Interactive Learning Environments

Assessing the use of instant messaging in online learning environments

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There is a body of evidence supporting the claim that informal interactions in educational environments have positive effects on learning. In order to increase the opportunities of informal interaction in online courses, an instant messaging tool, called CENTERS, was developed and integrated into online learning environments. This tool provides the students with awareness of the presence of others connected to the course at the same time and allows them to interact by means of two communication facilities: instant messaging and one-to-one chat. To evaluate the reliability of CENTERS as a tool to promote interaction, we studied the performance and use of the system during one graduate and three undergraduate online courses. The participants were 43 students and 4 teachers. Analyses of the logs show that the system was used mainly for socializing but that it also supported the students' learning activities. The responses to the questionnaires with regard to the students' perceived use of the system were in agreement with their actual use as registered in the logs. The high level of interaction showed by most participants, as well as their willingness to take more online courses using CENTERS, led us to conclude that instant messaging can be successfully integrated and used within online learning environments.

Introduction

Research on virtual environments shows that users follow the spatial metaphors used in these systems (a town, a factory, a store, a university) (Larose & Peraya, 2001; Meurnier & Peraya, 2004; Peraya, 2000). They tend to reproduce identical behaviours within these electronic walls as the ones they would make, in the same circumstances, in a real physical space. In virtual learning environments, the students' cognitive schemas are adapted according to the way the virtual spaces are denominated; their attitudes, expectations and dispositions are not the same if they access a workshop, a cafeteria, or a library. Besides, within these work spaces, the metaphor plays a fundamental role in the organization and development of the academic activities; the students adopt social behaviours identical to those required

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for the academic space of reference. Thus, the metaphor serves simultaneously as a cognitive frame of interpretation and as a model of social behaviour for the development of the learning activities (Larose & Peraya, 2001; Meurnier & Peraya, 2004; Peraya, 2000). The structuring of the spaces and behaviours in mediated learning environments can reinforce the practices and social conducts considered appropriate within the traditional contexts of education, for both students and teachers, and by the mere nature of the structure, the opportunities for informal interaction within these environments are then restricted.

In order to increase the opportunities for informal interaction, we developed and integrated into our online learning environments an instant messaging tool, called CENTERS. This tool provides participants with awareness of the presence of others connected to the course at the same time and allows them to interact by means of two communication facilities: instant messaging (IM) and one-to-one chat. We consider an instant message as a brief message that receives no response or is responded with one single message, while an online chat is the real time interaction of two or more people through continuous messages within the same window.

Theoretically, IM should improve course satisfaction and performance by increasing informal interaction opportunities as an extra aid in establishing rapport and collaboration among students and between students and the teacher. According to Yacci (2000), effective instructional interactivity can be viewed as having two distinct classes of outputs: content learning and affective benefits. Although the latter are less well understood and difficult to isolate, they are as important as the learning of content in any given formal course. Within virtual learning environments, Gilbert and Moore (1998) note that social rapport and increased collaboration can lead to greater levels of interaction which address instructional goals.

Research focused on the use of instant messaging within organizations shows that it has been successful in establishing social bonds and improving communication within work groups. Additionally, it serves as a medium for coordination with the consequent increment in productivity (Grinter & Eldrige, 2001; Isaacs, Walendowski, & Ranganthan, 2002; Nardi, Whittaker, & Bradner, 2000). Evidence also suggests that it is a favoured medium for socializing among teenagers and young persons (Grinter & Palen, 2002). This could be due to the perception that it is a less formal tool, lending a kind of intimacy that is often absent from other types of computer mediated communication (Hu, Fowler Wood, Smith, & Westbrook, 2004; Lovejoy & Grudin, 2003). IM has also been found to be less intrusive than mail or videoconferencing, allows multitasking, and supports many complex activities like coordination with multiple partners and social learning (Isaacs et al., 2002). These findings motivated us to investigate the acceptance and use of an IM tool integrated in formal online courses.

New delivery methods and technologies have raised different questions about the quality of interaction among distance course participants (Curtis & Lawson, 2001; Gunawardena, 1995; Gunawardena & Zittle, 1997; Hadidi & Sung, 2000). Social interactions are crucial for establishing rapport and developing a climate conducive to learning, thus enabling participants to form a learning community. Previous reports

on the analysis of social interaction during distance courses conducted by Gunawardena and Zittle (1997) and Kanuka and Anderson (1998) show that social interaction, both among students and between students and teacher, is strongly related to course satisfaction. Gunawardena and Duphorne (2000) also found that the characteristics of the tools used in a learning environment were the best predictor of learner satisfaction, and they note the need for technical systems that facilitate the building of an online learning community.

The limitations of available communication tools within formal learning environments (e.g. Blackboard, WebCT, Virtual U) and the lack of direct interaction faced by students and teachers aggravate the problems of isolation and frustration felt by participants (Hara & Kling, 1999). Some solutions previously proposed to address these problems were the use of telephone calls or face-to-face meetings (Harasim, Hiltz, Teles, & Turoff, 1995; Hassenplug & Harnish, 1998) and synchronous chat conversation. These solutions, however, in many cases require additional resources external to the learning environment which could raise the cost and be difficult to implement, especially in large distributed groups. Synchronous chat sessions have been used to discuss class topics, but sometimes these sessions become unmanageable, even if the group of students is small, due to their confusion as to who is answering what to whom (Thirunarayanan, 2000).

In order to address the above stated problems and to promote the building of a community within online learning environments, we developed and integrated CENTERS in our online courses. CENTERS has several features that distinguish it from other instant messaging tools. Specifically, CENTERS can be transparently integrated within course documents and allows Web navigation in a completely natural way, without interference. The display occupies only a small amount of space on the screen and the user can decide to navigate anonymously if he so wishes. The participants can be in two courses at the same time and communicate with each other in both courses, using two windows of the browser. Additionally, it allows a user to quickly load the page that another student is currently viewing, thus allowing for synchronous navigation and facilitating the discussion of online materials.

The CENTERS IM System

The CENTERS system consists of a web-based CENTERS client, a component that registers the user's URL, named URL locator, a Web server, which delivers all the course contents, and the CENTERS server, which provides the presence awareness and instant messaging facilities, and finally, the course content repository where all the course documents are stored.

When a user connects to the course web site the browser also loads, along with the course materials, two modules of the CENTERS system: the CENTERS client and the URL Locator, which stores the user's current URL and provides the means to establish synchronous navigation within course documents (it is not necessary to install any additional software in the user's PC). The CENTERS

client displays information of other users connected to the CENTERS server on the user's screen. Given the small amount of screen space occupied to display the CENTERS client, the navigation within the web site is natural and non intrusive (Figure 1). It also displays and updates information about users entering and leaving the course.

Through CENTERS, users can send and receive instant messages and chat requests. Instant messages are delivered directly to the user screen while chat requests must be accepted by the user in order to open the chat window and begin communication between users.

To enable synchronous navigation, the URL locator asks the Web server for the URL currently displayed on the browser of the user who made the request.

For evaluation purposes, the CENTERS system records all the instant messages and chat conversations, the identity of the sender and the receiver, the date and time when the message is delivered. It also keeps a log of accepted and rejected chat requests.

The current implementation of CENTERS was developed using Java. It was tested in different operating systems such as Solaris, Windows 9x, Windows NT and XP and Linux Mandrake version 6.2 through 8.2. In addition, the CENTERS client supports all major Web Browsers including: IE, Navigator, Mozilla and Opera (Contreras-Castillo, Favela, Perez-Fragoso, & Santamaria-del-Angel, 2004).
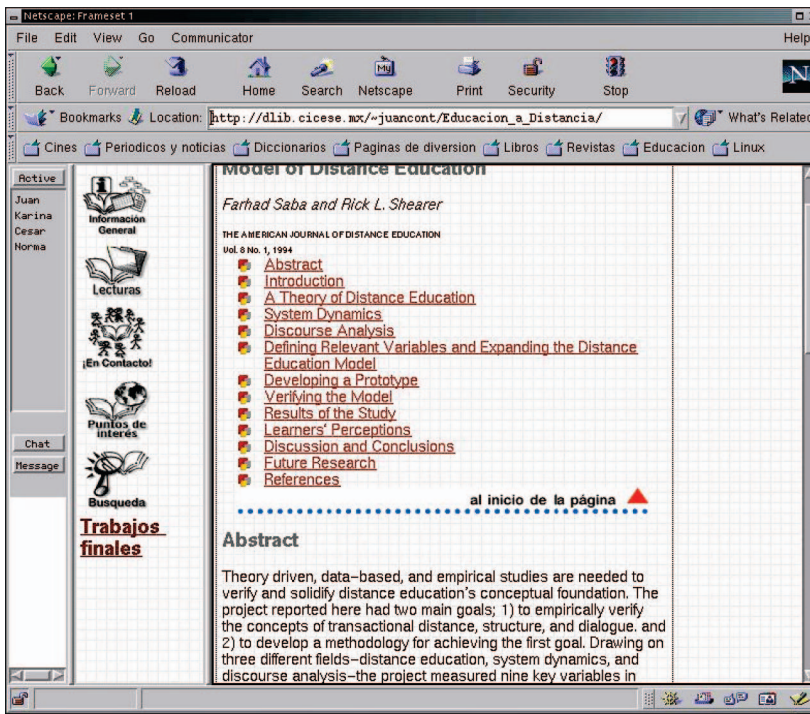

Figure 1. Screenshot of CENTERS

Research Questions

To evaluate the influence of CENTERS in promoting interaction within learning environments, we studied the use of the system during four online higher education courses. The primary purpose of our study was to analyse the use of instant messaging within the context of online courses and identify the types of interaction instant messaging supported.

The research questions that guided this study were as follows:

1. What were the uses given to CENTERS during the courses?
2. What is the relationship between the students' perceived usefulness of CENTERS and their actual use of it?
3. What was the level of student satisfaction with the use of CENTERS?

Methodology

The participants were 43 students (19 males and 24 females) and 4 (3 females and 1 male) teachers from two Mexican universities. They used CENTERS in four courses: one at the graduate level (Design and Evaluation of Learning Environments [n = 15]) at the University of Colima, and three undergraduate courses at the University of Baja California (Software Engineering [semester 4, n = 8] and Advanced Topics of Computer Programming [semester 8, n = 7] at the Faculty of Computer Science, and Management of Information Systems [semester 4, n = 13] at the School of Management, Informatics and Accounting). The mean age for the undergraduate students was 22.63 years and for the graduate students was 30.33 years. All students were enrolled full time and took other courses (with other teachers) in their classrooms during the same semester, having opportunities to interact face to face.

Because of their fields of studies (all related to computers), all students were familiar with Internet technologies. Demographically, 56% of the participants were females. Eighty-four per cent of the students used e-mail regularly and 60% had participated in chat conversations prior to taking the course. We also asked about the characteristics of their PC and if they had continuous access to Internet. In general, the students' equipment had the required characteristics to carry on with the course, and 32 students out of the 43 had continuous access to Internet. Regarding their previous experience taking online courses, 29 out of the 43 students had already taken one or more courses and all teachers had already taught via the Internet.

The courses were mandatory for the students' curricula, but their participation in the study was voluntary; all students were invited and eight did not accept, leaving our sample at 43. At the end of the courses we applied a questionnaire to assess the students' impressions and experiences with CENTERS, including their frequency of interaction with teachers and peers and satisfaction with the course. The questionnaire included items about the students' use and opinion of CENTERS as well as specific questions about topics identified in the literature as potential influences on course satisfaction (Harasim et al., 1995; Hiltz, 1994).

Additionally all interactions were registered and a random sample of 25% of all logs was categorized according to their content by two independent raters other than the authors. The categories were academic, technical, and social. The information obtained from these analyses was then contrasted with the information provided by the questionnaires applied to the students. Results on coincidences between students' responses to the questionnaire and recorded logs are then reported.

Results and Discussion

The total number of messages exchanged as well as the number of chat requests accepted and rejected between students and teachers and among students are shown in Tables 1 and 2.

On average there were more than 75 messages sent by each student, although some students were much more active and some hardly sent any messages. Thus, the median of messages exchanged between students and teachers is around 12 and the median of messages exchanged between students is 100.

The results show that most of the requests were accepted. The range of exchanges in chat and instant messaging conversations varied from 2 to 78, not counting 4 larger outliers. On average, the conversations consisted of 14.55 messages: 7 to 8 for each participant.

During our experiments we wanted to understand the real use of the system and how it was integrated into the student's work rhythm; to describe this information, we plotted the number of instant messages and chat conversations per hour of the day and per day of the week. These analyses are shown in Figures 2 and 3.

The analysis of the use by hour indicated that the distribution of messages and chat conversations peaked at around 5 p.m.; this could be due to the time coinciding with the end of the students' work day. A smaller peak forms around midnight. During informal interviews about the development of their courses, one student mentioned that she used night hours to work on her course activities, because it was when her children were sleeping, and another one mentioned that it was when he had free time; this could be consistent with Andriole (1997) finding that only 28% of students preferred interaction times during daytime. Thus it might be plausible to consider that the students' responsibilities other than the course might have influenced the time and frequency of use of the tool.

Table 1. Number of message exchanges

	Teachers to students		Students to teachers		Students to students	
	N	Median	N	Median	N	Median
Messages	377	12	365	11.5	3175	100

Table 2. Number of chat requests

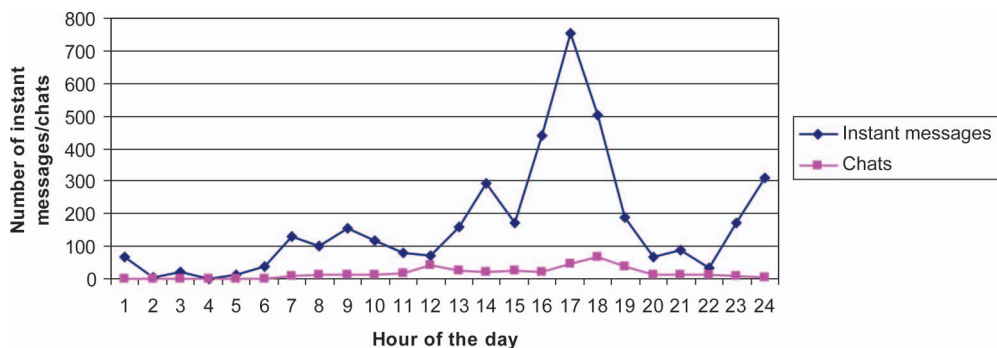|	Between students and teachers		Among students	
	Accepted	Rejected	Accepted	Rejected
Chat requests	101	13	271	29

Figure 2. Number of instant messages and chats per hour of the day
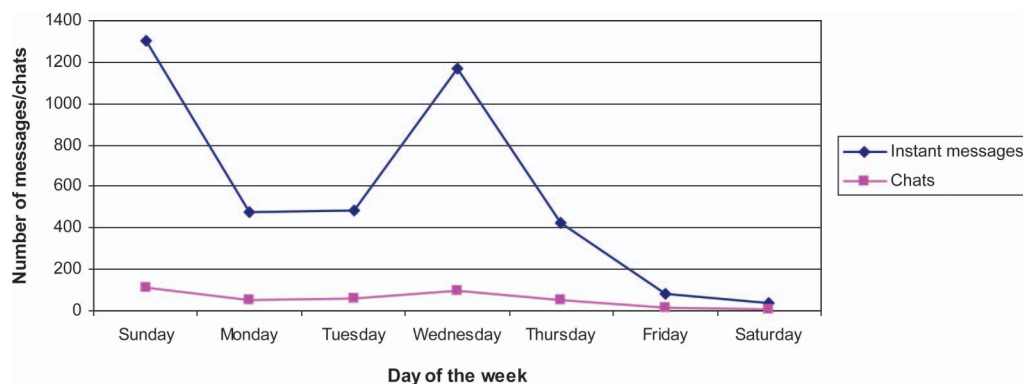
Figure 3. Number of instant messages and chats per day of the week

As shown in Figure 3, CENTERS was used more often on Sundays and Wednesday; this may be because on Mondays students had new course materials so they had more to discuss previous to receiving and starting with these new materials, and on Wednesday one course had synchronous meetings. We also found that in the graduate course many students had problems reading materials in English, and therefore asked each other for help with their translations. We asked in the questionnaire if they found useful these tools to complete their school assignments (discussed below).

Analyses of the Logs

The logs were thematically classified, within the following categories: academic (conversations related to class topics), technical (conversations about technical use of the system or software used during the courses), and social (conversations about social issues and other themes not related to the course); the category labelled ''academic'' was further subclassified into supporting teamwork, solving doubts, and coordinating final projects. The inter-rater scoring reliability was obtained for each category as well as for all the categories as a whole: academic $r = 0.905$; technical $r = 0.960$; social $r = 0.973$. The total inter-rater reliability was $r = 0.939$ (Trochim, 2004).

Tables 3 and 4 present the number of expressions related to the main topic in chat conversations and instant messaging exchanges according to their classification. The total is higher than the actual number of chats and messages reported above since some interactions contained expressions related to more than one category. For instance, it was not uncommon to begin a conversation socializing, and then proceed to discuss a course related issue or some other topic.

Table 3. Classification of chats according to message content

Category	Main topic of conversation	Number of expressions related to topic	Percentage
Academic	Teamwork	28	7
	Final project: Coordination, doubts, documents, meetings	73	17
	Course related doubts	61	15
Technical	Technical: Use of the system, other software used, and functioning of the site	22	5
Social	Social and other topics	236	56
Total		420	100

Table 4. Classification of instant messages according to their content

Category	Main topic of conversation	Number of expressions related to topic	Percentage
Academic	Teamwork	340	9
	Final project: Coordination, doubts, documents, meetings	783	20
	Course related doubts	500	13
Technical	Technical: Use of the system, other software used and the site	235	6
Social	Social and general themes	1,868	49
Total		3,917	100

Analysis of the system records by category show that most of the interactions were of a social nature (56%). The logs indicate that when a participant realized that somebody else was accessing the site they often sent messages to socialize with that person. Regarding the teacher, students commented that they often sent messages to greet and welcome him or her, which may have helped the teachers establish a better social presence (Gunawardena, 1995; Gunawardena & Zittle, 1997; Hiltz, 1994). In addition, analyses show that the frequency of interaction was greater after a student just entered the site, when he or she received greeting messages from other students, they generally responded. This is reflected in the higher use of chat and messages for social issues (see Table 1).

Regarding the technical category, which represented only 5% of the interactions, the analysis shows that most of the messages were to ask about a specific characteristic of the system or the site as a whole: For example, students asked how to change their nicknames within group chats. This low use could be due to the fact that most students came from study areas related to computing.

The interactions regarding academic issues accounted for 39% of the exchanges. Theoretically, the online classroom can reduce the traditional social distance between teacher and student due to its horizontality (Wegerif, 1998), where success of the course depends more on the collective efforts of all participants (Arbaugh, 2001). Research data on thousands of online students at SUNY (State University of New York) shows that students who reported higher levels of interaction with classmates perceived higher levels of learning (Fredericksen, Pickett, Shea, & Peltz, 2000), but studies on the influence of the use of electronic tools on learning, however, are not conclusive (Cradler, McNabb, Freeman, & Burchett, 2002; Picciano, 2002). For example, Ring, Wilson and Fuller (1996, in Oliver, Omari, & Ring, 1998) report that feedback obtained from students participating in online tutorial sessions using chat conversation showed an improved confidence in themselves as learners, and that this was reflected in the higher quality of their assignments. Their study refers to structured chat interactions; the analysis of our logs, however, show that for unstructured informal interactions this might not be the case. In general, the conversations that took place among course participants were more superficial than we thought they would be. For example, students did not discuss lectures or assignments using instant messages or chats, they just used them to ask their classmates if they had finished their work, or exchanged superfluous comments about course materials. Contrary to our expectations, students seldom used the option of navigating together through their course readings. This may be due to the fact that teachers did not motivate and model their use while solving students' doubts.

Regarding our second question, about the relationship between the students' perceived usefulness of CENTERS and their actual use of it, we found no clear relationship. As shown in Figures 4 through 7 and Table 5, the number of interactions recorded on the logs did not correspond with the students' responses to the opinion questionnaire about the usefulness of the system's facilities to interact with their teacher and classmates. Students that used the facilities more often did not necessarily consider their level of interaction to be high, and vice versa.
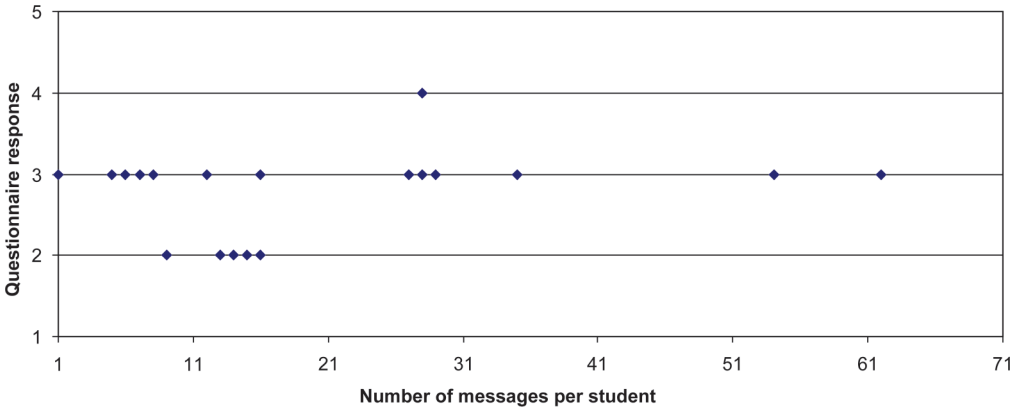
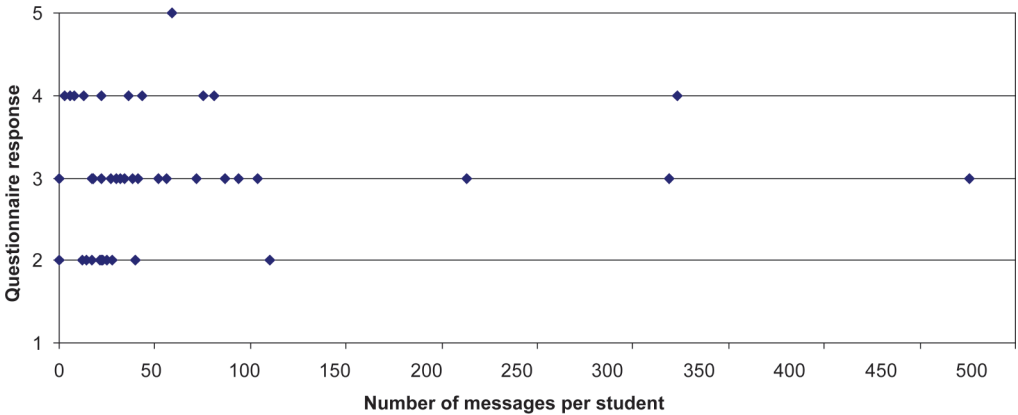Figure 4. Perception of interaction opportunities with teacher vs. actual usage of the message facility

Figure 5. Perception of interaction opportunities with students vs. actual usage of the message facility

Table 5. Spearman correlation between real usage of CENTERS and responses to the questionnaire

Variables	Spearman correlation	P
Message usage – Interaction opportunities (student–teacher)	0.256	0.098
Message usage – Interaction opportunities (student–student)	0.160	0.306
Chat usage – Interaction opportunities (student–teacher)	0.222	0.152
Chat usage – Interaction opportunities (student–student)	0.051	0.743

As it is shown in Figures 4 and 6, irrespective of the number of messages and chats they had with their teachers, most of the students responded that their interaction opportunities were equal to those offered in the traditional face-to-face courses; only a
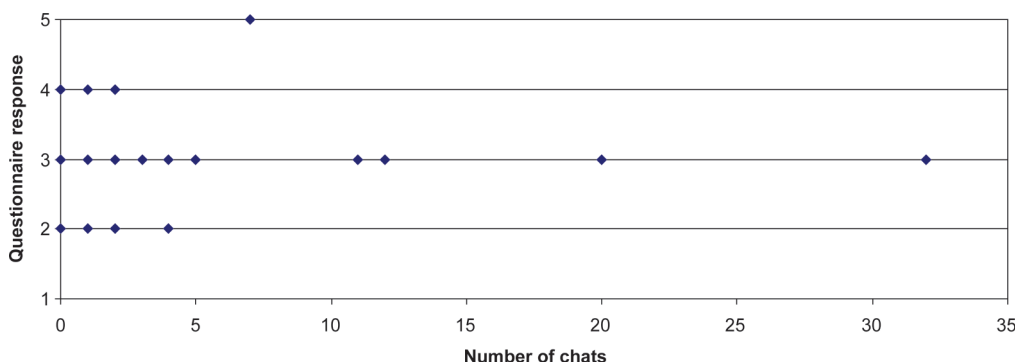
Figure 6. Perception of interaction opportunities with teacher vs. actual usage of chat facility
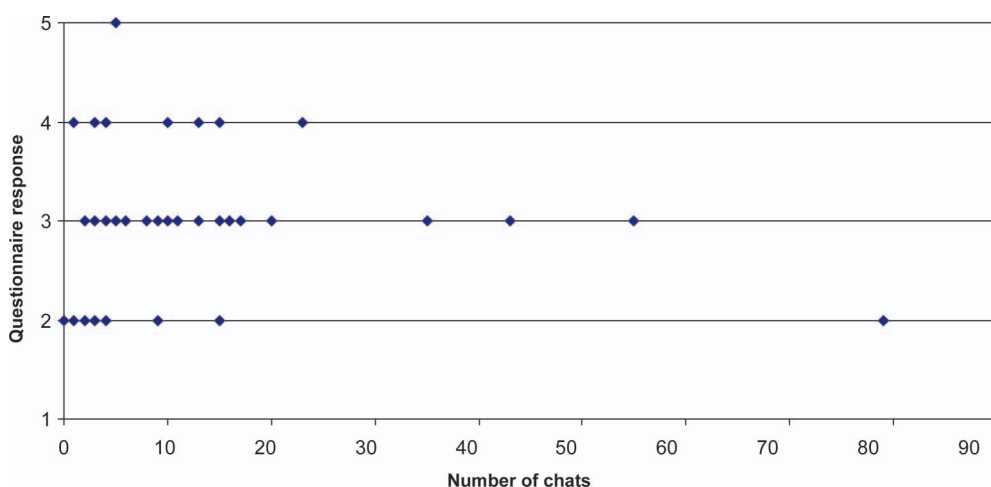

Figure 7. Perception of interaction opportunities with students vs. actual usage of chat facility

small percentage (14%) considered them as slightly higher or higher, but no one considered them to be lower.

This somewhat supports Matuga's (2001) findings regarding the fact that some students felt that they do not receive individual attention, even when the majority considered that their teachers provided answers and feedback promptly. In our case, participants considered the opportunities for interaction equal to those offered in face-to-face courses. This could mean that students felt they could interact with their teacher with the same intensity as they do in the classroom.

On the other hand, Motiwalla and Tello (2000) report that 67% of students that participated in their study agreed that computer-mediated communication tools facilitated student-teacher interaction, and 47% mentioned that those tools also facilitated student-student interaction. In our case, 68% of the students considered that their interaction opportunities with their teacher were equal to those they have in

a traditional face-to-face course, but 73% considered the opportunities for interaction with their classmates to be equal or higher than in the traditional settings, as shown in Figures 5 and 7. The plots show an agreement of the responses with their actual use.

The questionnaire included a dichotomous question asking students if they would be willing to take more courses using CENTERS, as a way to indirectly assess their satisfaction with the course. The vast majority of participants (82%) affirmed that they were willing to take additional online courses using the system. Students who answered that they would take more courses using the system sent an average of 89.83 messages and participated in 19.28 chat sessions. Students who answered they would not take other courses using the system had an average of 56.93 messages and 7.71 chat sessions.

When the responses of these students are contrasted with their actual use of the system, the results clearly show that the students who answered yes used it far more extensively than the students who would not like to take more courses in the same format. Being the majority, we inferred that their level of satisfaction was high. From our informal conversations with the students, we learnt that they considered that the educational experience had been more interactive when compared with other distance courses they had taken in the past.

Summary and Conclusions

In general, the results from both questionnaires and actual use of the system show that the system was a useful communication tool for our groups. Most participants showed a high level of interaction although the amount of messages sent by the teachers to their students was nearly 10 times lower than messages exchanged between students themselves. Chat was used less often, although the conversations were longer. Students mentioned that they used instant messages when they wanted to ask for something quickly and were not willing to establish a longer conversation.

Analyses of the logs, however, showed that as a communication medium it was used mostly for purposes related only tangentially to academic purposes. In this sense, the option of navigating together through the course materials was never used, and we think that students might have benefited if the teachers would have exemplified its use when answering their doubts. On the other hand, the high percentage of interactions between students might indicate that it helped them to establish better social relationships with their classmates. Oliver et al. (1998) discussed the benefits obtained from informal chat sessions in terms of building a supportive community of learners. They report that their students considered their informal chat sessions the second most successful form of communication, after email, helping to improve course satisfaction and retention rates. In this respect, the results on the use of chat in our case might indicate that the system as a tool provided them with more opportunities for social interaction.

The results suggest that the use of instant messaging during online courses increases students' satisfaction by providing continuous opportunities for interaction with the teacher and classmates. The high level of interaction showed by

all participants, as well as their willingness to take more online courses using CENTERS, led us to conclude that instant messaging can be successfully integrated and used within online learning environments.

References

Andriole, S. J. (1997). Requirement-driven ALN course design, development, delivery, and evaluation. *Journal of Asynchronous Learning Networks*, *1*(2). Retrieved March 8, 2006, from http://www.aln.org/publications/jaln/index.asp

Arbaugh, J. (2001). How instructor immediacy behaviors affect student satisfaction and learning in web-based courses. *Business Communication Quarterly*, *64*(4), 42–54.

Contreras-Castillo, J., Favela, J., Perez-Fragoso, C., & Santamaria-del-Angel, E. (2004). Informal interactions and their implications for online courses. *Computers & Education*, *42*(2), 149–168.

Cradler, J., McNabb, M., Freeman, M., & Burchett, R. (2002). How does technology influence student learning? *Learning and Leading*, *29*(8), 46–49, 56. Retrieved March 8, 2006, from http://caret.iste.org/caretadmin/news_documents/StudentLearning.pdf

Curtis, D. D., & Lawson, M. J. (2001). Exploring collaborative online learning. *Journal of Asynchronous Learning Networks*, *4*(2). Retrieved March 8, 2006, from http://www.aln.org/publications/jaln/v5n1/v5n1_curtis.asp

Fredericksen, E., Pickett, A., Shea, P., & Peltz, W. (2000). Student satisfaction and perceived learning with on-line courses: Principles and examples form the SUNY learning network. *Journal of Asynchronous Learning Networks*, *4*(2). Retrieved March 8, 2006, from http://www.aln.org/alnweb/journal/jaln-volume4issue2-3.htm

Gilbert, L., & Moore, D. R. (1998). Building interactivity into web courses: Tools for social and instructional interaction. *Educational Technology*, *38*(3), 29–35.

Grinter, R. E., & Eldridge, M. (2001). y do tngrs luv 2 txt msg? In W. Prinz, M. Jarke, Y. Rogers, K. Schmidt and V. Wulf (Eds.), *Proceedings of the Seventh European Conference on Computer-Supported Cooperative Work ECSCW 01, Bonn, Germany* (pp. 219–238). Dordrecht, Netherlands: Kluwer Academic Publishers.

Grinter, R., & Palen, L. (2002). Instant messaging in teen life. In *Proceedings ACM CSCW 2002* (pp. 21–30). New Orleans, LA: ACM Press.

Gunawardena, C. N. (1995). Nuevos caminos en el aprendizaje: Nuevas formas de evaluar. In *Cuadernos de educación a distancia 3* (pp. 57–83). Guadalajara, México: Universidad de Guadalajara.

Gunawardena, C. N., & Duphorne, P. (2000). Predictors of learner satisfaction in an academic computer conference. *Distance Education*, *21*(1), 101–117.

Gunawardena, C. N., & Zittle, F. J. (1997). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American Journal of Distance Education*, *13*(3), 8–26.

Hadidi, R., & Sung, C. (2000). Pedagogy of online instruction – Can it be as good as face-to-face? In *Proceedings of the American Conference on Information Systems, Long Beach, California, August 2000* (pp. 2061–2065).

Hara, N., & Kling, R. (1999). Students' frustrations with a web-based distance education course. *First Monday*, *4*(12). Retrieved March 8, 2006, from http://firstmonday.org/issues/issue4_12/hara/index.html

Harasim, L., Hiltz, R., Teles, L., & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online.* Cambridge, MS: The MIT Press.

Hassenplug, C., & Harnish, D. (1998). The nature and importance of interaction in distance education credit classes at technical institutes. *Community College Journal of Research and Practice*, *22*(6), 591–605.

Hiltz, R. (1994). *The virtual classroom: Learning without limits via computer networks.* Norwood, NJ: Ablex Publishing Co.

Hu, Y., Fowler Wood, J., Smith, V., & Westbrook, N. (2004). Friendships through IM: Examining the relationship between instant messaging and intimacy. *Journal of Computer Mediated Communication*, *10*(1). Retrieved March 8, 2006, from http://jcmc.indiana.edu/vol10/issue1/hu.html

Isaacs, E., Walendowski, A., & Ranganthan, D. (2002). Hubbub: A sound-enhanced mobile instant messenger that supports awareness and opportunistic interactions. In *Proceedings CHI 2002* (pp. 179–186). Minneapolis, MN: ACM Press.

Kanuka, H., & Anderson, T. (1998). Online social interchange, discord, and knowledge construction. *Journal of Distance Education*, *13*(1), 57–74.

Larose, F., & Peraya, D. (2001). Fondements épistémologiques et spécificité pédagogique du recours aux environnements virtuels en enseignement: Médiation ou médiatisation? In T. Karsenti & F. Larose (Eds.), *Les TIC… au cœur des pédagogies universitaires: Diversité des enjeux pédagogiques et administratifs* (pp. 31–68). Sainte-Foy, Canada: Presses de l'Université du Québec.

Lovejoy, T., & Grudin, J. (2003). When messaging becomes formal: Will IM follow the steps of email? Retrieved March 8, 2006, from http://www.research.microsoft.com/research/coet/Grudin/ShortPapers/IM.doc

Matuga, J. M. (2001). Electronic pedagogical practice: The art and science of teaching and learning online. *Educational Technology & Society*, *4*(3). Retrieved March 8, 2006, from http://ifets.massey.ac.nz/periodical/vol_3_2001/matuga.html

Meunier, J. P., & Peraya, D. (2004). *Introduction aux théories de la communication: Analyse sémio-pragmatique de la communication médiatique* (2nd ed.). Bruxelles, Belgium: Éditions de Boeck Université.

Motiwalla, L., & Tello, S. (2000). Distance learning on the internet: An exploratory study. *The Internet and Higher Education*, *2*(4), 253–264.

Nardi, B. A., Whittaker, S., & Bradner, E. (2000). Interaction and outeraction: Instant messaging in action. In *Proceedings CSCW 2000* (pp. 79–88). Philadelphia, PA: ACM Press.

Oliver, R., Omari, A., & Ring, J. (1998). Connecting and engaging learners with the WWW. In B. Black & N. Stanley (Eds.), Teaching and learning in changing times (pp. 237–241). *Proceedings of the 7th annual teaching learning forum, the University of Western Australia, February 1998.* Perth: UWA. Retrieved March 8, 2006, from http://cea.curtin.edu.au/tlf/tlf1998/oliver.html

Peraya, D. (2000). Le cyberespace: Un dispositif de communication et de formation médiatisées. In S. Alava (Ed.), *Cyberespace et formations ouvertes: Vers une mutation des pratiques de formation?* (pp. 17–44). Bruxelles, Belgium: Éditions de Boeck Université.

Picciano, A. G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks*, *6*(1), 21–37. Retrieved March 8, 2006, from http://www.aln.org/publications/jaln/v6n1/v6n1_picciano.asp

Thirunarayanan, M. O. (2000). Cutting down on chat confusión. *Ubiquity*, *1*(38). Retrieved March 8, 2006, from http://www.acm.org/ubiquity/views/m_thirunarayanan_1.html

Trochim, W. M. (2004). *The research methods knowledge base* (2nd ed.). Retrieved March 8, 2006, from http://trochim.human.cornell.edu/kb/index.htm

Wegerif, R. (1998). The social dimension of asynchronous learning networks. *Journal of Asynchronous Learning Networks*, *2*(1), 34–49. Retrieved March 8, 2006, from http://www.aln.org/publications/jaln/v2n1/v2n1_Wegerif.asp

Yacci, M. (2000). Interactivity demystified: A structural definition for distance education and intelligent CBT. Retrieved March 8, 2006, from http://www.it.rit.edu/∼may/interactiv8.pdf