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Integrating internet tools into traditional CS distance education: students' attitudes

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Abstract

This paper describes a study conducted on the attitudes of students towards the integration of the Web as a channel of communication and a study tool in traditional distance teaching of Computer Science (CS) at the Open University of Israel (OUI). We examined the incorporation of web communication into the traditional model with three different groups of undergraduate students—one of 700 students in our introductory course, another of 150 students in our advanced “Computer Networks” course, and the third including the remaining 3000 students in the CS department. Questionnaires were answered by a representative sample. The findings show that when the use of the Web is voluntary, students do not take full advantage of it, even those who are advanced in their studies and have rich experience in using computers and the Internet. The results, however, do show that the use of the Web increases as students advance in their studies, although even in this case the Web is not used as much as it could be, either as a communication channel or as a study tool. Our findings support the following assumptions: The Web cannot substitute entirely for face-to-face learning, but it can serve as a reasonable alternative when the latter is unavailable. Using the Web to its full pedagogical potential requires a high level of self-study ability; the more distance-based the learning is, the more the Web is used and accepted by the students, and the more it serves them as a communication channel and as a study tool. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Background

The Open University of Israel (OUI) is a distance education institution designed to offer academic studies to students throughout the country. Its study method allows its students to pursue higher education, whenever and wherever convenient, and without interfering with their other personal and vocational obligations. The OUI offers about 400 courses in Life Sciences, Natural Sciences, Mathematics, Computer Science, Social Sciences, Management, Judaic Studies, Education, and Humanities, and serves more than 33,000 students.

The OUI is a multi-campus university whose teaching method requires a complex logistic system which has evolved since the establishment of the university in 1976, based on the rationale of bringing the university to the student's home. Written materials for each course (course books, assignments, syllabus and schedule, study instructions, and administrative procedures) are mailed to students before the beginning of the course. Tutorial sessions are held in regional study centers, ranging from weekly in the group-study format, to every three weeks in the standard distance format, and the students can choose the preferred format. About 30% of the students prefer the standard format, while 70% select the group-study format, which provides more support.

Each course has a teaching staff that consists of an academic supervisor, a course coordinator and a number of tutors. The course coordinator is responsible for supervising the tutoring, writing assignments and examinations and preparing their answer keys. All students, regardless of study format, take the same final examination. Tutors receive a ready-made self-study course, and their job is to support the students throughout their studies and help them perform their tasks.

2. The computer-mediated-communication (CMC) model developed at the OUI

OUI has developed a model of learning based on new technologies which combines and integrates on-line technologies with traditional distance education teaching aids. Every CMC course has its own Website that provides interactive learning materials through electronic asynchronous communication including discussion forums, e-mail, and materials that students can download (Aviv, 1999; Lupo & Erlich, 2001). Through research, development and integration of new teaching methods that take into account pedagogical, social and technological aspects, the OUI makes use of advanced information and communication technologies for the mutual benefit of students and teachers, as described by Beller (1996, 1997).

2.1. CMC in computer science (CS) courses

To participate in a CMC course, students need to have basic knowledge of computer applications, including the Internet. We assume that most CS students have these skills, at least after taking an introductory course. Students who lack these skills can register for a "Computer Applications" course that builds up the background needed but awards them no credit (Lupo & Erlich, 2001). Our experience shows that no CS students needed the course as all the students came with the appropriate background.

The central guideline in introducing CMC into CS courses was to integrate the Web wherever it is beneficial and to avoid its integration in those cases when it becomes an impediment. For

example, to avoid the disadvantages of screen-based reading, we decided not to place the written materials on our sites, but rather to continue to send printed textbooks and other material to our students. Our books are the basis of our study method, which has proved effective for years, and we felt there as no reason to replace a successful existing method with a new, less convenient one. Some CMC courses provide printed materials in .pdf files which students can download and print out at home. We prefer to continue to mail the written materials to our students since not all of them can afford to print out and organize the extensive self-study materials. In addition, since the Web aspect is a voluntary addition to the distance courses described here, and there was no way of knowing in advance which students would take advantage of the Web, all students received the printed materials by mail.

The Internet is thus used mainly to improve communication between the teaching staff and the students, using methods that have been examined in various ways by a number of scholars (e.g. Beuschel, Bork, Hughes, McMahon, Serdiukov, & Stacey, 2000; Brooks, 1997; Mason & Kaye, 1989; Sandell, Stewart, & Stewart, 1997; Verdejo, Rodriguez-Artacho, Mayorga, & Calero, 2000). Our goal was to create a virtual campus in which students could get to know each other, form virtual study groups, and thus be compensated for the lack of an actual campus. However, we were unwilling at this stage to make the CMC obligatory in any way. The Web sites are designed to help the students, and we left the decision of whether or not to take advantage of the Web up to them. No additional credit was given for participation in the discussion forums, and we did not rely on the Internet as a formal channel of communication. All information continued to be sent to students by “snail mail” as had been the case before we introduced CMC into our courses. The CMC model has two different aspects:

The Web as a channel of communication. Today “snail mail” serves as the official communication channel between students and the university. All administrative announcements and clarifications regarding materials are sent by mail. At face-to-face meetings, a tutor provides additional explanations of the material and assignments, the examinations, etc. Because the tutorials are held throughout the country, the course coordinator can usually visit only one or two tutorial sessions for each group of students during a semester. Via the Internet, we attempted to augment communication between the students and the coordinator, making it more accessible, mutual and continuous throughout the semester.

The Web as a study tool. Many studies have examined the effectiveness of the Web as a study tool in terms of the various options it offers: asynchronous discussion forums, synchronous discussions (text, voice and/or video) and animated illustrations and multimedia applications in general (e.g. Beuschel et al., 2000; Moore, 1989; Sajaniemi & Kuitinen, 1999; Sandell et al., 1997) and in the special case of computer science education (e.g. Baker, Boilen, Goodrich, Tamassia, & Stibel, 1999; Boroni, Goosey, Grinder, Lambert, & Ross, 1999; Boroni, Goosey, Grinder, & Ross, 1998; Byrne, Catrambone, & Stasko, 1999; Cordova, 1999; Deaver & Resler, 1999; Mester & Krumm, 2000; Naps & Chan, 1999; Trondle, Mandl, Fischer, Koch, Schlichter, & Teege, 2000).

We believe that one of the important tools for distance education at the OUI today is the asynchronous discussion forum. Synchronous activities take place at tutorial sessions and there is justification for complementing these with activities that are time- and place-independent. Moreover, asynchronous discussions demand only minimal software and hardware, which is assumed to be available to all students.

As to the effectiveness of Web-based animated illustrations as a tool for improving learning, many studies have shown success in basic topics such as programming, data structures and algorithms (Baker et al., 1999; Boroni et al., 1999; Cordova, 1999), as well as advanced topics such as parallel algorithms (Naps & Chan, 1999), communication protocols and distributed algorithms (Mester & Krumm, 2000), and compilers (Deaver & Resler, 1999). Byrne et al. (1999) showed that animation for some known algorithms of varying difficulty do not differ much from detailed descriptions of snapshots of the algorithm steps. Such illustrations are not necessarily associated directly with the Web. Many illustrations may be constructed for viewing in a laboratory (Mei-Chuen, Wu, & Liu, 1999) or on a home PC. In the OUI as well, in some courses, CDs are mailed to students together with the printed materials sent them at the beginning of the semester (Lupo & Erlich, 2001).

2.2. Description of the course sites

All course sites are graphically similar, and linked to administrative information drawn directly from the OUI's central database: the course schedule and description, the course tutors and the list of students. The academic aspect of the sites includes Hebrew-based applications that were specially developed to enable the course coordinator to easily and independently update the data, without the need for any knowledge of Web programming. There are a number of links at the top of each course home site: among these, links to discussion forums, relevant Web sites and file downloads:

Discussion forums are opened by the course coordinator for each topic, depending on the structure of the course. Here all students registered in the course have read and write permission. This is the main virtual meeting place for students in all study groups around the country.

Links to other Web sites are sorted by subject, and contain useful links to other web sites, including links to similar courses in other universities around the world, and to Java-based visualizations of various topics covered in each course. A description of each link tells students how and when to incorporate the materials into their studies.

File downloads contain downloadable files posted by the course coordinator and include exercises, solutions to exercises, sample tests, etc.

A **bulletin board** is located on the course home page on which the coordinator posts brief important messages such as changes in meeting schedules, clarifications on deadlines for submitting assignments, etc. and can also be used to provide links on which students can click to reach more detailed information or feedback located elsewhere on the site. Fig. 1. shows a typical home page of a CS course.

3. The study

After integrating CMC into our courses for 2 years, we saw that only a small percentage of the students were taking advantage of this mode of communication. Thus, we decided to conduct a study to determine the students' attitudes towards the CMC model.

All CS students were divided into three groups. One included 700 students in our introductory course, who are new and still unaccustomed to our teaching method ("introductory" students).

The second group included 150 students in an advanced elective, “Computer Networks”, taken by students with rich experience in OUI courses (“advanced” students). The third group included the rest of the 3000 students in the department (“regular” students). Questionnaires were administered to all the students and a representative sample (20%) of the questionnaires for each group were examined (introductory group: $n=132$; regular group: $n=618$; advanced group: $n=33$).

3.1. Results

3.1.1. The Web as communication channel

We can clearly see a rising trend in the utilization of the Internet as a channel of communication as students advance in their studies. Introductory students tended to read the bulletin board less than regular or advanced students, as shown in Fig. 2. Among the regular students we found a significant correlation between use of the bulletin board and the tutoring format for which the students had registered (Chi-Square = 15, $P=0.020$, d.f. = 6). Students in the standard distance format, who have less contact with their peers and the tutor, tended to check the bulletin board more often than students in the group-study format.

Though students are aware of the fact that important messages are sent to them by snail mail as well, Fig 2. indicates that many of the experienced students use the bulletin board as a convenient and reliable source of information.

We also asked the students whether they preferred to use the Internet as an official channel of communication (completely replacing snail-mail messages), and here as well, we observed a slightly higher, though not significant, preference among the advanced students in comparison to others (Fig. 3). However, we cannot ignore the fact that one third of the students prefer not to use the Web as a channel of communication, even though over 90% of our students have access to



Fig. 1. Web site of CMC course.

the Internet. This means that the choice of many of the students who prefer not to use the Web as an official channel of communication stems from reasons other than the availability of the Internet.

As part of our attempt to develop a virtual campus through the CMC courses, on each course site we opened a discussion forum called “The Course Cafe”. The “Cafe” was defined as a place where students could discuss any topic they wished, from culture to politics. It was intended to compensate for the lack of social life in a distance education institution. Participation in this discussion forum was minimal in all courses.

Each site also included a list of students enrolled in the course which was intended to enable students to communicate among themselves by e-mail beyond the framework of the course itself. In order to appear on the list, students had to log-in to a specific page on the site, fill in their e-mail addresses, and give permission for their names to be posted. Here we also found differences in the numbers of students who posted their names in the site: 58% of the introductory students, 73% of the regular students and 82% of advanced students. However, less than 15% of the students made personal contact with other students, even though on the questionnaires many indicated that

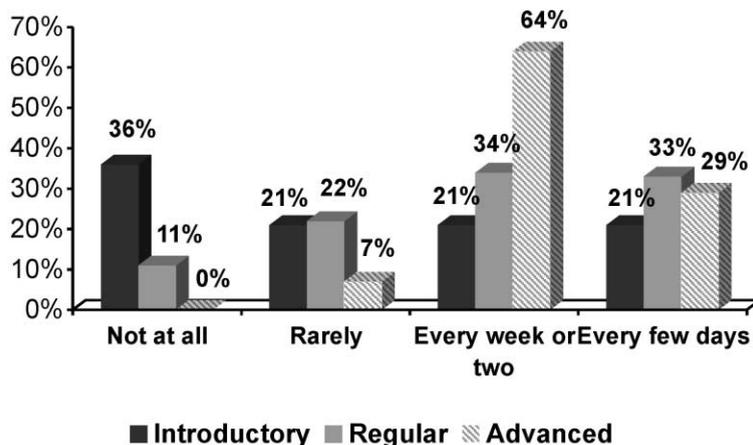


Fig. 2. Students' use of the bulletin board.

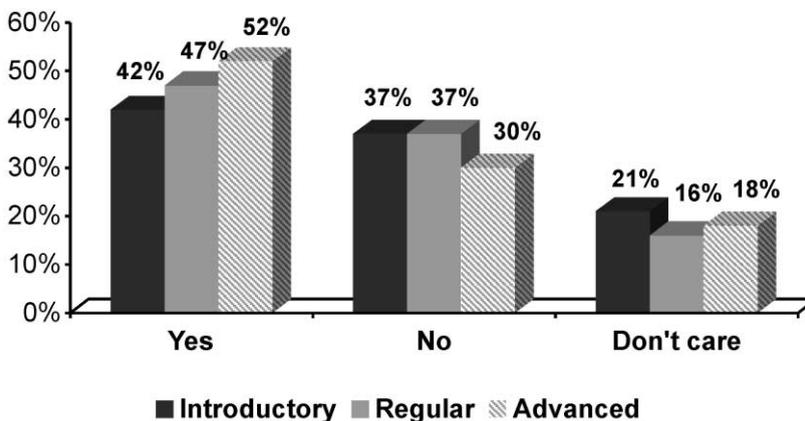


Fig. 3. Students' responses to the question, “Would you prefer administrative communication through the Internet?”.

contact with other students was important to them. The CMC seems to have provided a framework for such contact to only very few of the students in all three groups.

3.1.2. The Web as a study tool

The advanced group used the discussion forum more than the others, as shown in Fig. 4. It should be noted that from our previous experience we know that discussion forums in programming courses (such as the introductory course) are much more active than in theoretical courses, therefore, it turned out that introductory students actually used the discussion forum less than expected.

We found a significant correlation (Chi-Square = 10.23, $P=0.006$, d.f. = 2) between the study format and the tendency to use the discussion forum—students in the standard distance format used the discussion forum to a greater extent.

Among the regular students, we found another significant correlation between the way the students use the discussion forum and the study format (Chi-Square = 13.17, $P=0.01$ d.f. = 4). Students in the standard distance format tend to take an active part in the discussion forum more than students in group-study format who tend to be more passive (i.e. reading the messages without writing their own).

We asked the students who had participated in the discussion forums whether this helped them in their studies, and the answers we received are shown in Fig. 5. Over half of the students in all three groups answered “to some extent”, indicating that we need to improve the management of the discussion forums. However, it is clear that the students’ ability to benefit from the discussion forums is influenced by their maturity since the discussion forum serves as an aid to self-study—an ability that our students develop over time.

3.2. CMC study format

In the semester during which we conducted our study, we offered the option for signing up for the advanced course, “Computer Networks”, using the CMC format. Our intention was to open a study group which had no face-to-face tutorial sessions: all tutoring would be based on the

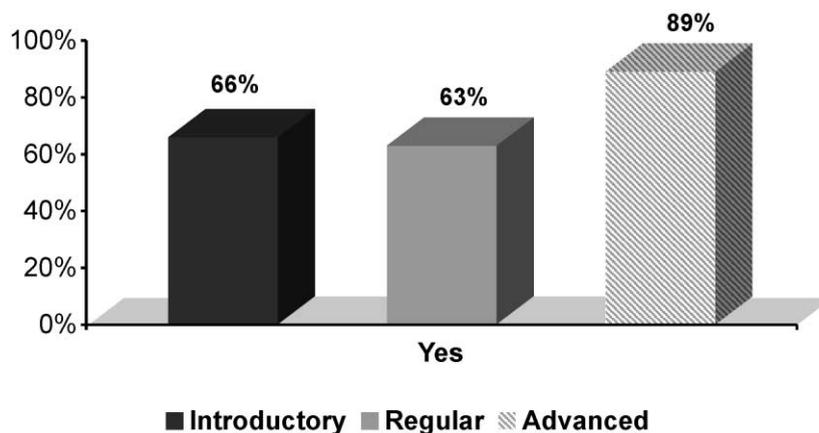


Fig. 4. Students’ responses to the question, “Did you use the discussion forum?”.

course site and specifically on the discussion forums. We knew from previous experience that about 60% of the students in the course choose the standard distance format, and that about half of these do not participate in any of the tutorial sessions. These students were the target population for the CMC tutoring group since they had nothing to lose by enrolling in it. Yet, only two of the 150 students registered for the course selected this option. To understand this phenomenon, the questionnaire included several options, representing reasons for their choice. The students' responses are summarized in Table 1.

We asked the group of regular students whether in the future they would enroll in CMC study groups, were we to offer such groups. Surprisingly, about 2/3 of the students did not reject the idea. About 30% responded that they would consider the option, and others stated that they would consider it under certain conditions. Their responses are shown in Table 2. It should be noted that the question defined a CMC group as a group in which more advanced teaching tools—such as videoconferencing—would be incorporated. It is possible that students feel that CMC is still in its early stages, and expect it to develop further, and become more user-friendly

Table 1

Responses of the advanced group to the question, "Why didn't you enroll in the CMC group?"^a ($n=33$, in percentages)

I study in the group-study format.	14.8
I study in the standard format, and intended to attend all sessions.	18.5
I saw no need for it. The course site in general and the study group in particular satisfied my study needs during the course.	22.2
I have no computer or regular access to the Internet.	11.1
I manage very well with the written study materials and the staff's phone instruction hours.	11.1
I did not understand the nature of the CMC group.	7.4
Other	40.7

^a The respondents could choose more than one response.

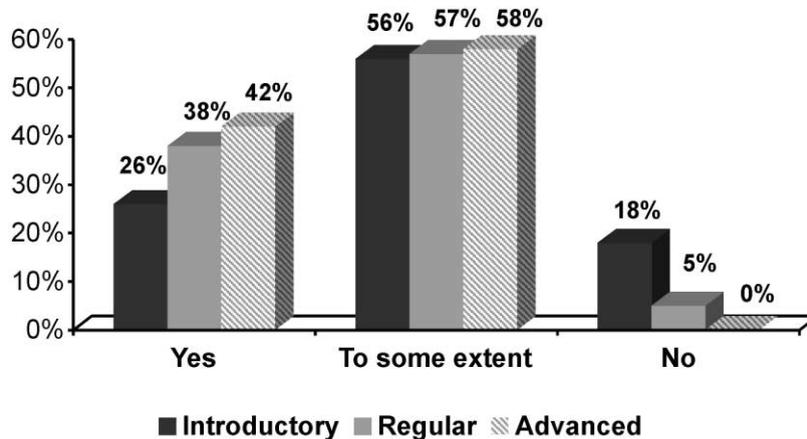


Fig. 5. Students' responses to the question, "Did the discussion forum help you in your studies?"

Table 2

Responses of regular group to the question, “Would you consider enrolling in the CMC study group format in the future?” ($n = 618$, in percentages)

No, I'd prefer one of the existing study formats.	35.9
Yes, I will consider it.	29.9
Perhaps, depending on the specific course and other factors.	15.6
Perhaps, if I have access to the Internet.	5.8
Perhaps, but only if I am not able to participate in the tutorial meetings.	12.8

and effective in the future. At present, the discussion forum interface poses problems in integrating Hebrew and English and in writing mathematical formulas, and while attachments are possible, these are time-consuming to open. This may be another factor that makes students wary of using the forums; however, students seem to be aware that this is merely a technical problem that will be resolved in the future. When this happens, it is likely that more students will opt for the CMC group.

4. Discussion and future research

While students expressed an interest in using the CMC model in the future, at the moment, the feedback from this study indicates that students use this medium relatively little. Therefore, we view CMC only as a supplement to the existing system, and found that its potential has not yet been realized. As long as there is communication via snail mail and frequent face-to-face tutorials, there is less need for additional electronic communication. It seems that a mixed mode of CMC together with traditional distance learning would be preferable.

The research systematically shows that, the more advanced the students are in their studies, the more they tend to use the Web in its various applications. It seems that students feel that the virtual learning environment cannot replace the live classroom, with its personal interaction between the students and the tutor and among the students themselves. The Web serves as an additional self-learning tool for the students when they sit alone at home and need to cope with the material from a distance, which requires a high level of self-learning ability on their part. Students who are used to the face-to-face study format from their previous experience, and especially the introductory students, find it difficult to use the Web as a study tool, just as they find it difficult to use other self-study aids used by the OUI, such as self-study texts, study guides and courseware. Tutoring meetings are designed, among others, to help them develop independent-study abilities that are essential for taking advantage of the OUI's learning method. In contrast, advanced students, who have developed self-study skills, were able to use the Web more efficiently. Therefore, we will try to develop a new distance learning model to serve our advanced students, based on the appropriate balance between face-to-face interaction with experts in the field, and the need and demand for distance learning (most advanced students are part-time students with additional obligations including work and families).

Where education is concerned, revolutions are unacceptable. Hence, the process of integrating technology into education must be evolutionary. Educators and policy-makers, separately and

together, must carefully examine where the technology can help, and where it has little value. As a result, we decided to try a new model of CMC in the advanced “Computer Networks” elective in the semester following this study. Only after examining this new model carefully, will we extend it to other advanced courses, and only after proven success, to other courses (implementing any changes required to adjust the model to students who are not on an advanced level).

The new CMC model will utilize the Internet to a greater extent in both the standard and the group-study formats by reducing the number of face-to-face tutorials, and defining the Internet as the sole channel of communication between the OUI, the teaching staff and the students. In the standard format, there will be only three 3-h face-to-face meetings (instead of seven meetings totaling 17.5 h), and the group-study format will have nine 3-h face-to-face meetings (instead of 15 meetings totaling 30 h), thereby making both formats more distance-based. The students will be told at the beginning of the course about this CMC model, and of their responsibility to keep themselves up-to-date through the course Web site. All information regarding course activities and procedures will be on the Web and no letters will be sent by snail mail during the semester. Students will be given the option to cancel their registration or to switch to another course if they find this mode of communication unsuitable for them, without having to give any explanation or to pay any fine (contrary to the usual procedures the OUI).

The tutoring will be based on the course Web site, where all students from all tutorial groups will form one large virtual class tutored by the course coordinator through asynchronous communication. CMC tutoring will include posting guidelines for readings and additional questions, emphasizing certain teaching points and clarifying known problematic areas in the material, presenting visualizations and illustrations of specific topics, publishing video-based solutions for course assignments, etc. All on-line activity will be asynchronous, while the synchronous activities will take place in the tutorial sessions. The tutors will integrate the on-line activities into the meetings with the help of the course coordinator. We will conduct a comprehensive study to determine the effectiveness of this model and try to find out how the Web can better serve as an asynchronous study tool, and how it can be integrated in the existing learning method of the OUI. The full research will be presented in a future paper.

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