

Between Tanzania and Finland: Learning Java over the Web

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Abstract

A pilot project between two institutions of computer science, one in Finland and the other in Tanzania, reveals potentials and risks of a collaborative learning framework. Two groups, one from the Department of Computer Science at the University of Helsinki, Finland, and the other from the Computing Centre of the University of Dar Es Salaam, Tanzania, were designing a web-based environment for learning the Java programming language. Preliminary experiences indicate that the challenges of the scheme fall into at least four categories, namely those of technicalities, organizational aspects, attitudes, and cultural differences.

1. Introduction

In several future visions, the Internet is characterized as the first technology to guarantee education for all those connected to the net [10]. As a practical expression of this dream, the World-Wide Web provides its global users with an increasing amount of educational sites. However, much of this effort reflects quite a traditional educational attitude: the sites serve as a cornucopia of information, to be poured on their information-thirsty consumers. The situation closely resembles the phase shift in international development aid politics. In the past, the politics emphasized one-way development aid which has largely been replaced by a more equal two-way – or even multi-way – collaboration. Hopefully, the same shift will happen also in distance education: instead of dividing the world into information producers and consumers, the future Web will serve as a shared construction ground for human learners.

In a pilot project, a group of Finnish students designed a learning environment TAOJAVA on the Java programming

language. TAOJAVA was to be used and developed further with Tanzanian students who participated in the design process by giving feedback and presenting questions. Tanzanian students were *not* provided with flashing ready-made Web pages, but the Web was used as a *common* design area to construct a functional and living environment. The design phase was an essential part of learning, both to the Tanzanian and Finnish students.

As computer scientists, we were faced with a technological challenge: how to choose an appropriate solution for our project? What is, after all, distance education: email or ready-made web pages, human communication or technological artifacts? We decided to combine these, as human teachers and learners use a mixture of pencils, papers, and books in a classroom. In the role of teachers, we had six Finnish students with prior knowledge in Java. Tanzanian students, eventually two different groups, were learners. The learning material was evolving during the design process. The tools were browsers, editors, and, email. And finally, there was Jeliot [3], a Web-based tool for experimental learning of algorithms which served as an environment for practical exercises.

Besides the technical challenges, the project also offered its participants a cultural confrontation process. For any successful framework based on collaborative learning, recognition of cultural differences in planning and working on assignments is most important. Although cultural impacts risk schedules and planned contents, they also teach the importance of identifying the needs of the users of the software to be designed. Furthermore, they can also influence the designers' and users' life at a more personal level, to make them conscious of their own background and way of thinking. Thus, a cooperative design project can lead into a learning process to the participants' own personality.

The described pilot project is linked to prior research on Web based learning environments, conducted at the University of Helsinki. Jeliot is an algorithm animation environment [3] with which a Web user can edit his or her own algorithm in the Java language and study its animated version. Jeliot generates the animation automatically according to the user's visual instructions. The Jeliot research group

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has also been studying how to support creative problem solving in groups, possibly consisting of web users [7]. In this project, Jeliot served in an authentic distance learning situation. Creative problem solving techniques were needed throughout the design process.

Related literature mainly describes technology that already exists or will be available in the near future [4,6,8], or it focuses on communication, not construction [5]. Our project, however, takes a look at how existing technology can be used in collaborative design and distance learning. Research and experiences from collaborative work has been published [2,9], but the area of collaboratively designing a learning environment has been so far left to lesser notice.

2. Description of the Project

2.1 Participating Groups

The Java learning project was arranged by two lecturers, one in the Computing Centre of the University of Dar Es Salaam, Tanzania, and the other at the Department of Computer Science, University of Helsinki, Finland.

The Computing Centre at the University of Dar Es Salaam takes 25–30 students each year. That is expected to increase to 100 by year 2001. There are currently only 7 permanent staff members, and a need for several more. From the next year Java is planned to become the mandatory programming language for the second year students. The original group in Dar Es Salaam consisted of 5–6 graduate students, but it was later on replaced by a group of 25 second year CS majors.

The Department of Computer Science at the University of Helsinki takes some 260 students annually, and the size of the staff is about 100 members. In Helsinki, Java has been the primary programming language since Fall 1997. In Helsinki the project was a part of a course on computer-aided learning environments, scheduled from January to April in 1998.

Besides computer scientists, the group in Helsinki had stu-

dents majoring in mathematics, political science, and education. Thus, it was able to cover different aspects of the learning process and teaching methods.

In the following, we refer to the group in Helsinki as “teachers” and the group in Dar Es Salaam as “learners”, to describe their prior expertise in the Java programming language (see Fig. 1).

2.2 Goals of the Project

Research goal. The research goal of the project was to get experiences in how collaborative learning of programming can benefit from the internet. The brainstorming-like project was supposed to provide us with ideas and problems for future research. Therefore, we did not specify the goals in detail at the beginning; on the contrary, the participants were encouraged to use their imagination and find creative ways to use the internet for learning and teaching. The choice of Java as the learning topic served this purpose: the applets, whether learnt or taught, could be embedded into the Web site to enhance the potential of the environment.

Learning goals. From the participating groups’ point of view, the goals were, however, narrower. For Tanzanian students, the goal of the TAOJAVA project was to learn Java; for this purpose, they needed a convenient and activating learning environment. For the Finnish students, the goal was to evaluate the benefit of network communications and collaborative learning for teaching a programming language in a real context.

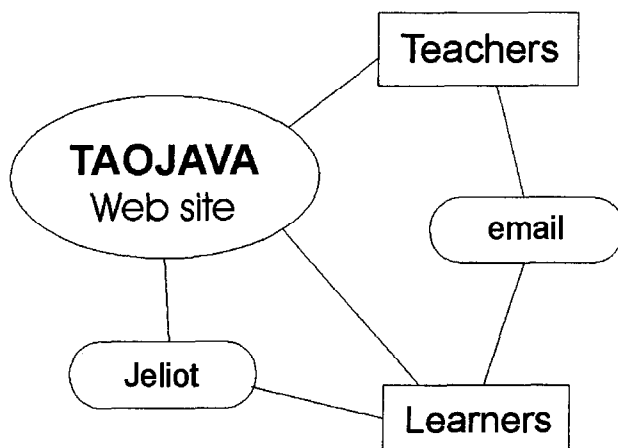
The implementation of the project was left open, to be specified during the experiment, based on both groups’ needs and preferences, and the project did not have to be completed by the ending date.

2.3 Getting Started

The Finnish group describes their experiences:

“Once the communication channel had been opened and a few messages exchanged, we started to plan the context of the learning material. Questions presented to the learners showed that we would be working with a group which wants to make Java applets for World-Wide Web pages and keep up with the latest fashion [1]. The members in the group had some programming skills but had never programmed in Java. As they knew how to use the Web and HTML, we decided that the learning material would be placed on the Web pages assigned for the project and we would be tutoring the group via email and possibly some other form of Internet communication.”

“The point was that this course would not be a self oriented learning course, but instead a guided tour with the help of a Web-based learning environment. The original idea also was that the learners would make their own Web site in which they would place their products and the teachers could then check the applets and give feedback but those



pages were never made. Next we organized ourselves by giving each person in our group a task that he/she would be primarily responsible for. One of us would build the Web pages, others who knew Java well started to code examples to be placed on the Web site and so on. However, we decided that none of us would be alone responsible for the tasks assigned but instead that all of us could share opinions on every aspect of the project."

In Tanzania there were some problems with organizing the group. First of all, it was divided into two smaller groups, one in which the members knew a good portion of programming and another in which they did not. Some effort had to be made to get the group that did not know so much about programming comfortable with what they were doing. It was also difficult for the Tanzanian group to get regular meeting hours in the beginning. At this time the Finnish students were slightly doubtful about getting a meeting hour so that both the learners and the teachers could be connected to the Internet at the same time. The Tanzanian group continued to meet at an irregular basis for the time being.

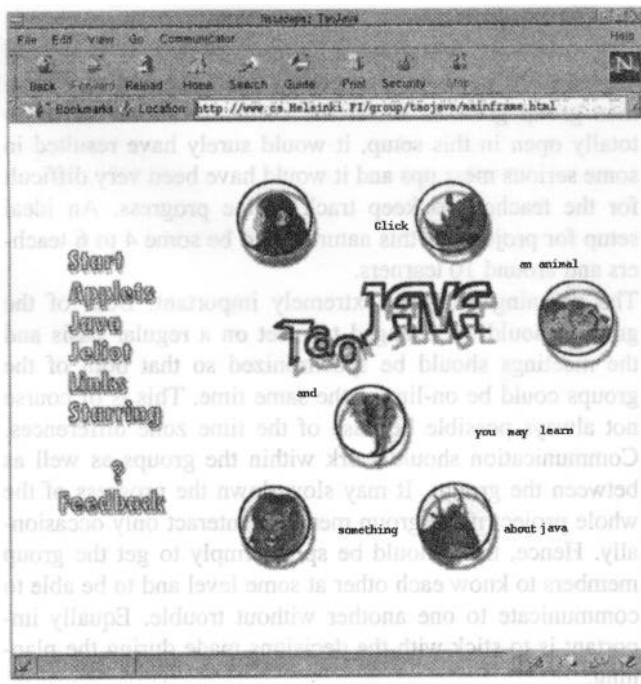


Figure 2 Start TAOJAVA (animals)

2.4 The Java Oasis

The teachers chose to present the material as a metaphor of animals on a Java oasis. Each animal would represent a part of the programming language. For example, by following an ape the user would go to a place where she or he could learn about communications in Java, while a rhino would teach about the security issues. One could learn the things in any desired order and would have a certain freedom of choice all the time. The final form of the metaphor was

rather hard to understand at the first glance on the page (Figure 2). Also, it was fairly difficult to cut a programming language into pieces that could be learned individually, since programming languages have certain qualities that should be learned before others. It took about a month to get the Web site into adequate condition and all the organizing problems sorted out before the initial learning process could start.

2.5 The Role of Jeliot

The original idea was to utilize Jeliot to help the learners to overcome certain difficulties in programming. Because of the slow communication lines, Jeliot was finally used only as an occasional help for the students. There were some problems at the Tanzanian end to get Jeliot working efficiently.

2.6 Communication between the Groups

Because of the limited period of the project, the teachers could concentrate on few Java applets. However, the teachers found it difficult to get information on the learning priorities from Tanzania. Due to technical problems, the planned real-time chat between the groups could not be organized. Apart from the contact person, the first group in Dar Es Salaam seemed to be somewhat less interested in the project than the teachers were. This resulted in changes within the composition of the Tanzanian group; a completely new group was put together. This time it consisted only of students, whereas the people in the first group were working while studying and therefore did not have enough time and motivation for the project. After reorganization, the teachers soon started to get answers for their questions. The students proved out to be very interested in taking part in the project and were able to provide the teachers with more precise information on what they wanted to learn. However, the time on the teachers' side was running out, and the tutoring the new students needed was not exactly what the teachers were prepared for. Especially troublesome was the learners' interest in learning to use advanced features which went beyond the level that could be properly taught in the given time.

2.7 Results

From the research point of view, the project served well its original intentions. It demonstrated possibilities and risks for internet based collaborative learning which will be evaluated in future projects.

Evaluating the learning outcomes is more difficult, especially because there were two learner groups, with different expectations. However, in the end, both learners and teachers were satisfied with the results. Given enough preparation and planning, this kind of inexpensive teaching-learning framework is more than a functional substitute of traditional teaching. The students at the Finnish side learned not only the potential of computers in education but

as teachers also more of the Java language. Teachers became also learners.

3. Technical Aspects

The composed Web pages included basic HTML, Java, images, and JavaScript. Due to the slowness of the connection, for example the applets were each on a separate page to allow the Dar Es Salaam side to load them only if necessary. Starting from the traditional "Hello Tanzania!"-applet, some simple applets were presented, intended to give the main idea of the Java language and applets. Using applets from other Web-servers, passing parameters to applets, and writing event driven code were some of the aspects covered. More detailed information was provided by tutoring with email and with links to other sites covering Java, especially that of Jeliot.

Jeliot. The biggest problem with the use of Jeliot was in the slowness of the connection. For example getting a ready animation on the screen with Jeliot that would take about two minutes in Helsinki would take twenty in Dar Es Salaam.

The slowness can hardly be totally solved within a project such as this. A proxy and a large cache could provide some help after the initial connection. Jeliot's speed could be improved by downloading the common classes used by all of the animations and then using a local copy. Their total size is just under 300 kB, not all of them are loaded during a typical session, but with very slow connections everything helps. This solution could present some problems if the downloaded classes are updated in the server, but not on the client side.

Communication. Communicating via email was fast and easy. Some small problems did occur, partly because the communication was arranged so that one member from each group was mainly responsible for receiving the mails, but everyone could send mail at will. Besides email, also a Usenet newsgroup type of platform could be used for questions and answers. This would remove the need for a lot of mail forwarding, since a single person in each group would handle all of the communication between the groups. In some occasions a chat could be set up and everyone could take part in discussion. This was in fact planned, but unfortunately could not be arranged, partly because of the strict firewall at the Helsinki end.

Platform dependency. Although Java is designed to be a platform independent language, some problems rose from the fact that the learners used Windows95 as the operating system, but the group in Helsinki used primarily Linux. It should be noted that the problems did not strictly concern Java as a language, but how it was used. For example, the learners used VisualCafé Pro as the programming environment and MS Access database. This presented some trouble at the Helsinki end when the teachers wanted to give an-

swers to some, for example tool-specific questions but did not have a possibility to confirm that their answers would definitely work at the other end.

Context-sensitive feedback. In a pilot project of this kind, even novel ways can be used and tested. One interesting technique would be to provide a sort of "context sensitive feedback", besides the conventional context sensitive help. Using CGI scripts, the cookie-technology and some type of logging in to the learning environment this could be done with the existing technology. The logging in would not have to be a means of access control, but a way to establish different groups for learners, teachers, administrators, etc. At proper times, learners could be presented suggestions about what to do next, and comments on how they have performed before. If they had comments of their own performance, they could provide feedback which the system could automatically link to the appropriate context. A teacher, visiting the same sections, would see the comments and questions related to the matter at hand, and could thus improve the material, based on the structured feedback.

4. Discussion

Organization. Assigning a contact person at each end proved to be necessary, especially when the size of Tanzanian group grew to 25. If the communications had been totally open in this setup, it would surely have resulted in some serious mess ups and it would have been very difficult for the teachers to keep track of the progress. An ideal setup for projects of this nature could be some 4 to 6 teachers and around 10 learners.

The planning phase is extremely important. Both of the groups should be arranged to meet on a regular basis and the meetings should be synchronized so that both of the groups could be on-line at the same time. This is of course not always possible because of the time zone differences. Communication should work within the groups as well as between the groups. It may slow down the progress of the whole project if the group members interact only occasionally. Hence, time should be spent simply to get the group members to know each other at some level and to be able to communicate to one another without trouble. Equally important is to stick with the decisions made during the planning.

Attitudes and expectations. The learners were very pleased with the project's outlook and learning value and were satisfied to see that it helped them to find also other Web sites for more information. Free discussion with the Finnish teachers was highly appreciated. Especially convenient was the fact that the students could get answers to their questions on their own time even without their own lecturer present. This was really a great advantage in Tanzania considering the need of teachers. Students could also get material and help they would not otherwise have been able to get. In this type of learning process new ideas and

questions arise within the students as the remote teachers usually teach topics that the local teachers do not cover. This requires the students to process the topic themselves, leading to a broader and more solid view of the whole picture.

The Finnish side of the project was expecting a somewhat more enthusiastic audience in Tanzania. That was received only after the Tanzanian group had changed. However, the new group wanted completely different sort of tutoring than the Finnish group was prepared for and this resulted in a new problem. The first group wanted to be able to program simple applets for their Web pages, whereas the new group had to be able to make a working connection between a database and Java application. Even though the existing material did not exactly cover the needs of the new group they were satisfied with it since they were new to Java and the material expected them to be. The expectations changed vastly during the project and could not be fully realized.

It is essential for a successful pilot project that each participating group commits to the project until it is over. Therefore, the participants should adopt not only their individual learning goals, but also those of the others, and even the general research goal in the background. Introductory sessions should motivate the participants by emphasizing the interdependence between diverse goals of the project.

Cultural differences. Although in this particular implementation the cultural differences did not pose any unbearable difficulties, they should be taken care of from the very early stages of the project. As communication plays an important role in the process, it should be made certain that the project will not get stuck just because of one or two misinterpreted sentences. General rules of good and polite behavior should be applied here and the possible misunderstandings dealt with and corrected right away.

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References

1. Cohen, S., F. Quest for Java. In *Communications of the ACM*, vol. 41, 1 (1998), 81-83.
2. Fitzpatrick, G., Kaplan, S., and Mansfield, T. Physical spaces, virtual places and social worlds: a study of work in the virtual. In *Proceedings of CSCW '96* (New York), ACM Press, 334-343.
3. Haajanen, J., Pesonius, M., Sutinen, E., Tarhio, J., Teräsvirta, T., and Vanninen P. Animation of user algorithms on the Web. In *Proceedings VL '97, IEEE Symposium on Visual Languages* (Capri, Italy, September 1997), IEEE 1997, 360-367.
4. Hiltz, S., R., and Wellman, B. Asynchronous learning networks as a Virtual Classroom. In *Communications of the ACM*, vol. 40, 9 (1997), 44-49.
5. Jawary, A., Birchak, C., and Vargo, S. International Initiative. In *Proceedings of ITiCSE '97* (Uppsala, Sweden, June 1997), ACM, 85-87.
6. Mark, G. Merging multiple perspectives in groupware use: Intra- and intergroup conventions. In *Proceedings of CSCW '97* (New York), ACM Press, 19-28.
7. Meisalo, V., Sutinen, E., Tarhio, J., and Teräsvirta T. Combining algorithmic and creative problem solving on the Web. In *Proceedings Teleteaching '98/IFIP World Computer Congress 1998*. Austrian Computer Society, 1998, 715-724.
8. Neal, L. Virtual classrooms and communities. In *Proceedings of CSCW'97* (New York), ACM Press, 81-90.
9. Olson, J., S., and Teasley, S. Groupware in the wild: Lessons learned from a year of virtual collocation. In *Proceedings of CSCW '96* (New York), ACM Press, 419-427.
10. 2B1 Project. In: <<http://www.2b1.org/mission.html>>.