The Effect of Computer-Adaptive Control (Remediation) on Achievement and Time on Task in Foreign Language Learning

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THE EFFECT OF COMPUTER-ADAPTIVE CONTROL (REMEDIATION)
ON ACHIEVEMENT AND TIME ON TASK
IN FOREIGN LANGUAGE LEARNING

by

Leslie R. Bachelder

A thesis submitted to the faculty of
Brigham Young University
In partial fulfillment of the requirements for the degree of

Master of Arts

Center for Language Studies
Brigham Young University
August 2007
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ABSTRACT

THE EFFECT OF COMPUTER-ADAPTIVE CONTROL (REMEDIATION) ON ACHIEVEMENT AND TIME ON TASK IN FOREIGN LANGUAGE LEARNING

Leslie R. Bachelder
Center for Language Studies
Master of Arts

Technology has provided the means for the creation of many tools to facilitate the teaching and learning of foreign languages. These tools include computer programs designed to aid language learning by providing various levels of control to the language learner. This control allows the learner to make decisions regarding some or all of the elements of a program such as the pace, sequence, and content to name but a few. Because the amount of learner control can be varied, many research efforts have sought to determine the optimal level of control for learning. These efforts have produced mixed results, with some research suggesting that learners perform better with less control while other findings suggest the opposite.

The purpose of this research was to investigate the use of remediation, a computer-adaptive control, in Swahili 101 university level courses and its
effect on achievement and time. Participants included Swahili language learners from two universities, three colleges, and one student not affiliated with any school. The study required that participants complete a pretest, a background survey, the Swahili 101 online lesson materials, and an opinion survey. “Gate pages,” or webpage-based assessments, were used throughout the online course to assess participant progress. The participants were randomly assigned to control and experimental groups. Those in the control group completed the online component at their own discretion, working through assigned tasks with review as desired. Those in the experimental group were required to obtain a minimum score on each lesson’s gate page in order to advance in the lesson and thus in the course. If that score was not met, then the software assigned a series of remediation or review pages. Scores from the gate pages and time spent on the gate pages were stored and analyzed for both groups.

The results from this study suggest that language learners benefit from computer intervention and guidance (remediation). The participants in the experimental group learned more Swahili than the control group, despite spending the same amount of time on the gate pages as the control group. Therefore, remediation, as defined and implemented in this study, can increase language learning while at the same time not requiring the learners to significantly increase the initial time they spend responding to questions presented on the gate pages.
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Chapter 1: Introduction

Background

The quest to determine how learners best learn language has long been important for language educators and researchers seeking the most effective teaching techniques. One specific area of concern in recent years has been the role that technology can play in this process. It is a common belief that technology aids in the language learning process given that it can help guide language learners, provide a way of monitoring their learning, and provide them with the opportunity to maximize their learning efforts. Some researchers, however, seem to subscribe to the notion that learners do not need computer intervention in order to learn more effectively believing that learners know how to learn on their own and should be allowed to self-monitor. This difference of opinion in the use of technology in language learning is a major part of the discussion as to the amount of control that computers should or should not have in technology-based language learning. Furthermore, although evidence has existed for years that technology can improve language learning outcomes (Bunderson & Abboud, 1971; Fry, 1972; Allen, 1972; Ross & Rakow, 1981; Crotty, 1984; Gay, 1986; Verano, 1987; Chun & Plass, 1996; Eom & Reiser, 2000; Chou & Liu, 2005) questions remain as to how it should best be implemented in the language learning environment.

Although numerous researchers have searched for evidence and direction about the amount of control that computers should play in language learning, no clear and definite strategies for implementing control have emerged. This is most likely because there are so many factors that have the potential for impact on implementation: prior knowledge, student ability, time on task, task at hand, and time in program to name but a
few. All of these factors make it very difficult to determine how best to teach the language learner. Nevertheless, researchers are still trying to understand when and how learners most optimally learn and how and if technology can contribute.

One approach to computer-assisted learning is to give the computer control over the elements of instruction. This type of control is termed program control. Because program control limits the amount of control that the students have on their learning experience, some researchers have interpreted this lack of freedom as a significant drawback to the program-controlled approach. Those that disagree with the proposition that program control is useful feel that learners should control how and what they learn. This type of control is referred to as learner control.

Learner control is not universally accepted, mainly because it offers a great deal of freedom to the learner but, some would argue, not enough guidance. Detractors feel that guidance is crucial for learners and learning outcomes would be significantly enhanced when intervention is allowed. Because neither type of control has proven to be better in all situations, more investigation is needed.

**Definitions**

The following definitions were developed from a review of the current literature. Any definition or part of the definition that was specific to certain researchers is noted.

*Program Control*

Program control is one element of a particular computer-based learning environment in which the amount and sequence of instruction is fixed with the assistance of a computer (Freitag & Sullivan, 1995). In essence, the program follows a pre-determined path.
**Learner Control**

Learner control is one element of a computer-based learning environment in which the learner has control over one or several parts of the program or even total control (Santiago & Okey, 1992; Hannafin & Sullivan, 1995). The possible areas that the learner can control are: pace, sequence, content, style of instruction, display, internal processing, number of examples, review, feedback, advisement strategy, and practice (Friend & Cole, 1990; Burwell, 1991; Milheim & Martin, 1991; Chung & Reigeluth, 1992, Kinzie et al., 1992; Hannafin & Sullivan, 1995).

**Program-Controlled and Learner-Controlled Options**

*Full.* The full option uses a program-controlled computer-based learning environment that provides the learner with the full version of the program.

*Lean.* The lean option uses a program-controlled computer-based learning environment that provides the learner with a basic version of the program.

*Full-minus.* The full-minus option uses a learner-controlled computer-based learning environment that provides the learner with the full version of the program with the choice to bypass additional instruction.

*Lean-plus.* The lean-plus option uses a learner-controlled computer-based learning environment that provides the learner with a basic version of the program with the choice to add additional instruction.

*Advisement.* The advisement option uses a computer-based learning environment which incorporates both learner control and program control. The option provides suggestions to the learners to help them accurately assess how well they are learning the
materials and what they could do to improve their comprehension and performance (Milheim & Martin, 1991).

*Adaptive.* The adaptive option uses either a program-controlled or a learner-controlled computer-based learning environment. This option adjusts the content, sequence, feedback, and/or review during instruction specific to the needs of each individual learner (Milheim & Martin, 1991).

*Remediation*

Remediation is a type of computer-adaptive control that assesses each learner at various points during the learning process and then assigns additional work to help the learner achieve competency. The program handles assessment through the use of a “gate page,” which is a Web page that contains an interactive activity. For this research learners receive a score on the activity, which is then used to determine whether review is necessary for the experimental group. If a score of 70% or higher is achieved, then there is no intervention. If a score below 70% is achieved then the learner is sent through a series of review pages. These pages are all previously encountered pages which focus on the key elements needed to understand and perform at the required level on the gate pages.

*Introduction to the Problem*

Computer-based instruction (CBI) is practiced fairly widely today in various foreign language learning settings. Schools are using computers in language teaching, businesses are marketing language courses, and the government is offering grants to produce language material. The inherent difficulty in developing educational software is that learners learn differently and it is impossible for one software package to
accommodate all of the disparate needs of all language learners; therefore, more research needs to be done in order to determine which available computer features facilitate the language learning process for the majority of language learners. Once these computer features are identified then more computer software packages can be created which will target these features and therefore better aid the majority of the language learning population in language acquisition.

**Purpose and Significance of the Study**

The purpose of this research was to investigate the use of computer-adaptive control specifically remediation, in foreign language learning and to determine whether there was any potential benefit in using this feature over allowing the learners to direct their own learning. To do this, two groups (remediation and non-remediation) were established using students of beginning Swahili at two universities and three colleges in the United States as well as one student not associated with any particular school.

The results from this study provide information regarding the effect of remediation in language learning. Specifically, results indicate how learners progress in their achievement when guided by the computer and when self-directed. The results also provide insight regarding how learners spend time on the gate pages when a specific level of achievement is required to move forward in the course as well as the effect that time on task has on language learning.
Research Questions

1. What is the effect of remediation upon language learning as measured by assessments of listening, reading, and writing skills?

2. What is the effect of remediation upon language learning as measured by time spent on assessment pages?

Null Hypothesis

There will be no difference in the language learning and time spent on the assessment pages between the remediation group and the non-remediation group.

Overview of Procedures

Several college Swahili instructors at various universities agreed to use a fully developed online computer Swahili course in addition to regular class materials and activities. Student participants in this study were asked to complete a background survey and pretest prior to studying the Swahili lessons. During the semester they learned the supplemental online course materials in addition to their in-class instruction. At the end of the course, participants were asked to complete an opinion survey and posttest.

The pretest established that the participants were indeed novice learners with minimal to no prior Swahili exposure, while the posttest assessed how well the participants had learned the materials presented in the course. The two surveys provided information about the participants, their language background, and their learning experience. The background survey also provided clarification about whether a participant was a novice learner when there was no pretest available.

Following the background survey and the pretest the participants were randomly selected into two groups: remediation and non-remediation. The non-remediation group
acted as the control group and the remediation group as the experimental group. The online learning experiences for both groups involved the use of the same language learning materials. The control group, however, had no intervention during computer course participation but could review course materials if desired. The experimental group, alternatively, had intervention in the form of remediation. The participants in the remediation group were assessed in each lesson and were then, if needed, guided through additional practice, known for the purposes of this research as remediation.

Following the data collection, multiple analyses were conducted in order to better understand the effect of remediation upon language learning. These analyses included a regression analysis, Pearson correlation analyses, an analysis of variance, a repeated measures analysis of variance, and $t$ tests.

Assumption and Limitations

This study involved multiple universities and colleges which provided a higher participant sample and a greater ability to generalize the findings. Because the participants were from various language programs, they received in-class instruction that was no doubt different from one program to the other. They all used the same supplemental online course materials, however, and were randomly assigned to a group which mitigated the teacher becoming a variable in the study. Therefore, grouping all of the learners together and concluding that those results would be accurate as to the effect of remediation upon language learning seemed appropriate.

Finding and recruiting beginning Swahili learners was difficult and proved to be a limitation since Swahili is a language that is less commonly taught than other more popular languages. This required an increase in the number of college and universities
participating in the study, given that the sample size at Brigham Young University was fairly small and would severely limit the possibilities for an effective experimental design.

The small number of participants who completed the end of course examination was a significant limitation in this study since it prevented the use of the end of course assessment as part of the analysis. Despite the efforts to encourage completion of the end of course examination, such as requesting that completion be a part of the final grade, modifying the test itself to make it shorter, and allowing the students to complete it in multiple sessions, very few participants did.

Technology was also a limiting factor in this research. One of the problems encountered was that the pretest answers were not always recorded. The reasons for this challenge were related to technical problems with the server from which the materials were delivered or technical problems at a participating school.

Finally, the attrition rate was a limitation in this study. As is often the case with online coursework, there were many who started the study but fewer who finished. Measures were taken to increase participation, but even with these efforts the attrition rate was much higher than was desired. Most of the attrition occurred where participants fell out between the first and second lessons with the majority, however being from the University of Washington. This means that although the sample size was smaller than desired, the majority of the lessons did have a sample of sufficient size where meaningful analysis could be made.
Chapter 2: Review of Literature

Introduction

Language learning is more than just reading and writing. Indeed, language learners often want to be able to communicate verbally and interact understandably. To address whatever set of objectives language learners might have, interactive computer programs have been developed to help facilitate a balanced four-skill approach to language learning. These computer programs teach listening, speaking, and pronunciation in addition to reading and writing. As these computer programs have developed, two major types of learning environments have emerged: program control (PC) and learner control (LC).

The program-controlled environment uses the computer to control and/or guide the learner whereas the learner-controlled program allows the learners to guide themselves. Comparisons of these two approaches have yielded mixed results, with some learners seeming to perform better when the computer guides the learning process while others seem to perform better when left to guide themselves.

As technology has progressed, several attempts to address the mixed results produced by these two language learning environments have emerged in an effort to fine tune learner control and program control. Also, because language teachers have seen mixed results in these two language learning environments, additional options have emerged. These options are full, lean, full-minus, lean-plus, advisement, and adaptive, with the software for each option assisting the learner and providing instruction to a greater or lesser degree.
In an effort to explore the role of adaptive computer-assisted learning, a specific computer-adaptive control, termed remediation, was researched in this study. The primary goal was to investigate how college level language learners progressed in their achievement when aided by remediation. Another goal was to explore the effect of time on task when learners knew that they had to meet an achievement requirement for advancement in the lessons. Finally, how time on task affected achievement over time was also evaluated.

Because a literature review revealed no prior research on computer-adaptive control that specifically involved remediation, it may be useful to review the findings associated with achievement and time spent in the more basic computer learning options of learner-controlled and program-controlled computer programs, also called environments. The review will begin with an overview of student achievement in learner control and program control including full and lean options. Next, past work evaluating time spent in learner and program control as well as in the full and lean options will be discussed.

**Achievement**

Studies have shown the benefits of both learner and program control with respect to achievement. Certain researchers have found that students learn more when they are given more control (Carrier & Williams, 1984; Hannafin & Sullivan, 1995). Others have found that students perform better when learning experiences are computer directed (Fry, 1972; Ross & Rakow, 1981; Gay, 1986; Eom & Reiser, 2000). This section will outline the research done on achievement in learner-controlled and program-controlled environments as well as the full and lean options.
In one major study Carrier and Williams (1988) investigated 114 sixth graders and their achievement using a computer-based tutorial. Upon completion of the tutorial, the students took two posttests, which were identical and had 16 items. The researchers administered the first posttest directly following the instruction, and the second came two weeks later. The results showed that the means for the learner-controlled students were 7.5 for immediate and 6.6 for retention posttest scores. The program-controlled means were 5.5 for immediate and 5.2 for retention posttest scores ($p < 0.05$). The program-controlled means were lower than the learner-controlled means which suggests that the learners were able to determine the amount of instruction that they needed since they performed better on the posttests.

Other researchers also found positive achievement effects when the learners monitored their learning. Hannafin and Sullivan (1995) found that in their learner-controlled group, the total mean for achievement, which came from a 30-item test, was 14.97 and for the program-controlled group it was 13.69 ($p < 0.05$ value). The limitation in this study was that the program-controlled groups experienced the fewest computer screens with no option to add more, therefore those participants who did not score as well may have been able to do so if they had had access to more instruction.

In contrast to the above studies, other researchers have found that students perform better when they are not in control of their learning. One example is a study by Ross and Rakow (1981), who investigated undergraduate math students. Their 124 undergraduate participants completed self-paced math rule learning lessons. In the rule-oriented posttest, which contained 30 possible points and occurred immediately after the rule was learned, the means were $PC = 9.48$ and $LC = 8.43$ ($p < 0.05$). In the immediate
posttest, which had 20 points possible and occurred after all the lessons were learned, the means were PC = 17.14 and LC = 14.69 ($p < 0.05$). Finally, for the posttest that was administered three weeks later and was out of 20 points, the means were PC = 14.81 and LC = 10.71 ($p < 0.05$). The means show that the PC group did better on all three of the tests. This study provides important support for the value of program control, given that program control produced higher results on all three of the posttests means.

Fry (1972) also found that his students achieved better results when they were in a program-controlled environment. In his study 192 Michigan State University students viewed video-taped segments of instruction that answered questions about computers. The students in the LC group were allowed to learn the questions in the order they wanted and were allowed to ask questions afterwards. Those in the program-controlled group with expert control viewed segments in a predetermined order and were not allowed to ask questions. The other program-controlled group saw the same segments but in a random order and were also not allowed to ask questions.

The results of the posttest, showed that the program-controlled expert group had a mean of 17.54 which was higher than the random group’s mean of 16.54 ($p < 0.05$). Both of these program-controlled groups’ means were higher than the LC group’s mean of 16.06 ($p < 0.05$). The retention test means followed in the same pattern: PC (expert) = 10.72, PC (random) = 8.33, and LC = 8.00 ($p < 0.05$). The means for both of these tests were a gain score which took the posttest or retention test score (50 multiple-choice questions) and subtracted the pretest score which was also a 50 multiple-choice test.

Similarly to the study by Ross and Rakow (1981), this research demonstrated that the
students who experienced the program-controlled versions outperformed those in the learner-controlled version.

Gay (1986) came to similar conclusions in a study of program control and learner control involving 156 Cornell University volunteer participants who learned about DNA. The posttest scores, which had a total of 20 points, showed that regardless of prior understanding (high prior understanding or low prior understanding), the program-controlled group achieved higher results. The means for students with a high prior understanding of the subject matter were LC = 17.85 and PC = 18.00 ($p < 0.001$). For low prior understanding the means were LC = 14.35 and PC = 17.25 ($p < 0.001$) (Gay, 1986). Although the results for the low prior understanding program-controlled group were comparable to the results for the high prior understanding in the program-controlled and learner-controlled groups, the results were more dramatic for the less knowledgeable students.

Another example of program-controlled groups achieving higher results is found in the Eom and Reiser (2000) study. The participants in their study were 37 sixth and seventh graders who were assigned to two groups (learner-controlled computer-based instruction and program-controlled computer-based instruction). The program-controlled group saw four advertising techniques presented in a fixed order. The learner-controlled group saw one to four advertising techniques depending on which ones they selected. They were also able to choose the order in which the techniques were viewed, which instructional events (definitions, examples, practice items, etc.) were presented and the order in which they were presented. The study concluded that the program-controlled
group scored significantly higher on the posttest, which had 15 items, than the learner-controlled group (M = 9.83 for PC and M = 7.11 for LC) (p < 0.05).

Although the above six studies provide a variety of results, the three studies that used college students as their participants had similar findings about achievement. These findings suggest that the program-controlled environment does have value beyond what is possible with learner control.

There is also some evidence that shows that neither program control nor learner control is superior in producing higher achievement. Ross, Morrison, and O’Dell (1989) found that there was no statistically significant difference between the learner-controlled and program-controlled groups in their study. Their 227 undergraduate participants were assigned to the contexts of Education, Sports, Business or no context. With respect to program and learner control, they were assigned to two support treatments that offered a maximum and a minimum of program control, or a group with a learner-controlled option. When broken down into the four contexts there was no significant difference in achievement found among the three treatments.

Kinzie, Sullivan, and Berdel (1992) also concluded that there was no significant difference in achievement between their program-controlled and learner-controlled groups of ninth-grade science students. The 164 participants were divided into two groups (learner-controlled and program-controlled) that worked through two units from Energy Choices and Challenges, part of The Energy Source Program that is nationally distributed for energy education. While both groups had the same basic information with practice, the learner-controlled group was allowed to opt out of additional practice. The program-controlled group had to do a certain amount of practice and could not bypass it.
The results concluded that there was no difference in the mode of instruction (program-controlled and learner-controlled). When separated by gender, however, males did better in program control and females did better in learner control, although the difference was not significant. Kinzie et al. (1992) reasoned that the two modes did not offer a significant difference in achievement score (even though some of the students viewed fewer screens) because the content was standard in both modes.

Schnackenberg and Sullivan (2000) provided more evidence that there is no difference between learner-controlled and program-controlled learning. They conducted a study that investigated mode (learner-controlled and program-controlled), option (full and lean), and ability (higher and lower). Their participants were randomly assigned to treatments in the higher-ability and lower-ability groups. The participants used a computer delivered instructional program and learned thirteen different objectives from, *Teaching for Competence*, a textbook by Sullivan and Higgins. The instructional material included information, examples, review, and summaries. The two options (full and lean) offered the major difference between the two groups since they varied in the amount of practice offered or allowed.

An analysis of variance (ANOVA) of their results suggested that there was no difference between the two modes (learner-controlled and program-controlled) and the authors attributed the lack of difference to the amount of practice both modes received (Schnackenberg & Sullivan, 2000). The results suggested nevertheless that those in the full versions achieved higher results on the posttest than those in the lean groups, indicating that different program options may play a role in achievement.
These three latter studies indicate that program control and learner control may produce similar achievement results and suggest that the control type may not matter with respect to computer-aided learning. Because two of the three studies used college students as their participant, these findings contradict the earlier cited studies that suggest program control produces better results. One reason for this discrepancy may be that the presentation of the content and the amount of practice offered in both the learner-controlled and program-controlled groups was very similar in the three latter studies, and was a limitation recognized by the researchers (Kinzie et al., 1992; Schnackenberg & Sullivan, 2000).

Further evidence that more instruction may produce better achievement results is found in an earlier study by Hannafin and Sullivan (1995). They studied the effects of lean and full modes in both learner-controlled and program-controlled environments on achievement, option use, and time in program. The 274 ninth and tenth graders involved in the study were instructed in geometry and had no prior knowledge of the subject area. The students in the learner-controlled full option were not required to select additional frames; they only had to press “continue” to encounter the other 105 screens (30 examples as well as 71 for practice, and 4 for review). The learner-controlled lean option, however, required that the student select each of the 105 optional frames. The students in the program-controlled lean option saw 90 of the 195 possible screens, and those in the program-controlled full group saw all of the 195 screens.

The results demonstrated that those in the full options (both learner-controlled and program-controlled) performed higher, although not significantly, on the 30-item posttest than those in the lean options. The achievement means for the two groups were lean
(across ability) $M = 13.84$ and full (across ability) $M = 14.82$ ($p = .08$). Thus these participants as well as the Schnackenberg and Sullivan (2000) participants achieved higher posttest scores in the full option. These two studies suggest that the full option may increase achievement with respect to computer-assisted learning.

In contrast, a third study investigated the effects of achievement, option use, attitudes, and interaction of college students in a learner-controlled environment and found that the full option did not increase achievement. Crooks, Klein, Savenye, and Leaders (1998) had their participants work alone or with a partner in either a full-minus (option to bypass practice) or a lean-plus (option to add practice) mode. The learners were then given a posttest which measured how well they had learned the content (how to prepare competency-based instruction).

An ANOVA compared instructional method and mode with score, option use, time, and attitude and showed that there was no difference in achievement between the two groups. The cooperative-learning and individual-learning condition scores were 25.03 and 24.62 respectively out of a possible 35 with mean scores for the full-minus and lean-plus conditions of 24.75 and 24.90 respectively. A possible reason suggested by the researchers for this similarity between groups, echoed reasons given earlier by Kinzie et al. (1992), that in well-designed treatment there is usually no difference in achievement.

The above studies suggest that achievement outcomes are mixed when using program control, learner control, and their options. Of those that had college students as their participants, three studies indicated that program control produces better achievement. There were also two studies that indicated that there was no difference between the two environments in terms of achievement. One showed no difference
between the two environments also showed that the full option produced higher scores. Finally, there was one study that showed that there was no difference in achievement when using the full option. There remains much research to be done to help decode how best to apply computer assistance and define its role in learning. This thesis will further explore achievement among college students and whether computer environment increases language learning.

Time

Although little is available, some limited research on time spent in the learner-controlled and program-controlled environments has been done. The results are mixed yet they do imply how time is spent in these two environments and their options. The two factors that will be discussed in this section are type of control (learner control and program control) and option (full and lean).

Learning efficiency may differ in learner-controlled and program-controlled environments. One major study concluded that more time was being spent viewing the materials in the program-controlled version of instruction than in the learner-controlled version. Eom and Reiser (2000) conducted this study and found that the program-controlled learners spent an average of 15.44 minutes studying the materials whereas the learner-controlled learners spent 11.74 minutes: A significant difference of almost four minutes of total time in the program ($p < 0.05$).

Similarly, Ross and Rakow (1989) found that more time was spent in the program-controlled environments and that the additional time resulted in better retention. In this study those in the adaptive program-controlled group spent an average of 40.57 minutes in each lesson, those in the non-adaptive (program-controlled) group an average
of 34.17 minutes and those in the learner-controlled group an average of 33.45 minutes. The first posttest results provided these means: adaptive program-controlled $M = 17.41$, non-adaptive program-controlled $M = 15.86$, and learner-controlled $M = 14.69$ ($p < 0.05$). The second posttest given three weeks after the first one provided the following data. For the program-controlled group, $M = 14.81$, for the non-adaptive program-controlled group $M = 12.21$, and for the learner-controlled group $M = 10.17$ ($p < 0.05$). The authors correlated the increased amount of time spent in the program-controlled environments to better posttest scores and to better overall retention.

In contrast to the two studies already mentioned, a third conducted by Hannafin and Sullivan (1995) found that those in learner control spent significantly more time learning than those in program control. Those in the learner-controlled mode spent an average of 48.3 minutes to complete the program and those in program control an average of 40.7 minutes according to the main effect means ($p < 0.01$). This study is important because it shows that learners in the program-controlled environment do not always spend more time learning than those in the learner-controlled environment. It is also possible that these findings could be a result of the quality of the materials.

These three studies show that time varies according to environment but that predicting how that environment will effect time spent is problematic. The second study (Ross & Rakow, 1989) is especially important because it is the only one of the three that used college students. This study showed that more time was spent in program control and that with the increase of time there was also an increase of retention and test scores.

In addition to the program-controlled and learner-controlled environments, the full and lean options within these environments provided some interesting results.
regarding time. These option types played varying roles in determining the amount of
time spent learning between the learner-controlled mode and the program-controlled
mode. In one study researchers, Schnackenberg and Sullivan (2000) investigated how the
full and lean options affected these two modes. Their data showed that the full program-
controlled option took more time per screen (M = 30.86 seconds) than the full learner-
controlled option (M = 24.86 seconds) and the lean program-controlled option took less
time per screen (M = 25.81 seconds) than the lean learner-controlled option (M = 28.17
seconds) (p < 0.05).

The Tukey post hoc tests revealed that the program-controlled full option took
significantly more time than the learner-controlled full option but not significantly more
time than the lean options. These findings suggest that the type of option may vary the
amount of time spent per screen and how significant that amount of time is statistically.

In addition to the amount of time that the participants were spending per screen,
the data also revealed that the full program-controlled option took more time than the
program-controlled lean one (M = 123.45 minutes and 84.30 minutes respectively) and
that the learner-controlled lean option took more time than the learner-controlled full
option (100.27 minutes and 94.13 minutes respectively). The amount of time that the
program-controlled full option took was significantly more than both the program-
controlled lean option and the learner-controlled full option (p < 0.001). It was not,
however, significantly more time than was spent in the learner-controlled lean option.

In another study researchers also found that option affected the amount of time
spent learning. Hannafin and Sullivan (1995) found that their students spent more time in
the lean version of learner control than in the lean version of program control. In the lean
version the mean for total time spent completing the program for the learner-controlled group was 44.5 minutes and for the program-controlled group, 27.5 minutes ($p < 0.001$). Furthermore, in the full version, those in program control spent only a little more time than those in learner control. The means for the full program-controlled group was 53.9 minutes and for the full learner-controlled group, 52.2 minutes ($p < 0.001$). The Tukey post hoc tests showed that the 27.5 minutes spent in the lean version of program control was significantly lower than the time spent in the other three groups (LC lean, LC full, and PC full). The Tukey post hoc tests also showed that the 44.5 minutes spent in the learner-controlled lean mode was significantly lower that the 53.9 minutes spent by those in the program-controlled full mode ($p < 0.001$). The authors suggested that the extra time spent in the lean mode might have been in an effort to supplement for the lack of instruction (Hannafin & Sullivan, 1995).

Hannafin and Sullivan (1995) also found that across environments (learner-controlled and program-controlled combined) learners spent more time to complete the program in the full option. In the lean mode of both program control and learner control combined the mean was 36 minutes and in the full mode it was 53 minutes ($p < 0.001$). These data suggest that the full option does require the learners to spend more time learning. These findings differ from the Schnackenberg and Sullivan (2000) findings which concluded that option may play a significant role in time spent learning but that the full option does not always require more time than the lean option.

Other research investigated what effect option type had on the amount of time spent within an environment. Freitag and Sullivan (1995) showed that more time was spent in the full versions of learner control than in the lean versions. They studied 75
United States and Far East employees from a major corporation and how well they scored based on whether they were assigned to their preference of learning or not. The participants completed a computer-based training program and then took a posttest. The results showed that the total means for the amount of time spent in the program for the participants in the full version was 71.70 minutes and for those in the lean version the mean was 63.74 minutes \((p < 0.01)\). The individual means also showed that more time was spent in the full mode. Those that were in the full programs had a mean time of 69.70 minutes in the preference matched version and 73.80 minutes in the unmatched version \((p < 0.01)\). Those in the lean versions had means of 59.20 minutes in the matched and 67.81 minutes in the unmatched \((p < 0.01)\). Thus those in the full programs (matched and unmatched) were spending more time despite the differing circumstances.

Further data reaffirmed that students spend more time in the full option of learner control. Crooks, Klein, Savenye, et al. (1998) investigated the effects of time that college students spent in learner control. As mentioned in the achievement section, their participants worked alone or with a partner in either a full-minus or a lean-plus option. The data revealed that for the learner-controlled mode, the lean-plus option seemed to be more efficient for students than the full-minus program, especially for students that were highly motivated (Crooks, et al., 1998). The mean for total time spent for learning mode (instruction, practice, summary, review, and practice tests) and instructional method (cooperative and individual) for the lean-plus option was 123.78 minutes. The mean for total time spent on all parts of the program for the full-minus option was 136.21 minutes \((p < 0.01)\). This significant difference in the amount of time spent suggests that, like in
the Freitag and Sullivan (1995) study, the full option requires more time than the lean option.

These four studies suggest that more time is necessary in the full option, however only two of the four studies used college students as participants. One study showed that college students spent significantly more time in the program-controlled full option than in the learner-controlled full option or in the program-controlled lean option. It also showed that more time was spent per screen in the program-controlled full option. The second study using college participants showed that students spent more time in the full-minus option.

Conclusion

Environment and options play significant roles in determining the amount of time spent learning. Of studies using college students, one concluded that program control took more time and resulted in better retention (Ross & Rakow, 1989). A second concluded that the full-minus option took more time (Crook et al., 2000). The third concluded that program-controlled full option required more time overall and per screen but that it was not significantly more time than the learner-controlled lean option overall and per screen (Schnackenberg & Sullivan, 2000). Given the small amount of data and their varied results, it is premature to draw conclusions about how environment effects time spent learning. This thesis will further investigate the time spent on the gate pages in an effort to determine whether remediation has an effect not only upon overall learning upon time spent on task.
Summary

This review of literature revealed no definitive answer as to which options of various computer-assisted learning environments have the most significant impact for college student upon language achievement and time efficiency. The reported studies indicated that program control may increase achievement but that learner control and program control can be equally effective. The studies also indicated that program control usually requires more time, but that in some cases it may increase achievement as well. Additionally, the research suggested that the full and full-minus options may take more time for college students and increase language achievement; however, under certain circumstances both the full and lean options produced equal achievement results and did not always differ significantly in the amount of time spent learning.
Chapter 3: Methodology

Background and Significance

Since the 1970’s there has been an interest in exploring the possible benefits of structured guidance and its role in the learning process. As part of this exploration, researchers have looked at program-controlled learning, where the learning environment was dictated to the learner and no adaptation for learner differences occurred. They also looked at computer-adaptive learning as well as learner-controlled learning. The body of evidence uncovered by researchers suggests that computer-adaptive learning accounts for differences in learners and learner-controlled learning allows the learners to monitor their own progress.

More specific conclusions are difficult to make, however, given that the results of these studies have come to varying conclusions. Some studies support the idea that learners learn best when they are in control of their learning (Carrier & Williams, 1984; Hannafin & Sullivan, 1995) while others have concluded that not all learners know how to monitor their learning and therefore benefit from some assistance (Fry, 1972; Ross & Rakow, 1981; Gay, 1986; Eom & Reiser, 2000). Accordingly, there appears to be no clear answer as to which learning environment is most beneficial to the language learner. In fact, there may not be one “best” environment but rather one where learning is better under most circumstances. Such disparate findings suggest that further study is necessary to determine how various learning configurations can best influence language learning.

The goal of the present study, therefore, is to provide research results that might help better explain the role of control in online learning environments. Specifically, it addresses the question as to the effects that program-controlled and learner-controlled
environments and the use of computer-adaptive control, namely remediation, will have
on foreign language learning online.

To further explore the role of computer-assisted language learning and the effect
of remediation, an online Swahili course originally developed for the Swahili 101 class at
Brigham Young University was used as the environment within which the research
questions were explored. This course, which used video and audio of native Swahili
speakers to teach language skills, was adapted for use in this study. Participants were
recruited through professional contacts with Swahili teachers at the college level
throughout the country.

Participants

The participants consisted of students studying beginning Swahili at Brigham
Young University, Bryn Mawr College, Haverford College, Swarthmore College,
University of Washington, and one student not affiliated with a university or college. The
number of participants for each school is shown in Table 1. The participants were
beginning Swahili learners as determined by pretest results and a background survey
administered prior to completing the online materials.
Table 1

Total Number of Participants by School

<table>
<thead>
<tr>
<th>School</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brigham Young University</td>
<td>13</td>
</tr>
<tr>
<td>Bryn Mawr College</td>
<td>9</td>
</tr>
<tr>
<td>Haverford College</td>
<td>4</td>
</tr>
<tr>
<td>Immaculata University</td>
<td>1</td>
</tr>
<tr>
<td>Independent Study</td>
<td>1</td>
</tr>
<tr>
<td>Korea National University of Education</td>
<td>1</td>
</tr>
<tr>
<td>Rice University</td>
<td>1</td>
</tr>
<tr>
<td>Swarthmore College</td>
<td>1</td>
</tr>
<tr>
<td>University of Richmond</td>
<td>4</td>
</tr>
<tr>
<td>University of Washington</td>
<td>99</td>
</tr>
<tr>
<td>University of Wisconsin at Madison</td>
<td>7</td>
</tr>
</tbody>
</table>

In addition to the multiple schools that participated in the study, there were also several semesters during which the study was conducted. The major reason that the study was conducted during more than one semester was the need to have enough participants that completed the material so that more accurate conclusions could be drawn from the data.

For example, the first attempt to gather data for this study occurred in 2004 and yielded very little usable information. There were very few participants who finished the materials in the fall of 2004 because they had no incentive. The teachers asked them to complete the supplemental online coursework as part of their coursework but there was no direct link between completion of the online materials and their grade.

The second attempt at data collection occurred in the fall of 2005 with some of the teachers, upon request of the researcher, requiring the participants to complete the
pretest, background survey, course materials, opinion survey, and posttest as part of their course materials and grade. The schools that responded to this request were Brigham Young University, Bryn Mawr College, Haverford College, and Swarthmore College. The result was a much higher participant sample.

In addition to Fall semesters 2004 and 2005, there were also other learners who began participation in the online Swahili course prior to the fall of 2005 who presumably had no extra incentives for completing the study materials as they began participation prior to requests that the online course be made mandatory. Some of these participants took part during the winter 2005 data collection and some participated for more than one semester.

Even with the incentive, the attrition rate (82%) was high for all parts of this study. Over the two years that this study was conducted, there were 142 participants who were novice Swahili learners. As is shown in Tables 2 and 3, of these 142 participants only 25 finished the lesson assessment pages for Chapters 1 and 2. Even higher was the attrition rate for completing the opinion survey and posttest. Even after the participants were required to complete the lessons, the opinion survey, and posttest as part of their grade there were very few who actually did. More details of the attrition for this study are discussed in Chapter 4.
Table 2

Participant Attrition by School per Gate Page

<table>
<thead>
<tr>
<th>School</th>
<th>C1L1</th>
<th>C1L2</th>
<th>C2L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brigham Young University</td>
<td>13</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Bryn Mawr College</td>
<td>9</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Haverford College</td>
<td>4</td>
<td>4</td>
<td>2</td>
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<tr>
<td>Immaculata University</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Independent Study</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Korea National University of Education</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rice University</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Swarthmore College</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>University of Richmond</td>
<td>4</td>
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<td>University of Washington</td>
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<td>7</td>
</tr>
<tr>
<td>University of Wisconsin at Madison</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 3

Participant Attrition by Gate Page

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>Valid N</th>
<th>Valid Percent</th>
<th>Missing N</th>
<th>Missing Percent</th>
<th>Total N</th>
<th>Total Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>141</td>
<td>99.3</td>
<td>1</td>
<td>0.7</td>
<td>142</td>
<td>100</td>
</tr>
<tr>
<td>C1L2</td>
<td>38</td>
<td>26.8</td>
<td>104</td>
<td>73.2</td>
<td>142</td>
<td>100</td>
</tr>
<tr>
<td>C2L5</td>
<td>25</td>
<td>17.6</td>
<td>117</td>
<td>82.4</td>
<td>142</td>
<td>100</td>
</tr>
</tbody>
</table>

Swahili 101 Course and Remediation Pages

A team in the ARCLITE Lab of the Center for Language Studies at Brigham Young University created the computer component portion of the Swahili 101 course from January 2002 until July 2003. This team went to Zanzibar and gathered authentic materials for a period of four weeks. These materials included video footage, audio, and still pictures of people and realia. Upon their return, the team put together the assets and used the previously written lesson plans to form a Swahili 101 computer-assisted course. This course was designed as the curriculum for the Swahili 101 course at Brigham Young University with the intent that the students would complete each lesson prior to attending class. The students would then have the opportunity to clarify any questions, practice, and use the materials during class time.

The computer-assisted course consisted of six chapters and 29 lessons with a range of topics from greetings to bartering. Twenty-eight of the lessons used video and all of the lessons used audio and images. The purpose of the video, audio, and images was to present the material and enable the learners to listen, read, write, and speak Swahili.
All participants used the above materials in addition to having classroom instruction and a textbook. During Fall Semesters 2004 and 2005, the participants at Bryn Mawr College, Brigham Young University, Haverford College, and Swarthmore College used *Tuseme Kiswahili* by F.E.M.K. Senkoro for their textbook. During those same semesters, the participants at the University of Washington used *Kiswahili: Msingi wa Kusema, Kusoma na Kuandika* by Hinnebusch and Mirza.

The Swahili 101 online course was not designed to conduct research so for use in this study, modifications were implemented so that data could be collected. Gate pages and remediation pages were identified and programmed in order to assess the participants and provide review as needed. The gate pages were chosen by the researcher as the key page in each lesson that summarized the main concept(s) and which allowed the participants to demonstrate their ability to use that/those concept(s). Each gate page was an already existing page in the course but it was modified in order to assess the participants’ answers and provide a percentage score.

The activities on the gate pages were oriented around listening, writing, or a combination of both. The listening-only activities required no writing and learners clicked on their responses, selecting from the options that were available. For the writing-only, as well as for the listening and writing activities, the software assessed the correctness of written answers using a fill-in-the-blank exercised that evaluated the accuracy of student response. Examining answers in one of three ways, the software looked for a right or wrong answer, a keyword within an answer, or a variety of answers for each response. This flexibility was important in order to provide a better assessment than would have occurred had only one answer or type of answer been accepted. Finally,
the assessment occurred at the completion of the page which was when the participant
either submitted their responses or left the page. Once the assessment was given, those in
the remediation group were assigned review if and when it was needed.

The gate pages not only assessed the learners and provided a review of the
materials for those learners not reaching a high enough level of achievement, but they
also kept the participants from continuing in the lesson or the course until they had
obtained a score of 70% or higher on the gate page. This established a systematic
presentation of the material and an assurance that those moving on had an acceptable
level of understanding and ability to use the most important concepts of each lesson.

Just as the researcher evaluated and chose the gate pages, so too were the
remediation pages selected. With the purpose of providing a review when deemed
necessary, the remediation pages were set up so that when students needed review, they
was guided through these pages. The number of review pages varied from 3 to 11
according to the concept and its presentation. These pages could go in order, for example
3, 4, 5, 6, 7, 8, 9, or they could skip pages, for example 3, 5, 6, 7, 12. The order was
dependent upon what was deemed most important for learning the desired concept(s).

These review pages were all pages that had previously been encountered but were
determined as the key pages needed in order to understand the concept and successfully
complete the gate page. Due to funding constraints new pages to aid remediation were
not created. Nevertheless, using pages that had previously been encountered provided a
way to gather data about time spent on the review pages that otherwise would not have
been possible. Furthermore, it allowed learners to express their thoughts and perceptions
about reexposure to previously viewed pages (during remediation) on the opinion survey. This data could then be further analyzed.

Programs and Instruments

The data collection was composed of two computer programs designed at Brigham Young University and multiple instruments created by the researcher. One of the programs was used to collect the amount of time each student spent on each screen. The program was able to determine this information based on the login time of the student. Then as the student advanced from page to page seconds were calculated for each of the pages and then recorded rounding down when necessary. In addition to collecting time per page, the time collection device was also able to calculate time per lesson and overall time in the course.

The other program, called “The Dasher” \(^1\) which assisted fill-in-the-blank, phrase, and sentence writing activities, was used to determine the correctness of the answers submitted. The Dasher, which examined typed responses, had three functions that were mentioned earlier. It could look for a right or a wrong answer, a keyword within an answer, or a variety of possible answers. Each function was decided according to the activity on the page.

In addition to the programs that were used to collect data, there were also several instruments. One such instrument was the pretest and was administered prior to beginning the course with the purpose of establishing that the participants were indeed novice Swahili learners at the 101 course level.

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\(^1\) This interaction type is called “The Dasher” in reference to software created by Dr. James Pusack and Dr. Sue Otto at the University of Iowa, which has been used in a variety of language learning materials and which inspired the creation of the writing activities used in the Swahili course.
Appendix C contains the pretest, which assessed prior knowledge of a wide variety of beginning Swahili concepts. For example, it contained past, present and future tenses, pronouns, verbs such as to have and to like, and use of the negative. It also included common vocabulary such as greetings, the house and family, transportation, clothing, and food. Finally there were expressions such as doing something for someone else and asking someone’s name and location.

The gate pages, as shown in Appendix F, constituted the instruments used to assess the learners during each lesson. The gate pages required the learners to look at, listen to and/or read and then respond by dragging, clicking, or typing. For clarity, a simple description of each gate page is given.

C1L1 consisted of seven multiple choice questions in English. The questions required the learners to remember the history presented at the beginning of the lesson and provide the correct response.

The learners were required to go through a greeting and response cycle five times on C1L2. For each iteration they listened to a greeting, responded, and then greeted the person in turn. The responses and greetings were to be typed but the learners had a drop-down box to help them. Smiley faces and x’s indicated when a greeting or response was accurate.

A drag and drop activity on C1L3 focused on pronunciation. The learners listened to six different audio samples and matched the audio that they heard with the correct written message.

C1L4 contained a series of video clips that illustrate various greetings. Adnaan, the video actor, greeted the learners several times and then asked a question. After each
greeting the learners were required to select the correct answer from the drop-down box. Each successive video would play only after the learners had selected the correct response to the previous question. The purpose of this page was to assess how well the learners could greet and give their name, which is necessary in almost every person interaction in Zanzibar.

The next gate page, C1L5, had a series of scenarios in English for which the learners needed to type the correct response in Swahili. These scenarios involved greetings, goodbyes, and welcomes. They included the plural and formal scenarios of saying hello, goodbye, and welcome as well as saying goodbye for a short and long period of time. The learners were required to type each response correctly, with the help of the Dasher and a list of possible answers from a drop-down box. The purpose of this page was to evaluate how well the learners knew which greetings, goodbyes, or welcomes to use and when.

C2L1 consisted of a series of five pictures that represented a person each with a question in Swahili beneath. With the first picture serving as an example, the learners were required to read the question and then answer by first negating the question and then providing a correct statement about the specific picture. For example, the second picture is of an older man. The question in Swahili asks, “Is he young?” The learner responds by writing in Swahili, “No, he is not young. He is old.” After the learner has finished, the Dasher assists in completing the statements accurately, if needed. This page measured the learners’ ability to understand some basic adjectives, use negation, and talk about a person using another adjective.
Similarly to C2L1, C2L2 had a series of pictures of people of various ages, an example to follow, and the Dasher to help the learners respond. This page assessed the learners’ ability to recognize numbers and state someone’s age. To accomplish this, the page required the learners to click on the picture and hear the narrator state the pictured person’s age. The learners then had to type in “yes, that is his age” or “no, that is not his age” in Swahili.

To assess the learners’ ability to distinguish between where someone lived and where someone was from, C2L3 had several video clips that required the learners to listen and type a response. The person in the video said where s/he was from or where s/he lived and the learners had to respond appropriately. The Dasher once again assisted the learners as needed.

C2L4 included 10 pictures of people doing various activities such as cooking, traveling, and fishing and required the learners to state whether they liked or disliked the picture content. To aid the learners in their responses, the Dasher and a word bank containing vocabulary words were available. The focus of this gate page was to assess whether the learners could accurately express likes and dislikes.

The last gate page, C2L5, also contained a series of pictures that were accompanied this time by two questions and an incomplete sentence in Swahili. The interaction was designed to measure the learner’s reading comprehension and ability to describe people and their activities. The first statement required the learners to reply using a full sentence regarding the activity underway in the picture. The second question prompted the learners to think about how to describe the people and then fill in the incomplete sentence with a correct adjective.
There were several gate pages that had drop-down boxes to assist the learner. These drop-down boxes were available for the learner to use during the entire activity but whatever was contained in the drop-down help box was not part of the assessment. For example, on C2L4 the learners look at series of pictures and state whether they like or do not like to do that activity. The drop-down box for this page contains vocabulary for the activities (i.e. cooking, traveling, and reading). The Dasher, however, assessed the use of the verb “to like” and not the vocabulary word for the activity and therefore provides a valid measurement for how well the learners can express likes and dislikes.

After the learners completed the lessons they were able to take the posttest, which was also one of the testing instruments. The researcher created this exam in order to determine if there was a difference in the overall achievement between the two groups. The exam consisted of a total of 35 screens in 2004 and 28 screens in 2005 that were Web-delivered and were similar in style both visually and conceptually to activities that were previously encountered in the course. The test items were formed from item and test specifications covering the major concepts that (a) a 101 student should have learned by the end of the semester and (b) were presented and taught in the lessons themselves. The amount of instruction in the course for each item and concept were also considered.

Most of the participants did not complete the posttest in 2004. In order to improve the completion rate, two modifications were made to the exam: it was shortened and the ability to log on and off and complete it during multiple sessions was added. The modifications were based on a review of the 2004 student exams as well as a review of the content in the course materials. The test was then shortened, eliminating pages and
sometimes reducing the number of questions on a page. Although shortened, the test kept all key elements. Most of the omissions were repetitions that were deemed unnecessary.

In addition to shortening the exam, the ability to log on and off while taking the test was implemented to allow the participants to take the test in multiple sittings if so desired. This did present some validity concerns since the participants could come back and complete a page later on. Once they had finished a page, however, they could not go back and change their answers. Although this ability to return to the same page was not favorable from a research standpoint, it seemed more important to have participants complete the posttest than to not attempt it at all. Furthermore, the participants were not informed that they could return to an unfinished page. They were only instructed to take the test in whole or to complete a page before logging off. Unfortunately, even with these two implementations, there were still many who did not complete the examination and the posttest results are therefore not included in the analyses.

In addition to the three testing instruments, there were also two surveys administered to the learners. The first was a background survey that gathered participant information including the previous languages they had learned or studied, their exposure to Swahili, and their computer experience. This survey, which is available in Appendix B, served as a way to determine whether there were any similarities in the participant profiles and to identify those that had already studied Swahili or had other contact with it. It also served as a way to measure the English proficiency of the participants since not all were native speakers. This was done by analyzing participants’ responses that identified study of English as a second or third language and how well they felt they spoke it. Their
responses also indicated whether the participants would be able to use the materials with ease since the instruction was primarily in English.

The second survey, the opinion survey, which is available in Appendix C, was administered with the purpose of gathering quantitative and qualitative information about the online course, participant use of the course, and the effect of remediation. Although this was supposed to be an end of course survey, most participants took the survey during the semester. In any case, there were few that completed this survey, limiting the usefulness of the information that was gathered.

**Server Collected Variables**

The Swahili 101 online course, the pretest, the background survey, the opinion survey and the posttest were all located on a server at BYU that was accessible to student participants at each of the participating schools. The researcher informed the teachers and student participants of the system requirements who in turn reported any technical or general problems. The research then handled these immediately with the assistance of the programmer who had been assigned to this project. Although the participants could access the course from any location, most of them had to use a school computer lab because of the need for a high-speed Internet connection. This obviously put some limitations on when the participants could use the course.

In addition to hosting the materials, the server also collected answers for the pretest, background survey, opinion survey, and posttest. Furthermore, it collected gate page scores (in the form of a percentage) for each participant but it did not record the specific gate page answers, given that this was not one of the software’s original design specifications.
The system recorded percentages for each attempt on each gate page. For example, if a participant attempted and/or completed the page multiple times there was a score for each attempt or completion. If no attempt was made but the page was opened, then a score of zero was assigned. On the other hand, if the page was never encountered, then obviously no score was recorded or assigned.

In addition to the tests, surveys and gate pages, the server also collected information about learner strategies and habits as course materials were completed. As the participants went through the course, time per page was recorded. Because some participants reviewed more than once, these times were recorded for each encounter with each review page.

The server also recorded the logon time for each user, thus enabling the researcher and the participating teachers to view an online report that listed the logon time, user data, and date for each participant’s online activity. The data included the participant’s name, username, school, lesson position, opinion survey and posttest status, and group (remediation or non-remediation). In order to view the data for a particular participant, the login username had to be known, which restricted knowledge of the participants’ performance to the researcher and their own Swahili teacher.

The course access time was also recorded and viewable on the online report that was provided. Along with the logon time, the system also recorded the dates and times when each participant accessed the course. The course access time was defined as the time the participants were actually using the course materials, whereas the logon time was defined from the point the participants logged onto the server. The participants then
had the choice of using the course, completing the opinion survey or taking the posttest once it was available.

The server also collected information about where the participants were in the course, from the background survey, and from the posttest. This information was also viewable to those authorized. The online report contained the username, the last page viewed and its time and date, the last gate page completed and its score, time, and date, as well as the weekly time in hours, minutes, and seconds. In addition, the online report showed the background survey status for each participant (whether it had been completed or if there had been no attempt), and the posttest status which included if it had been attempted, completed (which also listed the test percentage), or the page that the participant was currently using. Finally, the online report showed which group the participant was assigned (remediation or non-remediation).

This online report also helped identify problems that participants encountered. Oftentimes problems resulted from a gate page not being completed which prevented the participant from continuing in the course. Without referral to this online report, many of the problems would have been very difficult to solve.

**Participant Screening**

The pretest was administered in order to determine whether each participant was truly at the Swahili 101 level. This test was necessary because many of the students in the courses at the participating institutions had prior experience with Swahili, and it was important that the study only include novice learners at the 101 level.

The guideline for determining novice 101 learners defined participants who scored 16 or fewer on the 24-question test (66.7%) as Swahili 101 students. This was
essentially the same criterion used for the gate page scores, given that certain participants needed to have a score of 70% or higher in order to proceed to next the lesson after encountering a gate page.

There were two questions included in the pretest to insure that a participant could not volitionally define his status as a novice learner. These were basic questions that most novice 101 learners were expected to know, and if a participant were to miss both of them, then special attention was placed in reviewing his test.

Although the pretest was designed to determine whether participants were novice learners, there were several participants who either did not take the pretest or the data were not stored for them. When the data were not recorded, this was usually due to a technical problem either at the participant’s school or on the server itself. When there was no pretest information for a participant, the background survey became a second determiner for whether participants could be included in the study.

The background survey, as mentioned above, solicited information about languages known and studied and the proficiency of each. There was also a section that specifically asked about exposure to Swahili. These questions included: Have you been exposed to, studied or do you speak Swahili? How did you learn the language? How long have you studied or spoken Swahili? How long has it been since your last exposure to the Swahili language? and How would you rate your proficiency in Swahili?

In reviewing each participant’s background survey the researcher was able to assign Swahili 101 learner status and use their results in the analyses. Those that had no exposure were obviously included in the study. Because some participants with previous Swahili exposure had no pretest score, the researcher reviewed other participants with
both a pretest score and a background study to determine an appropriate cutoff point. Those individuals who had studied Swahili for less than 6 months but had no pretest score would be included in the study, but those with more than 6 months study and no pretest score would be excluded. Although this process was not a guarantee that all participants would be true Swahili 101 learners, it seemed a fair compromise. Finally, several participants who had no pretest and no background study were eliminated from the study.

Procedures

In the fall of 2003, an application was submitted to the Institutional Review Board to gain approval for this research using human subjects. Because it is necessary to obtain consent from each participant, the researcher insured that all those who participated, would do so on a voluntary basis, and would remain anonymous. This was accomplished by (a) providing an informed consent page to which all participants agreed prior to beginning the course and (b) requiring usernames and passwords that each participant chose and used throughout their involvement in the study. Because this study was ongoing over a three-year period, the IRB application was resubmitted and approved in the summer of 2005.

At the beginning of Fall Semester 2004, the participating professors informed their students of this study, explaining that participation was purely on a voluntary basis and that no compensation would be offered as an incentive. In the fall of 2005 the same was true except that this time the participants were required to complete the pretest, background survey, opinion survey, and posttest as a small part of their course grade. Prior to study participation and exposure to course materials, participants agreed to the
informed consent, then continued with the background survey and pretest before proceeding to the course itself. This initial agreement to participate was nonbinding as participants were free to discontinue their involvement at any point in the study, a fact outlined in the informed consent.

After the participants had accepted the terms in the informed consent, they completed the background survey and pretest and then were able to begin the course. In fact, to help insure that the pretest and background survey were completed, the link for the Swahili lessons did not appear on the participant’s browser until both had been accessed by each participant. For the 2005 participants, another link for the opinion survey accompanied the course link which helped to facilitate completion of the opinion survey. Later in the semester a link for the end of course exam was included.

In between obtaining consent and beginning the course, the system randomly assigned participants to one of two groups (remediation and non-remediation). The non-remediation group controlled their own learning while the remediation group received computer-adaptive-controlled learning. Those that controlled their own learning proceeded through the lessons at their own pace and monitored their own learning. They decided when, how, and if they needed to review. The computer-adaptive-controlled participants on the other hand, continued at their own pace until they encountered a gate page. Then they were assessed as to whether they had learned the most salient concept(s) of that lesson. Once the gate page was completed they were either allowed to continue with the lesson or, based on their score on the gate page, they were guided through specific previously encountered pages that would help them better understand how to apply the concept(s) presented in that particular lesson.
After the participants had finished the course materials, they completed the opinion survey and the posttest. Many took the opinion survey early in the semester in an effort to finish that requirement. No one attempted the posttest early even though the link was available several weeks prior to the end of the semester.

**Design and Data Analysis**

The experimental design used in this study was a randomized, repeated measures design. The two groups consisted of foreign language learners who were studying beginning Swahili at Brigham Young University, Bryn Mawr College, Haverford College, Swarthmore College, University of Washington, and one participant who was not affiliated with a university or college. The study compared learner-controlled learners (non-remediation group) and computer-adaptive-controlled learners (remediation group). Data were collected from August of 2004 until February of 2006. The semesters that had the majority of participants were Fall Semesters in the years 2004 and 2005.

The data were analyzed using a regression analysis, two-tailed Pearson correlation analyses, an analysis of variance, a repeated measures analysis of variance analysis, and \( t \) tests in order to accept or reject the null hypothesis:

There will be no difference in the language learning and time spent on the assessment pages between the remediation group and the non-remediation group.

The software used to conduct the analysis was SPSS as well as SAS and the standard of significance for the study was \( p < 0.05 \).

The regression analysis was used to investigate one independent variable with a subset population (sample population and treatment group) and one dependent variable (gate page score on the first gate page) to determine whether there was a bias in the
sample. One of the Pearson two-tailed correlation analyses was chosen to verify the findings from the regression analysis. The Pearson analysis was performed to establish a relationship, if any, between treatment and gate page score at the onset of the study. The variables were the gate page score on the first lesson page, remediation, and completion of the first lesson page. The second Pearson two-tailed correlation analysis was conducted to study a relationship, if any, of the gate pages. The gate page z-scores for all participants were selected as the dependent variable.

The analysis of variance was performed to determine the effect, if any, of remediation over time. This analysis used the two groups (remediation and non-remediation) and the last gate pages score.

A repeated measures analysis of variance was also performed with the intent to determine the effect of remediation, if any, on the gate page scores. Z-scores were used for each participant in the two groups.

Finally, two sets of $t$ tests were conducted in order to investigate the effect of time and performance on language learning. The first set included all participants that completed the gate page and analyzed for score and then time. The second set excluded those participants that spent less than 10 seconds or more than 20 minutes on the last two gate pages, eliminating outliers this set also analyzed for score and then time. The dependent variable was either gate page score or gate page time. The independent variable was group (remediation or non-remediation).

These analyses provided data that gave insight into the effect of remediation on learning in two ways. The first was the effect of remediation over time with respect to individual users, their gate page scores, and their participant group. The second was the
effect of remediation on the relationship between gate page scores and time spent on the
gate pages themselves.

Summary

It is important to teachers for researchers to determine the amount of control that
computers should have as they help to instruct students. In an effort to understand what
types of control are effective, the effects of learner-controlled and program-controlled
environments need to be evaluated. This study is an investigation of the effect of
computer-adaptive control (remediation) upon language learning. The data collected
(pretest scores, background survey information, gate page scores, and time spent on gate
pages) will help explain the effect of remediation on the outcome of specific exercises as
well as on long-term achievement. The analysis of the data will also explore the effect of
remediation on time spent on gate pages as well as the resulting effect on learning
outcome.
Chapter 4: Summary of Results

Introduction

The purpose of this study was to determine the effects of remediation (forced review) on language learning. Chapter 2 provided contradictory evidence and showed that the best learning environment or option for college student achievement remains unknown. The review concluded that in certain studies, program-controlled groups achieved higher results but that in other studies there was no difference in achievement between the learner-controlled and program-controlled groups. It also concluded that program control requires more time but results in better retention for college students. Finally, the literature review revealed that the full-minus option (full version of the program with the ability to bypass additional instruction) may take more time and produce better results but that comparison of the full and lean options (full and basic versions of the program) showed no difference in achievement and it varied in the amount of time spent learning.

Chapter 3 detailed the methodology and procedures used for conducting this study. For this research the participants completed a background survey, took a pretest, worked through the supplemental online Swahili 101 lesson materials, and filled out an opinion survey. The background survey and pretest verified that the participants were indeed novice Swahili 101 learners, the course materials provided a means to investigate the effect of remediation on achievement and time spent on the gate pages, and the opinion survey allowed the participants to articulate their experiences in the online course. End of lesson assessments (gate pages) were used to evaluate learning outcomes and remediation pages were assigned to members of the experimental group when the
key concepts for that lesson had not been learned well enough. These same gate pages also collected achievement scores for the control group. Participants in the control group, however, were not required to remediate even when scores were low. Finally, time spent learning was gathered for every gate page for all participants.

This chapter reports results from data that were collected as the participants progressed through the lessons from the Swahili 101 supplemental online course materials. These data include the score the participants received on his first attempt of the gate page as well as the time spent thereon. The data were then analyzed using a regression analysis, correlation analyses, an analysis of variance, a repeated measures analysis of variance, and $t$ tests.

**Attrition**

As mentioned in Chapter 3, 142 participants, who were novice Swahili learners, started the study and only 25 finished the lessons in Chapters 1 and 2. Of the 25 that finished the two chapters, there were only 17 that completed all 10 of the gate pages. The largest drop in participants occurred after the first gate page (C1L1) after which the number of participants remained about the same (between 25 and 40 total).

Even though there was a large attrition rate, the number of participants per group stayed fairly constant. The experimental group started with 67 participants beginning in the first lesson with the number ranging from 13 to 22 participants per lesson thereafter for both Chapters 1 and 2. The control group followed a similar pattern. It had 74 participants in Chapter 1 lesson 1 with the number ranging from 12 to 19 participants per lesson thereafter for Chapters 1 and 2. The number of participants per group and lesson for Chapters 1 and 2 can be viewed in the figure below.
The attrition rate for completion of the opinion survey and posttest was even higher than that for the Swahili 101 lessons. In 2004, 7 participants completed the opinion survey and in 2005, 13 participants completed the survey. As for the posttest, in 2004, 5 participants started the posttest and none completed it and in 2005, 9 participants started the posttest and six completed it.

*Sample Population*

The first research objective was to determine whether there was a bias in the sample.

*Results*

In order to establish whether the experimental and control groups were equivalent, gate page scores for each participant in both groups (remediation and non-remediation) were analyzed for the first gate page. All those that had a time greater than 0.0 seconds on the first gate page were included, not just those that finished the ten lessons. A
regression analysis was then performed using the gate page score as the dependent variable. As shown in Table 4, there was no significant difference in variance of the dependent variable for either the sample population or the treatment group since \( p > .05 \) in both cases.

Table 4
Initial Gate Page Scores of the Sample Population

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>50.73</td>
<td>7.75</td>
</tr>
<tr>
<td>Sample Population</td>
<td>5.92</td>
<td>8.00</td>
</tr>
<tr>
<td>Treatment Group</td>
<td>5.60</td>
<td>4.94</td>
</tr>
</tbody>
</table>

A Pearson correlation analysis was then performed in order to verify the above findings. These findings, as presented in Table 5, concluded that there was no correlation between completion of the first gate page and assigned group since the level of significance was too high for each of the \( r \) values.

Table 5
Correlation of Treatment and Completion on the First Gate Page

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>C1L1</th>
<th>Sample Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Group</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C1L1</td>
<td>.10</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>141</td>
<td>141</td>
</tr>
<tr>
<td>Sample Population</td>
<td>-.00</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>.47</td>
</tr>
<tr>
<td></td>
<td>142</td>
<td>141</td>
</tr>
</tbody>
</table>

Note: The first number in the column is the \( r \) value, the second is the level of significance (2-tailed), and the third is the number of participants (N).
Achievement and Time

The second research objective was to determine the effect, if any, of remediation upon achievement and time on task.

Results

An analysis of variance was used to compare the gate page score on the last lesson for the two groups (remediation and non-remediation). Table 6 shows that there was a significant effect for remediation on scores obtained, $F(1, 13) = 4.95$ ($p < 0.05$).

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>381281.86</td>
<td>1</td>
<td>381281.86</td>
<td>113.69</td>
<td>.00</td>
</tr>
<tr>
<td>Remediation</td>
<td>16595.86</td>
<td>1</td>
<td>16595.86</td>
<td>4.95</td>
<td>.04</td>
</tr>
<tr>
<td>Error</td>
<td>43596.63</td>
<td>13</td>
<td>3353.59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After it was established that there was indeed an effect of remediation upon achievement, z-scores were plotted to examine the scores by lesson and by group as is shown in Figure 2. The findings indicate that in lesson 1 there was no difference between the two groups since both groups’ z-scores were so close to the mean. As the groups continued through the lessons, there appeared to be an upward trend for the experimental group (remediation) and a downward trend for the control group (non-remediation). These trends would seem to indicate that remediation did indeed have a positive effect upon language learning.
Remediation over Time

Because of the value of using a z-score for each participant’s performance on each gate page and its ability to compare each score against all the other participants scores as well as factor out variables such as test differences (i.e. level of difficulty and number of questions), a repeated measures analysis of variance was performed in order to determine once again the effect of remediation over time. As shown in Table 7 the results indicated that there was a significant effect for remediation over time on achievement, $F (1, 50) = 15.91$, $p < 0.001$. These results confirm remediation did indeed have an effect upon achievement over time.
Table 7
Remediation Effect over Time Using Z-Scores in a Repeated Measures ANOVA

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remediation</td>
<td>50</td>
<td>15.91</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

*Scores and Time on the Individual Gate Pages.*

In order to further investigate the positive effect that remediation had on achievement, as well as to investigate its effect on time, two sets of $t$ tests were conducted. These $t$ tests provided a way to evaluate the effect of remediation on scores and times on each of the 10 gate pages. In addition, they made it possible to evaluate the effect of the treatment over time by comparing results for scores and time on the last two gate pages. An alpha level of .05 was used for both tests and equal variances were assumed.

The first set of $t$ tests included all participants with no missing values for the gate page or set of gate pages. The second set also included all participants that had no missing values but it excluded the outliers (those that had a time of less than 10 seconds or greater than 20 minutes on either of the last two gate pages). The following table, Table 8, shows the number of outliers per group and by lesson gate page.
Table 8

Total Number of Outliers and Non-Outliers for Each Group on the Gate Pages

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>Outliers/Non-Outliers</th>
<th>Control</th>
<th>Treatment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>72</td>
<td>61</td>
<td>133</td>
</tr>
<tr>
<td>C1L2</td>
<td>0</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>16</td>
<td>27</td>
</tr>
<tr>
<td>C1L3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>21</td>
<td>39</td>
</tr>
<tr>
<td>C1L4</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>19</td>
<td>34</td>
</tr>
<tr>
<td>C1L5</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>C2L1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>C2L2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>C2L3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>C2L4</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>C2L5</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>10</td>
<td>18</td>
</tr>
</tbody>
</table>

The results of the first $t$ test indicated that there was a significant effect for remediation on scores for three of the gate pages. The mean percentage scores for these gate pages, as is shown in Table 9, were for C1L3 $M = 55.26$ (control) and $M = 83.29$ (experimental), for C1L5 $M = 62.60$ (control) and $M = 91.07$ (experimental), and for C2L5 $M = 10.75$ (control) and $M = 33.54$ (experimental).
### Table 9

Mean Performance Scores on Individual Gate Pages (All Participants)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>Control</td>
<td>74</td>
<td>56.97</td>
<td>25.71</td>
<td>2.99</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>67</td>
<td>62.55</td>
<td>32.71</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>16</td>
<td>5.00</td>
<td>20.00</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>22</td>
<td>10.00</td>
<td>22.04</td>
<td>4.70</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>19</td>
<td>55.26</td>
<td>48.10</td>
<td>11.04</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>21</td>
<td>83.29</td>
<td>34.21</td>
<td>7.46</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>17</td>
<td>60.00</td>
<td>38.73</td>
<td>9.39</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>19</td>
<td>75.79</td>
<td>31.68</td>
<td>7.27</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>15</td>
<td>62.60</td>
<td>42.65</td>
<td>11.01</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>14</td>
<td>91.07</td>
<td>27.05</td>
<td>7.23</td>
</tr>
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<td>15</td>
<td>55.00</td>
<td>45.51</td>
<td>11.75</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>66.18</td>
<td>39.47</td>
<td>9.57</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14</td>
<td>28.57</td>
<td>46.88</td>
<td>12.53</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>14</td>
<td>48.21</td>
<td>47.50</td>
<td>12.69</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>12</td>
<td>47.17</td>
<td>40.07</td>
<td>11.57</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>13</td>
<td>52.54</td>
<td>40.71</td>
<td>11.30</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>12</td>
<td>46.67</td>
<td>45.79</td>
<td>13.22</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>13</td>
<td>64.62</td>
<td>41.15</td>
<td>11.41</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>12</td>
<td>10.75</td>
<td>18.47</td>
<td>5.33</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>13</td>
<td>33.54</td>
<td>28.35</td>
<td>7.86</td>
</tr>
</tbody>
</table>

As shown below in Table 10, the differences in the means for all of these gate pages (C1L3, C1L5, and for C2L5) were statistically significant at the $p < 0.05$ level.
Table 10

Remediation Effect on Individual Gate Page Score (All Participants)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>t</th>
<th>df</th>
<th>Sig (2-tailed)</th>
<th>Mean Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>-1.13</td>
<td>139</td>
<td>.26</td>
<td>-5.58</td>
</tr>
<tr>
<td>C1L2</td>
<td>-.72</td>
<td>36</td>
<td>.48</td>
<td>-5.00</td>
</tr>
<tr>
<td>C1L3</td>
<td>-2.14</td>
<td>38</td>
<td>.04</td>
<td>-28.02</td>
</tr>
<tr>
<td>C1L4</td>
<td>-1.35</td>
<td>34</td>
<td>.19</td>
<td>-15.79</td>
</tr>
<tr>
<td>C1L5</td>
<td>-2.13</td>
<td>27</td>
<td>.04</td>
<td>-28.47</td>
</tr>
<tr>
<td>C2L1</td>
<td>-.74</td>
<td>30</td>
<td>.46</td>
<td>-11.18</td>
</tr>
<tr>
<td>C2L2</td>
<td>-1.10</td>
<td>26</td>
<td>.28</td>
<td>-19.64</td>
</tr>
<tr>
<td>C2L3</td>
<td>-.33</td>
<td>23</td>
<td>.74</td>
<td>-5.37</td>
</tr>
<tr>
<td>C2L4</td>
<td>-1.03</td>
<td>23</td>
<td>.31</td>
<td>-17.95</td>
</tr>
<tr>
<td>C2L5</td>
<td>-2.36</td>
<td>23</td>
<td>.03</td>
<td>-22.79</td>
</tr>
</tbody>
</table>

As shown in Table 11, there was also a significant effect for remediation on time for C1L1, C1L4, and C2L5. The means for the two groups were C1L1 M = 1 minute 34.16 seconds (control) and M = 1 minute 14.51 seconds (experimental). For C1L4 the control group had a mean of 55.18 seconds and the experimental group a mean of 1 minute 19.74 seconds. Finally, for C2L5, the means were 2 minutes 43.75 seconds and 8 minutes 36.92 seconds for control and experimental respectively. The p value for each gate page can be seen in Table 12. It is interesting to note that C2L5 was the only one of
these pages that had a significant effect for both time and achievement. Because of the
nature of the $t$ test, however, time and achievement were not analyzed together.

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>Control</td>
<td>74</td>
<td>0:01:34.16</td>
<td>0:01:06.52</td>
<td>0:00:07.73</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>67</td>
<td>0:01:14.51</td>
<td>0:00:44.21</td>
<td>0:00:05.40</td>
</tr>
<tr>
<td>C1L2</td>
<td>Control</td>
<td>16</td>
<td>0:00:49.81</td>
<td>0:00:59.26</td>
<td>0:00:14.81</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>22</td>
<td>0:02:26.82</td>
<td>0:06:19.38</td>
<td>0:01:20.88</td>
</tr>
<tr>
<td>C1L3</td>
<td>Control</td>
<td>19</td>
<td>0:03:15.58</td>
<td>0:02:32.28</td>
<td>0:00:34.94</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>21</td>
<td>0:03:58.48</td>
<td>0:02:12.80</td>
<td>0:00:28.98</td>
</tr>
<tr>
<td>C1L4</td>
<td>Control</td>
<td>17</td>
<td>0:00:55.18</td>
<td>0:00:34.06</td>
<td>0:00:08.26</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>19</td>
<td>0:01:19.74</td>
<td>0:00:36.99</td>
<td>0:00:08.49</td>
</tr>
<tr>
<td>C1L5</td>
<td>Control</td>
<td>15</td>
<td>0:04:08.80</td>
<td>0:05:01.10</td>
<td>0:01:17.75</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>14</td>
<td>0:04:58.07</td>
<td>0:03:40.53</td>
<td>0:00:58.94</td>
</tr>
<tr>
<td>C2L1</td>
<td>Control</td>
<td>15</td>
<td>0:02:22.27</td>
<td>0:01:48.19</td>
<td>0:00:27.94</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>0:02:44.94</td>
<td>0:01:52.11</td>
<td>0:00:27.19</td>
</tr>
<tr>
<td>C2L2</td>
<td>Control</td>
<td>14</td>
<td>0:01:57.79</td>
<td>0:01:46.61</td>
<td>0:00:28.49</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>14</td>
<td>0:02:54.57</td>
<td>0:02:23.03</td>
<td>0:00:38.23</td>
</tr>
<tr>
<td>C2L3</td>
<td>Control</td>
<td>12</td>
<td>0:01:29.08</td>
<td>0:01:05.68</td>
<td>0:00:18.96</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>13</td>
<td>0:01:42.23</td>
<td>0:00:54.73</td>
<td>0:00:15.18</td>
</tr>
<tr>
<td>C2L4</td>
<td>Control</td>
<td>12</td>
<td>0:04:35.83</td>
<td>0:04:06.86</td>
<td>0:01:11.26</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>13</td>
<td>0:05:14.85</td>
<td>0:04:10.57</td>
<td>0:01:09.50</td>
</tr>
<tr>
<td>C2L5</td>
<td>Control</td>
<td>12</td>
<td>0:02:43.75</td>
<td>0:03:22.43</td>
<td>0:00:58.44</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>13</td>
<td>0:08:36.92</td>
<td>0:08:50.68</td>
<td>0:02:27.18</td>
</tr>
</tbody>
</table>
### Table 12

Remediation Effect upon Time Spent on Individual Gate Pages (All Participants)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>2.04</td>
<td>139</td>
<td>.04</td>
<td>0:00:19.66</td>
</tr>
<tr>
<td>C1L2</td>
<td>-1.01</td>
<td>36</td>
<td>.32</td>
<td>-0:01:37.01</td>
</tr>
<tr>
<td>C1L3</td>
<td>-.95</td>
<td>38</td>
<td>.35</td>
<td>-0:00:42.90</td>
</tr>
<tr>
<td>C1L4</td>
<td>-2.06</td>
<td>34</td>
<td>.05</td>
<td>-0:00:24.56</td>
</tr>
<tr>
<td>C1L5</td>
<td>-.50</td>
<td>27</td>
<td>.62</td>
<td>-0:00:49.27</td>
</tr>
<tr>
<td>C2L1</td>
<td>-.58</td>
<td>30</td>
<td>.57</td>
<td>-0:00:22.67</td>
</tr>
<tr>
<td>C2L2</td>
<td>-1.19</td>
<td>26</td>
<td>.24</td>
<td>-0:00:56.79</td>
</tr>
<tr>
<td>C2L3</td>
<td>-.55</td>
<td>23</td>
<td>.59</td>
<td>-0:00:13.15</td>
</tr>
<tr>
<td>C2L4</td>
<td>-.39</td>
<td>23</td>
<td>.70</td>
<td>-0:00:39.01</td>
</tr>
<tr>
<td>C2L5</td>
<td>-2.16</td>
<td>23</td>
<td>.04</td>
<td>-0:05:53.17</td>
</tr>
</tbody>
</table>

The findings from the second *t* test, which excluded the outliers, indicated that only one of the gate pages, C2L4, had a significant effect on scores, *p* = .04 as is shown in Table 14. The mean percentage scores, which are presented in Table 13, for this gate page were *M* = 57.50 for the control group and 90.00 for the experimental group. There were no statistically significant differences on any of the other gate pages.
Table 13

Mean Performance Scores on Individual Gate Pages (Outliers Excluded)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>Control</td>
<td>8</td>
<td>62.50</td>
<td>28.60</td>
<td>10.11</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>79.44</td>
<td>19.11</td>
<td>6.37</td>
</tr>
<tr>
<td>C1L2</td>
<td>Control</td>
<td>5</td>
<td>.00</td>
<td>.00(a)</td>
<td>.00</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>6</td>
<td>.00</td>
<td>.00(a)</td>
<td>.00</td>
</tr>
<tr>
<td>C1L3</td>
<td>Control</td>
<td>8</td>
<td>60.38</td>
<td>50.32</td>
<td>17.79</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>90.67</td>
<td>22.34</td>
<td>7.45</td>
</tr>
<tr>
<td>C1L4</td>
<td>Control</td>
<td>8</td>
<td>72.50</td>
<td>35.36</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>80.00</td>
<td>24.49</td>
<td>8.16</td>
</tr>
<tr>
<td>C1L5</td>
<td>Control</td>
<td>6</td>
<td>72.83</td>
<td>42.29</td>
<td>17.26</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>8</td>
<td>100.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>C2L1</td>
<td>Control</td>
<td>8</td>
<td>75.00</td>
<td>35.36</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>66.67</td>
<td>43.30</td>
<td>14.43</td>
</tr>
<tr>
<td>C2L2</td>
<td>Control</td>
<td>8</td>
<td>50.00</td>
<td>53.45</td>
<td>18.90</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>52.78</td>
<td>45.83</td>
<td>15.28</td>
</tr>
<tr>
<td>C2L3</td>
<td>Control</td>
<td>8</td>
<td>58.25</td>
<td>32.10</td>
<td>11.35</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>53.67</td>
<td>43.08</td>
<td>14.36</td>
</tr>
<tr>
<td>C2L4</td>
<td>Control</td>
<td>8</td>
<td>57.50</td>
<td>42.68</td>
<td>15.09</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>90.00</td>
<td>10.00</td>
<td>3.33</td>
</tr>
<tr>
<td>C2L5</td>
<td>Control</td>
<td>8</td>
<td>16.13</td>
<td>20.91</td>
<td>7.39</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>35.67</td>
<td>25.69</td>
<td>8.56</td>
</tr>
</tbody>
</table>

a. The value cannot be computed because the standard deviations of both groups are 0.
Table 14
Remediation Effect on Individual Gate Page Score (Outliers Excluded)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>t</th>
<th>df</th>
<th>Sig (2-tailed)</th>
<th>Mean Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>-1.45</td>
<td>15</td>
<td>.17</td>
<td>-16.94</td>
</tr>
<tr>
<td>C1L3</td>
<td>-1.64</td>
<td>15</td>
<td>.12</td>
<td>-30.29</td>
</tr>
<tr>
<td>C1L4</td>
<td>-.51</td>
<td>15</td>
<td>.62</td>
<td>-7.50</td>
</tr>
<tr>
<td>C1L5</td>
<td>-1.84</td>
<td>12</td>
<td>.09</td>
<td>-27.17</td>
</tr>
<tr>
<td>C2L1</td>
<td>.43</td>
<td>15</td>
<td>.67</td>
<td>8.33</td>
</tr>
<tr>
<td>C2L2</td>
<td>-.12</td>
<td>15</td>
<td>.91</td>
<td>-2.78</td>
</tr>
<tr>
<td>C2L3</td>
<td>.25</td>
<td>15</td>
<td>.81</td>
<td>4.58</td>
</tr>
<tr>
<td>C2L4</td>
<td>-2.23</td>
<td>15</td>
<td>.04</td>
<td>-32.50</td>
</tr>
<tr>
<td>C2L5</td>
<td>-1.71</td>
<td>15</td>
<td>.11</td>
<td>-19.54</td>
</tr>
</tbody>
</table>

Note: C1L2 was not analyzed because the mean scores were 0.

Furthermore, only one of the gate pages showed any effect for remediation on time. This was C2L5, \( p = .04 \), as can be seen in Table 16. The means, which are presented in Table 15, were \( M = 4 \text{ minutes } 3.25 \text{ seconds} \) (control) and \( M = 8 \text{ minutes } 8.44 \text{ seconds} \) (experimental). C2L5 also had a significant effect for remediation on time when the outliers were included.
Table 15

Mean Time Spent on Individual Gate Pages (Outliers Excluded)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>Control</td>
<td>8</td>
<td>0:01:33.62</td>
<td>0:00:55.78</td>
<td>0:00:19.72</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:01:22.33</td>
<td>0:00:23.98</td>
<td>0:00:08.00</td>
</tr>
<tr>
<td>C1L2</td>
<td>Control</td>
<td>5</td>
<td>0:00:41.40</td>
<td>0:00:40.66</td>
<td>0:00:18.18</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>6</td>
<td>0:00:49.50</td>
<td>0:00:57.59</td>
<td>0:00:23.51</td>
</tr>
<tr>
<td>C1L3</td>
<td>Control</td>
<td>8</td>
<td>0:04:02.25</td>
<td>0:03:30.17</td>
<td>0:01:14.31</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:04:10.56</td>
<td>0:02:38.33</td>
<td>0:00:52.78</td>
</tr>
<tr>
<td>C1L4</td>
<td>Control</td>
<td>8</td>
<td>0:01:08.88</td>
<td>0:00:27.98</td>
<td>0:00:09.89</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:01:18.89</td>
<td>0:00:32.43</td>
<td>0:00:10.81</td>
</tr>
<tr>
<td>C1L5</td>
<td>Control</td>
<td>6</td>
<td>0:03:43.33</td>
<td>0:01:52.87</td>
<td>0:00:46.08</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>8</td>
<td>0:04:35.25</td>
<td>0:02:17.18</td>
<td>0:00:48.50</td>
</tr>
<tr>
<td>C2L1</td>
<td>Control</td>
<td>8</td>
<td>0:02:49.88</td>
<td>0:01:27.94</td>
<td>0:00:31.09</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:02:03.33</td>
<td>0:00:55.02</td>
<td>0:00:18.34</td>
</tr>
<tr>
<td>C2L2</td>
<td>Control</td>
<td>8</td>
<td>0:02:59.62</td>
<td>0:01:38.55</td>
<td>0:00:34.84</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:03:11.56</td>
<td>0:02:44.16</td>
<td>0:00:54.72</td>
</tr>
<tr>
<td>C2L3</td>
<td>Control</td>
<td>8</td>
<td>0:01:57.37</td>
<td>0:00:53.75</td>
<td>0:00:19.00</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:01:52.78</td>
<td>0:00:55.83</td>
<td>0:00:18.61</td>
</tr>
<tr>
<td>C2L4</td>
<td>Control</td>
<td>8</td>
<td>0:05:37.88</td>
<td>0:03:51.74</td>
<td>0:01:21.93</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:07:19.44</td>
<td>0:03:09.87</td>
<td>0:01:03.29</td>
</tr>
<tr>
<td>C2L5</td>
<td>Control</td>
<td>8</td>
<td>0:04:03.25</td>
<td>0:03:26.69</td>
<td>0:01:13.08</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:08:08.44</td>
<td>0:04:07.23</td>
<td>0:01:22.41</td>
</tr>
</tbody>
</table>
Table 16
Remediation Effect upon Time Spent on Individual Gate Pages (Outliers Excluded)

<table>
<thead>
<tr>
<th>Gate Page</th>
<th>( t )</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1L1</td>
<td>.55</td>
<td>15</td>
<td>.59</td>
<td>0:00:11.29</td>
</tr>
<tr>
<td>C1L2</td>
<td>-.26</td>
<td>9</td>
<td>.80</td>
<td>-0:00:08.10</td>
</tr>
<tr>
<td>C1L3</td>
<td>-.09</td>
<td>15</td>
<td>.93</td>
<td>-0:00:08.31</td>
</tr>
<tr>
<td>C1L4</td>
<td>-.68</td>
<td>15</td>
<td>.51</td>
<td>-0:00:10.01</td>
</tr>
<tr>
<td>C1L5</td>
<td>-.75</td>
<td>12</td>
<td>.47</td>
<td>-0:00:51.92</td>
</tr>
<tr>
<td>C2L1</td>
<td>1.33</td>
<td>15</td>
<td>.21</td>
<td>0:00:46.54</td>
</tr>
<tr>
<td>C2L2</td>
<td>-.18</td>
<td>15</td>
<td>.86</td>
<td>-0:00:11.93</td>
</tr>
<tr>
<td>C2L3</td>
<td>.17</td>
<td>15</td>
<td>.87</td>
<td>0:00:04.60</td>
</tr>
<tr>
<td>C2L4</td>
<td>-.99</td>
<td>15</td>
<td>.34</td>
<td>-0:01:41.57</td>
</tr>
<tr>
<td>C2L5</td>
<td>-2.20</td>
<td>15</td>
<td>.04</td>
<td>-0:04:05.19</td>
</tr>
</tbody>
</table>

Scores and Time at the End of Chapter 2.

In an attempt to examine the effect of remediation over time, gate page percentage scores and times were analyzed for the last two gate pages. These scores and times were combined into one sample and then analyzed. The results from the first \( t \) test indicated that there was no significant effect on overall achievement or time as is shown in Table 18. The mean percentage score, as shown in Table 17, for the control group was \( M = 57.42 \) and for the experimental group \( M = 98.15 \). The means for time for the two groups were \( M = 7 \) minutes 19.58 seconds and \( M = 13 \) minutes 51.77 seconds. Although the
The results from the second $t$ test, which excluded the outliers, indicated that there was no significant effect for time on the last two gate pages, $M = 9$ minutes 41.13 seconds (control) and $M = 15$ minutes 27.89 seconds (experimental) as is shown in Table 19. Once again the experimental group was spending more time but the difference was not statistically significant. There was, however, a significant effect for score on the last two gate pages, $p = .02$, as is presented in Table 20, for equal variances assumed and
outliers excluded. The means for score on the last two pages were \( M = 73.63 \) for the control group and \( M = 125.67 \) for the experimental group.

---

Table 19

Mean Scores for Time Spent and Performance over Time (Outliers Excluded)

<table>
<thead>
<tr>
<th>Source</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Control</td>
<td>8</td>
<td>0:09:41.13</td>
<td>0:06:31.09</td>
<td>0:02:18.27</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>0:15:27.89</td>
<td>0:04:46.93</td>
<td>0:01:35.64</td>
</tr>
<tr>
<td>Score</td>
<td>Control</td>
<td>8</td>
<td>73.63</td>
<td>52.12</td>
<td>18.43</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>9</td>
<td>125.67</td>
<td>28.85</td>
<td>9.62</td>
</tr>
</tbody>
</table>

---

Table 20

Remediation Effect on Time Spent and Achievement over Time (Outliers Excluded)

<table>
<thead>
<tr>
<th>Source</th>
<th>( t ) test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( t )</td>
</tr>
<tr>
<td>Time</td>
<td>-2.10</td>
</tr>
<tr>
<td>Score</td>
<td>-2.59</td>
</tr>
</tbody>
</table>

---

Gate Pages

A closer examination of the gate pages, which can be viewed in Appendix F, showed that the gate pages were related in their content according to their chapter. For example, C1L2, C1L4, and C1L5 were similar because they tested greetings and goodbyes. The gate pages in Chapter 2 were also similar in content and dealt with ways
to describe people. Descriptive content included age, likes, activities, identity, where they lived and where they were from. Therefore a correlation between gate pages of similar content would be expected and was observed.

It was also observed that the end-of-chapter gate pages were a culmination of what the participants had learned in the entire chapter and could be considered the most difficult within the chapter. These end-of-chapter gate pages (C1L5 and C2L5), as is shown in Figure 2, have the most spread between the two groups and are each farther from the mean than the scores on any of the other gate pages.

The results from the Pearson correlation analysis, which can be viewed in Appendix E suggest a correlation within Chapter 1 and an even greater correlation within Chapter 2. In Chapter 1, C1L1 correlated with C1L4 and C1L5. In Chapter 2, C2L1 correlated with C2L2, C2L3, and C2L5. Furthermore, C2L2 correlated with C2L1, C2L4, and C2L5. Between the two chapters there was only one correlation and that was between C1L3 and C2L2.

The Dasher, which was the program used to assess the written answers submitted by the participants, was used on C1L5, C2L1, C2L2, C2L3, and C2L5. The activities on these gate pages were all productive in nature and were more difficult than the other activities that just required recognition. As a result of this common feature, it is possible that the Dasher is the contributing factor to the correlation found between certain gate pages, given that it was used in almost every lesson in Chapter 2. Therefore, although each gate page tested different concepts using different methods, those that used the Dasher were related because they required the learners to produce language and not just recognize it.
The opinion survey elicited some very interesting information about the effect of remediation. The following section provides an overview of the answers and comments that were given about the participants’ experiences in the Swahili 101 lessons in particular the assessment pages and the review pages. First, experiences from the 9 participants in the treatment group are detailed and then the experiences from the 4 participants in the control group are described.

The first question for the treatment group asked about the amount of time the participants spent reviewing in comparison to the amount of time they spent first encountering the materials. Five of the 9 participants said that they spent less time, one said the same amount of time, and the other three said that they did not do the pages because they did not feel like remediation was necessary.

The next question asked if remediation helped them to better understand the subject material. All nine of the participants responded that it did not.

The third question asked if the computer’s assessment was accurate in determining and assigning review. All but one of the participants said no. Those that commented said that they felt that being assigned to review was “unfair” and that the real problem was trying to guess what answers the computer was looking for. Furthermore, when asked if they would have reviewed on their own if the computer had not intervened only one of the nine said yes.

The majority of the participants (8 out of 9) chose the adjective “frustration” to describe their feelings when they had to review. They said they were “guessing”, “going in loops”, that they “didn’t understand the exercises”, or that there was “an error in the
program.” One of those eight also chose the adjective “impatience” to accompany frustration because s/he did not feel like the review was helping him to learn anything new. The other participant that did not choose frustration chose the adjective confusion to express his feelings.

Another question asked if the participants would prefer to determine when they needed to review themselves or if they would prefer to have the computer evaluate and provide review when necessary. Seven of the 9 participants preferred to determine when to review on their own. One of these 7 participants, however, said that although s/he wanted to monitor his/her own learning, s/he also wanted the computer to tell him/her a score to help guide him/her. Finally, of the two that wanted the computer to monitor and provide review as needed, wanted this capability only on the condition that the program was working properly.

Finally, when asked for additional comments one suggested that the review pages be different from the ones that they had already encountered in the lessons. Another person suggested that input be given as to what they needed to review before the review pages began.

The first question for the participants in the control group asked if they ever reviewed on their own accord. Unfortunately their responses were unintelligible.

The second question asked the participants if they would have benefited from or liked to have had some computer intervention to help them know when they needed to review. Two of the four said yes.
The third question asked the participants if they would prefer to decide when they needed to review or if they would prefer to have the computer decide and provide review pages as necessary. All four of them said they wanted to decide when to review.

The fourth and final question solicited additional comments. There was only one response that was related to remediation. This participant said that s/he was very glad that s/he was not in the treatment group because s/he was able to learn at his/her own pace and review when needed.

In sum, those in the treatment group did not like computer intervention. They felt that it was frustrating and they wanted to be able to monitor their own learning. Those in the control group liked monitoring their own learning and deciding when they needed to review. Some did say, however, that they would have liked to have had some guidance to know when to review but that they did not want the computer to provide the review.

Summary

The results from these analyses indicated that remediation had a positive effect on language learning because those in the treatment group obtained higher scores over time, as is most clearly seen in the repeated measures ANOVA. According to the opinion survey, however, those in the treatment group did not like remediation and wanted to be able to determine when to review. The results also suggested that remediation did not affect time spent on the gate pages since those in the treatment group did not spend significantly more time on the gate pages than those in the control group.
Chapter 5: Discussion

Overview

The purpose of this research was to determine whether remediation had an effect on language learning, specifically language achievement, language retention, and time spent on the assessment pages. In order to achieve this purpose, two questions were used to guide the direction of this study. These questions restated are: Do students who go through remediation obtain higher gate page scores (initially and over time) and does remediation increase the amount of time that the language learners spend on the gate pages?

In order to answer the research questions, a study was conducted in which students participated in a Swahili 101 course with computer-assisted exercises available online. Data were collected from the background survey, the pretest, the lesson pages, and the opinion survey which included Swahili language experience and proficiency, gate page scores, time spent on the gate pages, and the participants’ experiences in the online lessons. The analysis and results of these data are reported in Chapter 4.

This chapter will include a discussion of the results presented in Chapter 4. It will also include two sections that compare the results of the data with the current literature. Following the discussion of the data and how these results compare with the literature, there will be a section on the implications of the findings, a section on the limitations that were encountered with this research, as well as a section on suggestions for future research.
Achievement

The results from this study suggest that remediation does have a positive effect upon achievement. This conclusion is based on the fact that those in the experimental group obtained higher gate page scores and learned more Swahili than those in the control group as is shown by the upward trend in gate page scores over time. Additionally, an analysis of variance, which analyzed achievement on the last gate page, as well as a repeated measures analysis of variance, which showed that remediation did have an effect over time; both demonstrated the positive influence of remediation on the gate page scores. Finally, the results from the t test for the analysis that eliminated the outliers for the combined scores obtained on the last two gate pages also confirmed the positive effect of remediation.

The higher achievement may be due to several factors. First, the participants knew that they had to meet a certain requirement in order to proceed in the lessons and as a result they may have paid more attention to the Swahili lessons instead of just clicking through the pages to fulfill the assignment. Second, the guided practice that followed a gate page allowed the participants to focus on the key element(s) of the lessons. This focus lessened the amount of information the participants needed to learn in order to perform as needed on the gate pages. Also, since the participants had already encountered the gate page they were aware of what they needed to understand in order to successfully complete the assessment. Third, because the remediation group had to have a score of at least 70% for each lesson, their level of Swahili knowledge had the potential of increasing at a higher rate than those in the non-remediation group. Finally, the small sample size may have also had a role in affecting the gate page scores. Since the number
of participants was so low, any extreme in score or time would have a large impact on the analysis. This is one of the reasons the \( t \) test was conducted which excluded the outliers.

*Comparison with Findings from the Literature*

The findings from this study, which indicate that remediation does have a significant effect upon achievement, are consistent with the majority of the literature studying college students. Several researchers found that the program-controlled environment did have a positive effect on overall achievement (Fry, 1972; Ross & Rakow, 1981; Gay, 1986). The other researchers found that there was no significant effect of environment on achievement (Kinzie, et al., 1992; Schnackenberg & Sullivan, 2000).

*Time*

The results from the \( t \) tests indicated that times were indeed different on certain gate pages. The gate pages that were affected varied according to whether outliers were included. When the outliers were present, C1L1, C1L4, and C2L5 had a significant effect for time but when the outliers were excluded, only C2L4 was affected by remediation. The results of the data also concluded that there was no effect for time on the last two gate pages combined.

The most interesting gate pages to explore were the last two because of the amount of time that was spent. C2L5 had a mean time of 2 minutes 43.75 seconds for the control group and 8 minutes 36.92 seconds for the experimental group. This difference of almost 6 minutes proved to be statistically significant. The amount of time spent on C2L4 also proved to be statistically significant but only when the outliers were
eliminated. The mean time for the control group was 5 minutes 37.88 seconds and for the experimental group 7 minutes 19.44 seconds.

The significance of this comparison is that the treatment had no universal effect upon time, although the experimental group usually took longer to finish the gate pages. The outliers did play a role in determining which gate pages had significant differences according to treatment. They did not, however, indicate that remediation had a significant effect upon the last two gate pages when they were combined. This is because in both $t$ tests, with and without the outliers, there was no significant effect upon time.

One possible reason for this lack of effect on time may be attributed to the sample population. The language learners in this study were all college students and most likely had good study skills and were able to learn the materials at a fairly even pace. Another reason may be the language lessons themselves. The lessons may have presented the material well enough that the learners were able to learn them without difficulty. A third reason may be the help that the learners could access, namely their Swahili teachers. These teachers were able to answer questions that arose, which made it unnecessary for the learners to spend time extra time searching for the answers in the lessons.

Another consideration may be that, given that the experimental group usually took longer to complete the gate pages, the lack of statistical significance is a result of the small sample size. With higher numbers of participants completing the study, a statistically significant increase in time spent on gate pages by the experimental group may have been found. The study did not establish this, however.
Comparison with Findings from the Literature

The results suggesting that remediation does not effect time on task are consistent with some of the results found in other research. Schnackenberg and Sullivan (2000) concluded that there was no significant effect upon time spent per screen when option and learning environments were examined. All of the other research reported total time spent in the learning environment and therefore do not relate to the findings in this study.

Implications

The findings from this study imply that remediation is important on achievement scores because it does increase the amount of language learned in an online environment. This conclusion is based on two factors. First, there was a statistically significant difference in learner performance between those that had remediation as a form of intervention and those that did not. Second, a plot of the z-scores seemed to indicate an upward trend in gate page scores over time.

The results from this study also indicate that remediation did not increase the amount of time that learners spent on the gate pages. This implication originates from the t tests, which revealed that there was no statistically significant difference in the amount of time that the learners spent on the gate pages for either group.

Limitations

The first limitation of this study was the rate of attrition of the sample population. There were a total of 142 participants who started Chapter 1 lesson 1 and only 38 who completed Chapter 1 lesson 2. After lesson 2 there was an increase of 2 participants (two from lesson 1 who did not complete lesson 2) and thereafter the number of participants fluctuated until it eventually decreased to 25 for the last three lessons of Chapter 2.
After Chapter 2 the attrition continued until Chapter 6, where there were only 5 participants. This attrition had a significant impact on the research because the initial study design included all six chapters. Because so few completed the materials, however, the study was limited to the first two chapters. Furthermore, those that did remain in the study were self-selected, a fact that could hinder the generalizability of the findings.

The target language, Swahili, also proved to be a limitation in this study. Since Swahili is a lesser known language, finding participants was a challenge.

An additional limitation was the number of participants who completed the end of course examination. Even after measures were taken to increase the number of those who would complete the exam (i.e., requesting that completion be a part of their grade, modifying the test itself to make it shorter, and allowing the participants to complete it in multiple sessions) very few did. This poor completion rate prevented assessment of overall achievement.

Finally, technology was a limitation in this study because it created some difficulty in the learners’ ability to complete the assessments, surveys, and lessons. For example, some of the pretest answers were not recorded for certain participants because of an error either involving the central server or the school where the learner attended. Other problems such as the server being down or firewalls blocking some of the media content affected the ease of using the Swahili online course materials. As a result, the number of participants who completed all components of the study was smaller than it would have been had there been no difficulties encountered.
Suggestions for Future Research

There are numerous aspects of this study that could be examined in greater detail to build upon and verify the current findings. One would be to conduct this study with a larger participant sample, with higher participant numbers, and with more schools involved. This would increase the generalizability of the findings as well as provide more precise data on remediation, time, and achievement.

This study only investigated novice Swahili learners. Another consideration would be to include different target languages and examine the effect of remediation across languages. The use of multiple language groups would expand the validity of the data and increase the generalizability of any findings.

A third suggestion would be to investigate how learners felt during remediation. Questions could be asked about whether learners found remediation to be beneficial to their learning and/or whether they found it frustrating to have to repeat previously encountered material. Although the opinion survey asked several questions regarding these emotions, pop-up screens immediately following remediation would provide a more accurate account of how remediation affected the learners.

Further analysis could categorize the various gate pages according to screen type and then investigate correlations between gate page type, score, and time spent completing the gate page. This would reveal more about the gate page scores and whether certain screen types required remediation more often than others.

Finally, conducting research that explored how time affects performance on the gate pages might yield some interesting findings. A study of this factor could include initial time spent learning the materials, time spent learning the materials in remediation,
and total time spent learning. Analyses, also could explore the possible correlation between time spent learning and language retention (per lesson and chapter).

**Conclusion**

The computer-adaptive control, namely remediation, used in this study significantly improved achievement but had no effect upon time spent on the gate pages. Because of this significant improvement in achievement, it can be concluded that college language learners may benefit from computer intervention because they learn more and retain more, as demonstrated by higher scores. Thus, using remediation in online courses appears to be an effective way to help learners learn language, given that it helps them increase achievement scores. This is especially interesting, given that learners do not feel inclined to spend more time on the assessment pages. More research needs to be done to confirm these findings, however.
References


instruction: An alternative form of learner control. *Educational Technology
Research and Development, 43*(2), 5-14.

current literature review. *Educational Technology, 30*(11), 47-49.

Fry, J. (1972). Interactive relationship between inquisitiveness and student control of

Gay, G. (1986). Interaction of learner control and prior understanding on computer-


learning, self-regulation, and cognitive strategies. *Studies in Higher Education,
31*(1), 99-117.

*Educational Technology Research and Development, 37*(2), 5-14.

science computer-assisted instruction. *Journal of Educational Psychology, 80*(3),
299-303.

effects of learner control over content review within CAI. *Journal of Educational
Computing Research, 8*(1),101-114.


Appendix A

Informed Consent Form

The purpose of this research study is to determine the effect of learner-controlled learning and adaptive program-controlled learning environments on overall achievement. Leslie Bachelder, a graduate student in language acquisition at Brigham Young University, is conducting the study. You were selected for participation based on your knowledge of Swahili prior to beginning the CALL application and your desire to learn Swahili.

You will be asked to complete the Swahili 101 computer-assisted course. Each lesson is expected to take between thirty minutes and one hour to complete. You will then be asked to complete a Swahili 101 examination and an end-of-study questionnaire.

There are some benefits for participation in this study with no known risks. The participants who are taking a Swahili class will be able to supplement their learning. Those not taking a Swahili class will be exposed to basic vocabulary and communicative survival skills. Finally, for participants planning on working in Swahili speaking countries, this course will provide insights to culture through video and images which will aid in their understanding of Swahili daily life.

Information gathered with this study will remain confidential and will be reported as a group and not as data identifying individual participants. This strict confidentiality will be maintained by replacing participant names with control numbers and login names.

Participation in this research is voluntary. Each participant has the right to refuse to participate and the right to withdraw at any time without any jeopardy to grades or employment.

If you have any questions regarding this research project, you may contact Leslie Bachelder by e-mail: lesliebachelder@yahoo.com or through the Department of Linguistics, Brigham Young University, 2025 JKHB; phone (801) 422-2937.

If you have questions regarding your rights as a participant in a research project, you may contact Dr. Shane D. Schulthies, Chair of the Institutional Review Board, 120B RB, Brigham Young University, Provo, Utah 84602; phone (801) 422-5490.

Clicking on the “AGREE” button implies that the participant has read, understood, and agrees of their own free will and volition to participate in this study and accepts the benefits and risks related to the study. Copies of this consent form are available from Leslie Bachelder upon request.
Appendix B

Background Survey

Participant Information:

<table>
<thead>
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<th>Question</th>
<th>Answer options from drop-down box</th>
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</thead>
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<td>What is your native language? (Your</td>
<td></td>
</tr>
<tr>
<td>primary language if bilingual)</td>
<td></td>
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<td>Enrolled in a Master’s program</td>
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<td></td>
<td>Earned a Master’s Degree</td>
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<td>Enrolled in a Doctoral program</td>
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<tr>
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<td>Earned a Doctoral degree</td>
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Language Learning Information:

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<td>Do you know or have you studied a second</td>
<td>Yes</td>
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<tr>
<td>or third language?</td>
<td>No (No further questions)</td>
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<tr>
<td>What is your second language?</td>
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<tr>
<td>How did you learn the second language?</td>
<td>School</td>
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<tr>
<td></td>
<td>In a country or with a family that speaks the second language</td>
</tr>
<tr>
<td></td>
<td>Other</td>
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<tr>
<td>How long have you been learning the second</td>
<td>Less than 6 months</td>
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<tr>
<td>language in school?</td>
<td>6-12 months</td>
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<td>1 year</td>
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<td></td>
<td>2 years</td>
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<td></td>
<td>3 years</td>
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<tr>
<td></td>
<td>More than 3 years</td>
</tr>
<tr>
<td>How long have you been learning the second</td>
<td>Less than 6 months</td>
</tr>
<tr>
<td>language in-country or with a family?</td>
<td>6-12 months</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
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<tr>
<td></td>
<td>2 years</td>
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<td></td>
<td>3 years</td>
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<tr>
<td></td>
<td>More than 3 years</td>
</tr>
<tr>
<td>Question</td>
<td>Answer options from drop-down box</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
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<td>How would you rate your proficiency in that language?</td>
<td>Beginner, Intermediate, Advanced</td>
</tr>
<tr>
<td><strong>Third Language Information:</strong></td>
<td></td>
</tr>
<tr>
<td>Do you know or have you studied a third language?</td>
<td>Yes, No (No further questions)</td>
</tr>
<tr>
<td>What is your third language?</td>
<td></td>
</tr>
<tr>
<td>How did you learn the language?</td>
<td>School, In a country or with a family that speaks the language, Other</td>
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<td>How long have you been learning the third language in school?</td>
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<td>How long have you been learning the third second language in-country or with a family?</td>
<td>Less than 6 months, 6-12 months, 1 year, 2 years, 3 years, More than 3 years</td>
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<td>How would you rate your proficiency in that language?</td>
<td>Beginner, Intermediate, Advanced</td>
</tr>
<tr>
<td><strong>Exposure to Swahili:</strong></td>
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<tr>
<td>Have you been exposed to, studied or do you speak Swahili?</td>
<td>Yes, No (No further questions)</td>
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<tr>
<td>How did you learn the language?</td>
<td>School, In a country or with a family that speaks Swahili, Other</td>
</tr>
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<td>How long have you studied or spoken Swahili in school?</td>
<td>Less than 6 months, 6-12 months, 1 year, 2 years, 3 years, More than 3 years</td>
</tr>
<tr>
<td>How long have you studied or spoken Swahili in-country or with a family?</td>
<td>Less than 6 months, 6-12 months, 1 year</td>
</tr>
</tbody>
</table>
| How long has it been since your last exposure to the Swahili language? | Less than 1 year  
|                                                                 | 1-2 years  
|                                                                 | 3-4 years  
|                                                                 | 5-6 years  
|                                                                 | 7-10 years  
|                                                                 | More than 10 years  
| How would you rate your proficiency in Swahili?                 | Beginner  
|                                                                 | Intermediate  
|                                                                 | Advanced  

### Computer Experience Information:

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer options from drop-down box</th>
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</thead>
</table>
| How would you rate your computer proficiency?                           | Beginner  
|                                                                           | Intermediate  
|                                                                           | Advanced  
| How many hours a day do you spend on a computer?                        | Less than 1  
|                                                                           | 1-3  
|                                                                           | 3-6  
|                                                                           | 6-9  
|                                                                           | More than 9  
| Have you participated in self-paced learning, online courses or computer-assisted learning? | Yes  
|                                                                           | No  
| How would you rate your experience?                                     | Negative  
|                                                                           | Neutral  
|                                                                           | Positive  
| What are your expectations of this online course?                       |
Appendix C

Swahili Pretest

1. In a Disney movie, the expression “no worries” is the same as the Swahili expression
   a. Hakuna matata
   b. Jambo bwana
   c. Habari yako
   d. Nzuri sana

2. The word for friend, which is also the name of the monkey in Disney’s Lion King, is
   a. Simba
   b. Nala
   c. Mufasa
   d. Rafiki

3. Which of the following is NOT a Swahili greeting?
   a. Hujambo
   b. Poa
   c. Vipi hali
   d. Habari gani

4. What is the word for sister is Swahili?
   a. Baba
   b. Bibi
   c. Dada
   d. Dula

5. A correct answer for Anamiaka mingapi would be:
   a. 12:15 pm
   b. Kaden
   c. 15 years old
   d. Wednesday

6. What is the verb that expresses like?
   a. Penda
   b. Pika
   c. Taka
   d. Lala

7. One of the most common forms of transportation is a truck that carries numerous passengers in the back. It is called a
   a. Pikipiki
   b. Gari
   c. Baisikeli
   d. Daladala
8. Which of the following is NOT a day of the week?
   a. Jumatano
   b. Alhamisi
   c. Ijumaa
   d. Jumamoja

9. Women often wear a colorful cloth around their head and waist. It is called a
   a. Kanga
   b. Kofia
   c. Buibui
   d. Viatu

10. The expression Jina lako nani is asking for
    a. The time
    b. A person’s name
    c. A person’s age
    d. The date

11. Which of the following markers indicates the past tense?
    a. Ni
    b. Li
    c. Ki
    d. Si

12. Which of the following is NOT a Swahili food?
    a. Birianyi
    b. Pilau
    c. Paka
    d. Samake
    e. Chipsi

13. Which of the following expressions is in the present tense?
    a. Ninataka pesa
    b. Nitataka pesa
    c. Nikutaka pesa
    d. Nitaka pesa

14. Which of the following is NOT found in a classroom?
    a. Mwalimu
    b. Mwanafunzi
    c. Kalamu
    d. Tembo
15. Which of the following is NOT commonly found in a house?
   a. Meza
   b. Dirisha
   c. Muwa
   d. Chumba
   e. None of the above

16. What tense is expressed in the following sentence: Nitarudi shuleni.
   a. Past
   b. Present
   c. Future

17. What expression would you use to ask if someone has already eaten a certain food?
   a. Umeshakula
   b. Utakula
   c. Umekula
   d. Umolakula

18. What pronoun is used when talking about another person?
   a. Huyu
   b. Hawa
   c. Hamna
   d. Huko

19. Which of the following expressions is in the negative?
   a. Mlikula
   b. Hakula
   c. Wakula
   d. Tulikula

20. The verb phrase Alikuwa na is the equivalent of which verb in English?
   a. To be
   b. To have
   c. To need
   d. To want

21. Which of the following expressions is the correct form for the verb to wash clothes for someone?
   a. Kufua
   b. Kufulia
   c. Kuosha
   d. Kuoshea
22. The tense marker in Tumekwenda indicates that something
   a. happened in the past at an indefinite time
   b. will happen in the future
   c. happened in the past at a specific time
   d. didn’t happen in the past

23. Which of the following expressions means I was not at the store?
   a. Sikuwemo dukani
   b. Sikuwepo dukani
   c. Sikuweko dukani
   d. Sikuweloo dukani

24. Which of the following expresses to not have?
   a. Wana
   b. Muna
   c. Tuhana
   d. Hamna
Appendix D

Opinion Survey

One of the purposes of this study was to investigate the effectiveness of a computer system that monitored certain students' learning and then determined if and when those students needed to review. Those in the treatment group were given sections A and B to complete and those in the control group were given sections A and C.

Section A

1. What were the strengths of this program? Please be very specific and give examples including lessons, activities, etc.

2. What were the weaknesses? Please be very specific and give examples including lessons, activities, etc.

3. On average, how much time did you spend on each lesson?

4. When did you complete the lesson that was assigned for class? (Just before, the night before, two days before, etc.)

5. Which of the following activities/media were the most helpful? Please rank the ones you choose with 1 being the highest.
   - Video
   - Video with subtitles
   - Audio alone
   - Audio with images
   - Grammar explanations
   - Drag and drop
   - Check boxes
   - Fill-in-the-blank
   - Sentence writing
   - Paragraph writing

6. Would you recommend this course to someone wanting to learn Swahili? What specifically would you tell them about it to help them make their decision?

7. If we were to create another online language course, what should we do differently to make the materials more useful for you, as a student?

8. Would you be willing to participate in a more in-depth interview?

Section B

Please answer the following questions if you had to complete any remediation pages:
1. How long did you spend on the remediation pages? (more or less time than the first time thru?)

2. Did you feel like the remediation pages helped you to better grasp the subject?

3. In general, when you were sent through remediation did you feel that the computer’s assessment was accurate? If not, would you have made the standard higher or lower?

4. Based on your experience and the times that the computer sent you to review certain pages, would you have gone and reviewed those or others if the computer had not intervened?

5. Choose the adjective that best describes your feelings when you had to do remediation pages:
   a. relief
   b. frustration
   c. excitement
   d. impatience
   e. other: _____________
   Please provide more explanation as to how you felt and why.

6. Would you prefer to determine when to review or have the computer evaluate your progress and provide review pages when necessary?

7. If you have any other comments that you would like to add, please do so in the space below.

Section C
Please answer the following questions if the computer never sent you back to review certain pages in any of the lessons:

1. Did you ever go back and review a page, several pages, or a lesson on your own?

2. Would you have benefited from or liked to have had some computer intervention which would have helped you to know when you needed to review?

3. Would you prefer to determine when to review or have the computer evaluate your progress and provide review pages when necessary?

4. If you have any other comments that you would like to add, please do so in the space below.
Table 21

Correlation of Gate Pages According to Z-scores

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<th>C1L4</th>
<th>C1L5</th>
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**Correlation is significant at the 0.01 level (2-tailed).**
*Correlation is significant at the 0.05 level (2-tailed).*

Note: The first number in the column is the correlation value, the second is the level of significance (2-tailed), and the third is the number of participants (N).
Appendix F
Gate Page Screen Captures
Chapter 1 Lesson 1 (C1L1)
Chapter 1 Lesson 2 (C1L2)

Now let's see how good you really are at greeting in Kiwahili. On this page you will have the opportunity to try your greeting skills on Joe. He will start you out by greeting you. After Joe greets you, type a response in the box provided and then press "Itika." When you have responded correctly you will then need to greet Joe by typing into the box and pressing "Ankaia." The computer will not let you continue on unless you have spelled the response or greeting correctly. If you are having trouble spelling a particular word, you may refer to the drop-down word boxes of 'greetings' and 'responses' provided below. (Remember not to use any punctuation in your responses.) Each greeting must be different from the previous ones you used. You must complete at least five greetings to finish the activity, but there are ten possible choices provided. See if you can get all ten!

Watch the video, then type a response to Joseph in the textbox below. Press 'Itika' to try your response.

Number of greetings so far: 0
Click on each of the speaker icons and listen to the phrases. Match the phrases you hear to the corresponding kanga by dragging the 'jina la kanga...' labels onto the drop areas next to the kangas. When you are done, click the 'check answers' button.
Chapter 1 Lesson 4 (C1L4)

Swahili 101

Chapter 1
Lesson 1
Lesson 2
Lesson 3
Lesson 4
Page 1
Page 2
Page 3
Page 4
Page 5
Page 6
Page 7
Page 8
Page 9
Page 10
Page 11
Page 12
Page 13
Page 14
Page 15
Page 16
Lesson 5
Chapter 2
Chapter 3
Chapter 4
Chapter 5
Chapter 6
Appendix
Kamus
Login

Listen to Juma's friend greet you. You need to respond to his greeting and then select the response from the drop-down menu. Continue to respond to his greetings several times. After you have done this he will ask you a question. Answer his question using the correct kiwahili phrase and then ask him the same question in return.
Chapter 1 Lesson 5 (C1L5)
Chapter 2 Lesson 1 (C2L1)

Swahili 101

Chapter 1

Chapter 2

Lesson 1

Lesson 2

Lesson 3

Lesson 4

Lesson 5

Lesson 6

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Appendix

Kamusi

Logout

Chapter 2 Lesson 1

Wewe ni nani

Let’s see if you can identify what each person is. Look at the people on this page and answer the questions underneath each one. The first picture serves as an example. Tumia!

Huwa ni mungu?

Huwa ni kijana?

Huwa ni mwalimu?

Huwa ni mwalimu?

Huwa ni mwalimu?

Huwa ni mwalimu?

Huwa ni mwalimu?

Huwa ni mwalimu?

Huwa ni mwalimu?

Huwa ni mwalimu?
Chapter 2 Lesson 2 (C2L2)

The computer is going to ask you if the people pictured below are a certain age. Answer saying yes, he is that age or no he is not that age, he is this age. Look at the example below and then complete the activity yourself.

Example:

[Images of people]

[Input fields for user to write their answers]
Chapter 2 Lesson 3 (C2L3)

Watch each video and then click on the speaker icons below each one. Respond to the questions out loud and then type your answer into the text box. If you've forgotten where they are from or where they live, click on the video to hear again. Remember, when you are talking about someone else, you use the a prefix.
Chapter 2 Lesson 4 (C2L4)

Swahili 101

Chapter 2

Lesson 4

What do you like to do? Look at the pictures below and then say out loud and type in whether you like each of the activities/occupations or not. If you can't remember the word for a certain occupation, check the drop-down box below. Use the word bank to help you with unfamiliar words.