THE REALITY OF WEB-BASED INTERACTION IN AN EGYPTIAN DISTANCE EDUCATION COURSE

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ABSTRACT
This paper reports the results of a study conducted to evaluate the reality of interaction in a web-based distance education course. The learners were Egyptian first-grade secondary school students (15-16 years old) and the learning subject is mathematics. To investigate students' interactions via the Web, a Web-based learning environment was designed and implemented, called Wired Class, based on Willis' (1995, 2000) R2D2 instructional design model and constructivist principles. Quantitative and qualitative analyses were used to investigate the quantity and quality of learner-learner and learner-teacher interaction based on Mason's (1991) model.

INTRODUCTION

Researchers always emphasise the importance of interaction in education (Ritchie and Newby 1989; Harris 1999). Interaction is defined as a process that happens between the learner and the learning environment, in which the learner takes a more positive role (Berge, 1997). Interactivity has been described as a key to success in traditional classrooms to enhance learning and motivate learners (Fulford and Zhang, 1993; Wagner, 1994; Flottemesch, 2000). In a distance education context, studies found that students who enrolled in programmes that support and encourage interaction have highly positive attitudes toward learning, higher levels of achievement and less dropout rates than others in one-way systems (Ritchie and Newby, 1989; Comeaux, 1999; Garrison and Shale, 1990).

Holmberg (1990) believes that the ability of the medium to conduct interaction between the tutor and students is the essential criterion in selection among distance education technologies. He pointed out that any distance education medium should be able to provide the tutor and students with means of bringing about their experience, create rapport between them and offer opportunities for discussion.

To achieve social interaction in education programmes, usually a real-time (synchronous) communication technology (e.g., telephone and video conferencing) were being used. However, with the development in communication technology (like the Internet), these kinds of interaction do not necessarily require real-time communication. Interaction can be independent of time (asynchronous), using communication tools (e.g., e-mail and discussion boards). One of the important factors that have encouraged educators to use the Web in distance education is its ability to engage students in an interactive learning experience. The Web provides many mechanisms to facilitate dialogue between the learner and the course content and between the learner and others (Fisher, 2000).

However, implementing interactive technology, like the Web, and its components is not enough. Since distance education is characterised by the physical isolation of the learner from the tutor and peers by space and time (Rumble, 1989), it means less involvement and less possibility to ask questions. To solve these problems Trentin (2000) suggested that:

> 'One of the key ingredients for raising the quality of an online course is strong interaction between the players in the process; organized in full-fledged virtual classes, the participants must obviously respect schedules and deadlines if a collaborative working strategy is to be successful' (p. 20).

Many suggestions have been offered in the literature showing how to conduct successful interaction between learners, such as group-based collaborative projects, presentation boards and tutor questioning using interactive communication tools such as e-mail and discussion boards (Anderson, 1987; Moore, 1989).

Reviewing the literature has shown that the Web supports two different forms of student-student and student-tutor interaction; each form can be achieved using different methods: asynchronous interaction and synchronous interaction (Huang, 2000). Asynchronous interaction is time-independent and does not require real-time dialogue. It enables the tutor and learners to send and receive messages at any time, without the need for immediate response and gives them the chance to read, reflect and do more critical thinking (Liaw and Huang, 2000). E-mail, listservs and discussion groups, or forums, are the most common asynchronous methods used in the Internet. The distinct advantage of this type of interaction is that anyone can send a message to a group of people or read others' participations to a discussion forum at anytime, particularly with the 'threading' style, which are suitable for debating more than one idea under many sub-titles.

However, the most popular and widely used method for transmitting asynchronous information messages on the Internet is e-mail. There are many purposes for which students can use e-mail in distance education to interact with the tutor and peers. Students can send questions, submit assignments and receive evaluation results, prepare for real-time discussion, share ideas, receive materials or ask the instructor for help and receive feedback (Simpson, 2000). In addition, since e-mail is relatively cheap and simple to use, it facilitates and encourages collaborative work and exchanging of ideas and information (Stevens, 1994).

Although e-mail is the most popular and widely used method for individual asynchronous interaction, discussion boards and bulletin boards are also common group-based approach used in online learning (Carr-Chellman and Duchastel, 2000). Asynchronous interaction via discussion boards refer to 'the posting of messages in a common area for participants to read and respond to' (Huang, 2000, p. 42). Often, discussion boards focus on the subject matter and aim to encourage student-student dialogue and learning from others' experiences. Berge (2000) believes that on-line discussions have the same purposes as face-to-face discussions. For example, asynchronous discussions could be used to focus attention on an issue, diagnose specific learning difficulties, encourage reflection and self-evaluation and teach via students' answers. In addition, students can learn 'by expressing their ideas, opinions, or solutions to others, by critiquing one another's proposed models, and by defending or modifying their initial models' (Oliver, 2000, p. 9).

On the other hand, synchronous interaction is similar to telephone communication or audio-video conferencing systems. Many protocols are available on the Web for conducting real-time conferencing. Internet Relay Chat (IRC), for example, enables students to discuss in a real-time status via an audio-visual window or using text. Aoki and Pogroszewski (1998) indicated that synchronous interaction has the ability to motivate learners to learn, provide feedback and support immediately and encourage student interaction. Text-based chat is a simple and popular technique for communication on the Web. It fosters immediacy and social presence, is useful for brainstorming and decision-making and helps in building a community of learners (Murphy, 1997). Developers can easily integrate chat rooms into their courses to hold conferences between students and experts, monitor students' participation and encourage them to work collaboratively (Liaw and Huang, 2000).

However, although Web-based synchronous interaction offers a chance for real-time communication on the Web, it often requires sophisticated software and hardware to be installed, which are usually more expensive than asynchronous delivery systems. In addition, one of the critical limitations of this type of interaction is that it is restricted by time zones and students' typing and communication skills.

Lastly, since students access Wired Class at different times during the day, the on-line students' page presents a list of students who has logged-in to the class, with the time of logging-in/logging-out and links to those students' personal pages. The importance of this tool is that it allows the learner to know who is on-line while he/she studying encourages students to contact each other and minimises the sense that everyone is studying alone.

PARTICIPANTS

The learners were Egyptian first-grade secondary school students (15-16 years old), assigned randomly. Random selection of students at each school was made using alphabetical menus to control threats to external validity. By using random sampling, the researcher ensured that not only students with special interest in using the Internet or who had a high level of achievement or ambition were involved in the experiment. Due to the practical circumstances of implementation, only 32 students (24 boys and 8 girls) participated in this study.

The first step in the design and development phase is to understand students' needs, have information about their educational and cultural background and determine why they need to study at a distance. In Egypt, two types of public secondary schools are available. The first type of school is government-run and uses the Arabic language as a first language. Students at these schools study all subjects in Arabic. However, the English language is the second language. These schools account for more than 90 per cent of secondary schools in Egypt. The other type of schools, which may be government-run or private, uses the English language as a first language; therefore these schools are called ‘language schools’. Students at these schools study in English. These schools are estimated to constitute less than 10 per cent of secondary schools in Egypt.

In the present study, participants were students of the second type (language schools). Those students are a small minority and have many educational problems. For example: there is an insufficient number of well qualified teachers to teach at these language schools, particularly for vital subjects, such as mathematics and science, there is a lack of support provided to those students, as the official language of the educational authority is Arabic and most resources and well-designed instructional materials (such as broadcasting radio and television, videotape programmes and CD-ROMs) are available in Arabic.

Therefore, students wishing to develop their academic attainment and experience commonly use additional information sources, such as satellite television programmes and the Internet. Well-designed Web-based distance education programmes could be an efficient way to help those students to learn and interact with the world. Usually, language schools are well equipped with computers and the Internet to take advantage of the world-wide knowledge available in English and to interact with others around the world. Often, students at these schools have good skills and experience in using computers, WIMP-based programmes [*] and the Internet. This background is sufficient to allow them to use the Web and attend on-line classes in any subject, access remote resources and interact with others around the world using the English language.

INSTRUCTION AND TEACHING/LEARNING APPROACH

The learning subject is mathematics. This subject was chosen since it is probably the second most important subject in schools after language, important as an international language of communication and the nature of mathematics is such that it is not restricted by cultural, political or geographical boundaries like other subjects (such as languages and history). Algebra, in particular, was chosen because it is an important step in the learning of mathematics. It involves new and important concepts for studying mathematics, such as the concepts of formula, equation, function and variable. Functions, equations, co-ordinate systems and graphs are important topics in algebra in the secondary school curriculum. Linear and quadratic equations and functions, in particular, are fundamental lessons in this curriculum. Therefore, the topics, which were chosen to be learned in Wired Class, were functions and equations.

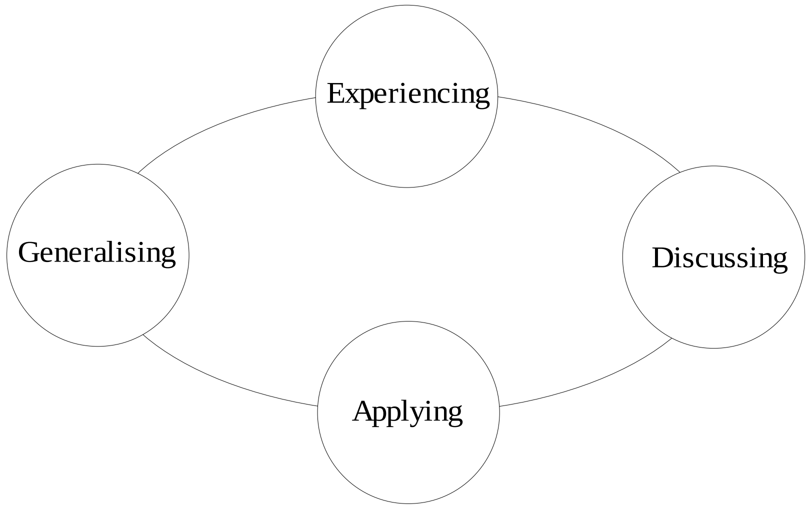
Based on the constructivist epistemology, constructivist theory seems to be the most suitable approach to design instruction for the Web. One of the key features of constructivism is that learning is not a passive operation, but a process in which learners construct their own learning. Constructivists believe that learning becomes more effective through learners’ active participation in the learning situation. In addition, social interactions between learners and the teacher and among learners themselves is a key issue in designing constructivist learning.

In the last few years, many frameworks and models have been developed and a variety of guidelines proposed for developing learning environments which support a constructivist approach. Honebein (1996) indicated that the constructivist-based learning environment is one in which the learner participates actively and on which he/she has a major impact. More recently, Nakahara (1997) has emphasised the designer’s role of challenging the learners’ thinking, active participation and social interaction to help learners to construct their own knowledge. Howe et al. (1995) suggested a constructivist-based approach for teaching and learning mathematics. This approach uses principles of co-operative and problem-centred learning. Howe et al. diagrammed the learning cycle in which learners can be involved to pass through these experience (Figure 1). Via discussion boards, viewpoints arising from the experiences need to be discussed with peers in order to be evaluated and validated.

In Wired Class, grading was based on test scores, class discussion, attendance, completion of activities and written assignments.

[*] WIMP means Windows, Icons, Menu and Pointer systems which is supported by both MS Windows and Mac systems.

Figure 1: The constructivist learning cycle (adapted from Howe et al., 1995)



THE DESIGN OF INTERACTION TOOLS

To investigate students' interactions via the Web, the need was emphasised to employ a Web-based learning environment. The design and development of the learning environment, called Wired Class, was based on Willis' (1995, 2000) R2D2 instructional design model and constructivist principles. In the definition focus, many pre-requirements were investigated and defined, including learners' needs, subject matter, front-analysis and technical requirements.

Constructing the learning environment required designing and developing tutorials and assessment elements, instructional support utilities, interaction tools, management and monitoring tools, help and support topics and a navigation system. The tutorial component was arranged in modules and lessons. Each lesson was arranged in a hierarchy of new concepts, examples, self-assessment, exercises, links to related Web sites and discussion areas. Management and administration tools were designed to help the on-line tutor to control/understand how the on-line class operated and to track students' progress. The interaction components (e-mail, chat rooms and discussion boards) were designed and integrated within the learning environment to facilitate student-tutor and student-student interaction.

First, to use e-mail via Wired Class, there were two possible ways. The first was to install e-mail server software in Wired Class server to work as an independent Web-based e-mail service, taking domain name of Wired Class Web server. Although this option allows a full control over the e-mail service, it is very costly and only suitable for big organisations. The second option was to ask students who have not e-mail account to subscribe to one of the free Web-based e-mail services (like Hotmail, Yahoo, Egypt.Net, etc.). The search for the most suitable free Web-based e-mail service for Wired Class students revealed that that Egypt Network offers an appropriate service. This service was selected for many reasons:

1. It offers a non-restricted e-mail address: Most e-mail service providers control the way in which the user can choose his/her e-mail address. For example, Microsoft Hotmail does not allow users to use special characters, such as the point (.) and hyphen (-). However these characters are allowed in Egypt Network e-mail.
2. Egypt Network offers a suitable and easy to remember domain for target users using the domain <username@egypt.net>.
3. Most e-mail servers have a high traffic rate. However, Egypt Network is favoured only by Egyptian users, allowing it to get a relatively low traffic rate.
4. The e-mail server is located in Egypt, which makes access to the server faster than other world servers (such as Hotmail and Yahoo).

For these reasons, Egypt Network was chosen as the Wired Class e-mail service provider. This enables every student in the class to get an e-mail address as soon as he/she registers. To use the e-mail service, learners are asked to enter their username and password within a form located in the Wired Class site. Students can use e-mail to prepare for real-time chat, share ideas, send questions to the teacher and receive feedback. In addition, unlike other learning environments (e.g., WebCT and TopClass), students are able to contact each other within Wired Class or other people who are not members in the learning environment.

Second, although there are numerous chatting systems available which vary in their capabilities (using text, audio and video), most of them are not suitable, either technically or educationally, to the students' level or to be hosted in Wired Class Web server. However, suitable chatting systems were found to be too expensive to be used in small-scale educational applications or at schools. For these reasons, it was necessary to design and develop a simple, and efficient, chat system for Wired Class students.

A text-based chat system was found to be the most popular type for easy and fast interaction via the Web. This kind does not require a high-speed connection or specifications or any additional software in the user's machine except the Web browser.

Technically, conducting a chat room requires running a script in the Web server to be used by two users, or more, at the same time. The main functions of this script are receiving one participant's inputs, using HTML form, and then forwarding them to the other participant browser who are running the same chat script. The chat system was designed as two windows in the student's Web browser. The upper window allows the student to input his/her information and a short message. At the same time, the lower one shows students' names and their participation.

The essential idea behind this simple design is that a CGI script handles each participant's inputs from the upper form, saves them in a temporary text file, then forwards them (after 5 seconds for example) to the other participant's lower window. The last task is achieved by involving the HTML command 'refresh' in the HTML code in the lower window. The complete CGI scripts in conjunction with HTML forms were designed and developed with students' needs and level in mind. Additional features were added to the chat system make it easy to use and interesting. For example, the learner can establish any number of new rooms and invite others for conversation. Alternatively, others can access a room already established already by the teacher or someone else using the option 'enter a room'.

Third, an investigation of discussion board programs available on the Web showed that using one of them in Wired Class would not be suitable to the students' level and discussion objectives. Although these discussion boards are 'threaded' discussions, which are suitable for debating more than one idea or topic in the same board, the developmental testing of Wired Class showed that the thread style discussion was taught to be unfamiliar to students and it would not allow them to take advantage of many messages presented under sub-titles. For these reasons, a simple discussion board was designed and developed for Wired Class students.

The design of the discussion board interface consists of two parts: The 'send' form and list of participants' messages to the board. This design allows the learner to submit his/her message to be added below at the top of the list. So, the learner can read others' messages to the board and compare his/her point of view against theirs. Technically, all posted messages are organised and saved in a HTML file in the Web server called a 'discussion file'. Every 'discussion file' in the server has a unique name. Every time the learner executes a discussion board script in the server side, the script generates an HTML page combining the HTML form (for inputs) and the specified 'discussion file' to appear on the same page in the user's browser.

METHOD

First, to solicit students' perceptions of ease of interaction with the tutor and peers using asynchronous and synchronous interaction tools (e-mail, discussion boards and chat), a questionnaire with closed-ended and open-ended items was constructed. The development of the students' questionnaire was based on the four phases of development (review of the literature, establishing content validity, construct the questionnaire and establishing scale reliability).

In addition, an on-line feedback form was made available throughout the eight weeks of the field-testing, to encourage students to send their own feedback and report any problem they might encounter instantly. The importance of this evaluation form is that it provides an on-demand and easy-to-use evaluation tool to students to provide their feedback, instead of waiting until the end of the course.

Second, to investigate students' interactions, both the quantity and quality of students' messages was analysed. Quantitative analysis was used to calculate the number of messages and investigate by whom they were sent, time of logons and length of messages. In addition, the qualitative approach was used to analyse the discussion content according to educational criteria, to enable conclusions to be drawn about the educational value of this activity. To analyse students' responses, a coding system was constructed based on research in computer conferencing and discussion content analysis by Mason (1991), Henri (1991), Fulford and Zhang (1993) and Berge (1997). Mason (1991), for example, suggested many questions to analyse students' responses, for example:

- Do they build on previous messages?
- Do they draw on their own experience?
- Do they refer to course materials?
- Do they refer to relevant materials outside the course (Mason, 1991)?

However, Henri (1991) categorised and coded students' responses in discussion boards using a more practical and comprehensive model for better understanding of the content of messages. This model highlighted five dimensions of the learning process exteriorised in students' messages. These dimensions, their definitions and indicators to them, are shown below (Table 1).

Table 1: Henri's analytical framework (Henri, 1991, p.125)

Dimension	Definition	Indicators
Participate	Compilation of the number of messages or statements transmitted by one person or group	Number of messages Number of statements
Social	Statement or part of statement not related to formal content of subject matter	Self introduction Verbal support "I'm feeling great…"
Interactive	Chain of connected messages	"in response to Celine…" "As we said earlier…"
Cognitive	Statement exhibiting knowledge and skills related to the learning process	Asking questions Making inferences Formulating hypotheses
Metacognitive	Statement related to general knowledge and skills and showing awareness, self-control, and self-regulation of learning.	"I understand…" "I wonder…"

Considering Mason's earlier typology and Henri's analytical framework, on the one hand, and students' level, the nature of the subject and the objectives of Wired Class discussion boards, on the other, these two approaches were adapted to build a new three-dimensional model. These dimensions are participation, interaction and cognition and content-related. Participation indicators provide information about the number of messages sent by students to every single discussion board, length of messages and time of posting. This information could help in identifying the type of discussion topic (e.g., low-level discussion topics, moderate-level discussion topics and high-level discussion topics) in which students are most active and clarifying the importance of on-line tutor participation in student participation.

In addition, the qualitative analysis of student-peers interaction shows how students worked together and exchanged their ideas to learn and construct their own learning. However, the cognitive and content-related dimension describes what is said about the subject and how it is said. This analysis, in relation to the cognitive tasks assigned in discussion topics, makes it possible to evaluate the level of information processing and thinking applied by learners and how this contributed to their learning.

The dimensions of this model and their indicators are shown below (Table 2). After the development of the coding system, messages were printed out and each message was divided into units of meaning. These units were analysed in the light of interaction and cognitive and content-related indicators to the answer the research question: How do students interact in the Wired Class? The results of the analysis, in conjunction with the results from the achievement test and perception questionnaire, would provide useful information about the contribution of on-line interaction to student learning and success in on-line learning.

Table 2: An analytical framework for discussion messages

Dimension	Indicators
Participation	· Number of messages per student in every discussion topic · The total number of messages per student in the course · Number of messages in earlier lessons · Number of messages in later lessons · Lengths of message per student (in statements) · Time of logons
Interaction	· Self-introduction · Statements that social in nature · Statements that comment in another message · Repeating information in another message · Responding to the tutor's views or advises · Responding to accept others' views and opinions without explanation · Responding to accept others' views and opinions with more explanation · Other statements that social in nature
Cognitive and content-related	· Providing solution without explanation · Providing solution with explanation · Providing more than one solution · Asking question related to the discussion topic · Asking question unrelated to the current discussion problem · Asking for more clarification · Judging the relevance of solution · Repeating information contained in the course materials · Repeating information contained in the discussion topic · Drawing conclusions

RESEARCH RESULTS

- **Ease of interaction with the tutor and peers**

In terms of ease of interaction with the on-line tutor and peers, a high majority of students (96.88%) indicated that they did not feel that they were isolated from the tutor during studying. In addition, 87.5% of students found the discussion boards were a very useful place for interaction and information exchange with classmates in Wired Class. However, the majority of students showed negative perceptions toward using e-mail as an individual tool for asynchronous student-student interaction. About 60% of students disagreed and strongly disagreed that e-mail is an easy way to communicate with other students in Wired Class (Table 3).

Table 3: Students' perceptions of ease of interaction with the tutor and peers

Statement	Response Distributions					% Choosing SA or A	Mean	Std. Deviation
	SA	A	N	D	SD			
I feel that the teacher is near to me whenever I am studying.	20	11	1	0	0	96.88	4.59	0.5599
Using e-mail, I can contact anyone in Wired Class easily.	5	4	4	14	5	28.13	2.69	1.3305
Discussion board is a good place to meet and talk to my classmates.	18	10	2	1	1	87.50	4.34	0.9708

Students' comments implied that they did not feel much geographical isolation from the tutor due to his regular messages and they appreciated his help and support.

> 'The online teacher is very good. He gives me a lot of lessons and examples and helps me to understand these lessons'.
> And
> 'I liked Wired Class because when I don't understand or have a question about something I can ask Mr […]'.

In addition, students preferred discussion boards to e-mail as a course-centred interaction approach. A student expressed that:

> 'I liked communication with classmates through the discussion board. It is really nice'.

Second, feedback from a student who did not think that using e-mail is a good method for student-student interaction indicated that:

> 'To contact my classmates I have to use the e-mail but only few students get into email and use it. Contacting them is very difficult'.

In addition, students showed less satisfaction with chat, as a real-time interaction tool, and the majority of them (93.75%) preferred e-mail to chat for peer-interaction and reported critical difficulties in using and communicating with others via chat rooms (Table 4).

Table 4: Students' responses to the ease of use

Statement	Response Distributions					% Choosing SA or A	Mean	Std Deviation
	SA	A	N	D	SD			
E-mail program is easy to use.	11	15	1	5	0	81.25	4.00	1.0160
Chat room is an easy way to communication with others in Wired Class.	7	10	4	11	0	53.13	3.41	1.1876
E-mail is easier than chat to communicate with others in Wired Class.	15	15	2	0	0	93.75	4.40	0.6148

In addition, students reported that:

1. 'I could not participate in chat meetings because I need to type very quickly and I am not very good at spelling'.
2. 'Other students couldn't enter chat'.
3. 'We were able to chat if only for a short time'.

- **Quantitative and qualitative analysis of interaction**

Quantitative analysis

Wired Class records and students' feedback revealed that conducting and facilitating synchronous interaction via chat rooms required planning and determining the time of chatting in advance using other medium, such as e-mail. However, since students are different in their abilities and rates of progress, it was difficult for many of them to manage their time to join real-time discussions about a particular topic. In addition, students could not arrange for chat sessions themselves, since they could not find peers who had time for real time conversation or who were interested in the same discussion topic.

Problems of access to chat rooms, occasional Internet connection problems and speed of conversation were very confusing to many students, according to students' feedback and chat transcripts. One chat transcript, for example, showed that while the tutor, or a student, was asking a question and responses were scrolling-down on the screen, other students seemed to be very engaged in thinking about and typing replies to previous entries. Those students confused others and affected the flow of chat, since contributions related to different issues were being sent concurrently.

In this chat session, the tutor sent an e-mail message to a group of twelve students asking them to join a chat room already opened by the tutor to talk about issues in functions and graphs. The tutor began by asking students to provide examples of functions. The purpose was to help students and introduce them to elementary functions, their graphs and their applications to real life situations. The chat transcript showed that only eight out of twelve students logged on and participated successfully in the conversation. In the 25 minute session, the number of messages sent by the tutor was 8 out of a total of 26 messages, representing more than 30% of the total number of messages, and only two main questions were asked.

In addition, multiple teacher's questions and students' responses occurred simultaneously, while the continued flow of students' responses to previous questions might be difficult for students to understand and follow. Therefore, during the eight week course, most planned chat sessions were interrupted or cancelled and students were asked to visit discussion boards to participate in asynchronous conversations.

Since e-mail was used in personal asynchronous interaction between the tutor and students and among students, on the one hand, and since students reported significant problems of access to others via e-mail, as mentioned above, on the other hand, analysis was conducted only of students' participations in discussion boards.

Consequently, a table representing students' usernames, the number of messages sent by every student in every lesson and the total number of messages posted was drawn up. Using this table, it was possible to calculate the number of messages in the first module (earlier lessons) and the second module (later lessons), the number of statements in each message and the total number of statements per student. Considering the nature of the learning subject, any algebraic term, operation, formula or algorithm was considered as a statement.

The average number of messages sent by students during the Wired Class

To make instruction effective and promote active learning, the tutor monitored the discussion board, motivated students to participate more positively, evaluated learners' participation and send his/her comments to learners, publicly or individually, if needed. The tutor emphasised the importance of thinking and adding personal thoughts (e.g., 'I do not want you to copy others' messages, instead I would like you to think and share your own ideas' and 'I would like to see the entire class become involved in discussions and everyone has at least one participation in every discussion board').

In Wired Class, twelve discussion topics were suggested by the tutor and students. Although participation in discussion boards was an essential activity and the tutor emphasised the importance of regular participation by sending many messages asking students to participate by responding or commenting on others' messages, and students had very high positive perception of using discussion boards, the results of quantitative analysis showed that the average number of messages sent by students was relatively low. Results from the Wired Class records showed that students responded to the Wired Class discussion boards by sending a total number of 136 messages. Assuming that every student in the Wired Class (32 students) should participate by sending at least one message to each discussion board, this number (136) represents only 35.42% of the predicted total number of messages (384) that should be sent to the discussion boards (Table 5). In other words, the average number of messages sent by each student throughout Wired Class was 4.25, compared with the ideal total of 12.

Table 5: The total number of messages posted to the discussion boards

Number of students	Total number of messages assumed to be sent	Actual total number of messages sent by students	Percent
32	384	136	35.42%

Students' participation in discussions varied from ignoring the discussion to positive and regular involvement. The minimum number of messages per student sent to the discussion boards was zero. However, three students posted between seven and nine messages during the Wired Class. Table 6 shows that the majority of students posted between two and six messages. Only one student did not participate in the discussion board.

Table 6: The number of messages per student

Number of messages per student	**Frequency**	**Percent of students**
0	1	3.13
2	7	21.88
3	4	12.50
4	5	15.63
5	6	18.75
6	6	18.75
7	1	3.13
8	1	3.13
9	1	3.13
Total	32	100

The average number of messages sent to every single discussion topic

For a more accurate picture of students' participations in discussion boards, the number of messages by students to every single discussion board was counted. The results revealed that students' level of participation in the discussions varied from one lesson to another and the number of students who participated in any given discussion board varied between 6 and 16 (Table 7). In other words, the number of students who participated in a single discussion topic was, at most, only 50% of students.

Table 7: The number of messages per student

Discussion topic		Number messages	% N=32
Module 1	Lesson 1	12	37.50%
	Lesson 2	8	25.00%
	Lesson 3	7	21.88%
	Lesson 4	6	18.75%
	Lesson 5	9	28.13%
	Lesson 6	8	25.00%
	Total	50	Mean = 26%
Module 2	Lesson 1	12	37.50%
	Lesson 2	14	43.75%
	Lesson 3	15	46.88%
	Lesson 4	14	43.75%
	Lesson 5	16	50.00%
	Lesson 6	15	46.88%
	Total	86	Mean = 44.8
Total	12	136	

The difference in the level of participation in discussion boards between earlier and later lessons

The results in the above section show that the level of participation in discussion boards varied greatly from the first module to the second module and from one lesson to another. The number of students who participated in the first lesson in the first module was relatively high (12 students out of 32, which is less than 33%). This number decreased to 6 students in lesson 4. In the second module, the number rose again to 12 students in the first lesson and increased to 16 in the fifth lesson. In general, the level of participation in discussion boards increased between earlier and later lessons. The mean number of messages per discussion topic increased from 8.33 in Module 1 to 14.33 in Module 2. Furthermore, the dispersion was reduced from 2.88 in the first module to 1.36 in the second module (Table 8). Overall, while only 26% of students participated in the first module, about 45% of students participated in later discussion boards, as shown above (Table 9-5).

Table 8: The average number of messages per lesson in the first and second module

Module	Mean	Std. Deviation
Module 1	8.33	2.8810
Module 2	14.33	1.3663

Using the number of student participations in the first and second module, a *t*-test of independent samples based on equal variances was used to test whether the difference in means between earlier and later lessons (Module 1 and Module 2) is significant. The results (Table 9) show that there is a significant difference between earlier and later lessons in the number of messages posted to discussion boards at the 95% confidence level.

Table 9: Independent-samples test for the number of messages per students in earlier and later lessons

Levene's Test for Equality of Variance		*t*-test for Equality of Means				
F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
0.488	0.501	-5.934	10	0.00	-6.00	1.0111

Time of access

Since discussion boards were designed to show the sender's name, date and time of sending, it was possible to know at what time students accessed the discussion boards. Analysis of discussion logs showed that around 65% of students who responded to discussions participated on the day of studying the lesson concerned. However, the rest of the students (35%) responded after one or two days. The majority (85%) of those students who responded on the same day accomplished this task in the last 10 minutes of the learning session. About 50% of them responded in the last 1-3 minutes. However, only 15% of students were able to manage their learning session and time well enough to respond to the discussion boards before or during other tasks (e.g., accessing external Web resources or doing self-tests).

7. The relationship between students' level of participation and tutor's participation in discussions

The number of messages sent by the tutor to discussion boards was 19 out of a total of 155 messages sent by both the tutor and students (19 by the tutor + 136 by students), which represents 12.3% of the total number of messages (Table 10). Initial analysis showed that increasing the number of messages sent by the tutor increased the level of students' participation in discussions.

Table 10: The number of messages sent by the tutor and students

Discussion topic		Number of participants	Number of tutor's responses
Module 1	Lesson 1	12	2
	Lesson 2	8	1
	Lesson 3	7	1
	Lesson 4	6	0
	Lesson 5	9	2
	Lesson 6	8	2
	Total	50	8
Module 2	Lesson 1	12	1
	Lesson 2	14	2
	Lesson 3	15	2
	Lesson 4	14	1
	Lesson 5	16	3
	Lesson 6	15	2
	Total	86	11
Total	12	136	19
Tutor contributions equal to 12.3% of the total message volume			

To investigate the significance of this relationship, the correlation coefficient (Pearson's *r*) was calculated to indicate the direction and the strength of the relationship. The results showed that Pearson's *r* for the relationship between students' level of participation in discussions and number of tutor's messages (0.635) was significant at the 0.05 level (Table 11). In other words, the lack of the tutor's presence in person, and lack of interaction with the tutor via the discussion boards might be one of the factors, though not the only one, that negatively affect the quantity of students' messages, as mentioned in the discussion below.

Table 11: The relationship between students' level of participation and tutor's participation

Correlation	Tutor's participation	N	Sig. (2-tailed)
Participation in discussions by the tutor and students	$r = 0.635$	32	0.027
Correlation is significant at the 0.05 level (2-tailed).			

RESULTS OF QUALITATIVE ANALYSIS

Since it is not enough to obtain an accurate picture of students' participation by counting only the number of messages and statements, the purpose of this analysis is to reveal patterns of responses in order to assess how well students responded to discussion topics and worked together, and whether there was any relationship between type of responses and other variables of learning in the Wired Class.

Therefore, qualitative analysis of students' messages was conducted in terms of interaction and cognition and content-related elements. First, statements which were interactive in nature were coded and categorised according to the interaction indicators, as shown below (Table 12).

Table 12: Patterns and examples of students' interactive responses

Patterns	Percent	Examples of responses
Self-introduction	23.81%	'My opinion is this equation […]' 'I plotted […]'
Statements that comment on another message	19.05%	'So do I […]' 'I found the same results as Mohamed Abd Elrahman […]' 'I think Walied found the correct answer […]' 'Of course Ahmed, for example […]' 'Mark, you can't use the Grapher […]'
Repeating information in another message	35.71%	'The relationship between the height of a plant and its age' 'The relationship between the age and the height of a person is a function'
Responding to the tutor's views or advice	7.14%	'I used Grapher to graph the negative values. The difference is the graph will be plotted in the quof page […]'. 'Hello Mr […], I'll do that at home because there is no time today'.
Responding to accept or reject others' views and opinions without explanation	2.38%	'[…] the relation between the two lines of the equations is changing a changes the slope of the equation as Mona said' 'I think Walied's found the correct answer. My answer is the same as his'
Responding to accept or reject others' views and opinions with more explanation	11.90%	'Yes this is correct. When a changes, the slope of the line changes. When c changes the y-intercept changes'

Content analysis revealed that responses which were interactive or socially oriented in nature made up 19.09% (42) of the total number of statements. A relatively high percentage of students (35.71%) responded by merely repeating the content of messages sent by others and about 24% of statements were related to students' own experience and showed that they had worked independently to find answers or solve problems. However, around 19% of statements were comments on messages sent by others. More than 14.28% of statements were responses that agreed or disagreed with others' views. The majority of these statements (11.90%) were accompanied by appropriate explanations reflecting the senders' own points of view. Regarding interaction with the tutor, 7.14% of the total number of statements responded to the tutor's requirements or demands.

The above analysis shows that although the tutor emphasised the importance of thinking and adding personal thoughts one of the important features noticed in students' responses was repetition. A large proportion of students (35.71% of the content) quoted or adapted what others said in their messages, instead of using their own points of view or expressions. Although this result has a negative side, it indicates that students, at least, read and interacted with what others said and communicated with them to some extent.

However, social interaction with other students by accepting, rejecting or commenting on their views was noticeable and more common than interaction with the tutor. Some students tried to emphasise or clarify classmates' solutions, although only a small percentage of students did so. At the same time, students presented themselves through self-introductions and opinions (e.g., 'my opinion is'…, 'I plotted the graph and I found' …, etc.) in the majority of their messages, allowing them to support each other and build a sense of community. In other words, students attempted to create a sense of social presence by referring to each other by name and to some elements in the learning environment (such as the Grapher and examples section) rather than interacting with the tutor. In other words, students preferred student-student interaction rather than student-tutor interaction.

To reveal patterns of cognitive and content-related responses, statements which would tell how students thought and responded to discussion questions were analysed. The statements related to understanding, reasoning, cognitive skills and problem solution were coded and categorised according to the content-related indicators (Table 13).

Table 13: Patterns and examples of students' cognitive and content-related responses

Patterns	Percent	Examples of responses
Solution without explanation	71.35%	'The relationship between the depth and pressure is a function'. 'My results are *x=0, y=9, x=1, y=12, x=2, y=15, x=3, y=18*'.
Solution accompanied with explanation	12.36%	'I used Grapher to graph these negative values. The difference is the graph will be plotted in the second quarter of the page'. 'The new pairing of the numbers is not a function because the record 35 has two values 1995,1996'. 'The graph does not represent a direct variation because it is not a line'.
Alternative solution	0.56%	'The length of shadow and the time. The time and temperature'
Question directly related to the discussion topic	1.12%	'[…] did you use the Grapher to graph it? If yes, how?'
Question for more clarification	1.12%	'[…] Do you need the results?' '[…] What other equations are?'
Judging the relevance of solution	5.06%	'6 notebooks are cheaper than 5. Because when 5 notebooks cost 4.5 then the book costs .9. When the 6 notebooks cost 5 pounds then the book costs .83. If we plot the table we will not get a straight line'. 'If it is positive then the gradient is positive. If it is negative then the gradient is negative'
Repeating information contained in the course materials	4.49%	'[…] the slope is positive if $a>0$ and it is negative if $a<0$ […]'
Repeating information contained in the discussion topic	2.81%	'1. What do you notice? I noticed that we got the same results. 2. Does the equation have the same solution in each case? Yes.' 'What do you notice about the graphs of the first group when a changes? The slope is changed'
Conclusion	1.12%	'If the value of the coefficient of x is positive then so is the slope and if it's negative then so is the slope'

The results of the content analysis showed that cognitive and content related statements accounted for more than 80% of the overall number of statements posted by students. The majority of statements (71.35%) were short answers to the main discussion topic. 12.36% of the statements were clarification statements accompanying solutions, to support or interpret participants' opinions. 2.81% of the statements came directly from the text of the discussion topic. 5.06% of statements were judgements showing the relevance of solutions provided by the same participant or other participants. Students posted only 2.24% of the total content to learn more about rules of participation in discussions or for more explanation. Only one statement gave an alternative or additional response to the discussion question.

Although the Wired Class provided students with instructions and ideas for how to participate and respond to discussion topics, as mentioned above, the above results indicate that the majority of students did not understand the actual purpose of on-line discussions, and responded to discussion questions as they would respond to conventional textbook exercises. Students did not go beyond stating the direct algebraic solution (71.35%) and did not establish a sense of argument in examining their own or others' responses. In addition, they did not clarify the evidence behind their answers in their messages, or provide alternative solutions to the problem, if applicable. Even messages that contained questions comprised only 2% of the total content and half of them were asked only to obtain assistance or more clarification. The application of higher level cognitive skills (e.g., judging the relevance of a solution) was minimal.

For example, in the first discussion topic the learning objective was understanding the definition of a function. Therefore, students were asked to suggest and examine examples of functions, as a special relationship in which each input (or *x* value) results in one and only one output (or *y* value). The purpose was to investigate students' understanding of the function concept, encouraging them to find a general expression for the function and pave the way to the next lesson. In addition, examining examples and non-examples could help students who have difficulty with the concept of a function, possibly because of its many interpretations, to understand the definition. Good examples of functions would be that each student at a school has a unique fingerprint, each house on a street is assigned a unique address and the distance a car travels in one hour is a function of the speed of the car.

Although the Wired Class students provided good examples of function, even if many of them were repeated, and they showed understanding that a function is a correspondence that applies to each element of one set one and only one element, they neither explained the correspondence between the two sets of variables (whenever *x* increases *y* increases) nor looked at the function concept in different ways (e.g., as a relationship between sets of information, matching up one group of numbers with another group or mapping of some domain onto some range), as explained in the lesson.

In addition, it was noticed that students did not refer to on-line course materials or exploit the Web resources provided within each lesson and discussion topic, to respond and enrich discussion content. Also, students' responses indicated that they did not exploit information and tools provided by the Web sites recommended by the tutor, which explained the co-ordinate graph and provided useful and interesting tools to help them to solve plotting problems. The analysis of students' messages in this lesson indicated that students did not cite or refer to conclusions, solutions or examples presented at these sites.

The third issue considered in analysing students' messages was the relationship between the structure and objectives of discussion topics and the quantity and quality of students' responses. Since discussion topics varied from simple discussion questions to controversial problems, the requirements for discussion varied from a low level of intellectual behaviour to a high level of intellectual operations and skills. To investigate this relationship, first, the requirements for each discussion topic were analysed and coded into three levels according to Bloom's taxonomy:

1. Low-level discussion topics, which require doing simple calculations or mathematical operations and directly depended on concepts and problems mentioned in the text.
2. Moderate-level discussion topics, which required translating knowledge into new context, solving problems using available knowledge and skills, formulating, comparing and interpreting results.
3. High-level discussion topics, which required analysing, creating and verifying evidence and results.

Table 14: Requirements for discussion and level of participation

Lesson	Requirements for discussion	Cognitive demand	Level of response (number of messages)
1	Give examples that meet the requirements of the definition	Low	High (N = 12)
2	Study external Web links, draw graphs and investigate relationships, similarity and differences.	Low	Moderate (N = 8)
3	Compare and assessing values of theories, verify values, generalise from definitions and solve problem.	Moderate	Moderate (N = 7)
4	Observe, list and recall information, compare, contrast, examine, test values and solve problem.	High	Moderate (N = 6)
5	Tabulate, graph, interpret, observe pattern, explain and generalise.	Moderate	Moderate (N = 9)
6	Tabulate, graph, use old ideas to create new ones and draw conclusion.	Moderate	Moderate (N = 8)
7	Change using mathematical operations, formulate, compare and interpret facts.	Moderate	High (N = 12)
8	Tabulate, plot and construct graph, interpret the new graph and examine, identify and describe changes.	High	High (N = 14)
9	Construct graphs, compare changes, experiment, distinguish, assess and conclude.	High	High (N = 15)
10	Apply, solve problem, examine, recognition of hidden meanings, predict, draw conclusion and make choices based on discussion argument.	High	High (N = 14)
11	Construct graphs, compare graphs, describe differences and draw conclusion.	Moderate	High (N = 16)
12	Evaluate the relevance of data, modify, assess presentation of equations, solve a problem and draw conclusion.	High	High (N = 15)

Consequently, each discussion topic was analysed using the above coding system (Table 14) and the quantity and quality of students' messages for each discussion topic were coded. The results showed that the development in requirements and cognitive demands of discussion topics from low-level demands, in earlier lessons, to moderate and high-level demands, in later lessons, might be associated with growth in students' level of involvement in peer-interaction.

However, correlation analysis between cognitive demands of discussion topics and students' level of responses showed that there was no significant relationship between the students' level of participation in discussions and cognitive demands of discussion topics. In other words, the structure and objectives of discussion topics did not affect students' quantitative performance in on-line discussions. However, this performance varied significantly between earlier and later lessons and was affected by the tutor's presence and participation in discussions, as reported above, and confirmed using correlation analysis below (Table 15). At the same time, it was not surprising to find that there was a significant relationship between the cognitive demands of each lesson and its order in the course, since in the design, care was taken to choose and construct discussion topics of graduating difficulty, from simple topics making low cognitive demands, in earlier lessons, to complex topics making high cognitive demands, in later lessons.

Table 15: The inter-relationships among students' level of responses, lesson and discussion order, tutor's responses and cognitive demands of discussion topics

Variables	Variable 1	Variable 2	Variable 3
1. Lesson and discussion order			
2. Students' level of response	.774**		
3. Tutor's level of response	.429	.635*	
4. Cognitive demands of discussion topic	.686*	.340	-.114
* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).			

In order to find out if the order of the lesson or discussion topic, and any other factors, could together predict the variance of the dependent variable, multiple regression analysis was conducted using students' level of response as the dependent variable. Independent variables included in the analysis were lesson order, tutor's level of response and cognitive demands of discussions.

Table 16: Summary of multiple stepwise regression analysis for variables predicting students' involvement in discussion boards

Model		Sum of Squares	*df*	Mean Square	F	Sig.
Model 1	Regression Residual	83.084 55.583	1 10	83.084 5.558	14.948	.003
Model 2	Regression Residual	98.666 40.001	2 9	49.333 4.445	11.100	.004
Model 3	Regression Residual	99.332 39.335	3 8	33.111 4.917	6.734	.014
R Square $_{\text{Module 1}}$ = .599, R Square $_{\text{Module 2}}$ = .712, R Square $_{\text{Module 3}}$ = .716						

The results showed that the R Square for model 1 (in which the predictor is the lesson number) is 0.599. The R Square of 0.599 means that about 60% of the variation of students' participation in discussion (the dependent variable) could be explained by the variability in lesson number. Adding the level of tutor response as the second independent variable added 0.113 to the R Square. However, adding the cognitive demands of discussions as the third independent variables (model 3) added only .004 to the R Square to become .716. These results show that around 70% of the variation of students' participation in discussions could be significantly explained by the variability in lesson number and level of tutor response to discussions, with a significant F value at 11.1 ($p<.05$).

Second, a content analysis of randomly-selected messages (50%) in low, moderate and high level discussion topics was carried out, in the light of the analytical framework for discussion messages to investigate the relationship between the requirements for discussion topics and types of students' responses. The analysis revealed that when discussion topics presented easy and direct questions requiring low-level intellectual skills (e.g., suggest examples, study external Web links, draw graphs and investigate relationships, etc.), students responded in brief statements without showing the cause and effect of the relationship or explaining the reasons behind their arguments. In addition, they did not use statements that were social in nature or try to build a sense of community through discussions (e.g., responding to accept others' views and opinions without explanation).

However, in moderate-level discussion topics, students sent more positive responses, solved mathematical problems correctly and in detail, and interpreted the results. For example, when students were asked to discuss together which of two tables provided a function and why, what was the difference between the graphs of two equations or how an equation not in the slope-intercept format could be graphed, they provided many alternative solutions and explained how and why the answer was correct. They also responded to accept or reject others' responses with more explanation.

In high-level discussions which addressed more controversial problems requiring relatively high-level thinking and intellectual skills (such as analysing, verifying evidence, assessing information and drawing conclusions) it was noticed that students posted more alternative points of view and detailed responses, with relatively more peer interaction.

DISCUSSION AND CONCLUSION

Students' feedback supported the belief that students were not far from the tutor and he/she was able to respond and answer their questions in a reasonable time, as well as providing them with useful feedback and support via e-mail and discussion boards. However, students did not find e-mail a useful and quick method of interaction with classmates. The reason is that classmates did not access and check their e-mails regularly then respond to others' messages. More interestingly, the results above showed that students found discussion boards more suitable than e-mail to access and interact with peers, and more so than individual messaging. Possibly, the reason is that students often find classmates' messages in discussion boards and read and reply to their ideas that focus on well-selected and course-related topics. However, using e-mail, it is difficult for students to contact each other and talk about the subject without guidance and support from the tutor.

However, students argued that the system is text-based and requires good spelling, vocabulary, grammar and typing skills, particularly for non-native speakers. Therefore, asynchronous rather than synchronous activities would be more appropriate and suitable for students. Discussion boards, e-mail and submission forms are good examples of asynchronous tools that give the learner the time to read, think, type and revises his/her inputs. However, chat might not be easy to use in formal learning sessions since it requires prior planning and arrangements using other medium, such as e-mail, good and appropriate Internet connection, logging-in to the chat room at a specific time, small number of participants and good typing and language skills.

These findings highlight the need to look for a more reliable means of communication for individual interaction in on-line learning environments. This means of communication should encourage and facilitate interaction among students when they are studying on-line.

In terms of quantity of interaction, students spent less time in this type of activity when compared to other types of on-line learning activities (such as self-assessment). In addition, students believed that participation in discussions was not as important as achieving other conventional tasks and the average number of messages posted to discussion boards was less than anticipated. Therefore, students should be encouraged to participate more regularly in peer discussions and tutors may need to assign grade weight to the quantity and the quality of contributions and ask students to spend more time and effort in peer interaction.

In addition, the quantitative analysis revealed that the more participation from the tutor, the more messages were posted by students. Correlation analysis revealed that the number of students' responses per discussion topic had a significant relationship with the number of tutor's responses. The non-appearance of the tutor might have been interpreted by students as non-involvement, rather than giving them the chance to think and negotiate meaning themselves. To make instruction effective and promote active learning, discussions should be carried out within a tutor's scaffolding approach at management level (tracking, encouraging, grading, etc.) and cognitive level (explaining, facilitating, suggesting, etc.), particularly for those at lower academic levels.

Although participation in discussion boards was an essential activity and students had very high positive perception of using discussion boards, the results of quantitative analysis showed that the average number of messages sent by students was relatively low. One possible explanation is that students thought that they could not post correct answers that would add meaningful value to discussion, or simply they had nothing to say. Another explanation is that students did not consider discussions to be as important as conventional tasks. This explanation is supported by the results from formative evaluation which, revealed that more than 85% of students completed conventional tasks (such as exercises and 'send to the teacher' tasks) regularly and without more pushing from the tutor, even if they were not successfully achieved.

In addition, analysis of students' logs showed that the majority of students accessed discussion boards only in the last few minutes of the lesson, which did not allow them to participate fully. This may have been because the discussion questions came at the end of each lesson. Therefore, students, particularly those who could not manage their time effectively, paid less attention and time to discussions. Although all students accessed the discussion boards and read their contents, according to their logs, a significant number of students (21.8%) 'lurked' and sent no messages or fewer than three messages for twelve discussion topics.

However, it was noticed that one of the significant factors that may have affected students' participation in on-line discussion was the structure and objectives of discussion topics. Since discussion questions varied between easy-to-answer open-ended questions and more debatable and controversial problems, it was found that in discussions that addressed more debatable questions, students were motivated enough to engage actively in critical thinking processes and pay more attention to interaction with peers. However, topics that required low cognitive demands did not help students to use higher order thinking, interact with others or learn from others' experience.

Moreover, it was found that the number of participants who got involved in the later discussions was greater than those who got involved in the earlier discussions. The correlation results showed that although there was no significant relationship between students' level of response and cognitive demands of discussion topics there was a significant difference in students' level of involvement between earlier and later discussions. Multiple regression analysis has shown that about 60% of the variation of students' participation in discussions could be explained by the variability in the lesson number. According to earlier research, students very rarely interact via discussion boards, due to lack of opportunity to develop peer relations and intimidation about using new technology (Flottemesch, 2000). Possibly, after four or five weeks of studying in Wired Class, students who could not participate in public discussions had begun to engage actively and become familiar with the new style of constructivist learning and technology.

Also, it was found that the more participation there was from the tutor, the more messages were posted by students. The non-appearance of the tutor might have been interpreted by students as non-involvement or absence, rather than giving them the chance to think and negotiate meaning. Although personal e-mail messages were sent from the tutor to students, asking them to be more active, e-mail messages did not give them the evidence or the impression of the presence of the tutor. This result indicates that, possibly, students need more encouragement and support to participate more positively, bring ideas, agree on whose ideas will be accepted and feel a sense of community.

This result was expected and is consistent with Harris (1999), who indicated that the role of the tutor in discussion is as important as the role of the 'chair of a conference'. He argued that the tutor's role is essential to open and close discussions, encourage students to participate and interact, keep discussions on track and assess learning. Also, Jonassen et al. (1996) argued that tutor-student interaction 'exemplifies the constructivist design model' of on-line education, but the instructor's contributions should be only 9-15% of the message volume, as achieved in Wired Class. Trentin (2000) called the tutor's modest participation the 'initial approach'. This approach aimed at 'breaking the ice between the students and those responsible for leading and assisting them throughout the course' (Trentin, 2000, p. 19). According to Trentin, the outcome of using this approach is that the distance learners' sense of isolation is reduced and this helps in enriching and fostering discussion.

However, the result of this study did not agree with research results on learning via discussion by Dymock and Hobson (1998), who argued that students usually participate more in discussion when the teacher is away from the discussion group. This inconsistency in findings may be attributable to two reasons. First, these earlier studies were implemented at the university/higher education level, not in earlier education. Young students, particularly those who are isolated at a distance, may not be motivated enough to use discussion boards. Second, presence/absence of the teacher is not the only factor that affects student participation. The nature of the discussion topic and the possibility of more interesting issues being raised by students during discussion play an important role in fostering and encouraging the debate.

Therefore, on-line tutors should pay more attention and address more concern to strategies to foster participation and interaction and build the sense of community in Web-based learning environments. This can be achieved by directing comments or questions to students, suggesting materials, encouraging further exploration or opening up new avenues for development (Cox, 2000).

Stating another point of view, since discussion boards addressed more controversial issues and problems than those addressed by other tasks, students who had good experience and skills responded to discussion problems more frequently than those who lacked these abilities (Stahl, 1999).

Moreover, it was not surprising to find that also the quality of social and cognitive-related interaction was low. This low quality of participation was visible in the 'surface processing' of information, which reflected in repeating information in the discussion topic or others' messages without self explanation, supporting/rejecting others' opinions without adding personal comments or providing clear evidence, offering solutions without providing clear interpretation, providing solutions directly depicted from the text not from external Web resources or self-experience and asking questions that were not directly related to the discussion topic.

Superficial processing of information showed that much of students' learning came out as a result of interaction with the course content, rather than by negotiating and constructing meaning via peer-interaction or Web resources suggested by the tutor. Content analysis of students' messages showed that when students were challenged by discussion questions, they did not resort to Web links and this did not allow them to find information to clarify the discussion problem or respond to the discussion question.

Consistent with this finding, since interactive and co-operative learning is based on the student's interactivity and social skills (Fisher, 2000), on the one hand, and since the learning process is influenced by the level of information manipulation (Henri, 1991), on the other, little educational effectiveness can be gained from involving students in this type of activity if they are unable to carry out in-depth processing of discussion problems, are not interested in group-based learning or do not have the necessary skills and experience to participate in group and interactive activities.

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