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Evaluating the Efficiency and Straightforwardness of a Customized WKO Web-based Application

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Abstract—**Whole Kids Outreach (WKO) is a non-for-profit organization in Missouri that provides low-income families with education and guidance for raising children. We designed a web application for WKO staff members to easily track and record client information. The interface of the web application was designed to be easy to use as well as efficient and straightforward. We conducted a formal usability study, consisting of ten participants, on this web application to simulate the major tasks of an Outreach Specialist staff person, which are: tracking and recording the results of a client visit and tracking the overall progress of clients. A post-test questionnaire was administered to ten participants as well as to five WKO staff members. The answers from the two groups were examined and compared. The usability test targeted learnability and robustness usability principles. Through analyzing the qualitative and quantitative results of the usability tests, we found that this application is efficient, straightforward, and user-friendly.**

Keywords—usability-study; user-interface; WKO; learnability; robustness;

I. INTRODUCTION

Whole Kids Outreach (WKO) is a non-for-profit organization in Missouri that provides low-income families with education and guidance for raising children. As of now, WKO currently is helping over 200 to 300 pregnant women and families with young children [8]. The staff at WKO consists of Outreach Specialists who are specially trained to treat and educate these families. The client data being recorded by the Outreach Specialists is confidential information and can be used if called upon in legal matters. The Outreach Specialists perform two main roles: tracking and recording results of a client visit, and tracking the overall progress of their clients over many visits. These specialists have been tracking their client's information using paper forms, which is very time consuming and a waste of resources. Using the WKO web application that we created the Outreach Specialists will be able to perform these tasks more efficiently and effectively.

Jeff Brookshaw, Brett Sissel, and myself, under the supervision of Dr. Francioni in accordance with Winona State University, have developed software for WKO. The software that was created for WKO was a web based application, using a customized user interface. The application connects to a database hosted on-site at the WKO center and consists of lengthy forms and detailed client information. These forms, as shown in Figure 1, are used to display information of an existing client by reading from the database. They are also used to submit any update on a new or existing client's information by posting to the database. The application was designed to be not only functional, but also user friendly and as straightforward as possible. The forms consist of a tabbed form view, and a user-friendly layout design. There is also a left navigation submenu, which allows easy access to any page in the application.

Since this is a new system, there is no baseline usability data on the web application. Although the application was designed with the user in mind, there is no way of knowing that it is easy to use and user friendly without testing it. A usability study can be used to provide data about the usability of the application as is now, and also provides baseline data of usability for future use. This way, if changes are to be made to the web application, the usability testing may be performed again to see where the modified web application then stands in comparison. A usability evaluation is an important part of the interface design process, which gives insight into what makes the interface a limited or successful interface [3].

A. Usability Studies

A usability study is a research methodology used to collect a user's tendencies and likings while in a controlled environment [1]. The principles tested in a usability study are learnability, flexibility, and robustness, as defined by Dix in [7]. Learnability is the ease with which new users can begin effective interaction and achieve maximal performance. Flexbility is the different number of ways in which a user and system exchange information. Robustness is the level of support provided to the user in determining successful achievement and assessment of goal-directed behavior [7]. A usability study consists of tasks/scenarios for the participants to complete. Each task performed by the user testing for one or more of these principles, where the results are analyzed to show the usability of a given application. A pre- and post-test questionnaire provides qualitative results about the users'

Fig. 1. Adult Visit Form within WKO application

opinion of the usability of a given application. The large amount of information recorded is qualitative, which gives insight about the design [4]. It is important for a web application or web site to be user friendly and easy to use. A usable web application makes for a more successful application. If a webpage or web application does not provide usability and accessibility then it will make it hard for the users to efficiently use the application [6].

This usability study focused on the learnability and robustness categories including the following specific principles: predictability, synthesizability, familiarity, and observability. Predictability is support for the user to determine a future action based on their past interaction history. Predictability was determined by how the participants were able to figure out a future correct path of action based on their understanding of what they have already encountered. Synthesizability is about the system support provided to a user to help them determine the effect of any prior operation on the current state. Synthesizability is related to the participant's understanding of what they did, and how they got to where they are. Familiarity is how the users' knowledge and experience within other real-world computer-based systems can be used when using a new system. This was related to the scenarios that included filling out the web forms, and how well they were able to begin using them. Observability is the extent of how the user is able to evaluate the internal state of the system from the representation on the user interface.

Observability was used to test the participant's understanding of where they currently where, and where they could go [7].

Hypothesis: The assessment of a formal usability study on the Whole Kids Outreach Web Application will show that, with minimal training, the custom user interface is easy to use and more efficient than the current paper-based system.

II.   METHOD

A formal usability study was conducted to provide usability data through analyzing the feedback and test data from a group of 10 participants. The software was set up for specific tasks to be performed by the participants. The following methodology tests the hypothesis that with minimal training the participants found the application easy to use and more efficient than a similar paper-based system. The usability study also gave useful information to the application developers regarding the design of the application, as well as anything the users liked or disliked, which may help improve the application. The following sections discuss the in depth creation, setup, and design of the usability study.

A.   Participants

Ten participants from around the Winona area participated in the usability study. Among these participants, there were four females and six males between the ages of 19 - 58. There were also five WKO staff members who participated in the post-test questionnaire. The usability study was limited to only users who have used a Mac to eliminate any flawed data. Running a test of ten users gives statistically significant numbers and results [6]. The average Mac comfort level was a 3.6 out of 5, and none of the particpants have taken a usability study before. Of these participants two said to fill out forms less than once a month, one fills out one form a month, three fill out two forms a month, and four said to fill out three or more forms a month. After the tutorial was given, six particpants said that they felt they could use the application and four said that maybe they could use the application with more practice.

B.   Setup

The software used was the WKO web application Beta version. It was run on a Mac Book Pro 12 with the operating system of OS X version 10.9. The Apache Web Server XAMPP 1.8.3-1 was running to process the PHP requests from the application.

C.   Test Procedure

Each participant was first informed of what a usability study was, and then was read the test facilitator script. The facilitator script (see Appendix A) welcomed and thanked each participant for partaking in the usability study, and informed him or her of the purpose. They were reminded that the test is not a test of them, and that there is no right or wrong answer. Also, if for any reason they felt uncomfortable, they were able to exit the testing at any time. The participant was then asked to sign the consent and waiver form (see Appendix

B) giving the permission to use their information for the study. After the participants signed the consent and waiver, they were given the tutorial and then asked the pre-questionnaire. The testing then started, and each participant was given a copy of the test scenarios. Each scenario was read aloud to the participants, where they were asked to complete each scenario. During the testing, it was important to stay calm and not make the participants feel as though they had done or were doing something wrong, which could have made the participant feel anxious, or add stress [2]. The participant was asked to inform us when they believed they were done, and then we would move to the next scenario. After the participants completed all of the tasks/scenarios, they were given the post-questionnaire and again thanked for participating in the study.

D.   Training

Each user was briefed on what the study is about, and was told that no personal information was taken from them to ensure privacy. The tutorial consisted of informing the participant of the roles that each Outreach Specialist performs, including: the tracking and recording of the their client visit results, and the tracking of the overall progress of clients through their visits. There was also a 2-minute brief tutorial that familiarized the participants and showed the major functionalities of the application. This showed the participants the overall layout of the application as well as the layout of the forms

E.   Pre- and Post- Questionnaire

A questionnaire was administered to each participant before and after completion of the study. The pre-questionnaire (see Appendix C) obtained general information of each participant including: their gender, age, a Likert scale of their comfort level using a Mac computer from 1 to 5 (1 being not very comfortable and 5 being very comfortable), how often the participant fills out online forms, whether or not the participant has partaken in a usability study before, and after the tutorial has been given if they believed they could use the application or not. The post-questionnaire (see Appendix D) obtained information of the users overall experience of the application. The information collected included: the overall impression of the application, a Likert scale of the ease of use from 1 to 5 (1 being hard to use and 5 being easy to use), what the participant liked best and least about the web application, what they would do to improve the app, a Likert scale of their comfort level of the application from 1 to 5 (1 being very frustrating and confusing and 5 being very straightforward and comfortable), and whether or not they believe the application is more efficient than a similar paper based system.

F.   Test Scenarios

The usability tests were based on the two main functions that an Outreach Specialist performs, which include: tracking and recording the client visit results and tracking the overall progress of clients. To be able to observe participants, they should be given an assignment known as a task or scenario to complete [5]. Some of the tests/scenarios may be performed

more often than the others, but together, they should cover the range of tasks an Outreach Specialist may have to perform. Test scenarios were developed for the following specific tasks:

1. Downloading an existing client's information (see Appendix E)
2. Starting a new visit on an existing client (see Appendix F)
3. Starting a new visit on a new client (see Appendix G)
4. Filling out a missed visit (see Appendix H)
5. Viewing the information on an existing client (see Appendix I)
6. Filling out a client termination (see Appendix J)
7. Deleting a client (see Appendix K)
8. Edit a previously recorded visit (see Appendix L)
9. Submitting a visit. (see Appendix M)

The test scenarios above follow a sequential order in which an Outreach specialist is likely to perform them. However, the test scenarios in this usability study were also made independent of each other, so that the completion of one task would not rely on the completion of a previous task. This ensured a participant could still perform a future task if they are unable to complete the current task. Table 1 shows the usability principles in each scenario tested.

An example test scenario was the deletion of a client. The test scenario was written as "An Adult client named Jennifer Smith has moved to a new address, which is outside of your assigned county. The address change has already been made, and another Outreach Specialist has already been given the client. You now no longer need this client to be downloaded on your laptop computer, and for security reasons want to delete the client. Can you delete Jennifer Smith from your list of clients?"

G. Pilot Testing

A pilot usability test was administered to two participants to assess the study as a whole. This pilot testing helped find problems with the wording of the test scenarios and questionnaires. The pilot testing also helped find the expected completion time and clicks for each task. These were determined by the expected completion time the designers determined before the sample testing, and the sample time and number of clicks the participants achieved during the pilot test.

H. Errors

User errors during the tests consisted of both non-critical and critical errors. Non-critical errors involved false and extraneous information entered. If the user were to misspell or add in extra information based on the given information, then they were deemed non-critical. These errors were considered non-critical errors because the participant was still able to find the location to enter in the data, but entered in the wrong information. Critical errors occurred when the participant failed to enter in the given data into the necessary field. These were deemed critical errors because the participant was unable to find the required field, which affected the usability of the application. Critical errors were recorded during the study, where non-critical errors were not.

I. Data Collection

The data was collected via two main methods. First a pre- and post-questionnaire collected basic information and feedback from all of the participants. The questionnaire focused mostly on the layout and design of the application, and anything in particular the participant liked or disliked. The second method involved the recording of the user's interactions with the computer and the results of the tasks. The participants were asked to perform a think aloud strategy while performing tasks and navigating through the app. The completion of the tasks was rated based on the success of the participant ranging from 0 to 2 (0 – not completed, 1 – completed with difficulty or help, and 2 – easily completed) and the number of clicks to complete the task. This method for collecting data allowed us to observe the interactions of the participant and the computer,

TABLE 1. Test Scenarios with applied usability principles

as well as get an insight into what the participants were thinking as they went through certain tasks, and what made

	Predictability	Synthesizability	Familiarity	Observability
Scenario 1	X	☐	X	☐
Scenario 2	X	☐	☐	☐
Scenario 3	X	☐	☐	☐
Scenario 4	☐	☐	☐	☐
Scenario 5	☐	☐	X	☐
Scenario 6	☐	☐	☐	☐
Scenario 7	☐	☐	X	☐
Scenario 8	X	☐	X	☐
Scenario 9	☐	☐	X	☐

them click on certain objects.

III. RESULTS

After the 10 participants completed the usability study, we analyzed the results and observations recorded from the tests and the answers to the questionnaire. The results were reviewed to find trends or multiple occurrences of situations and scenarios that may show the usability of the application.

A. Test Scenario Results

The test scenario results provided ample information to be analyzed. For each of the nine scenarios, the duration, number of clicks, errors, success rate and general comments were recorded. There was a predefined expected completion time and number of clicks defined for each scenario. Figure 2 shows the acutal and expected durations of each scenario in seconds, and Figure 3 shows the actual and expected number of clicks. (Figures on following pages) Note that if a scenario had a success rate of 0, then the time and click count was discarded. The actual values for time and number of clicks were computed as of each scenario for the group of participants.

As the participants moved through the scenarios, their times and number of clicks decreased in regards to the scenarios expected time and clicks. The first three scenarios each have a higher average completion time and number of clicks than the expected completion time and click count. The last six scenarios only have two scenarios where the average time and clicks are larger than the expected. The percent difference was calculated between the actual and expected times and number of clicks in regards to the first three scenarios, and the last six scenarios using a formula

$$\frac{|v_e - v_a|}{\frac{v_e + v_a}{2}} * 100$$

where v_e stands for expected value, and v_a stands for actual value. The first three scenarios had an average +15.14 percent difference in time and a +23.8 percent difference in clicks. The last six scenarios had an average -3.44 percent difference in time and -1.39 percent difference in clicks. This shows that the last six scenarios were completed on average faster and with fewer clicks than what was expected. The participants figured out the application relatively quickly, and were able to use the application efficiently.

The results clearly show that, scenario three had a significantly greater completion time and number of clicks than the other scenarios. For this scenario the user had to enter a relatively large amount of information into two different forms and save them. We noticed many of the participants went back over and reread the scenario multiple times. This is consistent with the higher error rate for scenario three when compared to the other scenarios. Since this scenario had the most information to be entered, the participant had the chance of making the most errors.

As stated earlier the success rate ranged from 0 through 2, where 0 was an incomplete scenario, 1 was a scenario that was completed with difficulty or help, and a 2 was an easily completed scenario. The average success rate and number of errors for each scenario are shown in Table 2.

Out of the 90 total scenarios completed by the participants, there was a total of 80 scores of 2, 9 scores of 1, and 1 score of a 0. This means that all of the scenarios were completed except for one, which results in a 98.9% completion rate. Out of all the scenarios, 88.9% were easily completed and 10% were completed with difficulty or help.

For the participants who took the study, the average Mac comfort level was a 3.6 out of 5, and none of the particpants had taken a usability study before. Two of the participants said they filled out forms less than once a month; one, one form a month; three, two forms a month; and four, three or more forms a month. After the tutorial was given, six particpants said that they felt they could use the application and four said that maybe they could use the application with more practice.

B. Post-Questionnaire Results

After the participants completed all of the scenarios, they were asked the post-questionnaire. Members of the WKO staff were also asked the same post-questionnaire to back up the results from the study. The main data taken from this survey to determine the usability was the participants' ease of use while using the application, the users experience using the application, and the efficiency compared to a similar paper-based system.

TABLE 2. Average Success Rate and Errors Per Scenario

	Success Rate (Avg.)	Errors (Avg.)
Scenario 1	1.7	0
Scenario 2	2	0
Scenario 3	1.7	1.8
Scenario 4	2	0.2
Scenario 5	1.9	0
Scenario 6	2	0.3
Scenario 7	2	0
Scenario 8	1.8	0.3
Scenario 9	1.8	0

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
Expected	60	110	300	75	15	90	25	104	43
Actual Average	79.4	130.3	337.3	73.2	26.7	85.8	26.9	90.5	37
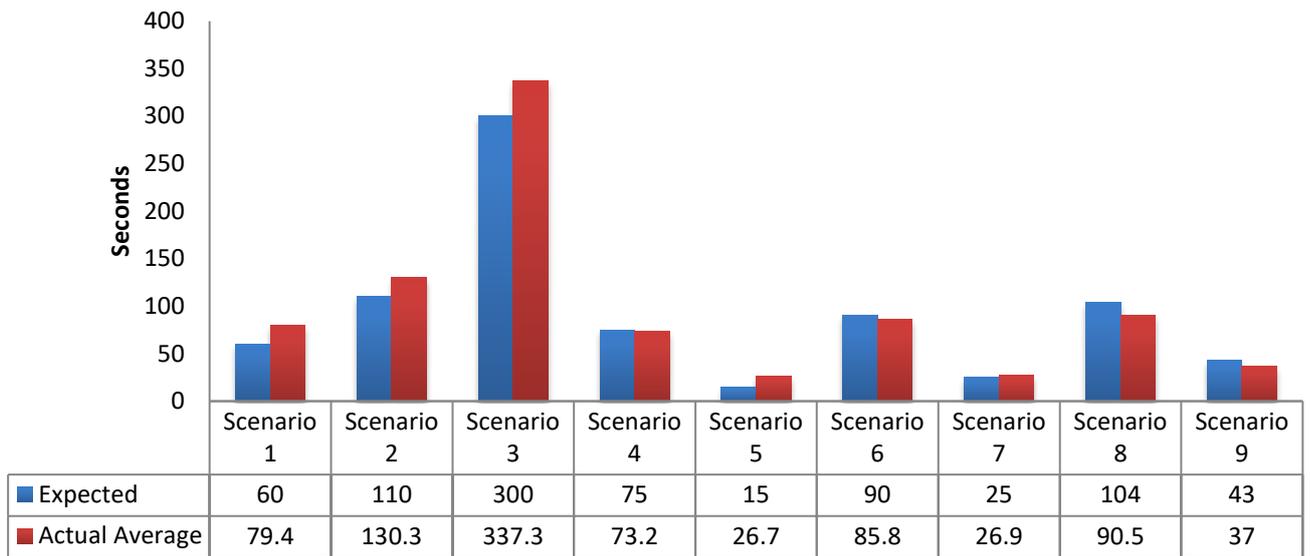
Fig. 2. Expected v. Actual Scenario Completion Times

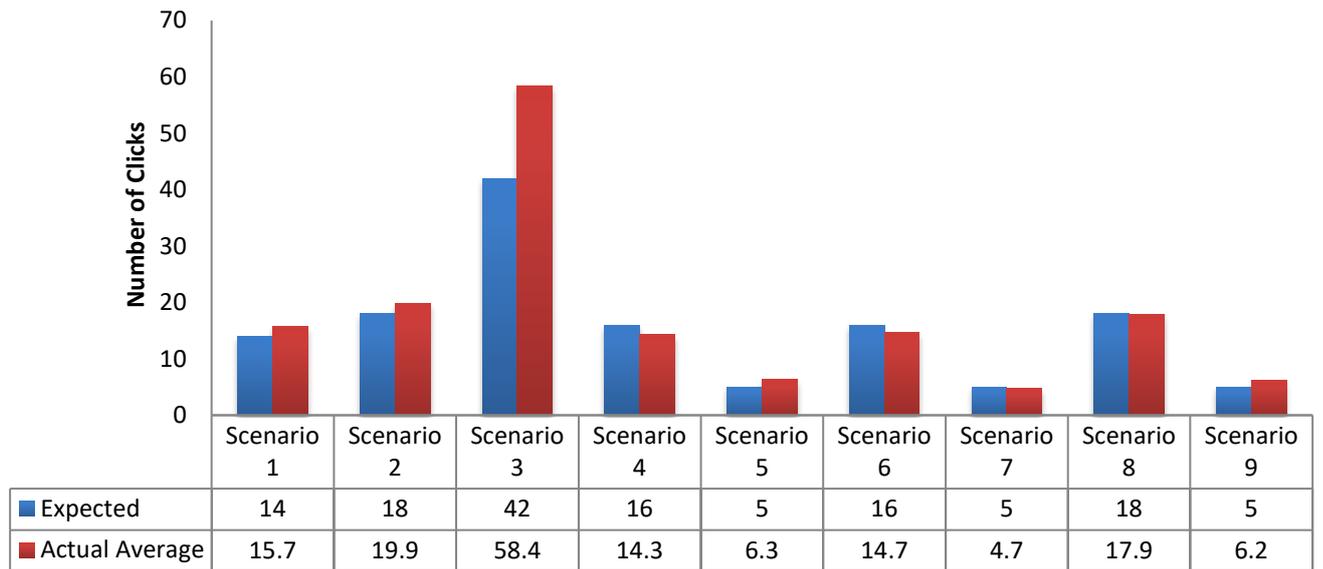|	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
Expected	14	18	42	16	5	16	5	18	5
Actual Average	15.7	19.9	58.4	14.3	6.3	14.7	4.7	17.9	6.2

Fig. 3. Expected v. Actual Scenario Number of Clicks

TABLE 3. Comparison of Participants and WKO Staff ease of use and experience of the application

	Participants from Study	WKO Members
Ease of Use	4.4	5
Experience	4.6	4.6

The participants the application's ease of use as a 4.4 and their experience using the application a 4.6, and the WKO members rated the ease of use a 5 and their experience a 4.6, shown as in Table 3.

The participants in the study and the WKO members both rated their experience using the application as a 4.6 on average. The WKO staff rated the ease of use as a 5 compared to the participants from the study's 4.4 rating. The WKO staff had been working with the software for approximately two to four weeks, where the participants were only given a two-minute tutorial on the application. Even so the participants still rated the application's ease of use close to the WKO members' rating. All of the participants found the application to be more efficient than a similar paper-based system. Many thought that it was more efficient for these main reasons: (1) the client's information backfilled for each visit so they would not have to retype it on each visit; (2) they liked being able to type in the information, and said it was faster than having to write out all of the information; and (3) they also thought it would be more organized.

IV. ANALYSIS

A. Predictability

Predictability was determined by how the participants were able to figure out a future action based off what they had already encountered [7]. Predictability was tested in scenarios four, five, six, seven, and nine, which included filling out a missed visit form, viewing client data, filling out a client termination form, deleting a client, and the submission of visits. The average success rate for these scenarios was a 1.96. Three out of the five scenarios had an average completion time that was less than the expected completion time; scenario seven had an average completion time that was less than two seconds longer; and scenario five had a average time that was 11.7 seconds longer than expected. The scenario five had two ways to perform the scenario: view the client under the my clients page and view the client under the 'Searchdb' page. Five participants viewed the client under the 'My Clients' page and five viewed it under the 'Searchdb' page. Using the 'Searchdb' path usually took longer, and the five participants who performed the task this way had an average completion time 14.6 seconds longer than the group who viewed it under the 'My Clients' page. Each scenario that tested for predictability had an average number of clicks that was ± 2 of the expected number of clicks. Having a high success rate and low average completion time and number of clicks on the given scenarios shows the participants were able to figure out future actions based on what they had already encountered, and application supports good predictability.

B. Synthesizability

Synthesizability is the participant's understanding of what they did, and how they got to their current situation [7]. Synthesizability correlated with the completion of a scenario, and participants knowing the actions they took and the outcome of those actions. 89 of the 90 scenarios were completed, which is a 98% success completion rate. This shows that the participants were aware of the actions they were performing, and the results of those actions. Synthesizability correlates well with the success rate, time and number of clicks of the tests.

C. Familiarity

Familiarity is how the users' knowledge and experience within other real-world computer-based systems can be used when using a new system. Testing in this category focused on the scenarios that included filling out the web forms, and how well the users were able to begin using them [7]. Familiarity tested for scenarios two, three, four, and six, which were the scenarios the participant had to fill out client forms. Two of the four scenarios were completed with an average time less than the expected time, and all of the scenarios together had an average that was only 12.9 seconds longer than the expected time. Three out of the four scenarios had an average number of clicks that was ± 2 of the expected number of clicks, and scenario three had an average that was 16.4 clicks larger than the expected. This could be because it was a long scenario with a lot of information to be filled in, and two of the participants used a built in calendar option for the birthdates, which increased the number of clicks dramatically. The average 12.9 seconds longer than expected was not very long when completing these tasks.

D. Observability

Observability was the participant's understanding of where they currently where, and where they could go from that point [7]. Observability tested for the overall flow of the website, why they were on the current page, and what pages they could access at that point. The participants did not have any difficulty navigating through the application. Out of the 90 scenarios, only 1 was not completed. This shows the participants where aware of where they were, and where they could have gone. The biggest observation taken from the tasks was determining the difference between accessing the 'My Clients' and 'My Visits' page. Where the 'My Clients' page shows all existing clients and starting visit information, and the 'My Visits' page shows all current visits. In the post-questionnaire seven of the participants answered what they like best about the application with an answer dealing with the application's flow. The answers varied from the organization and layout to flow to easy to find and access items.

E. Improvements of Application

By tracking observations and participants' comments, we were able to determine if pieces of the application could be improved to increase usability. The most noticeable observation was that some participants had difficulty

distinguishing the 'My Clients' and 'My Visits' pages functionalities. A participant noted that a 'help' button or subpage would be helpful in distinguishing between the functionalities of these as well as other pages. We also came across a smaller UI issue that could be changed to increase usability. When a user is asked to delete a client, a screen pops up to ask the user if they are sure and to type 'y' to delete. This pop up includes a long dialog sentence and a large text box to type in 'y'. A participant pointed out that the dialog could be shorter and to the point, and that the box could be shorter since they were only entering in 'y', or this functionality could be changed to a radio button with yes or no choices.

V. Conclusion

This usability study on the WKO application tested that with minimal training the application was easy to use and more efficient than the current paper-based system.

Although the testing went smooth, there were some changes that we would consider for future testing. The type of computer used would be judged with a higher concern. A Macbook Pro was used because that was the computer that was available. Although all of the participants had previously used a Mac computer before, many participants did not rate their comfort level very high. Also the possibility of allowing the participants the ability of using a mouse instead of the trackpad should be examined. Two participants had said during the testing that they prefer a mouse to a trackpad. Even though the Outreach Specialists run the application on their laptops, they are still able to use a mouse if they prefer. For a future study we could ask the participants before hand if they would prefer a mouse or to use the trackpad.

This study helped to provide baseline usability data, which is very helpful for any future changes made to the application. WKO may plan on adding in additional features to the application, or changes may be made to the existing application. Since the Outreach Specialists are traveling they may want to go to strictly mobile devices such as an iPad or other device. If any of these or other major changes are made to the WKO application, then this usability study may be duplicated to compare the usability data of the two applications.

Through testing the ten participants and comparing the questionnaires with the WKO staff members, we conclude that with minimal training the application is easy to use and more efficient than the current paper based system.

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RESEARCH / CREATIVE PROJECT ABSTRACT / EXECUTIVE SUMMARY
FINAL REPORT FORM

Title of Project
Whole Kids Outreach Web Application

Student Name   Matthew Genelin; Brett Sissel; Jeff Brrokshaw

Faculty Sponsor   Dr. Joan Francioni

Department   Computer Science

Abstract
Whole Kids Outreach (WKO) is a non-for-profit organization in Missouri that provides low-income families with education and guidance for raising children. We designed a web application for WKO staff members to easily track and record client information. The interface of the web application was designed to be easy to use as well as efficient and straightforward. We conducted a formal usability study, consisting of ten participants, on this web application to simulate the major tasks of an Outreach Specialist staff person, which are: tracking and recording the results of a client visit and tracking the overall progress of clients. A post-test questionnaire was administered to ten participants as well as to five WKO staff members. The answers from the two groups were examined and compared. The usability test targeted learnability and robustness usability principles. Through analyzing the qualitative and quantitative results of the usability tests, we found that this application is efficient, straightforward, and user-friendly.

The end product of this project in electronic format has been submitted to the Provost/Vice President for Academic Affairs via the Office of Grants & Sponsored Projects Officer (Maxwell 161, npeterson@winona.edu).

Student Signature _____ Date _____

Faculty Sponsor Signature _____ Date _____