REPORT FOR A USABILITY STUDY OF THE INDUCTIVE REASONING TRAINING PROJECT

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Description of the Evaluation Context

Background and Directions for Use

This prototype is a web-based training of inductive reasoning skills for multiple age groups and different settings. The layout of the screens in this project is programmed in Adobe's Flash vector animation software. The minimum system requirements for using this program are:

1. Internet access
2. Flash player version 8 or above installed
3. A browser that supports Flash 8 player

The Inductive Reasoning Training project is accessible on the web site: http://129.186.123.4
This project is a translation of the Cognitive Training for Children based on a Developmental Program of Inductive Reasoning and Problem Solving (Klauger & Phye, 1994). It was designed to test a recent prescriptive theory of inductive reasoning by testing a strategy that enables participants to solve any kind of inductive reasoning problem.

Description of the Inductive Reasoning Training program

This prototype is designed to train fourth graders and higher to reason inductively. It provides an opportunity for participants to acquire the basic strategy of inductive reasoning, to modify it appropriately for the six varieties of inductive tasks, and to experience sufficient opportunities through practice to internalize the strategy.

Description of a Training Episode

A complete training episode is made up of an Introduction, 6 lessons, each ending with a quiz, and two extra quizzes. Problems and quizzes increase in complexity from introductory lessons to more advanced lessons. In other words, the number of problems requiring surface analysis decreases further into the training, whereas the number of problems requiring structure analysis increases in the more advanced lessons. Additionally, the quizzes help assess a student's understanding of the material.

In the Introduction, students learn about the basic concepts of inductive reasoning: characteristics and relationships.

In Lesson 1 students are to solve problems naively. Beginning with Lesson 2, the meta-cognitive aspects are at the center of the instruction. In Lessons 2 and 3, problem classes are defined by attributes, whereas in Lesson 4, problem classes are defined by relationships. Lessons 5 and 6 repeat what has been learned so far but in a different order. This way the users are provided the opportunity to realize that problems can differ with respect to the category involved (attributes or relationships) but can require identical processes (looking for similarities and differences or for both).

Extra Quizzes 1 and 2 provide review and practice to help students consolidate what they have learned. Extra Quiz 1 should be taken two weeks after students have finished all of the lessons. Extra Quiz 2 should be taken one month after Extra Quiz 1.

All lessons, except for Lesson 6, contain four examples, which provide students the opportunity to practice one or two of the information processing procedures of the training. Examples are object-based as well as fraction based. The object-based examples of the procedures always precede the fraction-based example of that same procedure to facilitate learning. Use of concrete symbols, such as objects, should help students understand more easily how to solve certain problems. Then, when the general idea is clear, students practice with an abstract fraction-based example, which should further prepare them for the quiz. After taking either lesson quizzes or extra quizzes, users will be able to see their scores and correct answers along with the feedback and explanation.

Description of the Navigation Structure

The navigational structure of the application is a combination of the linear and tree model. At some point in the application, students have no choice but to follow the path constructed by the designer/developer. At other points throughout the application, it is the student who chooses the direction of the instructions. The linear model is used to navigate within each particular lesson. Students can proceed forward and back through lessons and quizzes by using the navigation buttons NEXT and PREVIOUS. The tree model is used for navigation between lessons, because students may want to take one lesson at a time or will need to take one extra quiz at a time. This way, users will have access to each of the six lessons from the Lesson Page screen and to extra quizzes from the Home page. (See Figure 1: Navigational Structure of the Application).

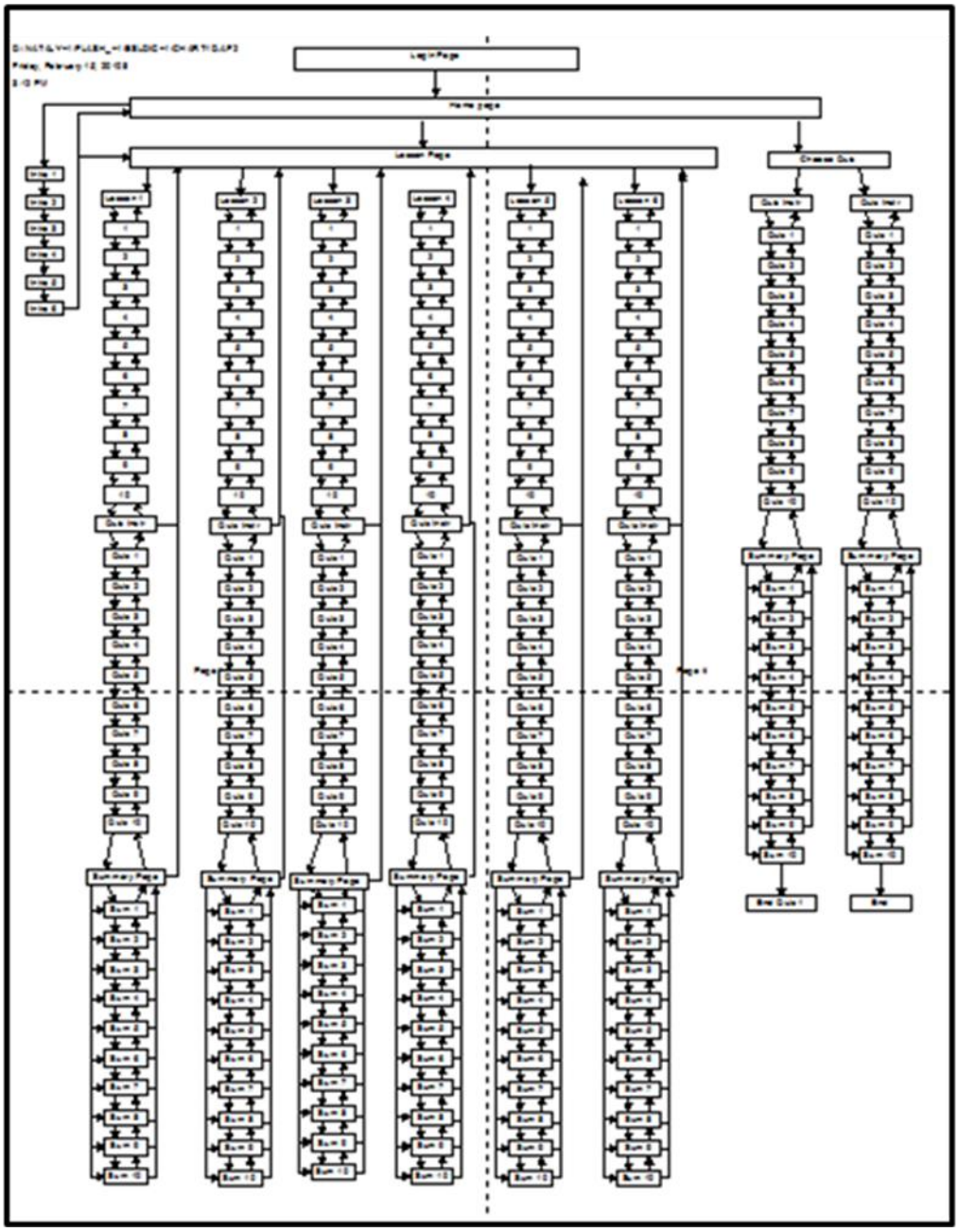

Figure 1: Navigation Structure of the Inductive Reasoning Training Project

As you can see in Figure 1, the application consists of both general and individual pages. The general pages would be Home page, Lesson page, Go to Quiz page, and Summary page. These pages present the same information to all students independent of the lesson or quiz taken. The individual pages on the other hand, contain specific information related to the path chosen by the students. In other words, Lesson 5 contains specific examples related to the procedures taught and they are different from the examples in Lesson 2. Each quiz also contains unique questions, complementing the information taught in its specific lesson. After taking a quiz, students can find their score on a Summary page and review their responses and get feedback by going from a

Summary page to a View Results page corresponding to each particular question. They can also navigate from a Summary page to the Lesson Page if they want to choose another lesson (See Figure 2: Summary page). The HOME button takes students to the first screen.

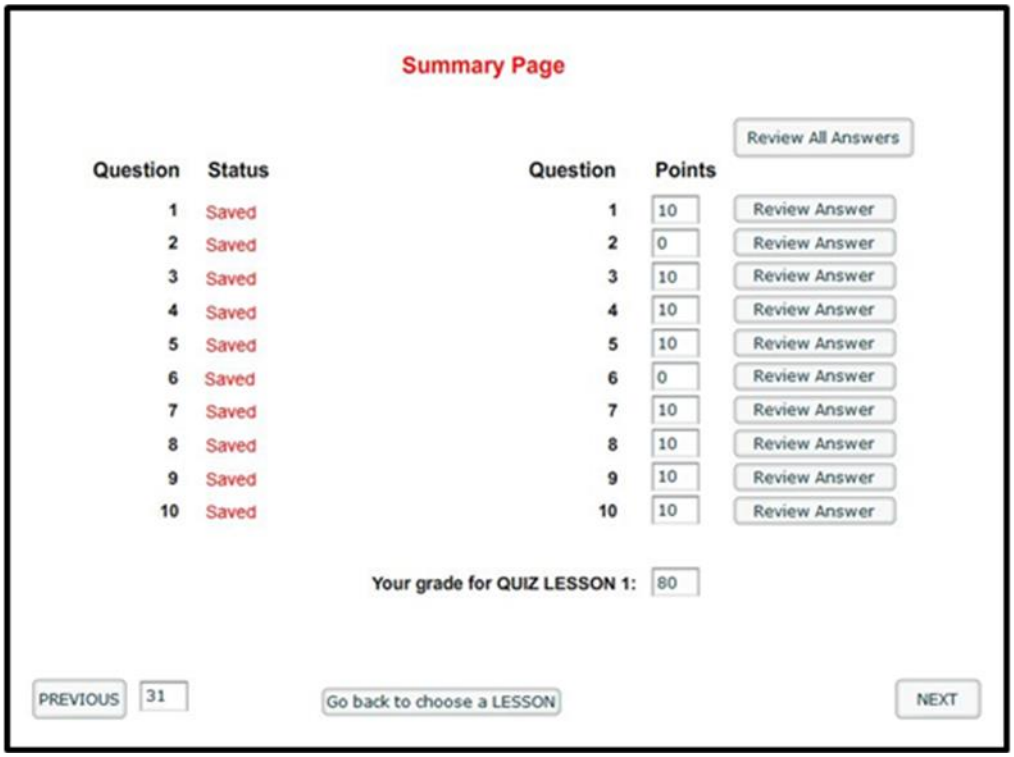

Figure 2: Summary Page

Description of the Login Process and Data Collection

The access to the program is through the login page. The data about the students' navigation through the program and their performance will be captured while students proceed through the program and stored in a database located on an Iowa State University (ISU) server. (See *Figure 3:* Login page).

If a user wants to register, he/she enters the demographic information and clicks the REGISTER button. All the information will be stored in a database and associated with the unique user ID assigned by the program. Next time when the same user accesses the program, they will just need to LOGIN. All the data about this user's performance, namely all their answers and scores, will be stored in the database. In addition, all the data about how they navigate through the program will also be stored in the database. The process of registration includes entering a *class code*. Each *class code* is created by the administrator and assigned a beginning and ending date. The class participants can only register and login to the class code between these dates. A class code of GENERAL has been created for the general public and is available anytime. This approach will allow the administrator to separate data about users from different schools in Iowa from general public users, because the program will store the information by class codes. The administrator will be able to query the database and select data for any *class code* for evaluation purposes.

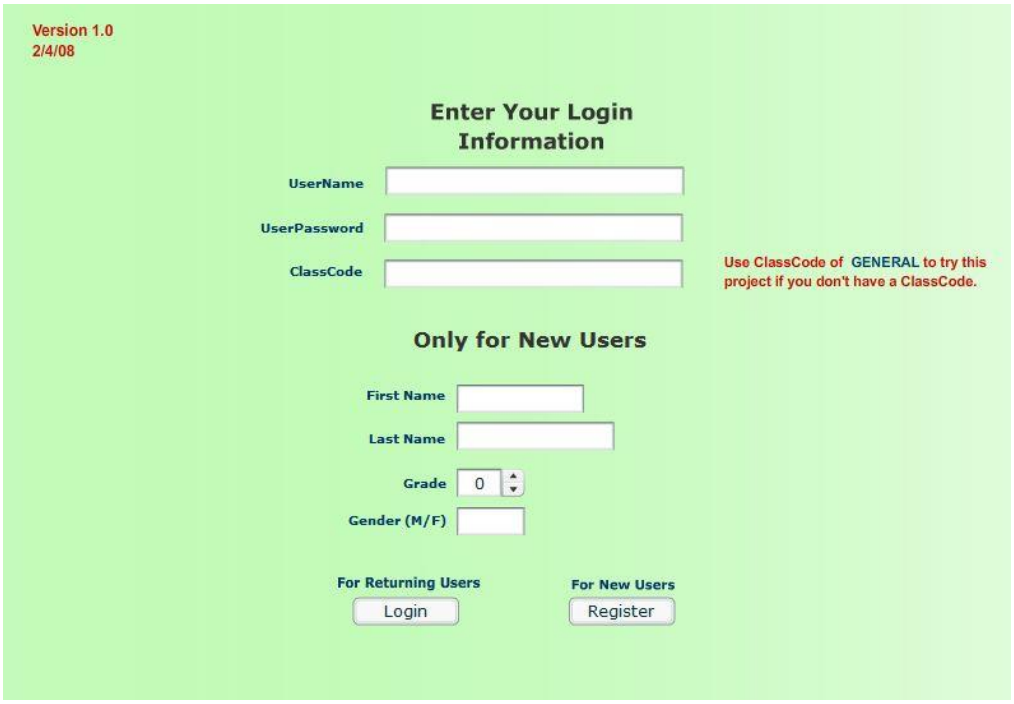

Figure 3: Login Page

Description of the Target Audience

The main target audience for this project is fourth graders from multiple public elementary schools in Iowa. The class codes will be assigned by the administrator to each of the fourth grade classes participating in the training. This project will be used in the classrooms for individual and group training for those students who have difficulty acquiring problem-solving skills through regular classroom instructions in the area of fractions and proportional reasoning. It is expected that the target population, fourth graders, will have studied basic fractions in school.

This web-based training will also serve as a remedial classroom activity in the fourth grade and higher with the students from the state of Iowa who have problems with the transition to Algebra I, because the main prerequisite skills for Algebra I course are mastering fractions and proportions, and the Inductive Reasoning Training project is focused on fractions and proportional reasoning. It can be appropriately used with regular classroom children and learning disabled youths with weak performances in school and who are at risk for vocational integration.
Another broad audience for this project is the general public in Iowa that can use this inductive reasoning training in a home setting. This program provides the opportunity for participants to acquire the basic strategy of inductive reasoning, to modify it appropriately for the six varieties of inductive tasks, and to experience sufficient opportunities through practice to internalize the strategy.

The above target audiences are expected to have some experience with computers such as using a mouse, a keyboard, and ability to read and understand the instructions on the screen.

Notes to Teachers

Various kinds of verbal instructions are helpful and it is useful to give participants tips and hints such as, "*Comparing* means looking for *similarities* and *differences"*. During the last three lessons, participants are encouraged to acquire the habit of monitoring themselves and their solution processes. Three procedural processing questions identified below should be asked and students should be expected to answer appropriately to all three queries for each new problem. (See Table 1. Procedural Processing Questions).

Table 1: Procedural Processing Questions

Question	Answer
1. What do I have to look at?	1. Similarities or difference or both with attributes or relationships
2. What should I do to find the solution?	2. Compare (i.e., look at similarity or difference or both). Do it according to an assumption or systematically.
3. How can I check my solution?	3. By the opposite comparison.

Description of Intended Outcomes

In this project the acquisition of basic thinking processes that define inductive reasoning is taught within a problem-solving context.

After taking the lessons offered in this prototype, fourth graders will be able to:

- Distinguish attributes and relationships
- Recognize the three attribute classes
- Recognize the three relationship classes
- Solve procedures with similarity problems
- Check procedures with similarity problems
- Solve procedures with difference problems
- Check procedures with difference problems

Data Collection Process

The Evaluation Object

The object of evaluation is a prototype of a web-based inductive reasoning training, applied in the area of fractions, relational and proportional reasoning. It has been designed for fourth grade students of public schools in Iowa, but can also be used as a remedial activity for students up to sixth grade facing difficulty in transition to Algebra 1. It aims to equip students with the basic inductive reasoning logic that underlies all math problems and teach problem solving through reasoning, rather than trial and error.

The prototype, programmed in Adobe Flash, is still in the developmental stage. This is a pilot project spearheaded by Dr. Gary Phye, with the help of a graduate student (Natalya Koehler), who designed the interface and navigation of the web-based prototype and programmed its database. The content is being transferred unchanged from the original program and visually being adapted

to Flash. The original program was implemented through WebCT. During an interview with Dr. Phye, he said that although the WebCT environment allowed tracking students' behavior and performance, it was very cumbersome to extract and analyze these data. It was also very difficult to navigate; and the interface was uninspiring.

Flash was chosen as the development platform because of its more versatile programming capabilities, which allowed not only student answers and scores, but also their navigation pattern and time spent on each page to be recorded in the database. Moreover, its ability to better represent visual content and thus scaffold students' understanding of properties and relationships made it a better pedagogical tool to meet the objectives of the program (Gary Phye, personal communication, 22nd February 2008).

Since the program was still in the developmental stage and had not yet been tested with the intended users, we thought the time was right to conduct a usability testing on it, with formative purposes, which would help indicate those product areas that needed improvement or changes. For this, we first had to identify the evaluation questions and criteria in order to arrive at the focus the usability testing should take.

The Evaluation Questions

Two main stakeholders involved at this stage of development of the inductive reasoning prototype were the Project Director and the Designer/Programmer. In the divergent phase of question development, both were interviewed to gain an idea of the expectations and concerns about the product, the information they seek from the evaluation and aspects they consider key to meeting the program's goals. Some of the concerns voiced (such as of content) were carried over from the previous program while others were related to the usability of the new interface, navigation tools and procedures for access.

The questions generated at the **divergent phase** can be placed in the following categories:

Concerns about Content Material and Instruction:

1. Is there logic in the way the instruction develops?
2. Does the content reflect the logic of inductive reasoning?
3. Are the examples given also consistent with this logic?
4. Is the material appealing to the teachers and subject matter experts?
5. Does the instructional material address the target audience (4th Graders)?
6. Is the vocabulary and language of the instruction appropriate for the age level?

Concerns about Cognition/Learning:

7. Do the users find anything interesting?
8. Do they find anything challenging?
9. Do they learn something new from it?
10. Does the instruction facilitate building understanding, competency, skill and confidence in solving math problems?

Concerns about Design and Navigation:

11. Is the user interface amenable to use by 4th graders?
12. Is the navigation structure amenable to use by 4th graders?
13. Are the instructions for login and registration easy to follow?
14. Are navigation buttons easily visible and their use obvious to the users?
15. Are more instructions or scaffolding required?
16. Are navigation instructions clear and easy to follow?
17. Are error messages clear and helpful in correcting navigation mistakes?
18. Are users able to easily find and move around different sections of the instruction?
19. Is the interface design (colors etc) appealing to the users? Does it meet their expectations?
20. Is the way in which the material is presented on the screen (visual design) distracting?
21. Do the users find the experience satisfying?
22. Are there any 'bugs' in the program?
23. What changes are needed to improve the program usability?

From the above, it was clear that the most immediate need was for information about usability with the target audience in mind. It was thus decided to perform a usability test to inform further program design and development. The test was to be administered through a series of 14 performance tasks (Appendix 1) that were aimed to measure general usability criteria such as ease of navigation and use, satisfaction, appropriateness of vocabulary used for target audience, visual design, and satisfaction.

The six final evaluation questions selected in the **convergent phase** and the criteria they address were:

1. Are participants able to navigate the program? (Measures: Ease of use and navigation. Determined by error rate)

2. Are navigation instructions appropriate and sufficient to allow participants ease of navigation (Measures if participants are able to follow navigation instructions and whether there are areas where lack of instruction causes navigation errors)

3. Does the vocabulary and language of instruction address the target audience? (Measures if participants able to comprehend the lesson instructions)

4. How many of the performance tasks are the participants able to complete successfully? (Measures overall effectiveness)

5. Do participants find the visual design appealing and does it meet their expectations? (Measures likeability and preference)

6. How do participants feel about their experience with the program? (Measures satisfaction, likeability, ease of use and areas of difficulty)

Selecting Participants

The inductive reasoning prototype was targeted towards 4th to 6th grade students at public schools in Iowa, so in order to get appropriate data for the evaluation questions, it was important to conduct usability testing with participants drawn from the target audience. It was also important to see if the difference in age between fourth and sixth grade children would affect their

experience of the program with regard to vocabulary and navigation skills. Moreover, for the testing to be successful, it required that the participants have a grade-appropriate knowledge of English, at least a grade-appropriate exposure to computer use and internet, and should have been taught fractions in school (although we were not testing any aspects of math learning from the program, we had to ensure that the participant did not get nervous about something they had no idea about).

To locate such participants, we contacted parents/friends within our peer group who we knew had children attending public schools in Ames, IA. We explained the reason for the testing, the procedures we would be using and the time it would take, and asked if they consented to their child's participation. The consent was both asked and given verbally. The basic screening questions used were:

1. Grade level of the prospective participant
2. Whether the prospective participant had learnt fractions in school
3. Whether the prospective participant was comfortable with computer use and internet
4. Which computer equipment did they prefer (PC/Mac, touchpad, mouse)
5. Would they be able to make it to the testing place at the date and time

We were thus fortunate to locate four participants from within our peer circle, who met these requirements. Of the four, two were in the fourth grade, one in the fifth grade and one in the sixth grade. However, working with children posed some unique challenges for framing the evaluative instruments and testing plan and some of the protocols we used were thus modified to the situation in order to obtain maximum data.

Evaluative Instruments

The next important step was to decide what evaluative instruments could be used to best obtain data about the above evaluation objectives and how to modify it for use with children. Literature on usability testing with children helped much in choosing and designing the evaluative instruments as well as for conducting the test (Hanna, Risden, & Alexander, 1997; Nielsen, 2002; "Usability testing with children", 2006).

The main data collection instruments that we decided to use were:

1. Think aloud protocol
2. Performance based tasks
3. Observation Grid
4. Debriefing
5. Navigation report from program database

These instruments were chosen and designed to yield both qualitative and quantitative data.

The **think aloud protocol** is very powerful as it gives an insight into how the participant is conceptually interacting with the software, but this protocol is challenging to administer with

children, as it can distract them from the task. They might also not be articulate enough to express everything that they feel/think and might end up frustrating and tiring them. To overcome this problem yet take advantage of the depth of information this measure gives, an innovative approach was adopted. We decided to make the children work in pairs and while doing so, encouraged them to talk to each other and work out any problems they were having together.

According to Hanna, Risden and Alexander (1997), elementary school age children (6-10 yrs) are used to task-based work at school and are ready to follow directions and answer questions from adults. But some might be shy expressing themselves truthfully, for fear of displeasing the adults. Children express themselves more by non-verbal cues and behavior. Keeping these points in mind, it was decided that we would use **specific tasks** to direct the usability testing and include key checkpoints in the **observation grid** to record the successful performance of each task, and the actions and behaviors. This observation will be supplemented by **video and sound recordings** showing the children's expressions and non-verbals. All these observations will be triangulated with data from the **program database** that records each keystroke and page visited, actions done there and time spent. Based on the convergent phase questions, six testing objectives were created. The matrix of objectives and instruments are summarized below. (See Table 2: Matrix of Objectives and Instruments).

Table 2: Matrix of Objectives and Instruments

	Think-Aloud Protocol	Performance-based Tasks	Observation Grid	Debriefing	Report generated from program database
Objective 1: Ability to navigate the program	X	X	X	X	X
Objective 2: Understand and follow the navigation instructions	X	X	X	X	
Objective 3: Understand and follow the lesson instructions	X	X	X	X	
Objective 4: Perform the given tasks	X	X	X		X
Objective 5: Make judgments on the visual design of the program				X	
Objective 6: Make judgments on the overall satisfaction with the program				X	

Description of the Data Collection Process: Test Plan

This section details the steps that will be followed on the test day and preparation required for it. This is detailed in the table below. (See Table 3: Test Plan).

Table 3: Test Plan

Steps	Person conducting	Materials needed	Approximate time
1. Introductions and warming up: Informally introduce participants to each other, give them time to get used to the test area and equipment – allow them to play on the computer and explore	Kajal	1. Tables and chair set-up (participants seated opposite one another) 2. Laptop Computers set up with mouse 3. Video Cameras, microphones, tripods, batteries	1. Prior setup time and equipment testing – 45 mins 2. Warm up time – 5 mins
2. Orientation: Introduction to the test and test observers	Kajal	1. Orientation script 2. Cookies, juice	3 mins
3. Background Interview	Kajal Karina Natalya	1. Background Interview Guide and Questions 2. Pens to write interview answers	10 mins
4. Testing Instructions: Explaining the conduct of the test: working in pairs, completing tasks, observation, think-aloud protocol, special instructions	Kajal	Orientation script	5 mins
5. Tasks While the participants do the tasks, one of us will facilitate the tasks and the other two will observe (fill out the observation grid)	Task facilitator - Kajal Observers - Karina and Natalya (sitting beside the participants) Participants will do the tasks and think aloud	1. List of tasks (for facilitator and chits made for participants) 2. Observation grid 3. Camera and wireless microphone turned on (image and voice data) 4. Computers	40 – 45 mins
6. Break for participants Observers prepare for debriefing	Kajal, Karina Natalya go through observation grid and observations made to identify specific follow up questions	Pen and paper to jot down additional questions	10 mins
4. Debriefing	Karina and Natalya, helped by Kajal. Participants answer questions about their experience	1. Debriefing Guidelines and questionnaire. 2. Observation grid remarks 3. Computers – to walk-through specific areas with participants 4. Microphone and camera	10 mins

Data Analysis Process

The data gathered with the evaluative instruments – namely background questionnaire, observation grids, video recordings, and debriefing – were typed and compiled to facilitate the analysis. The video recordings were watched more than once and comments from the think aloud were also typed and compiled. Comparative tables were created for the data in the background questionnaire (Appendix 5), the observation notes and video recordings (Appendix 6), and the

answers to the debriefing questions (Appendix 7).

Then the data were summarized to address each evaluative question. A qualitative analysis was conducted. Any differences in the interpretation of the results were resolved by the three researchers. Finally, a triangulation of the data was done to enable a more comprehensive investigation and better understanding of the findings.

Analysis of the Data

Results

The findings will be reported in this section according to the evaluation question they attempt to answer.

Program Navigation

The participants were able to navigate the program with ease. For the most part, the buttons seemed to be intuitive and the participants were able to figure out what to do without requesting assistance. For instance, during the debriefing, the 4th graders wanted to login again and went through the whole registration process. After clicking the REGISTER button they were given the error message "User already exists." Without requesting any assistance, they comprehended that all they needed to do was to type their information and click on the LOGIN button. Nevertheless, a few situations where the participants encountered problems are worth analyzing more in detail.

According to the observation and video recording analysis, the participants had trouble locating the BACK TO THE SUMMARY PAGE button on the Review Answer screens. The Summary page summarizes the results of the quiz the user has just taken, in the case of this usability testing Quiz 1, and lists the score. The users are able to click on the REVIEW ANSWER button – there is a REVIEW ANSWER button for each question in the quiz – in order to see the question, their answer, the correct answer, and an explanation for the correct answer. (See Figure 4: Feedback page). The users' task was to select one of the questions they did not answer correctly, click on the REVIEW ANSWER button and read the feedback. However, during the debriefing the users pointed out that as they were trying to return to the Summary page after accessing information about the questions they answered incorrectly, they clicked on the NEXT button. Because of that, they were thrown out to the Choose a Lesson page. This would not have happened if they had been able to see the BACK TO THE SUMMARY PAGE button. So, the users had to navigate through the lesson all over again in order to access the Summary page. This can also be seen in the reports from the database (Appendix 8) and the video recordings. The fact that both pairs hit NEXT might suggest that the navigation structure for these pages is not commensurate with intuitive and subconscious navigation habits.

Another problem occurred when the 6th grader tried to save a question by hitting the ENTER key on the keyboard. Although this might be an expected command in other programs and WebPages, this

is not how it works for the Inductive Reasoning Training Project; to be able to save the answer the participant needs to click on the SAVE ANSWER button. So, when the 6th grader hit ENTER, the answer disappeared. He typed the answer once more and then remembered to click on SAVE ANSWER. Nonetheless, the database recorded their answer twice and, thus, counted it as incorrect (Appendix 10). When checking the feedback for this answer the 5th/6th graders seemed frustrated and confused since the program claimed they had given the wrong answer but listed their answer as the correct one. (See Figure 4: Feedback page).

Moreover, all users expected to be able to interact more with the program. While answering some questions where pictures had to be grouped the participants tried to move the pictures with the mouse or asked questions such as "How can we place the blocks somewhere?" and "How do we move the blocks?" (See Figure 5: Example). During the debriefing, the users' first reply to the question regarding expectations was "I would not change anything". Later, during debriefing, after being shown the page again and reminding them of their comments, how a drag and drop would work, the users agreed that this would be a good idea.

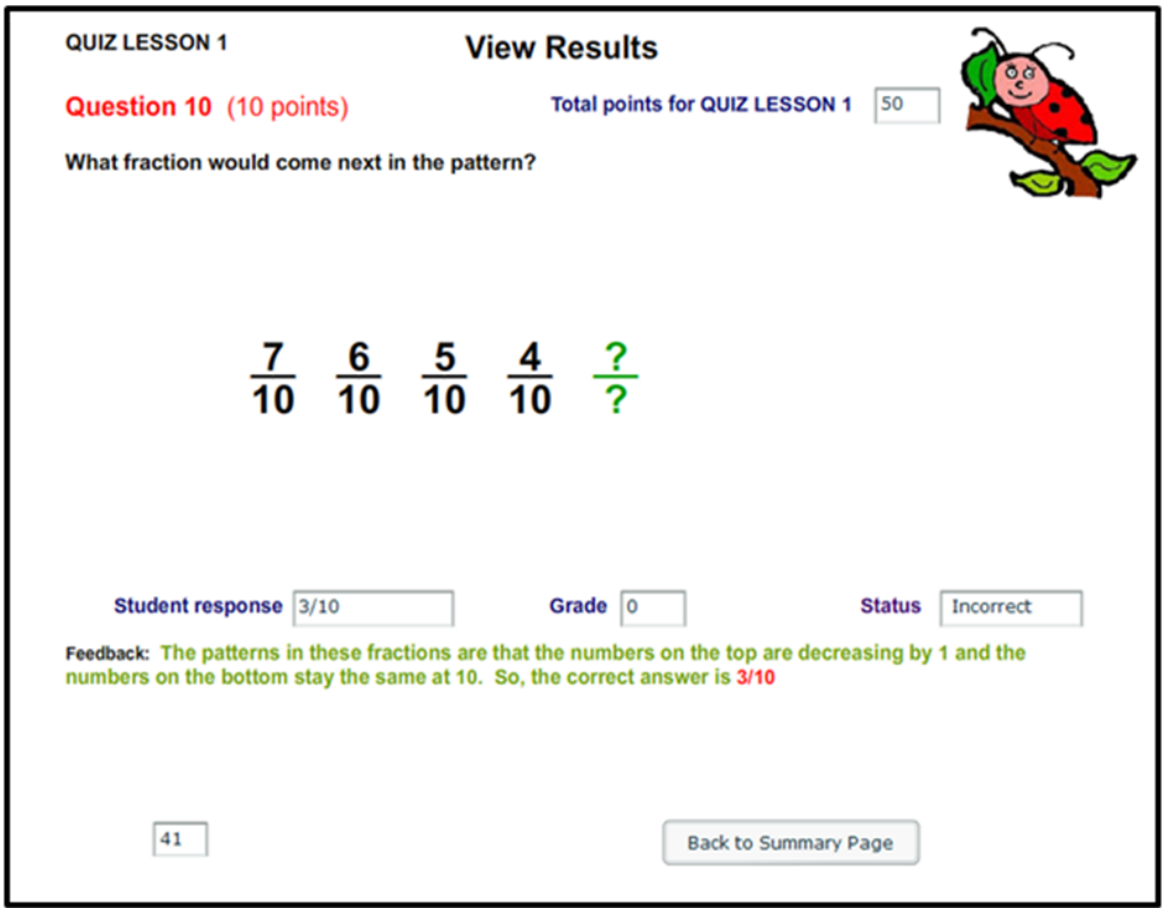

Figure 4: Feedback Page

Clarity of Instructions

Most of the navigation instructions were clear to the participants and caused no problems. Nevertheless, a closer analysis of the video recordings showed that the participants were not sure about how to go about solving the questions. For example, while answering a question the 4th graders commented: “Can you remember all that?” and “We don’t have to memorize it”. It seemed like they were having difficulty remembering long strings of alphabets and groupings. Another example would be the question asked to the facilitator regarding the need to capitalize the answers in the quiz.

Besides being unsure of how to go about answering some questions, the participants demonstrated some boredom while reading the instructions. They also mentioned during the debriefing that they felt the instructions were a little too long, which explains why they sometimes looked bored in the video recordings (fidgeting, distracted, yawning). Later during the debriefing, one of the fourth graders mentioned that they would rather have more worked examples than abstract explanations of concepts. It might be the language in the explanations that was confusing or some students would rather learn from worked examples than from abstract presentations of the concepts of *characteristics* and *relationships.*

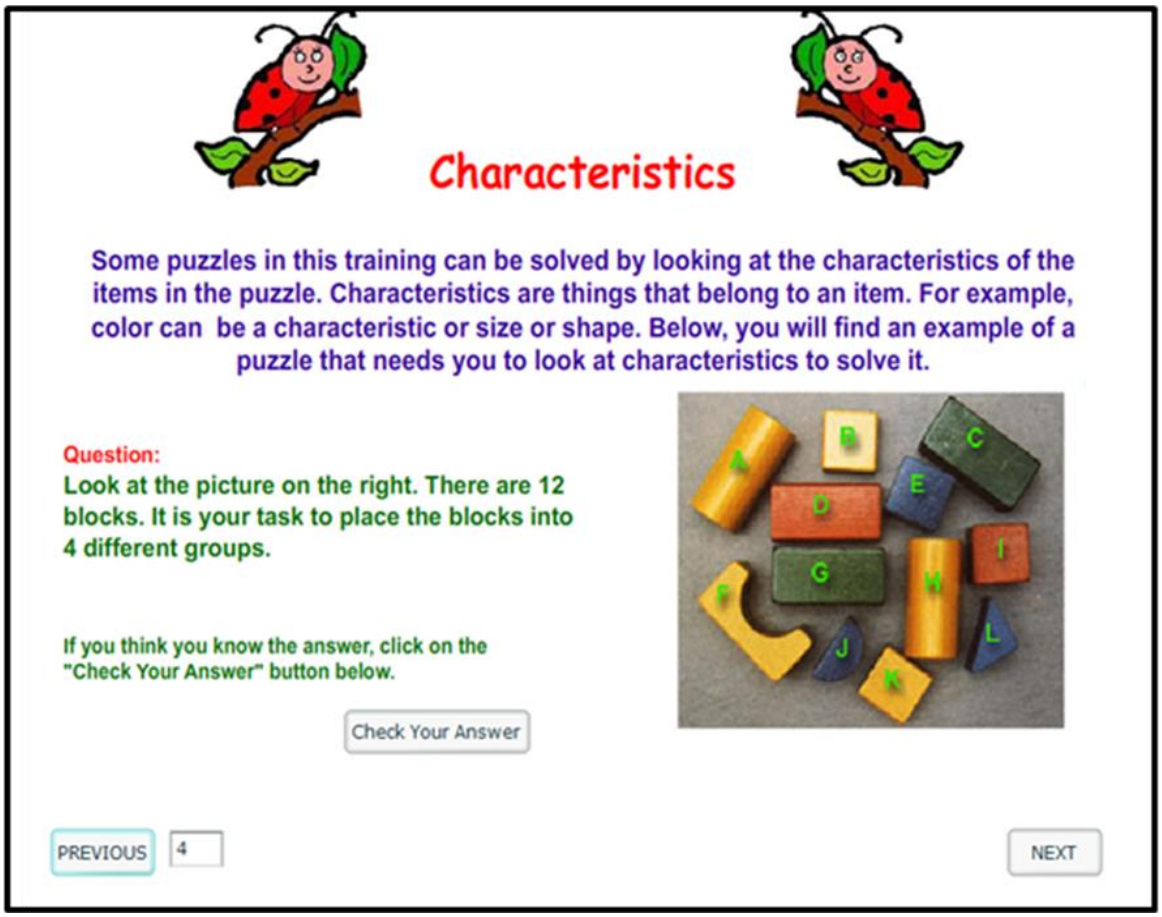

Figure 5: Example

Vocabulary and Language of Instructions

When asked during the debriefing whether language was a problem the participants said they did not think so. Nevertheless, the video recordings showed that the 4th graders had trouble to read words such as *characteristics* and *appropriate*. One of the participants asked, "What is a characteristic?" Later, while analyzing the program more in-depth, we noticed a sentence that did not make much sense to us: "*When you find what happens between the items in the appropriate order or questions that ask you to add the item that could come next*". Although the participants did not express having any difficulty with this sentence in particular, it seems clear that this sentence should be reworded.

Successful Task Completion

Both pairs were able to complete all the tasks successfully. Successful completion of the tasks was defined as the ability to complete the tasks without help. Even when they took the wrong step they were able to find the way out and correct themselves.

Visual Design

During the debriefing the participants mentioned that they thought the program was "very very cool". At first they felt that nothing needed to be changed in the program. After being asked about some of the more specific features, they were able to spot some things they would change. For instance, they said the pictures should be bigger and clearer. They also felt that the feedback needs to be easier to see, perhaps with a different font color and size. (See Figure 4: Feedback Page). They also mentioned the Summary page. Their suggestions included a change in the BACK TO THE SUMMARY PAGE button to make it brighter and more apparent. They also thought it would be a good idea to change the wording of this button to something like "Back to the Score page".

Participants' Experience

The participants said they liked the experience because the program made them think and they thought it was fun. During the observation, and later during the analysis of the video recordings, it was easy to see the participants' interest in the program, shown by their non-verbal behavior (e.g., pointing to the screen) as well as expression of satisfaction when they could figure a puzzle out.

As previously mentioned, the participants made suggestions for the improvement of the instructions and the pictures. Both pairs said they expected to be able to interact more with the program. Moreover, one of the 4th graders mentioned her wish to see the questions categorized according to their level of difficulty and more examples with the correct answers.

Although they thought the program included "very good exercises, very easy at first" it was possible to verify, both during the observation and in the video recordings, that there were some quite challenging questions. The questions in the quiz seemed to be more difficult than the ones in the lesson, based on the amount of time the participants took to answer these questions (Appendix

8). In addition, a closer look at the data from the database shows that questions 2 and 6 seem to have intrigued the participants, who spent on average more time than in any other question (Appendix 8). The 5th/6th graders got the answers to both of these questions wrong and the 4th graders were able to answer question 2 correctly but missed question 6 (Appendix 9). Even though the participants did not mention this difficulty, it was obvious for us during the observation and video recording analysis. Another problem with the questions was spotted by the 4th graders. They were able to notice that the first question in the quiz was the same as a question in the lesson. Answering this question was certainly not challenging for them because they remembered their previous answer (Appendix 9). Finally, it is important to note that some of the questions in the Quiz required a reduction function to be performed. Since it was not a trend of other questions, both pairs' answers were wrong.

To sum up, both pairs reacted differently to the program. The 5th/6th graders had fewer difficulties using the program than 4th graders. The 4th graders had more problems with the lengths of the instructions and the language used in the instructions. The 5th/6th graders, on the other hand, seemed to have less trouble to understand the language in the program but scored lower on the quiz (Appendix 10). These findings support the program director's suspicions that the language used in the program are targeting 6th graders rather than 4th graders. Nevertheless, it would be interesting to further investigate the differences between both pairs; more specifically the reasons for the 5th/6th graders' lower score.

Recommendations

Based on the data gathered, we would recommend some changes to the program itself and to future usability testing. Changes to the program refer mainly to improvements in its navigation, design and instructions. Changes in the design and implementation of other usability testing include considerations of the challenges one faces when working with children, as well as modification to the data collection instruments and procedures.

Program

Regarding the program, more interactivity seems to be important for the users. All of them claimed they expected to be able to move or click on the pictures. Drag and drop could be a way to make this possible. There could also be a space for the users to write tentative answers to cross check.

Navigation

The main navigation problem was with the Summary page. It is important to make sure the users understand how to check the feedback for their answers without being thrown out of the page. This can be done be making the PREVIOUS and NEXT buttons invisible in the Review Answers page.

Navigation would also be improved if there were some instructions regarding the use of the keyboard and browser buttons. That is, it is important the users understand that these buttons and keys should not be used at all. Besides writing these instructions on the front page, it would be good to include an error message that gives people a chance to correct their navigation mistake

before being thrown out of the program. If possible it would be good to integrate the ENTER key in the keyboard as a way of saving the answers. Another option is to disable the ENTER key button. Simply providing instructions might help but, since using this key seems to be a natural action ingrained by long use in other programs and WebPages, occasional unconscious errors might still occur.

Visual Design

In terms of the visual design, pictures and text can be made more apparent. Pictures, as suggested by the children, should be bigger and clearer. The feedback on the Review Answer pages should be placed more prominently than at the bottom of the page. Bigger fonts and a contrasting color might also help. Alternatively, the feedback could come as a pop-up window when you click the REVIEW ANSWER button, which would also remove the problem of navigating back and forth the Summary page. The SUMMARY button could also be changed. As mentioned by 4th graders, this button could be brighter or use a different expression such as "Go to the Score page" which seemed to be more comprehensible for them.

Instructions

The instructions can also be improved. The users seemed to feel that the instructions were too long and they demonstrated some boredom to read them all. One of their suggestions was the inclusion of more examples with answers, which would illustrate what the instructions were trying to explain. Likewise, the number of instructions could also be reduced. The use of interactive examples seems to be a good way to accomplish this. Another suggestion related to the instructions is the use of simpler vocabulary. For example, instead of the word *appropriate*, the word *correct* could be used. This would make it easier for the users to read, should they choose to read the instructions aloud, as well as facilitate comprehension. In addition, in order to ensure understanding, some instructions could be reworded and instructions could be added to the initial page to ensure the users always know how they are supposed to go about answering the questions. To this extent, it would be important to tell the users that some questions might require them to work out the fractions before they can see the characteristics and relationships. This might prevent frustration and confusion.

Challenges and Recommendations for Future usability testing:

Future usability testing should take several things into account. First, it is important to note that working with children poses some limitations. Children are not able to remember specific things; rather they are able to tell you general impressions about the overall experience (Hanna et al., 1997). For example, the children in this usability testing could recall the repeated navigation error from the review page probably because it felt particularly frustrating for them. However, they did not remember they had wished to move the pictures in the first pages of the program. For this reason, it is important to walk through the specific pages with them, making sure to explain unknown terms such as *interactivity*, *drag and drop*, and *feedback* and paying attention to non-verbal cues ("Usability testing with children, 2006). While working with children it is vital to show

them different parts of the program in order to get the best feedback possible. By asking them different questions, the researchers made sure there was mutual understanding and rich data were collected.

Moreover, data collection should include a variety of instruments that might need to be adapted to guarantee the best results possible. As was the case of this usability testing, a think aloud protocol was used but the children worked in pairs to help them feel more at ease with the whole experience and collect their comments as they were trying to figure out the solutions to the problems. The children's discussions gave greater insights into specific expectations and problems they were facing. In order to better comprehend these reactions it is recommended that video recordings are done and carefully examined.

Limitations of this testing and recommendations:

Future usability testing should also consider different changes in the instruments and procedures. For instance, the observation grid we used should be modified to provide more space for comments and the order of tasks one and two should be inverted. It is also important to remember to check the equipment not only before the usability testing but also while it is in progress. In the case of this usability testing, the DVD needed to be replaced and we lost several minutes of data that could have been very important for our analysis. Another place where we lost some data was in the program data base itself. While triangulating the data from the program data base with our observation grid and video recordings, we noticed some discrepancies and gaps in the program data base. Although leading to loss of some data, it was a blessing in disguise, because it brought to light problems within the programming itself, which we had not planned to address, and was bonus information which will help improve the program.

Further investigations should also reconsider the procedures of data collection and selection of participants. We were not able to do the usability testing with a pair of users at a time. Nonetheless, it is important to note that doing the testing with the pairs separately would allow for more in depth observations. Similarly, our participants probably did not represent the target population; they were proficient in the language, highly motivated, and computer savvy. Thus, it would be helpful to conduct a brief survey in schools to find out the learner profile of those who are generally assigned to this program. The usability testing could then include a cross-section of these learners to get a good user profile and accurate feedback. It might also be worth verifying other issues such as whether the differences in level of maturity with language – as exhibited between 4^{th} and $5^{th}/6^{th}$ graders in this test – would be more pronounced when dealing with English as a Second Language (ESL) learners or even remedial students.

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Authorship of the Project

Throughout the project, all decisions were taken collaboratively after discussion with the group members in face to face meetings, through email and synchronous online communication. Primary responsibility for each of the three deliverables was distributed among the group members. Other members of the group contributed edits and recommendations and the final deliverable incorporated all their inputs.

Evaluation Context Description Report

Background and directions for use	Natalya
Description of the Inductive Reasoning Training program	Natalya
Description of the target audience	Natalya
Description of intended outcomes	Natalya
Appendices	Natalya
Writing	Natalya
Suggestions and Edits	Natalya, Kajal

Data Collection Report

The Evaluation Object	Kajal
The Evaluation Questions	Karina , Natalya, Kajal
Selecting Participants	Kajal
Evaluative Instruments	Natalya, Kajal, Karina
Description of the Data Collection Process: Test Plan	Kajal
Evaluation Plan for the Instruction	Kajal, Karina, Natalya
Appendices	Kajal
Writing	Kajal
Suggestions and Edits	Kajal, Karina

Final Report

Data Analysis Process	Karina
Results	Karina, Kajal, Natalya
Findings from evaluation	Karina, Kajal
Recommendations	Karina, Kajal
Appendices	Karina
References	Karina
Writing	Karina
Suggestions and Edits	Karina, Natalya, Kajal
Authorship section	Natalya

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Appendix 1

Performance-based tasks for usability testing:

Task 1: To use this program, you will have to **register as a new user**. Can you try and register please? Your class code is CI504. Be careful to type this without any space between the words.

Task 2: That's great! Now can you **please go into the website**?

Task 3: This page is the homepage. Can you **read the instructions and click where it is asking you to go first?**

Task 4: Very good! Now this page is the introduction lesson. Can you **go through the introduction and learn from the lesson**? Take your time. Remember to talk with your partner about anything that is difficult.

Task 5: If I wanted to **start the introduction lesson again**, can you show me how to do it? The instructions on the page will help you.

Task 6: Can you **go to lesson 1** please

Task 7: Can you **go through lesson 1 and learn from it**? Stop when you reach the quiz.

Task 8: Can you **take the quiz and tell me your grade**? Remember, we re not testing you – we just want to see if children your age will find it easy or hard.

Task 9: Now, I want you to **choose any question that you got wrong and find the correct answer** for it.

Task 10: Could you please **go back to the page which had your grades?**

Task 11 : Could you show me **how to get to Lesson 2 from this (grade summary) page**?

Task 12: Can you please **take me back to the Choose Lessons page**?

Task 13: Could you **find 'Extra Quiz 1' from the homepage and click on it**?

Task 14: Okay, now please **exit the program.**

Appendix 2

Usability Testing: Inductive Reasoning Prototype

Student Background

Semi-structured Interview

The objective of this background interview is to gauge the testee children's experience with computers and internet use, their basic computer skills, attitudes and preferences that might impact their performance during the lest. The aim is also to obtain specific information about things that might help explain the child's behavior and reaction to the object of evaluation, such as: areas of computer use, access to computers, software packages they are used to, how they learnt it and their length of exposure to computers and the English language. These factors will frame their testing experience for instance their expectation of the user interface, navigation buttons, login procedures, following and understanding of instructions.

Things to keep in mind:

- Remember we are also using this time to get the children used to the testing environment and us. We are putting them at ease.
- Make the tone of the questions casual and easy – like a conversation.
- Ask clearly and put in encouraging comments and prompts eg. 'oh, that's a good school – do you like it?.
- Questions don't have to follow this order. Ask them in any order that sounds natural
- Children like to talk about birthdays and games, so you may preface a question with these – for eg.
    - Ask about their birthday before/after the question about Age.
- Sometimes give some information/experience about yourself to take the stress of answering so many questions off them.
- Take things from the child's answer to ask follow up questions like
    - 'what are your favorite computer games?'
    - 'What else do you like to use the computer for' or '
    - tell me more about what you like to do on the computer' so that the child starts talking easily.

<u>Note: Interviewer to first introduce herself.</u>

Hi, my name is _____.

What is your name?	
How old are you?	
Do you live in Ames?	
Which school do you go to?	
Which grade are you in?	
Do you like using computers? What's your favorite thing to do on it?	
Do you use Computers in your school? (ask also if Mac or PC)	
What do you use computers at school for? (prompt for the following information) 1. school work 2. teaching computers as a subject (specific software packages) 3. specific tasks - creative work, writing, tutorials 4. internet use (websites, information searching, web quests, podcasts etc)	a. Do you use it for Class work? What do they make you do? Prompt for specific tasks or use b. Do they teach you how to use different programs or do you learn yourself/with your friends? c. Do you use the Internet in school? For what?
Do you also use the computer at home? (mac or pc?) **What do you use it for?**	1. Homework 2. Games/Internet/other 3. How long before mother/father gets angry?
What language do you speak at home?	
Have you lived in another country before the US? **Do you remember how old you were then? (when and for how long)**	
Did you use a computer there?	
Do you remember what you used it for?	

Thank you (name of participant). It's been great knowing all these things about you!

We need to start the test soon. Would you like to take a little break before that? (go to the bathroom, drink water, eat a cookie)

Appendix 3

Orientation Script

Hello everyone, My name is_____ and I'll be working with you today. I am very excited that you all are here and want to thank you for coming to help us do this test. Let me explain what we are going to do today.

Somebody has made this new internet program to teach children how to solve some problems. We need your help to test how easy it is to use. I call this a test, but it is not like a test you have in school. We are not testing you. We are testing the program. We need your help to see what is too easy or too hard for children your age so we can fix it and make it better. Okay?

I would like you to meet two other people who will be working with us. This is Natalya and this is Karina. They are also very happy that you are here and have some questions they want to ask you. We have some cookies and juice for you, so while you are talking with them, feel free to have some.

Background Interview.

Urge children to take a break.

Provide brief re-orientation

Okay, so as I said before, we are here to test how easy it is to use this new program made for children your age. I am now going to tell you how we will do this so please listen carefully and if you don't understand something, then ask me right away. Okay?

I will be asking you to do some tasks on this program for us. For this, you will work together with someone in the same grade as you. I have made 2 teams according to your age and grade level :

Team 1 : Ana and Aaron

Team 2 : Ester and Sri.

You will sit together with your team partner. I will give you the tasks one by one and you will be working with your team partner to finish them. When you finish one task, tell me 'finished' and I will give you the next one. While you are working, I'll be sitting nearby. Natalya and Karina will also be here, watching you work and taking some notes. We would like you to work like you normally work on the computer with a friend. Don't try to work faster or be worried about getting things wrong – remember – this is not a competition and we are not testing you. Okay?

While you are working on the tasks, we would also like you to talk to each other about what you want to do, how you will do it and what you think. Things you say to each other are important information for us, so don't feel shy to say what you really feel, or talk about any trouble you are having doing the task.

We are here if you get stuck, but most of the time, we would like you to try and figure out things on your own with your team partner. By doing this, you will really be helping us to improve this program.

We will be video-recording you as you do the tasks. See those cameras there? This is because we might want to remember something after the test and can go back and watch it again. We also want to remember what you did for us today! To hear you better, we have these mics that we will clip to your collar.

Is this okay with you?

After you have finished all the tasks, Natalya and Karina will ask you some questions to know what you think about program. Again, don't be shy telling them exactly what you feel. If you want to take a break at any time, please do so.

There is one last but very important thing about the program that you must remember while doing the tasks. If you want to move back or forward in the page, look for the 'previous' and 'next' buttons at the bottom of the page. Remember NOT to hit the back button on the top left corner. Will you remember this for me?

So, did you understand how we have to test this program?

Do you have any questions before we start?

If not, then let's start.

We have the front page of the program open for you. Click on it and we can start!

Appendix 4

Debriefing

Start with the very general overall experience/satisfaction/Ease of use and then go to more specifics using observation data. Begin with affirming their actions – tell them they did great!

Questions

1. So, tell me, what do you think? How was the experience? (Let them talk freely). If not forthcoming, probe a bit with:
2. Did you enjoy the experience?
    a. if they say yes – then what about it did you like most;
    b. if no – what about it did you not like?
    c. If hesitant encourage them reminding them that it is important for us to know
3. Did you like the program?
    a. if they say yes – then what about it did you like most;
    b. if no – what about it did you not like?
    c. If hesitant – encourage them to speak reminding them that its important to know
4. Was it easy or hard to find the things we asked you to find?
5. Can you remember for me what made it hard? (Probe for easy visibility of navigation buttons). How can we make it easier?
6. Were there words or sentences you did not like or found difficult?
7. Now start asking about specific difficulties they had (from the observation grid).

    Take them to the specific pages to help them recall.

    Refer to non-verbal/verbal expressions and ask them how they felt? For Example you seemed puzzled or hesitant here or you took a long time here or you seemed lost. Was there a problem?

[A *special note for the interviewers:* If something is not clear to you when you were taking observation notes, ask the participant now to clarify your doubts.]

8. Can you give us some ideas about how we can make it better?
    a. Make the pages more exciting
    b. Make it easy to use
    c. Make questions and instructions easy to understand.
9. Did you learn anything new today? Were the puzzles hard or easy?

Thank you very much for helping us. We will use your help to improve our program. We were really interested to see how easy it was for you to use our program. Could you accept this small treat as our way to say thank you to you?

Appendix 6

Data from the Background Questionnaire

	Sri	***Ester***	***Anna***	***Aaron***
Age	11	11	10	10
Do you live in Ames?	Yes	Yes	Yes	Ames 2 years
Which school do you go to?	Ames Middle	Edwards	Edwards	Edwards
Which grade are you in?	6th	5th	4th	4th
Do you like using computers? What's your favorite thing to do on it?	Doing exercises - Teen 3000 – school website Games, videos, Watching Telugu movies (his mother tongue) on CD	Yes Check e-mail, talk to friend abroad, computer games	Yes Games	Yes Video games
Do you use computers in your school (ask also if Mac or PC)?	Mac, yes	Yes. She doesn't know if they use PC or Mac	Mac	Yes Mac
What do you use computers at school for?	Word document, essay, (mostly for paragraph), watch websites Independent Google search (on own). Till now they haven't done any power point. Access to computers in school – Media center, computer carts in class room	Writing and researching She learned how to use a program called Comic Life	Social Studies Science They teach spreadsheets Sometimes to look for information	Learning, typing Teachers teach them and they also learn by themselves They also use internet at school
Do you also use the computer at home? (Mac or PC)	Laptop at home. Need to do 4 Teen-whiz activities a week in school – if not completed in class, has to complete at home.	Check e-mails and sometimes for homework	They use computers a lot – computer games And sometimes (on CDs) for	Email, computer games

	Other things – finish homework. Used to play online games on mom's laptop – then it got virus so disallowed to download games. Allowed to play for ½ - 1 hour after homework is done.		Internet	
What language do you speak at home	Telugu (a south Indian Language)	Hebrew and English	Mixed – English and Portuguese	Hebrew and English
Have you lived in another country before the US?	Yes, in India till last year. Came to the US in June/July 2007	Moved to Israel when she was 4 yrs old. Moved back to US back 2-3 years back.	Born in Portugal. Moved to the US when about 2 yrs or so.	Moved to Israel when he was 3 yrs old. Moved back to US back 2-3 years back.
Computer use in country before US	Play station In India. Computer - PC games, talking on Skype with uncle in the US. Mom taught how to use computer. Computers not used in school in India	Used computer at home in Israel and also in school. Were allowed to play a little on it at home in Israel – but were banned from use after Aaron drew all over the screen with a green marker	Remembers computer use in the US.	

Appendix 7

Data from the Observations

	Comments		Behavior and Observations from Video	
	4th graders	**5th/6th graders**	**4th Graders**	**5th / 6th Graders**
Task 1: Register as new user	They tried to register without putting the login information but did it without help They thought about the upper case when they typed the class code.	They started before they got the task. No problems to figure out where to click to go to the login page.Sri did it. Ester figured out the class name. Sri started typing where it says login information. No problems to figure out which grade or to type the information. They decided together what they wanted.	Registration procedure: In the beginning, they were a little unsure about the user name and password – wanted confirmation 'any user name? any password?" But got through the procedure without any problems. This was just initial unsureity with the process.	Again a little unsureity and initial nervousness detected – "So we write our name as the user name?" Class code – " Is it Capitalized?"
Task 2: Enter website	(task 2 should be before task 1!!!)	They seem to be waiting for the second task. They started before they got the task.	Homepage – Spelling error detected by another person uninvolved in the project (for Natalya to know): Solve is spelled as 'Sovle'	
Task 3: Read instruction on homepage and click on where they should go first	Easily		Once on the Homepage, they intuitively knew they had to click on Introduction. When asked whether they were guessing or is that what the instructions said, they replied "We know".	Going to introduction was very intuitive – did not need to read instructions for that – so page setup is good.

Task 4: Navigate through introduction lesson and learn from it	Went next than previous. Reading aloud Anna tried *next* couldn't move the blocks Anna said that she didn't get it (page5) spent time trying to understand characteristics read answers carefully to understand better (page 6)	It seems like they did not have any problems to understand it. They read the instructions aloud. As they are deciding how to group the pictures they're putting the mouse over the ones they think should be together. I'm not sure they agreed on the correct answer before they checked it. I think they understood the answer after they checked the correct answer. (page4) Non-verbal behavior – pointing. They take turns reading and they also talk about their answers and explain why they chose it.	1. Detected hesitancy and difficulty in reading the word 'Characteristics'. Behavior – bending head side to side (to get a better look), eyebrows furrowed and word pronounced broken-up –'Char-rac-ter-is-tics'. Aaron commented (a little inaudibly) 'What's a characteristic?' This problem with fluidly pronouncing the word was repeated more than once. It does not seem to be a word they are familiar with. 2. Seem to have made some mistake – Anna saying to Aaron – Click next – then exasperatingly – 'Oh Aaron, click previous, now click next. Seemed to have jumped a few pages 3. First example – with blocks – which asks them to group the blocks by some characteristic (shape, color, size etc). Comments: "No, we are not done, we need to move the blocks around there' - (asking facilitator and talking amongst themselves) 'How do we move them? How do we move the blocks?" **Actions -** clicking and dragging on screen. 'I think we need to click next' (they press next) then say 'Nope'. Then went back, discussed the problem for sometime and checked answer. (So, although the instructions did say 'if you think you know the answer, click on the check answer button below, it was still not very apparent to them how they should go about	1. Had no problems with language and the word 'Characteristics'. 2. Had same problem with blocks – they were unsure about how to work out the answer "How do we place the blocks somewhere"? 3. Did not really grasp what to do – just checked answer. Then Sri says 'Oh, now I get it'. (SO it was not very apparent to them how to solve the answer) 4. Sri and Ester are alternating reading. They are reading problems and feedback very well. 'Learning from it'.

			working it out – eg. mentally or on paper. Clearer instructions needed) 4. In fraction page (pg 5) they went straight to the question – did not read explanation and instructions on top. Ana said 'I don't get it' Discuss possible answers for a bit – 'AB, CE.. ..Ana looks around - 'Do you have a pencil?" They figure out the answer – AB, CE DF – then got confused because the example given (AB CD EF) was very close to what the answer. Ana said 'But that's what they said'. Reads problem again and says – that's already done' Asking Aaron 'Do you know what it is?' Aaron says 'uh-uh' Then after sometime figured out the difference – took a bit of time in this. (so there a 'top down' perception error due to the example given being too close to the answer. Consider changing the order of alphabets in the example). 5. Pg. 6: (Relationships) Read instructions. Quickly got the answer. Richly collaborating and figuring out answers.	

Task 5: Know how to navigate to introduction again	Got the correct answer (page 7) Were able to find the home button and get back to the home page	They really seem enthusiastic about it. They are eager to move forward and answer the questions. They also seem to like reading the instructions and explanations. They also seem to do it very fast and need no help.	Pg. 8: Aaron is reading. Even he has trouble pronouncing 'Characteristics'. After introduction, immediately went to homepage. (Intuitive setting of buttons – good)	Clicking homepage to go back to introduction was very intuitive to them. Also figured out that pressing 'previous' a few times will also take them back.
Task 6: Navigate to lesson 1	Easily			
Task 7: Navigate through lesson 1	Reading the instructions aloud (Anna reads) (page 11) Got the answer right (page 12) Anna read the instructions aloud (page 13) Anna: how to divide into two groups – got the right answer (page14) – Didn't need assistance but spent time to get it It's boring for them to read the text – Anna is distracted with the cookie (page15)	Assistance: they checked if they could do start the quiz.	1. Lesson 1, pg 11: Aaron is yawning and distracted. Ana is reading. Starts slowing down and stumbling from 3rd line (..that the items have the same…When you think you know the answer…). Seems a little confused – and reads haltingly. (Maybe wording of instructions a little complicated for them?) 2. Pg 13 – Ana is reading instructions and Aaron more distracted. Yawns, plays with bottle cap, turns around to look at Natalya. Ana brings his attention back. Facilitator intervenes and suggests Aaron also take turns reading. (Although bored with instructions, is very interested in the tasks) 3. pg 14: Found lesson difficult. Spend substantial time figuring it out. Ana 'I don't get it' Aaron finally says 'its E,B,F and then A,B,C' Ana answers – 'Can you remember all that?' (Comment: It is difficult to just mentally work	Lesson 1 Instructions – Sri is yawning a bit. Instructions seem long. Ester also yawns. Lesson 1 – first fraction – Sri just guesses answer and wants to quickly know what the right answer is by checking it. Ester wants to not do that but try and figure it out first. ----Rest Missing------

			out the groupings specially with so many alphabet combinations to remember. Some interactive feature or a space to work out or type answers would help) 4. pg 15: Had difficulty pronouncing work 'appropriate' (Maybe use a simpler word – like 'right' or 'correct'. (Also the second part of the sentence 'When you find what happens….or questions that ask you to add…' does not make sense even to me). 5. Question about Geese – got answer correct. Aaron says 'We don't have to memorize it' (I think this is another indicator that they have difficulty remembering orders and groups of alphabets for answers and a place to work it out will help them concentrate on solving the problem and not remembering the answers/combinations they try out) 6. Pg 18 – Solved it easily. Ana comments 'That was easy'	
Task 8: Take quiz 1	Anna gave the idea to group geese by size and got the right answer (page 16) Anna is eating a cookie and Aaron reads aloud (page17) The page gets their attention (page 18) Aaron reads and Anna	They seemed to take more time when the problem involves fractions. Ester really seemed to want to solve the problem and it was easy to hear her expression of surprise and happiness when she could do it. They sometimes	1. Quiz question 1: both detect that it is the same question as one asked before in Lesson 1 (pg 14). Ana - 'That was the same one as…' Aaron 'I know – same answer!' Start filling out the answer. In the middle of it, ask facilitator – 'Do they have to be capitalized?' (Maybe include in the instructions that it doesn't matter if letters are capitalized or not. Same for login page as same question was asked by 5^{th}/6^{th} graders)	----Much missing----- Quiz – Question 10 – Sri fed in the answer and hit enter. Answer disappears and he says 'Uh-oh what did I do' Then typed it again and this time remembered to 'save answer'. (Comment: Hitting 'enter' key seems to be a natural action, ingrained by long use in other programs or web pages. This key therefore

	listens – Recognized the icon to go to quiz (page19) Anna reads the instructions (page 20) Work hard very interested (page 21) Trying to figure out the pattern (pages 22-24) Aaron picks patterns quickly (pages 26-28) – spent time on page 26 difficult pattern, wrong answer (26 and 29) Can't figure out that the answer was saved on page 22 then they figured it out Score: 70	seemed to be surprised to see there was another possible answer besides the one they could think of. They seem to take more time for the quiz than for the exercises in the lesson. They did remember to save their answer. They figured out how to go back. Questions 2, 6 and 9 seemed to be more challenging. They reminded each other to save the answers. Score: 50	2. Find most questions easy. Got stuck in Quiz question 6 (pg 26). Answered question by guesswork rather than figuring it out. (I feel that it should be specified somewhere in the instructions that this is a pure math problem, which requires a reduction function to be performed on the fractions to see the relationship. This is especially because this question deviates from the pattern set by all previous examples and questions, which so far haven't required a math function. $5^{th}/6^{th}$ graders also got this answer wrong, so it should be specified in the main instructions page that some questions might need you to work out the fractions before you can see the characteristics or relationships). 3. Question 9 (pg 29) also solved by guess work. 4. At the end of the Quiz, they were surprised they got a zero for one of the answer and clicked review answer on their own (probably for Q. 6), They stare at the screen for sometime and then Ana said 'Go back to summary page'. Aaron clicks on this. Then seems to have clicked on review answer again, because he is muttering 'ACD'). They go back to summary page and wait. (But this event is not recorded in the event details. The first review answer recorded is for question 10 (pg 41), but this cannot be, since they got this question right.)	must be either integrated into a way of saving answers or disabled. Providing instructions might help, but still cause some occasional unconscious errors.)

Task 9: Review one answer	Had problem with navigation back to the Summary page. Hit the Next button and got to Choose Lessons screen. Then they understood that they have to go Lesson1 again and answer the questions again. Figured out that the answers are already saved and they don't need to take the Quiz 1 again. Did the same mistake with the navigation back to the summary page again. After that they figured out the problem and reviewed other answers and went to the summary page by pressing the button " Go back to Summary Page"	They figured out how to do it before Kajal asked them to do it. But they couldn't understand the feedback. They required assistance because the computer's feedback didn't make sense – the computer counted as wrong but they actually answered it right. Summary page – 41	1. When facilitator asks them to review one answer they got wrong, they choose answer 7. They see the answer and figure out what they got wrong. Not clear if figured it out on their own, after seeing the correct answer or by reading the feedback (Again, this event that they reviewed question 7 is not reflected in the events record)	Really worried about why they got Question 10 wrong. Did not seem to be reading the feedback at this point. Just went back to question and tried to figure out what was wrong. It was pointed out by Karina and the facilitator that the feedback actually says their answer is correct, so it was probably a bug in the program. This seems to have assuaged them a bit.
Task 10: Navigate back to summary results	Trying to fix the student response (page 38) – don't like errors Easily navigate from summary page to lesson 1 and 2	They hit on next and they got out of there and back to the lesson's page. They didn't see the summary page button. They figured it out later.	Error committed – clicked next and got thrown out to Choose Lessons page. Aaron says 'We did something wrong and we went back to the ladybugs'. Said it was an accident. Facilitator asks them to quickly go through it again. While navigating through the pages again, they	Same error committed – hit 'next' and got taken back to choose lessons page. Now, when I got them back to Review Answer page and asked them to go back to summary page, Sri says 'press previous' while Ester says 'back to summary'

			tried to fix the answer to a question they got wrong and realized it's already saved and figured out its not supposed to change. Ana is not happy about that! T he navigation error happened twice. After the second time, they get to the summary page and wait. Natalya asked if they had any problems navigating or going back and forth and they answered that when they hit 'next', they got taken back to the Lessons.	So this also reveals some of the navigational problems which might happen often due to intuitive pressing of keys and page navigation habits.
Task 11: Navigate to lesson 2	Easily Choose lesson page couldn't under that page with ladybugs can get out of the program – they closed it		No problems	
Task 12: Navigate back to lesson page	Easily		No problems to report	
Task 13: Find extra quiz 1 from homepage	Easily		No problems	
Task 14: Close the program	Closed it They missed the go back to summary page button		No problems – Did file – exit to quit.	

Appendix 8

Data from the Debriefing

	4th graders	*5th&6th graders*
How was the experience?	They liked the program.	"very very cool" because they liked the questions – they made them think "very good exercises, very easy at first"
Did you enjoy the experience?	Good instructions The quizzes hard questions	Both students liked everything. "I like everything because they are fun exercises"
Did you like the program?	They like the program Know how to use	They liked most – Sri - the quizzes – because it does not give answer immediately – have to finish all and then see – so its curiosity, exciting. Ester - "the question they ask us to put it into groups" "Some questions I didn't get it" – math concepts
Was it easy or hard to find the things we asked you to find?	They thought it was easy	Easy – questions in the lesson
Can you remember for me what made it hard? How can we make it easier?	Questions	Easy navigation
Were there words or sentences you did not like or found difficult?	No	No
Specific difficulties	Go back to the Summary page from the Review Answers page They also tried to click on the pictures and drag and drop them	They said they did not expect the pictures to be drag and drop but later, on being walked through to they specific page, they said they think it would be good if they were. – "That was the only problem." They tried to click on the pictures. Said they got 'confused' about what they had to do with the blocks – drag it or what – (page does not specify

		what to do). Didn't get it so clicked check answer and then realized that they just had to do it mentally.
Suggestions to improve the program	Change the color of a button Improve the summary page Enough interaction Categorize questions by the Level of difficulty	They wouldn't change anything. Picture on page 4 – it would be good to be able to move it. Page 6 – enlarge picture so that it's easier to see the blocks. Blocks should move and keep it in answer. Be able to grab and move them.
Other comments	They would like to use the program in the math class They prefer the program to textbooks. Liked it for warm up for math and later to see what we learnt; e. g. . – if we learn about 'patterns' in school then teacher can tell us to go and practice on this program and check the answers. It would be nice to include more worked examples with the correct answers.	They would like to do this at school Did you learn anything? They learned some differences They liked the colors of the pictures and they thought it was not boring to read the instructions.
What did you like the most about the program?	Aaron – probably the quizzes. Ana did not answer. Just smiled.	
What did you not like about the program?	Aaron would like it more challenging. Ana would like to divide the difficulty by level. Ana – Some questions were harder than others. Did not find a logic and consistency in arrangement of hard/easy questions. Thought question difficulty should be progressive as per defined levels – either Easy-Medium-Difficult levels, or Easy-normal-hard levels (Aaron) or Grade level – Grade 4, 5 or Grades 3&4, 5&6 etc.	
Question about instructions	Ana – There are a lot of instructions. They are good. Then hesitated a bit and said – 'When they say 'for example' on the side	

	they should show an example already answered instead of writing it. Give more examples of a finished answer so they know this is how to answer it. Actually 'seeing' it rather than reading it.	
Did you read the feedback? Was it helpful?	They didn't seem to understand what 'feedback' is, so Natalya had them login again and showed it. They said 'No, uh-uh.' Ana said – it was kind a hard to notice. (Good point).	
Did you learn anything new?	Couldn't really answer. Said 'how to use the program, fractions etc'	
Suggestions for avoiding navigation error from review answer page	Ana – Change the 'back to summary' button to a different, brighter color so we can see it – like yellow or orange. Aaron – Change the language to 'Go to answer or Go to score page'. (So the language 'summary page' not very clear to the 4th graders.	Ester – At the end of the review page, it should say 'go back to summary page' (so more instructions needed)

Appendix 9

Data from the Database – Events

Class Code	idUser	Window.	Window	Event	TimeStamp	Seconds
CI504	38	1	Login	LOGIN	3/11/08 5:33 PM	0
CI504	38	2	Home	Window Open	3/11/08 5:33 PM	0
CI504	38	3	Introduction	Window Open	3/11/08 5:34 PM	54.459
CI504	38	4	Introduction	Window Open	3/11/08 5:37 PM	191.255
CI504	38	4	Introduction	Check Information	3/11/08 5:39 PM	120.994
CI504	38	5	Introduction	Window Open	3/11/08 5:40 PM	34.699
CI504	38	5	Introduction	Check Information	3/11/08 5:40 PM	52.696
CI504	38	6	Introduction	Window Open	3/11/08 5:41 PM	13.019
CI504	38	6	Introduction	Check Information	3/11/08 5:41 PM	49.03
CI504	38	7	Introduction	Window Open	3/11/08 5:42 PM	25.127
CI504	38	7	Introduction	Check Information	3/11/08 5:42 PM	33.287
CI504	38	8	Introduction	Window Open	3/11/08 5:43 PM	11.447
CI504	38	2	Home	Window Open	3/11/08 5:44 PM	75.609
CI504	38	9	Choose Lesson	Window Open	3/11/08 5:44 PM	9.573
CI504	38	10	Lesson 1	Window Open	3/11/08 5:44 PM	0
CI504	38	11	Lesson 1	Window Open	3/11/08 5:44 PM	18.246
CI504	38	12	Lesson 1	Window Open	3/11/08 5:45 PM	61.569
CI504	38	12	Lesson 1	Check Information	3/11/08 5:46 PM	13.449
CI504	38	13	Lesson 1	Window Open	3/11/08 5:46 PM	5.108
CI504	38	14	Lesson 1	Window Open	3/11/08 5:46	43.512
CI504	38	14	Lesson 1	Check Information	3/11/08 5:48 PM	78.062
CI504	38	15	Lesson 1	Window Open	3/11/08 5:48 PM	27.049
CI504	38	16	Lesson 1	Window Open	3/11/08 5:49 PM	34.971
CI504	38	16	Lesson 1	Check Information	3/11/08 5:49 PM	21.741
CI504	38	17	Lesson 1	Window Open	3/11/08 5:50 PM	23.874
CI504	38	18	Lesson 1	Window Open	3/11/08 5:51 PM	61.228
CI504	38	18	Lesson 1	Check Information	3/11/08 5:51 PM	15.583
CI504	38	19	Lesson 1	Window Open	3/11/08 5:51 PM	15.081
CI504	38	19	Lesson 1	Window Open	3/11/08 5:52 PM	34.28
CI504	38	20	Quiz 1 Instructions	Window Open	3/11/08 5:52 PM	0
CI504	38	21	Quiz 1 Question 1	Window Open	3/11/08 5:53 PM	67.437
CI504	38	21	Quiz 1 Question 1	Question	3/11/08 5:54 PM	67.917
CI504	38	22	Quiz 1 Question 2	Window Open	3/11/08 5:54 PM	1.212
CI504	38	22	Quiz 1 Question 2	Question	3/11/08 5:56 PM	154.122
CI504	38	23	Quiz 1 Question 3	Window Open	3/11/08 5:57 PM	1.932
CI504	38	23	Quiz 1 Question 3	Question	3/11/08 5:57 PM	17.065
CI504	38	24	Quiz 1 Question 4	Window Open	3/11/08 5:57 PM	1.372
CI504	38	24	Quiz 1 Question 4	Question	3/11/08 5:57 PM	15.522
CI504	38	25	Quiz 1 Question 5	Window Open	3/11/08 5:57 PM	0.962

CI504	38	25	Quiz 1 Question 5	Question	3/11/08 5:58 PM	39.446
CI504	38	24	Quiz 1 Question 4	Window Open	3/11/08 5:58 PM	10.465
CI504	38	25	Quiz 1 Question 5	Window Open	3/11/08 5:58 PM	22.042
CI504	38	26	Quiz 1 Question 6	Window Open	3/11/08 5:58	3.916
CI504	38	26	Quiz 1 Question 6	Question	3/11/08 6:00 PM	123.818
CI504	38	27	Quiz 1 Question 7	Window Open	3/11/08 6:00 PM	0.911
CI504	38	27	Quiz 1 Question 7	Question	3/11/08 6:02 PM	71.132
CI504	38	28	Quiz 1 Question 8	Window Open	3/11/08 6:02 PM	1.122
CI504	38	26	Quiz 1 Question 6	Window Open	3/11/08 6:02 PM	0.51
CI504	38	27	Quiz 1 Question 7	Window Open	3/11/08 6:02 PM	6.76
CI504	38	24	Quiz 1 Question 4	Window Open	3/11/08 6:02 PM	0.501
CI504	38	25	Quiz 1 Question 5	Window Open	3/11/08 6:02 PM	0.491
CI504	38	22	Quiz 1 Question 2	Window Open	3/11/08 6:02 PM	0.45
CI504	38	23	Quiz 1 Question 3	Window Open	3/11/08 6:02 PM	0.521
CI504	38	21	Quiz 1 Question 1	Window Open	3/11/08 6:02 PM	0.501
CI504	38	22	Quiz 1 Question 2	Window Open	3/11/08 6:02 PM	1.292
CI504	38	23	Quiz 1 Question 3	Window Open	3/11/08 6:02 PM	10.495
CI504	38	24	Quiz 1 Question 4	Window Open	3/11/08 6:02 PM	0.45
CI504	38	25	Quiz 1 Question 5	Window Open	3/11/08 6:02 PM	0.471
CI504	38	26	Quiz 1 Question 6	Window Open	3/11/08 6:02 PM	1.032
CI504	38	27	Quiz 1 Question 7	Window Open	3/11/08 6:02 PM	1.592
CI504	38	28	Quiz 1 Question 8	Window Open	3/11/08 6:02 PM	0.671
CI504	38	28	Quiz 1 Question 8	Question	3/11/08 6:02 PM	12.328
CI504	38	27	Quiz 1 Question 7	Window Open	3/11/08 6:02 PM	1.872
CI504	38	28	Quiz 1 Question 8	Window Open	3/11/08 6:02 PM	2.824
CI504	38	29	Quiz 1 Question 9	Window Open	3/11/08 6:02 PM	0.691
CI504	38	30	Quiz 1 Question 10	Window Open	3/11/08 6:04	71.233
CI504	38	29	Quiz 1 Question 9	Window Open	3/11/08 6:04 PM	3.525
CI504	38	29	Quiz 1 Question 9	Question	3/11/08 6:04 PM	21.641
CI504	38	30	Quiz 1 Question 10	Window Open	3/11/08 6:04 PM	2.343
CI504	38	30	Quiz 1 Question 10	Question	3/11/08 6:04 PM	19.849
CI504	38	31	Quiz 1 Sum page	Window Open	3/11/08 6:04 PM	1.412
CI504	38	9	Choose Lesson	Window Open	3/11/08 6:07 PM	36.542
CI504	38	10	Lesson 1	Window Open	3/11/08 6:07 PM	0
CI504	38	11	Lesson 1	Window Open	3/11/08 6:07 PM	2.734
CI504	38	12	Lesson 1	Window Open	3/11/08 6:07 PM	1.232
CI504	38	12	Lesson 1	Check Information	3/11/08 6:07 PM	2.414
CI504	38	13	Lesson 1	Window Open	3/11/08 6:07 PM	1.141
CI504	38	14	Lesson 1	Window Open	3/11/08 6:07 PM	1.492
CI504	38	14	Lesson 1	Check Information	3/11/08 6:07 PM	7.501
CI504	38	15	Lesson 1	Window Open	3/11/08 6:07 PM	0.982
CI504	38	16	Lesson 1	Window Open	3/11/08 6:07 PM	0.701
CI504	38	16	Lesson 1	Check Information	3/11/08 6:07 PM	1.562
CI504	38	17	Lesson 1	Window Open	3/11/08 6:07 PM	1.171

CI504	38	18	Lesson 1	Window Open	3/11/08 6:07 PM	0.551
CI504	38	19	Lesson 1	Window Open	3/11/08 6:07 PM	1.893
CI504	38	20	Quiz 1 Instructions	Window Open	3/11/08 6:07 PM	0.891
CI504	38	21	Quiz 1 Question 1	Window Open	3/11/08 6:07 PM	0.912
CI504	38	22	Quiz 1 Question 2	Window Open	3/11/08 6:07 PM	0.711
CI504	38	23	Quiz 1 Question 3	Window Open	3/11/08 6:07	0.721
CI504	38	24	Quiz 1 Question 4	Window Open	3/11/08 6:07 PM	0.611
CI504	38	25	Quiz 1 Question 5	Window Open	3/11/08 6:07 PM	0.56
CI504	38	26	Quiz 1 Question 6	Window Open	3/11/08 6:07 PM	0.531
CI504	38	27	Quiz 1 Question 7	Window Open	3/11/08 6:07 PM	0.521
CI504	38	28	Quiz 1 Question 8	Window Open	3/11/08 6:07 PM	0.551
CI504	38	29	Quiz 1 Question 9	Window Open	3/11/08 6:07 PM	0.44
CI504	38	30	Quiz 1 Question 10	Window Open	3/11/08 6:07 PM	0.381
CI504	38	31	Quiz 1 Sum page	Window Open	3/11/08 6:07 PM	0.32
CI504	38	31	Quiz 1 Sum page	Window Open	3/11/08 6:08 PM	49.231
CI504	38	31	Quiz 1 Sum page	Window Open	3/11/08 6:08 PM	16.003
CI504	38	9	Choose Lesson	Window Open	3/11/08 6:09 PM	15.993
CI504	38	50	Lesson 2	Window Open	3/11/08 6:09 PM	0
CI504	38	2	Home	Window Open	3/11/08 6:09 PM	6.94
CI504	39	1	Login	LOGIN	3/11/08 5:34 PM	0
CI504	39	2	Home	Window Open	3/11/08 5:34 PM	0
CI504	39	3	Introduction	Window Open	3/11/08 5:35 PM	67.406
CI504	39	4	Introduction	Window Open	3/11/08 5:35 PM	34.688
CI504	39	3	Introduction	Window Open	3/11/08 5:35 PM	5.265
CI504	39	4	Introduction	Window Open	3/11/08 5:35 PM	3.125
CI504	39	5	Introduction	Window Open	3/11/08 5:37 PM	80.438
CI504	39	4	Introduction	Window Open	3/11/08 5:37 PM	2.281
CI504	39	4	Introduction	Check Information	3/11/08 5:38 PM	75.844
CI504	39	5	Introduction	Window Open	3/11/08 5:38	10.843
CI504	39	5	Introduction	Check Information	3/11/08 5:40 PM	111.141
CI504	39	6	Introduction	Window Open	3/11/08 5:40 PM	5.797
CI504	39	6	Introduction	Check Information	3/11/08 5:41 PM	37.5
CI504	39	7	Introduction	Window Open	3/11/08 5:41 PM	12.094
CI504	39	7	Introduction	Check Information	3/11/08 5:42 PM	40.578
CI504	39	8	Introduction	Window Open	3/11/08 5:42 PM	9.234
CI504	39	9	Choose Lesson	Window Open	3/11/08 5:42 PM	21.875
CI504	39	2	Home	Window Open	3/11/08 5:42 PM	3.594
CI504	39	9	Choose Lesson	Window Open	3/11/08 5:44 PM	109.547
CI504	39	10	Lesson 1	Window Open	3/11/08 5:44 PM	0
CI504	39	11	Lesson 1	Window Open	3/11/08 5:44 PM	14.203
CI504	39	12	Lesson 1	Window Open	3/11/08 5:45 PM	49.39
CI504	39	12	Lesson 1	Check Information	3/11/08 5:46 PM	33.5
CI504	39	13	Lesson 1	Window Open	3/11/08 5:46 PM	3.063
CI504	39	14	Lesson 1	Window Open	3/11/08 5:46 PM	36.265

CI504	39	14	Lesson 1	Check Information	3/11/08 5:49 PM	145.25
CI504	39	15	Lesson 1	Window Open	3/11/08 5:49 PM	25.438
CI504	39	16	Lesson 1	Window Open	3/11/08 5:50 PM	61.312
CI504	39	16	Lesson 1	Check Information	3/11/08 5:51 PM	29.329
CI504	39	17	Lesson 1	Window Open	3/11/08 5:51 PM	8.968
CI504	39	18	Lesson 1	Window Open	3/11/08 5:52 PM	64.516
CI504	39	18	Lesson 1	Check Information	3/11/08 5:52 PM	19.016
CI504	39	19	Lesson 1	Window Open	3/11/08 5:52	3.312
CI504	39	19	Lesson 1	Window Open	3/11/08 5:53 PM	40.484
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 5:53 PM	0
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 5:54 PM	81.485
CI504	39	21	Quiz 1 Question 1	Question	3/11/08 5:55 PM	60.094
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 5:55 PM	1.828
CI504	39	22	Quiz 1 Question 2	Question	3/11/08 5:56 PM	65.906
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 5:56 PM	1.109
CI504	39	23	Quiz 1 Question 3	Question	3/11/08 5:57 PM	14.438
CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 5:57 PM	1.062
CI504	39	24	Quiz 1 Question 4	Question	3/11/08 5:57 PM	27.782
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 5:57 PM	0.843
CI504	39	25	Quiz 1 Question 5	Question	3/11/08 5:58 PM	38.719
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 5:58 PM	1.375
CI504	39	26	Quiz 1 Question 6	Question	3/11/08 5:59 PM	73.313
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 5:59 PM	1
CI504	39	27	Quiz 1 Question 7	Question	3/11/08 5:59 PM	19.14
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 5:59 PM	1.125
CI504	39	28	Quiz 1 Question 8	Question	3/11/08 6:00 PM	16.188
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:00 PM	1.047
CI504	39	29	Quiz 1 Question 9	Question	3/11/08 6:01 PM	78.437
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:01 PM	0.953
CI504	39	30	Quiz 1 Question 10	Question	3/11/08 6:01 PM	16.25
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:01	1.391
CI504	39	41	Quiz 1 Review Q10	Window Open	3/11/08 6:02 PM	20.156
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:03 PM	62.14
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:04 PM	33.219
CI504	39	10	Lesson 1	Window Open	3/11/08 6:04 PM	0
CI504	39	11	Lesson 1	Window Open	3/11/08 6:04 PM	1.422
CI504	39	12	Lesson 1	Window Open	3/11/08 6:04 PM	0.219
CI504	39	13	Lesson 1	Window Open	3/11/08 6:04 PM	0.203
CI504	39	14	Lesson 1	Window Open	3/11/08 6:04 PM	0.203
CI504	39	15	Lesson 1	Window Open	3/11/08 6:04 PM	2.578
CI504	39	16	Lesson 1	Window Open	3/11/08 6:04 PM	0.844
CI504	39	17	Lesson 1	Window Open	3/11/08 6:04 PM	3.625
CI504	39	18	Lesson 1	Window Open	3/11/08 6:04 PM	0.5
CI504	39	19	Lesson 1	Window Open	3/11/08 6:04 PM	0.406

CI504	39	19	Lesson 1	Window Open	3/11/08 6:04 PM	2.219
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:04 PM	0
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 6:04 PM	4.547
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 6:05 PM	40.672
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 6:05 PM	9.015
CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 6:05 PM	0.297
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 6:05 PM	0.86
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 6:05 PM	0.421
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 6:05 PM	0.344
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 6:05	0.328
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:05 PM	0.75
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:05 PM	0.547
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:05 PM	32.047
CI504	39	39	Quiz 1 Review Q8	Window Open	3/11/08 6:06 PM	14.406
CI504	39	40	Quiz 1 Review Q9	Window Open	3/11/08 6:06 PM	0.516
CI504	39	41	Quiz 1 Review Q10	Window Open	3/11/08 6:06 PM	0.422
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:06 PM	3.39
CI504	39	10	Lesson 1	Window Open	3/11/08 6:06 PM	0
CI504	39	11	Lesson 1	Window Open	3/11/08 6:06 PM	1.141
CI504	39	12	Lesson 1	Window Open	3/11/08 6:06 PM	0.219
CI504	39	13	Lesson 1	Window Open	3/11/08 6:06 PM	0.187
CI504	39	14	Lesson 1	Window Open	3/11/08 6:06 PM	0.188
CI504	39	15	Lesson 1	Window Open	3/11/08 6:06 PM	0.203
CI504	39	16	Lesson 1	Window Open	3/11/08 6:06 PM	0.453
CI504	39	17	Lesson 1	Window Open	3/11/08 6:06 PM	0.375
CI504	39	18	Lesson 1	Window Open	3/11/08 6:06 PM	0.562
CI504	39	19	Lesson 1	Window Open	3/11/08 6:06 PM	0.938
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:06 PM	2.609
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 6:06 PM	0.781
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 6:06 PM	0.188
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 6:06 PM	0.234
CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 6:06 PM	0.203
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 6:06	0.204
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 6:06 PM	0.234
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 6:06 PM	0.406
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 6:06 PM	0.281
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:06 PM	0.297
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:06 PM	0.625
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:06 PM	0.5
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:07 PM	41.875
CI504	39	10	Lesson 1	Window Open	3/11/08 6:07 PM	0
CI504	39	11	Lesson 1	Window Open	3/11/08 6:07 PM	1.172
CI504	39	12	Lesson 1	Window Open	3/11/08 6:07 PM	0.203
CI504	39	13	Lesson 1	Window Open	3/11/08 6:07 PM	0.187

CI504	39	14	Lesson 1	Window Open	3/11/08 6:07 PM	0.157
CI504	39	15	Lesson 1	Window Open	3/11/08 6:07 PM	0.172
CI504	39	16	Lesson 1	Window Open	3/11/08 6:07 PM	0.203
CI504	39	17	Lesson 1	Window Open	3/11/08 6:07 PM	0.343
CI504	39	18	Lesson 1	Window Open	3/11/08 6:07 PM	0.516
CI504	39	19	Lesson 1	Window Open	3/11/08 6:07 PM	0.672
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:07 PM	0.562
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 6:07 PM	0.954
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 6:07 PM	0.203
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 6:07 PM	0.172
CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 6:07 PM	0.171
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 6:07	0.188
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 6:07 PM	0.187
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 6:07 PM	0.204
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 6:07 PM	0.203
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:07 PM	0.203
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:07 PM	0.5
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:07 PM	19.734
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:08 PM	15.063
CI504	39	50	Lesson 2	Window Open	3/11/08 6:08 PM	0
CI504	39	51	Lesson 2	Window Open	3/11/08 6:08 PM	18.484
CI504	39	52	Lesson 2	Window Open	3/11/08 6:09 PM	66.156
CI504	39	53	Lesson 2	Window Open	3/11/08 6:09 PM	9.797
CI504	39	54	Lesson 2	Window Open	3/11/08 6:09 PM	0.219
CI504	39	55	Lesson 2	Window Open	3/11/08 6:09 PM	0.203
CI504	39	56	Lesson 2	Window Open	3/11/08 6:09 PM	0.484
CI504	39	57	Lesson 2	Window Open	3/11/08 6:09 PM	0.219
CI504	39	58	Lesson 2	Window Open	3/11/08 6:09 PM	0.594
CI504	39	59	Lesson 2	Window Open	3/11/08 6:09 PM	0.75
CI504	39	60	Quiz 2 Instructions	Window Open	3/11/08 6:09 PM	1.281
CI504	39	61	Quiz 2 Question 1	Window Open	3/11/08 6:09 PM	0.219
CI504	39	62	Quiz 2 Question 2	Window Open	3/11/08 6:09 PM	0.187
CI504	39	63	Quiz 2 Question 3	Window Open	3/11/08 6:09 PM	0.203
CI504	39	64	Quiz 2 Question 4	Window Open	3/11/08 6:09 PM	0.219
CI504	39	65	Quiz 2 Question 5	Window Open	3/11/08 6:09	0.235
CI504	39	66	Quiz 2 Question 6	Window Open	3/11/08 6:09 PM	0.218
CI504	39	67	Quiz 2 Question 7	Window Open	3/11/08 6:09 PM	0.297
CI504	39	68	Quiz 2 Question 8	Window Open	3/11/08 6:09 PM	0.297
CI504	39	69	Quiz 2 Question 9	Window Open	3/11/08 6:09 PM	0.406
CI504	39	70	Quiz 2 Question 10	Window Open	3/11/08 6:09 PM	0.422
CI504	39	71	Quiz 2 Sum page	Window Open	3/11/08 6:09 PM	0.313
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:09 PM	2.015
CI504	39	50	Lesson 2	Window Open	3/11/08 6:10 PM	0
CI504	39	2	Home	Window Open	3/11/08 6:10 PM	4.938

CI504	39	1	Login	LOGIN	3/11/08 6:28 PM	0
CI504	39	2	Home	Window Open	3/11/08 6:28 PM	0.016
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:28 PM	6.781
CI504	39	10	Lesson 1	Window Open	3/11/08 6:28 PM	0
CI504	39	11	Lesson 1	Window Open	3/11/08 6:28 PM	1.922
CI504	39	12	Lesson 1	Window Open	3/11/08 6:28 PM	0.156
CI504	39	13	Lesson 1	Window Open	3/11/08 6:28 PM	0.188
CI504	39	14	Lesson 1	Window Open	3/11/08 6:28 PM	0.172
CI504	39	15	Lesson 1	Window Open	3/11/08 6:28 PM	0.312
CI504	39	16	Lesson 1	Window Open	3/11/08 6:28 PM	0.719
CI504	39	17	Lesson 1	Window Open	3/11/08 6:28 PM	0.203
CI504	39	18	Lesson 1	Window Open	3/11/08 6:28 PM	0.375
CI504	39	19	Lesson 1	Window Open	3/11/08 6:28 PM	0.172
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:28	1.062
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 6:28 PM	0.922
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 6:28 PM	1.078
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 6:28 PM	3.141
CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 6:28 PM	0.172
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 6:28 PM	0.156
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 6:28 PM	0.188
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 6:28 PM	0.578
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 6:28 PM	0.187
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:28 PM	0.313
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:28 PM	0.562
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:28 PM	0.61
CI504	39	38	Quiz 1 Review Q7	Window Open	3/11/08 6:29 PM	34
CI504	39	39	Quiz 1 Review Q8	Window Open	3/11/08 6:29 PM	1.64
CI504	39	40	Quiz 1 Review Q9	Window Open	3/11/08 6:29 PM	0.953
CI504	39	41	Quiz 1 Review Q10	Window Open	3/11/08 6:29 PM	0.657
CI504	39	9	Choose Lesson	Window Open	3/11/08 6:31 PM	113.156
CI504	39	10	Lesson 1	Window Open	3/11/08 6:31 PM	0
CI504	39	11	Lesson 1	Window Open	3/11/08 6:31 PM	1.328
CI504	39	12	Lesson 1	Window Open	3/11/08 6:31 PM	0.157
CI504	39	13	Lesson 1	Window Open	3/11/08 6:31 PM	0.328
CI504	39	14	Lesson 1	Window Open	3/11/08 6:31 PM	0.469
CI504	39	15	Lesson 1	Window Open	3/11/08 6:31 PM	0.14
CI504	39	16	Lesson 1	Window Open	3/11/08 6:31	0.563
CI504	39	17	Lesson 1	Window Open	3/11/08 6:31 PM	0.453
CI504	39	18	Lesson 1	Window Open	3/11/08 6:31 PM	0.453
CI504	39	19	Lesson 1	Window Open	3/11/08 6:31 PM	0.281
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:31 PM	0.172
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 6:31 PM	0.594
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 6:31 PM	0.219
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 6:31 PM	0.171

CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 6:31 PM	0.25
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 6:31 PM	0.438
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 6:31 PM	0.469
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 6:31 PM	0.406
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 6:31 PM	0.406
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:31 PM	0.188
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:31 PM	0.781
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:31 PM	0.734
CI504	39	34	Quiz 1 Review Q3	Window Open	3/11/08 6:35 PM	0.39
CI504	39	35	Quiz 1 Review Q4	Window Open	3/11/08 6:35 PM	0.485
CI504	39	36	Quiz 1 Review Q5	Window Open	3/11/08 6:35 PM	221.578
CI504	39	31	Quiz 1 Sum page	Window Open	3/11/08 6:35 PM	0.312
CI504	39	32	Quiz 1 Review Q1	Window Open	3/11/08 6:35 PM	0.344
CI504	39	33	Quiz 1 Review Q2	Window Open	3/11/08 6:35 PM	0.344
CI504	39	29	Quiz 1 Question 9	Window Open	3/11/08 6:35 PM	0.438
CI504	39	30	Quiz 1 Question 10	Window Open	3/11/08 6:35	0.594
CI504	39	26	Quiz 1 Question 6	Window Open	3/11/08 6:35 PM	0.187
CI504	39	27	Quiz 1 Question 7	Window Open	3/11/08 6:35 PM	0.297
CI504	39	28	Quiz 1 Question 8	Window Open	3/11/08 6:35 PM	0.484
CI504	39	24	Quiz 1 Question 4	Window Open	3/11/08 6:35 PM	0.359
CI504	39	25	Quiz 1 Question 5	Window Open	3/11/08 6:35 PM	0.282
CI504	39	21	Quiz 1 Question 1	Window Open	3/11/08 6:35 PM	0.359
CI504	39	22	Quiz 1 Question 2	Window Open	3/11/08 6:35 PM	0.344
CI504	39	23	Quiz 1 Question 3	Window Open	3/11/08 6:35 PM	0.422
CI504	39	19	Lesson 1	Window Open	3/11/08 6:35 PM	0.172
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:35 PM	0.344
CI504	39	20	Quiz 1 Instructions	Window Open	3/11/08 6:35 PM	1.609
CI504	39	18	Lesson 1	Window Open	3/11/08 6:35 PM	0.375
CI504	39	19	Lesson 1	Window Open	3/11/08 6:35 PM	2.781
CI504	39	16	Lesson 1	Window Open	3/11/08 6:35 PM	0.375
CI504	39	17	Lesson 1	Window Open	3/11/08 6:35 PM	0.469
CI504	39	17	Lesson 1	Window Open	3/11/08 6:35 PM	1.453
CI504	40	1	Login	LOGIN	3/11/08 6:33 PM	0
CI504	40	2	Home	Window Open	3/11/08 6:33 PM	0
CI504	40	3	Introduction	Window Open	3/11/08 6:33 PM	4.837
CI504	40	4	Introduction	Window Open	3/11/08 6:33 PM	4.446
CI504	40	5	Introduction	Window Open	3/11/08 6:33 PM	0.992
CI504	40	4	Introduction	Window Open	3/11/08 6:33 PM	1.922
CI504	40	4	Introduction	Check Information	3/11/08 6:33	1.242
CI504	40	5	Introduction	Window Open	3/11/08 6:35 PM	140.692
CI504	40	6	Introduction	Window Open	3/11/08 6:35 PM	2.364
CI504	40	5	Introduction	Window Open	3/11/08 6:35 PM	5.788
CI504	40	4	Introduction	Window Open	3/11/08 6:35 PM	0.501
CI504	40	5	Introduction	Window Open	3/11/08 6:36 PM	28.24

CI504	40	6	Introduction	Window Open	3/11/08 6:36 PM	13.53
CI504	40	7	Introduction	Window Open	3/11/08 6:37 PM	33.067
CI504	40	8	Introduction	Window Open	3/11/08 6:37 PM	5.168
CI504	40	9	Choose Lesson	Window Open	3/11/08 6:37 PM	7
CI504	40	9	Choose Lesson	Window Open	3/11/08 6:37 PM	7.471
CI504	40	10	Lesson 1	Window Open	3/11/08 6:37 PM	0
CI504	40	11	Lesson 1	Window Open	3/11/08 6:37 PM	37.103
CI504	40	10	Lesson 1	Window Open	3/11/08 6:38 PM	2.534
CI504	40	11	Lesson 1	Window Open	3/11/08 6:38 PM	4.696
CI504	40	10	Lesson 1	Window Open	3/11/08 6:38 PM	2.945
CI504	40	9	Choose Lesson	Window Open	3/11/08 6:38 PM	5.147

Appendix 10

Data from the Database – Quiz 1

ClassCode	Lesson	idUser	txtFirstName	Q	A	B	C	Correct	Pts	Total
CI504	1	38	SRI	1	ACD	BEF		Y	10	50
CI504	1	38	SRI	2	4/3			N	0	50
CI504	1	38	SRI	3	1/10			Y	10	50
CI504	1	38	SRI	4	6/4			N	0	50
CI504	1	38	SRI	5	AB	CE	DF	Y	10	50
CI504	1	38	SRI	6	BCE			N	0	50
CI504	1	38	SRI	7	11/15			N	0	50
CI504	1	38	SRI	8	1/6			Y	10	50
CI504	1	38	SRI	9	AD	BF	CE	Y	10	50
CI504	1	38	SRI	10	3/10 3/10			N	0	50
CI504	1	39	AARON	1	EBF	ADC		Y	10	70
CI504	1	39	AARON	2	3/3			Y	10	70
CI504	1	39	AARON	3	1/10			Y	10	70
CI504	1	39	AARON	4	4/6			Y	10	70
CI504	1	39	AARON	5	AB	CE	DF	Y	10	70
CI504	1	39	AARON	6	BCE			N	0	70
CI504	1	39	AARON	7	11/13			N	0	70
CI504	1	39	AARON	8	1/6			Y	10	70
CI504	1	39	AARON	9	AD	BE	CF	N	0	70
CI504	1	39	AARON	10	3/10			Y	10	70
CI504	11	38	SRI	1	D,E			N	0	0