I. Introduction.

This past summer, four MIT students conducted the inaugural MIT-AITI (African Internet Technology Initiative) project at Strathmore college in Kenya. The project involved teaching a four week Java seminar and a one week UNIX course. In addition to teaching, the MIT students helped improve the school network by delivering switches and a router which were integrated into the schools existing network.

The goals of the project included: introducing web technology to an African school by teaching students how to write simple applications that utilize resources on the web, promoting cultural interaction between MIT and African students and providing the building blocks for both students and faculty that would enable them to explore the web's potential. The project achieved this and much more.

In this report we document how the project was carried out, the implementation details, the objectives achieved, the benefits of the program and the problems encountered. We also discuss recommendations for future programs.

II. Overview

The project started on June 2nd, 2000 and ended on July 4th, 2000. The first week involved setting up the labs, installing software, and reviewing the curricula with the school administrators. The next three weeks involved teaching an intensive Java seminar. Throughout the fifth week the students participated in web site development

projects that involved the local communities. Also during that last week, the switches were integrated into the network.

III. Implementation

This section details how the Java seminar was carried out: the syllabus employed, the number of students in the seminar, their background, the projects they carried out, the organizations they worked for, and the impact the seminar had. In addition to the Java seminar there was a one week course on Unix. The implementation details of this course and its ramifications are also discussed.

A. Java Seminar.

There were forty-five students registered for the java seminar and none of them had previous experience with java - this was one of the reasons why we had decided to offer Java. Nevertheless, the students were computer literate and had worked with computers before. A number of them also had some experience in programming, but only a few students had experience with Objected Oriented Design.

The curriculum we had developed in Boston had not adequately addressed Object Oriented Design so we revised it. The new version included design methodologies which would enable the students to learn proper design techniques for Java as it is an Object Oriented language. After consulting with the school, we included three speakers in the web development field in Kenya in our teaching schedule. We felt that three weeks of continuous Java teaching would prove monotonous; therefore, we had a speaker come once a week and deliver one to two hours of lecture on web related material.

The seminar ran on weekdays. Classes began at 9:00 a.m. in the morning and end at 5:00 p.m with two morning sessions and one afternoon section. The two morning sections ran from 9:00 a.m. - 10:00 a.m. and 10:30a.m. - 12:30 p.m. In these sessions we taught theory regarding the Java language and object oriented design. The afternoon session ran from 2:00 p.m - 5:00 p.m. In these sessions we had lab exercises where students were able to practice using Java and what they had learnt in class. We were able to run the seminar at these times because the school was on vacation and they had dedicated their main lab to our project.

The class syllabus was based on the one used in Lynn Stein's Introductory Java class (Lynn Stein is a professor at MIT). We modified it to include more internet related material and focused more on object oriented design. (Table 1)

Table 1. MIT -AITI Java Class Syllabus

Week	**MONDAY**	**TUESDAY**	**WEDNESDAY**	**THURSDAY**	**FRIDAY**
Week one	Introduction	Expressions and Statements	Expressions and Statements	Objects/Classes	Objects/ Classes
Week two	Interface/ Exceptions	Inheritance	Object Oriented Programming	Object Oriented Programming	Event Driven Programming
week three	Communication	Communication	Servers/Applets	Servers/Applets	Graduation
week four	Project	Project	Project	Project	Project

The first two weeks of the workshop involved teaching the java language and object oriented design philosophies. The lessons in the third week were geared toward using Java on the internet while the fourth week involved project implementations

In addition to learning the basics of Java the students learnt how to create applets and integrate them onto HTML code. They also learnt how to create a simple Java server and client application. Armed with their new Java knowledge the students were split

into groups of five and each assigned to a project. The groups were free to develop their own projects and those that didn't have a project in mind were assigned projects that the school had identified.

The school had selected several local organizations to work with the AITI group. Some of these organizations required their web pages upgraded while others needed new sites. Organizations cooperating with the AITI project included local high schools and governmental organizations. The following is a list of organizations for which the students developed projects:

- National Museums of Kenya
- Highway Secondary
- Kenya WildLife Service
- Kenya Book Foundation
- Family Life Counselling Association Of Kenya
- Strathmore Website
- All Saints Cathedral Primary School Website

One group worked on their own independent project which was to build a portal.

This phase of the project helped the students implement their newly acquired knowledge and skills by carrying out real life projects. One of the consequences of this was that local institutions benefited directly from the initiative. For example, All Saints Cathedral Primary School, which previously did not have web presence received a new website.(htt) Apart from impacting the local community the "hands-on" experience spurred the students to think independently and pursue their own web initiatives; one of

our students approached a local radio station with the proposal of designing a site for them. We are continuing to monitor his progress.

Local web development companies also showed a keen interest in the students. Three of them interviewed our students after the seminar with the intention of employing a number of them. This was the kind of reaction that we had hoped to generate with our workshop.

After the Java workshop there was a closing ceremony officiated by African Online CEO Ayisi Makatiani. At this ceremony the students were awarded certificates of completion. In his speech, the CEO addressed the relevance of the web in developing countries and recognized the role AITI would play in such a sector. The members of the AITI project emphasized the role of MIT and that of the sponsors in making the project come through. This event was covered by the local media and appeared in two of East Africa's leading magazines - *the Standard* and *the East African*. The AITI program and its overall objectives was given a full page dedication in *the Standard*. The event was also covered by local television- a presentation about the project was aired on KTN -Kenya Television Network.

B. Unix Seminar

In tandem with the Java workshop we also carried out a one week seminar on Linux. This seminar was attended by lecturers and system and network administrators at the college. This one week course had five students. The college was moving its operating system onto a unix platform and had asked us to help them better understand linux. We incorporated this into our program: the students were taught linux for about an hour and half each day for a week (table 2). At the start, some had only heard of linux while oth-

ers had received some limited exposure. By the end of the seminar, however, they were comfortable with the basic Linux commands and confident with working on their new platform.

Table 2. MIT AITI Linux Class Syllabus

Day 1:	Basics of file and directory use and manipulation
Day 2:	File ownership and permission
Day 3:	Account customization and networking
Day 4:	Process control and system administration: installing new software, backing up data and keep track of disk usage.
Day 5:	Topics by request: Emacs, DNS, NFS, NIS,

The Linux class had an excellent student to teacher ratio which gave the students more individual attention. With only five students it was much easier to judge how well the students were understanding lectures from their questions and facial expressions. The small class size also seemed to help foster more questions (See appendix B).

This class had not been part of the original program but was added at the request of the teachers and administrators. The seminar was very well received and we believe it succeeded in “de mystifying” Linux for the administrators who, by the time we left, were doing installations and solving problems on their own. We encountered several snags in installing the Linux lab and several of these problems were solved not by the MIT crew but by the students. Often the most difficult part of solving a problem in Linux is learning which command or tool to use; one of the goals of the class was to teach the students where to look for solutions to problems and how to use the wealth of documentation and support available for Linux. We feel that the class, even though it was only 5 days long, covered the basic principles necessary to understand linux and introduced the students to many different topics and concepts that they can continue to learn about.

IV. Problems Encountered

In this section we report the problems we encountered while implementing the Java and Unix Seminars. The problems range from lack of enough reference material for the students to impractical student to teacher ratios during lab times.

A. Java Seminar

The following are the problems we encountered while teaching the Java seminar:

1. Student To Teacher Ratio.

We had a class of 45 students and three teachers on duty during the afternoon lab sessions. We found that this was inadequate for individual student attention during the three hours of lab; we were unable to effectively spend enough time with each of our students.

2. Lack of our own computer.

The college was locked up at seven-thirty p.m. everyday. This meant that to prepare for the next day's lessons and lab exercises we had to borrow a laptop computer to use in our hotel at night. In some occasions the laptop was not available and this was an inconvenience because we were forced to handwrite notes instead of making slides.

3. Lack of Books

We did not carry books on Java programming with us which meant the students lacked reference material. Although they had web access and could have looked up tutorials and references online, the computer laboratory was not always available. We should have brought a number of books to be kept in the class library.

B. Unix Seminar

1. Lack of free computers for Unix lab

The largest difficulty was not having a working Linux lab when the class began. As a result, at the start of the course, there were not enough computers for the students. By the end of the class, there were more computers made available. While frustrating, the problem was not insurmountable and we, as well as the students, felt that the class went quite well. This problem arose because we had not initially planned for a Linux course.

V. Recommendations

For a proper interactive session with students we think that a ratio of about 1 teacher to 10 students would suffice. This would mean either reducing the class size, increasing the number of teachers, or increasing the lab time. We would prefer increasing the number of teachers.

For the MIT students to be able to have flexible working hours we believe that a lap top computer is essential. This would enable them to work independently, outside school hours and at their residences if the need arises.

The lack of enough books for the students was an oversight on our part. Next time we will include extra books and reference material as part of our package.

The lack of a prepared lab for Linux was an artifact of its late inclusion into the program. This problem can be easily solved in future years by having some or all of the students arrive in advance to prepare the facilities before the classes begin.

VI. Program Impact and Benefits

Why was our project important? What did we accomplish? The main goal of the program was to empower the students with knowledge concerning the internet and teach them how to create simple java applications that can run on the web. We believe that the program did indeed accomplish this. We exposed the students to Java technology and bequest them with enough knowledge for them to be able to pursue it further and develop their skills; the projects the students did is testimony to this.The following site contains links to the projects http://web.mit.edu/mit-africa/AITI/summer00.html.

The speakers brought in from the industry not only added diversity to the curriculum, but they also shared their real life experiences with the students. The speakers, who happened to be budding entrepreneurs, presented a business view to web development which complimented the technical skills the students were receiving. This gave students a well rounded view of technology and business.

The Java course empowered the students with enough foundation skills in Java to enable them to write simple stand alone progams. These are skills that could be used in their university study or in the local software marketing which is beginning to grow. The internet is picking up in Kenya and the students are now in a competitive position thanks to their introduction to Java. In fact a number of our students were hired by some of the web companies operating in Kenya as a direct result of our project.(Appendix A)

On the other hand, local organizations benefited from the project as they had new websites built for them or old ones upgraded. Thus, the project had a positive effect on the community.

The exposure AITI received through the media highlighted the help given to the project by MIT and its sponsors 3COM and AfricaOnline. This publicity, we believe, helped show the East African people the kind of initiatives that MIT, as a leading technological school, supports. It also showed MIT's commitment to producing and fostering technology as well as spreading it to other parts of the world for the development of mankind as a whole.

VII. Future Prospects

Following the success of this first AITI initiative we are planning to carry out the same project next year with the improvements suggested. Our goal is to teach as many students as our resources will allow. While in kenya we did a survey on the potential of expanding to other schools that are near strathmore college. There was, however, a problem in that the country is going through an energy crisis and most of the schools do not have a steady supply of power. This means that expanding to these schools would be difficult. The government, however, has commissioned projects that will increase power output by the end of this year and the situation is supposed to improve. Strathmore college has agreed to act as a hub for us to teach students from different high schools next year. Since they already have connectivity and resources, their offer to host a number of schools alleviates our problem. Furthermore, they also plan to invite students from a school in Uganda and Ethiopia to participate in the workshop. This would improve our regional participation and move AITI toward its goal of teaching African students about the internet and how they can enter into the world of information technology. We are also currently looking into going to Ghana; one of our members is busy doing a feasibility study there and if the results are positive we also hope to expand the project there. Other countries that we hope to spread to in the near future are South Africa and Gabon.

VIII Conclusion.

In conclusion, we have demonstrated that the AITI model for internet teaching in Africa is applicable and feasible. The project is flexible enough to accommodate regional changes - the curriculum can be changed in consultation with the school to see what best meets the students needs. This project achieved its goals of introducing internet technology to African students and had other positive effects - we were able to work with the local community and have students design web sites for them, the inclusion of leading web technologists in our schedule provided students with first hand information on web development in Kenya and introduced them to entrepreneurship. As a result of the skills they acquired, a number of our students were able to get jobs with local companies. Most importantly, however, we left them with sufficient skills and knowledge to prepare them for the internet cyclone that is about to hit Africa.

ACKNOWLEDGEMENTS

We would like to thank several people whose help made this project possible. They are important contributors who through their suggestions, comments, financial support and direction inspired us to do this project.

We are very grateful for the guidance, inspiration and direction that has been provided to us by Professor Paul Gray through all the stages of the project implementation.

The development of the project has been heavily influenced by many members of the MIT community and alumni. These members have provided assistance in terms of ideas, financial support and criticism. In particular we would like to thank the following people: Gordon and Kate Baty, Professor Lynn Stein, Professor Bob Rose, Dean Isaac Colbert, Doctor Philip Clay, Patricia Gercik, Professor Suzanne Berger, Martin Mbaya, Solomon Assefa, Saria Hassan, Phillip Osafo, Amy Capman, Christine, Jake Seid, Paul Gallagher, Ron Cao, Andrew Nevins and Eric Traub. We would also like to thank the Legal Office at MIT for helping us with Export procedures, in particular Tom Henneberry and Peter Roggeveen.

We would like to thank our sponsors 3Com who provided us with net working equipment. In particular we would like to thank Mr. Bill Swift of 3Com who tirelessly worked with us on procuring the equipment. Also we would like to thank Africa Online for their financial contribution especially their CEO, Ayisi Makatiani, for presiding over the closing ceremony at the college.

From the Kenyan side we would like to thank Strathmore College for letting us use their facilities and agreeing to host four MIT students. We would like to thank Joe

Sevilla (the Strathmore College Project Manager), Mr. George Njenga and Father Paul Mimbi, who constantly provided assistance to us while we were in Kenya.

There are many others who are not named but whom we earnestly thank for their various contributions.

Appendix A: Report From Strathmore College

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Return-Path: <jsevilla@strathmore.edu>
Received: from MIT.EDU by po12.mit.edu (8.9.2/4.7) id JAA12332; Tue, 22 Aug 2000 09:48
Received: from linux.fora-net.com by MIT.EDU with SMTP
        id AA01235; Tue, 22 Aug 00 09:47:27 EDT
Received: from athi.strathmore.edu (strathmore.edu [212.49.88.77])
        by linux.fora-net.com (8.9.3/8.9.3) with ESMTP id QAA31521;
        Tue, 22 Aug 2000 16:46:31 +0300
Received: by athi.strathmore.edu with Internet Mail Service (5.5.2448.0)
        id <RM472MKF>; Tue, 22 Aug 2000 10:22:00 +0300
Message-Id: <A0456ADADD5ED411B96E0080AD7E75C914E3C2@athi.strathmore.edu>
From: Joseph Sevilla <jsevilla@strathmore.edu>
To: Paul K Njoroge <pnjoroge@MIT.EDU>
Cc: wbaya@hotmail.com, arevins@MIT.EDU, junta@sub-zero.MIT.EDU
Subject: MIT-AITI / Strathmore College Project Report
Date: Tue, 22 Aug 2000 10:21:58 +0300
Return-Receipt-To: Joseph Sevilla <jsevilla@strathmore.edu>
Mime-Version: 1.0
X-Mailer: Internet Mail Service (5.5.2448.0)
Content-Type: text/plain;
        charset="iso-8859-1"

Re: MIT-AITI / Strathmore College Project Report

Forty-five Strathmore students attended the Java course taught by the
MIT-AITI team during June/July 2000. A further five members of staff
attended a one-week Linux introductory course held over the same period.

The courses were well conducted. The preparation and delivery of the classes
was done in a professional manner. The topics chosen were very relevant for
the local scene; a lot of interest in the Internet and e-commerce has been
developing in Kenya over the last year and there is an extreme shortage of
IT professionals with the adequate skills to develop web-based applications.
The students shared in the enthusiasm of the lecturers and learnt a lot over
a short period of time. Some of them have already found jobs due to the
skills they acquired during the course. The feedback that I received from
participants was very positive.

A number of guests from local industry were also invited to give a few
lectures on more general topics. Apart from breaking the monotony, I think
the participants were helped to understand the current needs, problems and
limitations facing our environment and learned some practical ideas on the
way ahead.

The MIT-AITI group also received a donation of network equipment from 3COM
for the College. The equipment was installed and has noticeably improved
network performance in the computer labs.

We appreciate this initiative and hope to continue with this collaboration
and organize similar courses in the future.

We would like to extend our gratitude to all who were involved in the
project.


Joseph Sevilla
Strathmore College
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Appendix B. Photographs

Andrew teaching a JAVA theory session in the morning.

The computer lab in which the students did their practicals.

Eric Traub teaches Strathmore Administrators how to work with Linux.

Appendix C: Budget

The airfare from Boston to Nairobi costs approximately $1300 per person. In Nairobi we stayed at a guest house for $60 dollars a night. Transportation from Strathmore to the guest house in Nairobi cost about $2 per person per day. Food cost fifteen dollars per person per day. Also included are miscellaneous costs; this covered things such as, service fees etc. The total budget for a duration of five weeks for one person was.

	Cost	No. of Days	Total
Round-Trip Airfare	1800		1800
Hotel	60	35	2100
Food	15	35	525
Ground Transportation	2	35	70
Miscellaneous	4	35	140
Travel Visa	50		50
			4685