmingly performed better with the search text box results for '*Eastern Red Cedar*'. Ninety-three percent of the participants answered two, which was the correct answer. On the other hand, only forty-six percent gave the correct answer for the Magnolia search, where participants had to select an option from the drop down menu and click on the hierarchical buttons ListMajorGroups, 'ListFamilies', 'ListGenera' and 'ListTaxa'. Because instructions were given on what options to choose for the drop down menu and what buttons to click to get results for Magnolia, it was determined that the organizational layout of the results caused the low correct response rate. This confusion is best summarized in a comment made during the search for '*Eastern Red Cedar*' when a participant said, "I had to look at it a while to figure out it was two different plants and not two different plants with the same common name". Since there were six major groups in the returned results for magnolia, each with multiple species and common names, the results displayed had more information to view and understand. It is likely that this made a significant impact on the clarity of the results. Suggestions, like those made by one participant to add color to associate different categories and address large areas with blank space, could definitely help identify the information returned from a search. As previously reported, an overwhelming majority of participants ranked page layout, clarity of the information, ease of use on the PIC database search interface a 4 or

higher. Clearly, scores were quite positive while still indicating that some improvements could be implemented to make the interface more user-friendly.

SUMMARY AND CONCLUSION

Participants indicated that they considered the pictures and detailed information provided by the PIC database of enough value to warrant revisiting the site, but did indicate that some interface modifications could help in locating sought-after information. The main recommendations focused on the introductory screen, providing instructions for search, a statement of purpose for the newcomer, a tutorial for optimizing search strategies and performance, and making the interface more interactive. In regard to the results page, identifying the Family, Genus and Species associated with a Major Group was important. Suggestions also included addressing blank space and color, and indicating the function of links such as the browse links. Lastly, the participants suggested maintaining a history of previous searches performed.

Recommendations for future research on the PIC database interface include evaluating the USDA and white card links, as well as the GroupInfo, FamilyInfo, and GenusInfo buttons. These features were not evaluated in the current study because of dead links or active development, making availability of information inconsistent.

The Java-based on-line questionnaire can also be reused for future studies of the PIC database interface, as it can be modified to target tasks or questions which are specific to other groups. In fact, this tool could be used for a broad range of studies focusing on web databases and their user interfaces. In the current study, step-by-step instructions were given to the participants to evaluate their perception of the buttons without interference from lack of knowledge regarding scientific terms. However, an on-line questionnaire for a professional user population might include performing searches for specific plants without giving detailed instructions and evaluate any frustrations that arise. Additionally, it is recommended that the tool be implemented in a slightly different way the current study. Instead of providing a URL to the on-line questionnaire, it is recommended that a link be provided on the PIC search database site that would open the questionnaire in a smaller browser window. The smaller window would provide easier maneuvering between screens and minimize the confusion that some participants had opening

two larger browser windows. This change would also prevent users from losing their place, since the current on-line questionnaire disables the back button and does not allow users to go back to the URL they were visiting before starting the test instrument. While this did not affect data entry, it was inconvenient for participants.

The results of this study are intended to assist in the revision of the Plant Information Center database search interface, but may have implications for other designers interested in web front-ends that will be used by groups at the extremes of the spectrum of professional knowledge, such as professional botanists and amateur botanists. This investigation was limited to undergraduate biology students for practical reasons, although PIC is intended for a wide range of users seeking information about plants. Future studies will probably include the performance of a similar study with professional botanists as well as amateur botanists who are not from the undergraduate population. This would give a more complete picture of the needs common to both groups, as well as needs that may be unique. The combined data would be invaluable in providing a better search interface for finding useful information, resources and pictures related to plant life in the United States.

REFERENCES

- Ahlberg, C., & Shneiderman, B. (1994). Visual information seeking. Tight coupling of dynamic query filters and starfield displays. *Proc. ACM CHI94 Conference*, 313-317.
- Belkin, N., & Henninger, S. (1996). Interface issues and interaction strategies for information retrieval systems. *Proceedings of the CHI '96 conference companion on human factors in computing systems: common ground*, 352 – 353. [On-Line] Available at: http://www.Acm.org/sigchi/chi96/proceedings/tutorial/Henninger/njb_txt.htm.
- BrightPlanet.com. (2001). Tutorial :guide to effective searching of the internet. [On-Line] Available at: <http://www.completeplanet.com/Tutorials/Search/part2.asp#topic1>.
- Daniel, E., White, P. , Greenberg, J. ,& Massey, J. (2000). The Plant Information Center. *First Monday: Peer Reviewed Journal on the Internet*. 5(6). [On-Line] Available at: http://www.firstmonday.org/issues/issue5_6/daniel/index.html.
- Galpern, N., & Albert, K. (1997). Uncover on the web: search hints and applications in library environments. *Medical Reference Services Quarterly*, 16(3), 1-18.
- Greenberg, J., Daniel, E., Massey, J., & White, P. (2000). The Plant Information Center (PIC): a web-based learning center for botanical study. *WebNet 2000*. [On-Line] Available at: <http://ils.unc.edu/daniel/PIC/Web2000.html> .
- Lopes de Oliveira, J. (1994). On the development of user interface systems for object-oriented databases. Proceedings of the workshop on advanced visual interfaces, 237-239. [On-Line] Available at: http://www.acm.org/pubs/articles/proceedings/chi/192309/p237-de_oliveira/p237-de_oliveira.pdf
- Plant Information Center. (2001). Plant Information Center: about us. [On-Line] Available at: <http://www.ibiblio.org/pic/about.html>.
- Rennie, S., Lane, A., & Wilson, M. (2000). Web access to environmental databases: a database query and presentation system for the UK environmental change network. *Proceedings of the 2000 ACM Symposium on Applied Computing*, 2, 894 – 897.
- Shneiderman, B., Byrd, D., & Croft, B. (1997). Clarifying search: a user interface framework for text searches. D-Lib. [On-Line] Available at: <http://www.dlib.org/dlib/january97/retrieval/01shneiderman.html>.
- Xie, H., & Cool, C. (2000). Ease of use versus user control: an evaluation of web and non-web interfaces of online databases. *Online Information Review*, 24(2), 102-115.

APPENDIX A: CONSENT FORM

Consent Form for the Analysis of the Plant Information Center(PIC) Search Database Interface

Purpose of this Study

We are inviting you to take part in a research study of Plant Information Center (PIC) Search Database Interface, a database portal which allows for retrieval of plant specific information. This study will test the usability of the user interface. Elizabeth Palena Hall is the Principal Investigator of this research project. Dr. Jane Greenberg is the faculty advisor.

What Will Happen During the Study

First, you will be asked to sign a consent form. Next, you will complete a questionnaire with basic demographic information, including your gender and age. The first page of the on-line questionnaire will provide some brief instructions and description of the study. As a participant we will ask you to answer a series of questions related to your demographic characteristics, perform 2 database searches and answer some questions concerning the characteristics of the user interface.

Your Privacy is Important

We will make every effort to protect your privacy. Any information obtained in the study will be recorded with a participant number, not your name. Your answers to the on-line questionnaire will be kept in a database owned by the researcher. There will be approximately 20-25 subjects participating in this study.

If you have any questions regarding this study, please contact Dr Jane Greenberg at (962-7024, janeg@ils.unc.edu).

Risks and Discomforts

We do not know of any personal risk or discomfort you will have from being in this study.

Your Rights

This study should last approximately 30 to 45 minutes. You are free to refuse to participate or to withdraw from the study at any time without penalty and without jeopardy.

Institutional Review Board Approval

The Academic Affairs Institutional Review Board (AA-IRB) of the University of North Carolina at Chapel Hill has approved this study. If you have any concerns about your rights in this study, you may contact the Chair of the AA-IRB:

Barbara Goldman, Chair
CB# 4100, 201 Bynum Hall
UNC-CH
Chapel Hill, NC 27599-4100
962-7761
aa-irb@unc.edu

I have had the chance to ask any questions I have about this study, and they have been answered for me.

I have read the information in this consent form, and I agree to be in the study. I understand I will get a copy of this consent form after I sign it.

(Signature of Participant)

(Date)

APPENDIX B: QUESTIONS AND TASKS

Introduction Screen

The purpose of this study is to test the web accessible database that is part of the larger project known as the Plant Information Center (PIC), a partnership of the North Carolina Botanical Garden, UNC Herbarium, the UNC School of Information and Library Science, the McDougle Middle School, and the Orange County Public Library. An on-line questionnaire will help us test the clarity of the PIC database, which provides access to specimen images and other scientific and botanical information.

To help with testing, please complete the questions that follow to the best of your ability. If you are not sure of a question, ask the proctor for clarification or move onto the next question.

Please open the following URL if you have not done so already. The following link will open a new window for you. Please note that both browser windows must remain open in order to complete the study.

<http://dbserv.ils.unc.edu/projects/botnet/asp/plantsearch.asp>

Demographic Questions

Please enter your SubjectID: <textbox>

What is your profession? < drop down menu>

Radio Button Options:

- Scientist, Researcher or Professor
- Amateur Botanist
- Undergraduate Student
- PhD student
- Other

How often do you use a computer? <drop down menu>

Radio Button Options:

- Daily
- Weekly
- Monthly
- Rarely

What is your gender? <drop down menu>

Radio Button Options:

- Male
- Female

Plant Information Database Questions and Tasks

1. What is your first impression of the PIC Database Search site?
<textarea>

2. Is it clear you are searching a database? Why or Why Not?

<textarea>

3. Click the 'ListMajorGroups' button. Choose 'Angiosperms' from the drop down menu, and click the 'ListFamilies' button. Select 'MAGNOLIACEAE' from the new drop down and click 'ListGenera'. Now select 'Magnolia' and click 'ListTaxa'. How many answers are returned?

<textarea>

4. Are the button labels clear?

Radio Button Options:

- Yes
- No

4.1 What would make the button function clearer to you? (if 4 was answered no)

<textarea>

5. Would you like to see the common and scientific terms for the drop down options?

<textarea>

6. If you needed help with your search, where do you think you would find further help on this screen?

<textarea>

7. Click on the 'ListMajorGroups' button again at the top of the page. Do you like the fact that pressing this button clears the results?

Radio Button Options:

- Yes
- No

8. Now, perform a search on 'Eastern Red Cedar' using the search box at the top of the page. How many entries does 'Eastern Red Cedar' have? <textarea>

9. Are the display of the results for 'Eastern Red Cedar' clear? <textarea>

Radio Button Options:

- Yes
- No

9.1 Please explain what would clarify the display for you. (if 9 was answered no)

<textarea>

10. Click the 'Browse' link for the second entry in the results. Is the function of the browse link what you expected? Please explain. <textarea>

11. Click the link 'View Specimens' for the results with the species name 'Juniperus virginiana Linnaeus'. Does this link give you the information you were looking for?

<textarea>

12. What did you like about your search experience on the PIC Database Search Page?

<textarea>

13. What did you dislike about your experience on the PIC Database Search Page?

<textarea>

14. For the following questions, please rate the general site characteristics on a scale of 1-5 by clicking the radio button below.

Ease of Use (1 = not easy to use 5 = easy to use)

Radio Button Options: 1 2 3 4 5

15. Clarity of the information (1 = unclear 5 = clear)

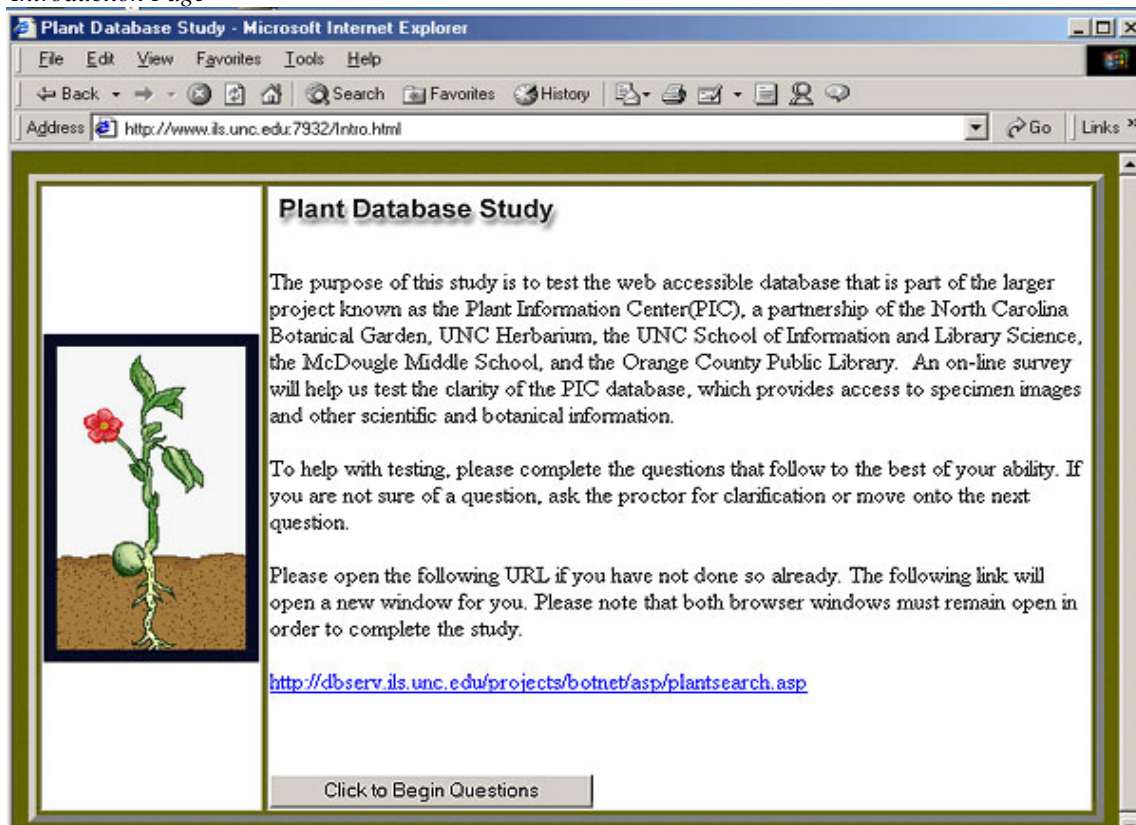
Radio Button Options: 1 2 3 4 5

16. Page Layout (1 = disorganized 5 = organized)

Radio Button Options: 1 2 3 4 5


17. Is this a site you would come back to in the future? Why or Why not?

<textarea>

APPENDIX B.2: SAMPLE QUESTIONNAIRE SCREEN SHOTS*Introduction Page*

Plant Database Study

The purpose of this study is to test the web accessible database that is part of the larger project known as the Plant Information Center(PIC), a partnership of the North Carolina Botanical Garden, UNC Herbarium, the UNC School of Information and Library Science, the McDougle Middle School, and the Orange County Public Library. An on-line survey will help us test the clarity of the PIC database, which provides access to specimen images and other scientific and botanical information.



To help with testing, please complete the questions that follow to the best of your ability. If you are not sure of a question, ask the proctor for clarification or move onto the next question.

Please open the following URL if you have not done so already. The following link will open a new window for you. Please note that both browser windows must remain open in order to complete the study.

<http://dbserv.ils.unc.edu/projects/botnet/asp/plantsearch.asp>

Click to Begin Questions

Demographic page

Plant Database Study - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Plant Database Study


Date: 2001-4-07

Please enter your SubjectID:

What is your profession?

How often do you use a computer?

What is your gender?



First Question <sample text box question>

Plant Database Study - Microsoft Internet Explorer


File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites History Print Mail News RSS

Address: <http://www.its.unc.edu/7932/Controller.jsp> Go Links

Plant Database Study

What is your first impression of the PIC Database Search site?




Likert Scale Question

Plant Database Study - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites History Print Mail Stop

Address http://www.ils.unc.edu/7932/Controler.jsp Go Links



Plant Database Study

Clarity of the information (1 = unclear 5 = clear)

1 2 3 4 5


Go To Next Question

Go Back a Page

Last Page

Plant Database Study - Microsoft Internet Explorer

File Edit View Favorites Tools Help



Plant Database Study - End

Thank You for your participation in this study!

Close this Window

APPENDIX B.3: CODE FOR QUESTIONS AND TASKS

The only unique programming issue faced while constructing this tool was that of the back buttons. The researcher custom-created back buttons which retrieved the question number, set the appropriate question on the screen and disabled the browser back button in order to prevent data from entering the database while the associated question was not on the browser screen. This potential error was possible because using the browser back button did not necessarily correctly update the information associated with the page. Implementing the customized back buttons resolved this issue.

Intro.html

```

<!doctype html public "-//w3c//dtd html 4.0 transitional//en">
<html>
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
  <meta http-equiv="content-type" content="text/html; charset=iso-8859-1">
  <title>Plant Database Study</title>
<script language="JavaScript">
  <!--
      history.go(1);
      //-->
</script>
</head>
<body background="grn_back.jpg">
<form action="Demographic.jsp" method=post>
<table BORDER=5 CELLSPACING=3 WIDTH="718" >
<tr>
<td BGCOLOR="#FFFFFF"><img SRC="plant2.jpg" BORDER=0 height=234
width=144></td>

<td BGCOLOR="#FFFFFF"><img SRC="title.jpg" height=34 width=199>
<p>The purpose of this study is to test the web accessible database that
is part of the larger project known as the Plant Information Center(PIC),
a partnership of the North Carolina Botanical Garden, UNC Herbarium, the
UNC School of Information and Library Science, the McDougle Middle School,
and the Orange County Public Library.&nbsp; An on-line survey will help
us test the clarity of the PIC database, which provides access to specimen
images and other scientific and botanical information.
<p>To help with testing, please complete the questions that follow to the
best of your ability. If you are not sure of a question, ask the proctor
for clarification or move onto the next question.

```

<p>Please open the following URL if you have not done so already. The following link will open a new window for you. Please note that both browser windows must remain open in order to complete the study.

<p>http://dbserv.ils.unc.edu/projects/botnet/asp/plantsearch.asp

<p><input type="submit" name="submitButtonName" value="Click to Begin Questions"></td>

</tr>

</table>

</form>

</body>

</html>

Controller.jsp

```

jsp:useBean id="formHandler" class="thesis.LizThesis" scope="session">
</jsp:useBean>
<jsp:setProperty name="formHandler" property="*" />
<%
System.out.println(formHandler.getPrevPage());
System.out.println(formHandler.getAction());
System.out.println(formHandler.getQuestionNum());
System.out.println("-----");
// begins if Demographic.jsp
if (formHandler.getPrevPage() == null ||
formHandler.getPrevPage().equals("Demographic.jsp"))
{
if(formHandler.getSubjectId() == null || formHandler.getSubjectId().length() > 50 ||
formHandler.getSubjectId().length() == 0)
{
formHandler.setErrorMessage("Please enter a valid Subject ID");
%>
<jsp:forward page="Demographic.jsp" />
<%
}
formHandler.doInsert();
formHandler.setQuestionNum("1.0");
%>
<jsp:forward page="Questions.jsp" />
<%
// Begins if Questions.jsp
} else if (formHandler.getPrevPage().equals("Questions.jsp"))
{
if ( formHandler.getAction() != null && formHandler.getAction().equals("back") ) {
formHandler.setAction("");
formHandler.setQuestionNum(formHandler.backOne(formHandler.getQuestionNum()));
%>
<jsp:forward page="Questions.jsp?action=forth" />
<%
}
formHandler.doAnswer();
if (formHandler.getQuestionNum().equals("17.0"))
{
%>
<jsp:forward page="Final.jsp" />
<%
}
if (formHandler.getAnswer() != null && !(formHandler.getAnswer().equals("no")))
{
formHandler.setQuestionNum(formHandler.getJumpYes());
}
else
{
formHandler.setQuestionNum(formHandler.getJumpNo());

```

```
}  
%>  
    <jsp:forward page="Questions.jsp"/>  
<%  
}  
%>
```

Demographic.jsp

```

<!doctype html public "-//w3c//dtd html 4.0 transitional//en">
<html>
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
  <meta http-equiv="content-type" content="text/html; charset=iso-8859-1">
  <title>Plant Database Study</title>
<jsp:useBean id="formHandler" class="thesis.LizThesis" scope="session">
</jsp:useBean>
<jsp:setProperty name="formHandler" property="*/>
</head>
<body background="grn_back.jpg">
<% formHandler.setThisDate(formHandler.myDate());%>
<script language="JavaScript">
  <!-- history.go(1); //-->
  </script>

<%
formHandler.setPrevPage("Demographic.jsp");
formHandler.setSubjectId(null);
%>
<br><form name="LizForm" action="Controller.jsp" method="post">
<table BORDER=5 CELLSPACING=3 WIDTH="715" >
<tr height="422">
<td WIDTH="145" HEIGHT="422" BGCOLOR="#FFFFFF"><img SRC="plant2.jpg"
BORDER=0 height=234 width=144></td>
<td HEIGHT="422" BGCOLOR="#FFFFFF"><img SRC="title.jpg" height=34 width=199>
<p>Date: <%=formHandler.getThisDate()%>
<br>
<% String temp = formHandler.getErrorMessage();
if (temp == null)
{ temp = ""; }
else { formHandler.setErrorMessage(""); }
%>
<center><font color="#FF0000"><%=temp %></font></center>
<p>Please enter your SubjectID:<input type="text" name="subjectId" size="24">
<br><% String select="SELECT professionid,professiontype from PROFESSION";%>&nbsp;
<p>What is your profession?<select name="professionName" >
<%=formHandler.myQuery(select)%>&nbsp;</select>
<br><% String select1="SELECT computeruseid,computerFreq from
COMPUTERUSE";%>&nbsp;
<p>How often do you use a computer?<select name="computerUse" >
<%=formHandler.myQuery(select1)%>&nbsp;</select>
<br><% String select2="SELECT genderid,gendertype from GENDER";%>&nbsp;
<p>What is your gender?<select name="subjectGender" size="1">
<%=formHandler.myQuery(select2)%>&nbsp;</select>
<p><input type="submit" name="submitButtonName" value="Go to next question"></td>
</tr>
</table>
</form>
</body>
</html>

```

Questions.jsp

```

<jsp:useBean id="formHandler" class="thesis.LizThesis" scope="session">

</jsp:useBean>

<jsp:setProperty name="formHandler" property="*" />
<html>
<%

formHandler.getQuestionInfo(formHandler.getQuestionNum());
formHandler.setPrevPage("Questions.jsp");
%>
<html>

<head>
<script language="JavaScript">
<!-- history.go(1); //-->
</script>

<meta http-equiv="content-type" content="text/html;charset=iso-8859-1">
<title>Plant Database Study</title>
</head>

<body bgcolor="white" background="grn_back.jpg">
<p></p>
<form action="Controller.jsp" method=post>
<table border="5" cellpadding="1" cellspacing="0" width="716" bgcolor="white">
<tr border="0">
\<td bgcolor="white" border="0">
</td>
<td border="0" bgcolor="white"><img SRC="title.jpg" height=34 width=199>
<p></p>
<p>
<%
if(formHandler.getQuestionNum().equals("4.0") || formHandler.getQuestionNum().equals("5.0")
|| formHandler.getQuestionNum().equals("7.0") || formHandler.getQuestionNum().equals("9.0")
|| formHandler.getQuestionNum().equals("11.0") )
{
<%=formHandler.getQuestion()%>
</p>
<p></p>
<p><input type="radio" value="yes" name="answer"> Yes           <input type="radio"
value="no" name="answer">No</p>
<%
}

else if(formHandler.getQuestionNum().equals("14.0") )
{
<p>For the following questions, please rate the general site characteristics<br> on a scale of 1-5
by clicking the radio button below.</p><br>
<%=formHandler.getQuestion()%>

```



```

<p><input type="radio" value="1" name="answer">1
  <input type="radio" value="2" name="answer">2
  <input type="radio" value="3" name="answer">3
  <input type="radio" value="4" name="answer">4
  <input type="radio" value="5" name="answer">5
</p>
<p></p>
<p>
<% }else if(formHandler.getQuestionNum().equals("15.0") ||
formHandler.getQuestionNum().equals("16.0"))
{
%>
<%=formHandler.getQuestion()%>
<p><input type="radio" value="1" name="answer">1
  <input type="radio" value="2" name="answer">2
  <input type="radio" value="3" name="answer">3
  <input type="radio" value="4" name="answer">4
  <input type="radio" value="5" name="answer">5
</p>
<p></p>
<p>
<% } else {%>
<%=formHandler.getQuestion()%>
<p></p>
<p><textarea name="answer" cols="40" rows="4"></textarea></p>
  <% }%>
<p><input type="submit" name="submitButtonName" value="Go To Next Question"></p>
</form>
<form name="FormName" action="Controller.jsp?action=back" method="post" >
<input type="submit" name="action" value="Go Back a Page">
</form>
<p></p>
<p></p>
</td>
</tr>
</table>
</body>
</html>

```

Final. jsp

```

<!doctype html public "-//w3c//dtd html 4.0 transitional//en">
<html>
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
  <meta http-equiv="content-type" content="text/html; charset=iso-8859-1">
  <title>Plant Database Study</title>
<jsp:useBean id="formHandler" class="thesis.LizThesis" scope="session">
</jsp:useBean>
<jsp:setProperty name="formHandler" property="*" />
</head>
<body background="grn_back.jpg">
<%formHandler.getQuestionInfo(formHandler.getQuestionNum());%>&nbsp;
<script language="JavaScript">
  <!--
    history.go(1);
  //-->
</script>

<br><form action="Demographic.jsp" method=post>
<table BORDER=3 CELLPADDING=0 CELLSPACING=0 WIDTH="667" HEIGHT="248"
BGCOLOR="#000000" >
<tr BGCOLOR="#FFFFFF" height="234">
<td WIDTH="146" HEIGHT="234" BGCOLOR="#FFFFFF"><img SRC="plant2.jpg"
BORDER=0 height=234 width=144></td>

<td HEIGHT="234" BGCOLOR="#FFFFFF"><img SRC="titleend.jpg" height=28 width=257>
<p>Thank You for your participation in this study!
<p><input type="button" value="Close this Window" onClick="javascript:window.close();"
</p></td>
</tr>
</table>
</form>
</body>
</html>

```

LizThesis.java (Java Bean)

```
package thesis;
import java.util.*;
import java.sql.*;
import java.math.*;
import java.io.*;
import java.net.*;
import java.lang.*;

public class LizThesis{

    private String thisDate;
    private int professionName;
    private int computerUse;
    private int subjectGender;
    private Connection con;
    private String prevPage;
    private String subjectId;
    private String answer;
    private String questionNum;
    private String question;
    private String jumpYes;
    private String jumpNo;
    private String errorMessage;
    private String action;

    public LizThesis() {
    try {
        Class.forName("org.gjt.mm.mysql.Driver");
        con = DriverManager.getConnection("jdbc:mysql://ruby.ils.unc.edu/my_thesis", "xxxx",
"xxxx");
    }
    catch (Exception e) {
        System.out.println(e.toString());
    }
    }

    public void construct()
    {
        try {
            Class.forName("org.gjt.mm.mysql.Driver");
            con = DriverManager.getConnection("jdbc:mysql://ruby.ils.unc.edu/my_thesis", "xxxx",
"xxxx");
        }
        catch (Exception e) {
```

```

        System.out.println(e.toString());
    }
}

public void destruct()
{
    try{
        con.close();
    }
    catch(Exception e) {
        System.out.println(e.toString());
    }
}

public String myDate()
{
    java.util.Date myDate= new java.util.Date();
    String currentDate=myDate.toString();
    StringTokenizer st = new StringTokenizer(currentDate);
    st.nextToken();
    String dummy=st.nextToken();
    String month = ""+(myDate.getMonth()+1);
    String day=st.nextToken();
    st.nextToken();
    st.nextToken();
    String year=st.nextToken();
    String mydate=(year+"-"+month+"-"+day);
    return mydate;
}

public void doInsert()
{
    try {
        Statement myStmt = con.createStatement();

        myStmt.executeQuery ("INSERT INTO SUBJECTS (subjectid, computeruseid,
genderid, professionid, subjectdate) VALUES (" +subjectId+",
"+computerUse+", "+subjectGender+", "+professionName+", "+thisDate+"");
        //myStmt.close();
    }
    catch(SQLException e) {
        System.out.println( "Error SQL: " + e.toString() + '\t');
    } //end catch
}

```

```

public void doAnswer()
{
    try {
        Statement myStmt = con.createStatement();
        myStmt.executeQuery ("INSERT INTO ANSWERS (subjectid, questionnum, answer)
VALUES ("'+subjectId+'", '"+questionNum+',\''"+answer+"')");
        //myStmt.close();
    }
    catch(SQLException e) {
        System.out.println(e.toString());
        doUpdate();
    }//end catch
}

public void doUpdate() {
    try {
        Statement myStmt = con.createStatement();
        myStmt.executeUpdate("UPDATE ANSWERS set answer = \''"+answer+"\' WHERE
subjectid = \''"+subjectId+"\' AND questionnum = \''"+questionNum+"\'");

    }
    catch(SQLException e) {
        System.out.println(e.toString());
    }
}

public String myQuery(String x)
{
    String myString="";
    try{

        Statement vtmt = con.createStatement();
        ResultSet getRset=vtmt.executeQuery(x);

        while(getRset.next())
        {
            myString+="<option
value='"+getRset.getString(1)+">"+getRset.getString(2)+"</option>";
        }//end while
        vtmt.close();
        getRset.close();
    }

    catch(SQLException e) {
        System.out.println( e.toString());
    }//end catch
    return myString;
}

public void getQuestionInfo(String x)

```

```

    {
        try {
            Statement myStmt = con.createStatement();
            System.out.println(questionNum);
            ResultSet mySet =myStmt.executeQuery ("SELECT question,jumpyes,jumpno from
QUESTIONS where questionNum="+x+" ");
            mySet.next();
            question=mySet.getString(1);
            jumpYes=mySet.getString(2);
            jumpNo=mySet.getString(3);

        }

        catch(SQLException e) {
            System.out.println( "Error SQL: " + e.toString() + '\t');
        }//end catch
    }

public String backOne(String inNum) {

    String outNum = "";
    if ( inNum.equals("1.0") ) {
        outNum = "1.0";
    } else {
        int tempNum = (int)Math.floor(Float.parseFloat(inNum));
        tempNum--;
        outNum = ""+tempNum+".0";
    }
    return outNum;
}

public void setThisDate(String thisdate) {
    thisDate =thisdate;

}

public void setAction(String inAct) {
    action = inAct;
}

public void setQuestion(String lizquestion) {
    question =lizquestion;

}

public void setJumpYes(String jumpyes) {
    jumpYes=jumpyes;

}

public void setJumpNo(String jumpno) {
    jumpNo=jumpno;
}

```

```
    }

    public void setErrorMessage(String errormessage) {
        errorMessage=errormessage;
    }

    public void setQuestionNum(String questionnum ) {
        questionNum =questionnum;
    }

    public void setAnswer(String inanswer ) {
        answer =inanswer;
    }

    public void setSubjectId(String subjectid ) {
        subjectId =subjectid;
    }

    public void setProfessionName(int professionname) {
        professionName =professionname;
    }

    public void setComputerUse(int computeruse) {
        computerUse =computeruse;
    }

    public void setPrevPage(String prevpage) {
        prevPage =prevpage;
    }

    public void setSubjectGender(int subjectgender) {
        subjectGender =subjectgender;
    }

    public String getAction() {
        return action;
    }
    public String getThisDate() {
        return thisDate;
    }
    public String getErrorMessage() {
        return errorMessage;
    }
}
```

```
public int getProfessionName() {
    return professionName;
}

public int getComputerUse() {
    return computerUse;
}

public String getSubjectId() {
    return subjectId;
}

public String getQuestionNum() {
    return questionNum;
}

public String getAnswer() {
    return answer;
}

public String getQuestion() {
    return question;
}

}

public String getPrevPage() {
    return prevPage;
}

}

public String getJumpYes() {
    return jumpYes;
}

}

public String getJumpNo() {
    return jumpNo;
}

}

}
```