A New Approach to Information Technology Instruction for Medical Students

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Abstract

Background and purpose: *Active learning, combined with computer-assisted instruction, can enhance medical students' performance and learning. This article is an attempt to introduce a new web-based approach to information technology instruction for medical students.*

Methods: *Eight topics were selected to be instructed in Web-based workshops. PHPBB Forum was used for web-based collaborative learning. One oral lecture session was held to make the students familiar with the Forum and their duties. For each topic, groups of 6-9 students had to search the Web, based on a search strategy to find answers for the questions. The students could discuss their findings in their group Forum under the supervision of a tutor.*

Results: *Direct (face-to-face) and indirect (Web-based) interactions among students was considerably increased. The students showed greater interest in participating in class activities. Students' attitude toward Web-based learning was improved.*

Conclusion: *Adding collaborative learning to computer-assisted instruction, along with constant supervision by the tutor, can enhance students' learning, since they can have free discussion and express their opinions*

Key word: *Small group, Information technology, Web-based learning*

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Introduction

Medical students had their first experience with the new - reformed- medical education curriculum in the first semester of 2004. One of the topics that was introduced to the students for the first time was information technology (IT); we were required to teach one part of it, i.e. systematic search in the Web. The skill objectives of our class, which was designed in an active-learning style, included the following:

1. Ability to analyze a medical question and extract its technical keywords
2. Writing a 'search strategy' using logical and advanced operators
3. Ability to use different web search tools
4. Individual and group work in the Web and practical of use forums to express individual ideas

Ewing and coworkers have proposed a model for applying a constructivist approach to e-learning; th eir model has six features:

1. Learning should be context based
2. Conceptual learning is through active involvement
3. Learning is through collaboration with others
4. Learner should have personal autonomy and control over learning
5. Learning is personal growth; and

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6. Learning outcome is a perspective and an understanding (1).

Material and Method

We considered active learning, practical examples, communication with the society, formative and summative assessments as the main factors of our class sessions which were conducted as workshops for 63 students.

1. Active learning

The students have to register in courseware which was designed for this purpose, and observe a categorized list of the activities they had to perform during the session. According to a time-table, the workshop tutor announces the password for each chapter and reviews its contents. The students then have the chance to read the contents and answer various objective and descriptive questions. All questions have feedbacks; thus, students can learn some subjects by the means of these questions. The students have to write down the answers to descriptive questions, even if they don't know the correct answers. At the end of each session, the answers are explained and the students have the chance to correct their mistakes for the next workshop. Using this method, learners can actually control what they are learning.

2. Practical examples

Subjects that our students had to search on and write about in the forum were all medical issues, including crush syndrome during earthquakes, the relation between blood pressure and myocardial infarction in non-diabetic persons, and hypertension in pregnancy. This task, although unfamiliar and difficult for freshmen, was encouraging for the students and enhanced their enthusiasm for the topics.

3. Communication with the society

After being introduced to the topics on the Web, students attend in the instructor's office in groups and observe his/her patients, their physical exam and lab results, and get familiar with the actual work environment and physician-patient relationship. They have to prepare a report and post it on the Web.

Table 1 shows the variety of topics and instructors, which includes a combination of basic and clinical issues. Practical aspects of these issues can strongly encourage freshman students.

4.Formative assessment

Students' activities were completely recorded in the system; any time during the course, therefore, their results and answers were all available in the forum for evaluation. This helped us find out students' mistakes and problems and assist them during sessions and thus, we did not have to wait for the final evaluation at the end of the course. Of the final score, 60% was determined with these in-course evaluations (including home works and virtual seminar presentation), 10% with regular presence and 30% with the final exam.

Table 1. Number of groups and their topics

Group Num.	Topic	Instructor's Department	Group Num.	Topic	Instructor's Department
1	Hypertension and herbal medicine	Pharmacology Dept., Babol Medical Univ.	5	Cytokines	Immunology Dept., SBMU
2	Internet as a library	DLN Center, SBMU	6	Disaster management	Emergency Medicine Dept., SBMU
3	Asthma	Pulmonology Dept., SBMU	7	Infant feeding	Pediatric Dept., SBMU
4	Epilepsy	Physiology Dept., SBMU	8	Complement ary medicine	Pharmacology Dept., Shahed Univ.

SBMU: Shaheed Beheshti Medical University

5. Summative assessment

The final exam was practical and the students had to answer a medical problem using the Internet. In order to do this, they had to prepare a systematic report of what they do in the Internet and then, as shown in Table 2, state their search strategy and the important resources they found in their search. This clearly shows that the students' skills are evaluated based on their actual outcome.

Class Instruction

We used PHPBB Forum for web-based collaborative learning. The Forum was tested and customized by the technical team one month prior to the class beginning. Each class included:

1. One oral lecture session to introduce the students with the general features of the program, registration in the site, and student grouping
2. Four workshop sessions, each of which was done in two separate groups for 4 hours. For these sessions, 80 topics and activities were described to the students under the tutor's supervision
3. Distance learning activities

Table 2. Worksheet for systematic Web search

Preparing List of Relevant Keywords		
1	Main topic (or question)	
2	Related topics (or questions)	
3	Identifying main concepts and keywords	
4	Finding technical terms (medical terms)	
5	Identifying phrases	
6	Finding synonyms and related terms	
7	Check for misspelling	
8	Check for alternative spelling	
Writing Search Strategies		
9	Selecting a search engine (SE)	
10	Using Boolian operators (AND- OR-NOT)	
11	Using advanced operators (in title, ext, site, in URL)	
12	Selecting a subject directory (SD)	
13	Searching SD using "proper keywords"	
14	Searching SD by browsing different categories	
15	Selecting a medical database	
16	Searching inside relevant sites (societies, journals, etc)	
17	Reviewing primary search results and writing new search strategy using different keywords and operators	
18	Repeating search using different search tools	
Ranking and Evaluation		
19	Document ranking	
20	Document evaluation	

Results

	Search Tool	**Search Strategy**	**No. of Results**	**Most Relevant Documents**		
				URL	**Ranking**	**Evaluation**
1						
2						
…						

The classes were organized as follows:
1. Selecting 8 tutors and 8 topics for virtual seminars
2. Description of secondary topics for each virtual seminar (64 subtitle in total)
3. Uploading the tutor's biography and introducing his/her virtual seminar and subtitles in the Web
4.The first session was dedicated to students' introduction with the general concepts and registration in the site
5. The students created their own groups, each consisting of 6-9 persons (8 groups in total, one for each seminar topic). They also selected a group moderator; someone with more computer literacy
6. Student registration and uploading students' pictures and demographic data by themselves
7. Creating discussion groups in the Forum and limiting students to work only in their own group
8. Searching the Internet, finding references, and selecting material for the related topic in the Forum
9. Connecting the tutors with student groups
10. Activating moderators to guide the students
11. Finalizing virtual seminars and making it possible for all students to access each others' seminar
12. Practice session and exam orientation; and
13. Examination: practical search to find answers for a clinical problem

Results

Types of group interactions

Group interactions included direct (face-to-face) interactions in classroom sessions, and virtual (in-the-Web) interactions, including asynchronous interactions. We did not have synchronous (real-time) interaction in this course. Interactions in this course can be classified as in Table 3.

A. Direct Interactions

Direct group interaction among students occurred in four levels, and all students participated in all four levels:

DL0: three-member groups worked on a computer with a group password.

DL1: 6-9 member groups, including two to three DL0 groups, worked on a virtual seminar.

DL2: All groups participated in workshop classes

DL3: All students participated in lecture sessions (selection of seminar subject and primary grouping)

B. Virtual Interactions

VL 1: Each 6-9 member group worked on a single subject via their specific Forum. These interactions were improved by the moderator, and group members could only see their own Forum activities.

VL 2: All students observed other groups' activities at the final session.

Figure 1 shows the flow of data in the Forum to prepare a virtual seminar. Moderator sends messages to activate group members. These messages were especially important in encouraging the students. Also, members see each other's messages and make their own notes. All these activities are student-centered which the first principle in quality improvement strategy. As can be seen in Figure 1, tutor (T)

Table 3. Different levels of student interactions

Groups		Interaction Level		
Group size	No. of Groups	Direct (physical) [Classroom-based]	Virtual (indirect) [Web-based]	
			Non-real-	Synch.
3	21	DL 0	-	
6-9	8	DL 1	VL1	
31-33	2	DL 2	-	
64	1	DL 3	VL 2	

has no role yet; this is because, at the beginning, tutor cannot connect to students' Forum so that they would be stress-free in preparing their drafts.

students' activities during the course via their representative and moderators, and moderators' briefing to train them in helping their group

Figure 1. Schematic demonstration of interactions in a 9-member group

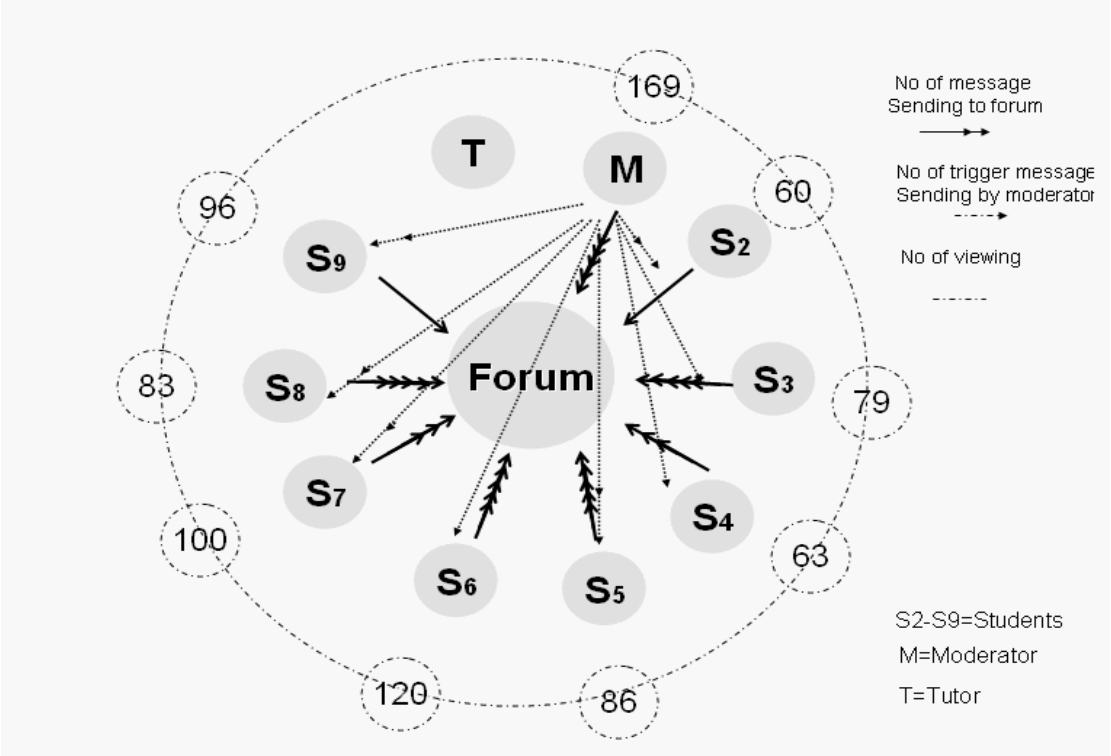


Figure 2 shows the temporal distribution of activities during the 3-month class period. It shows students' activity according to the average number of clicking on the web-pages (all kinds of activity) in a day. Serious differences can be seen in daily activities during the 90-day period, which is due to class circumstances and other events. Almost everyday, however, even on holidays and when the Internet connection of the university was disrupted, some activity can be seen. Vertical bands A-D in Figure 2 show various events as follows:

Band A: Interaction between administration and students

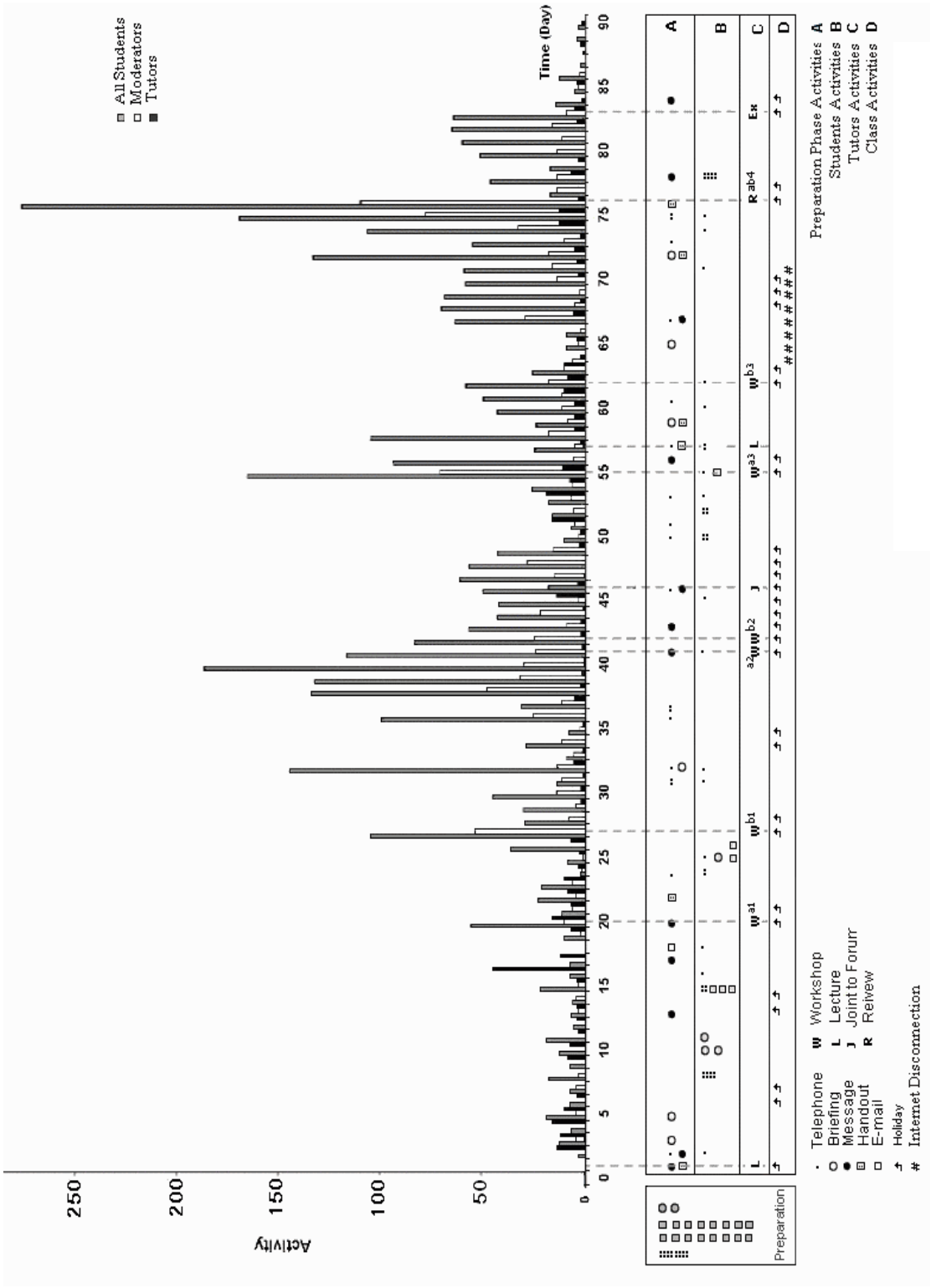
The administration was always in contact with the students during the course. The goal of these communications was to constantly follow members. As can be seen, 6 such briefings were held during the course (symbol E% Band A).

In addition to direct communication with the students, course rules and regulations, warnings and notification messages were constantly sent to the site's first page so that the students could see them as they entered the site and before they could do anything (symbol I% in Band A). Students' scores were also reported in the same manner. Also, students had the option to state their opinions and recommendations on the site and express their problems such as difficulty in entering the site and using site links (not shown in Figure 2).

Band B. Communication among administration and tutors

As Figure 2: Band B shows, prior to the first

Figure 2. Temporal distribution of activities during the 3-month course



workshop, there were lots of communication among administration and tutors via phone, meetings and e-mail in order to prepare them, coordinate their activities and training, develop seminar titles and complete tutors' profiles. Day 46, which is shown with a 'J' in the Figure, was when tutors were allowed to enter students' Forum. Note that in spite of a seven-day holiday (Days 42-49), students had considerable activity to prepare their site's content before their tutor could see it. Since rapid coordination was sometimes necessary, and it could not be done via the Web, telephone communication (symbol I% in Band B) was used for at least 17 times during the course.

Band C: Students' educational curriculum

This Band shows the educational curriculum which includes:

A. Workshops (W): Four 4-hour workshops for groups A and B

B. Lectures (L): Two 1.5-hour sessions

L1: Introduction to general concepts, explanation of site registration, grouping and topic selection

L2: Introduction to medical references in the Internet.

Of the total 19 educational hours, 16 hours (85%0 was performed by the students themselves.

Band D: Holidays

As Figure 2 shows, except for Thursdays in which workshops session were held, some activity can be seen on the Web even on holidays; especially days 43-49, which was a 7-day holiday, show a high level of activity.

For different reasons, the students' activity level had fluctuation in each day. Figure 3 shows one such fluctuation. It shows that in the day before the last workshop (in which students were required to present all their work on the Web), there is extensive activity in various hours of the day; between 10-15 in the School and between 19-1 am in home.

Tutors had less activity on the Web, as shown for a sample day in Figure 4. As can be seen, the observed tutor had great communication with his students between 24-2am.

Active Learning

In order to create a setting for active learning, all educational programs of the first and second workshops were designed with specific program; Local Course Manager (LCM). From the beginning of the workshop, each group had to enter its own LCM and do its job according to the time-table. Before starting each new section, the tutor revealed the password and gave a brief explanation. Tables 4 and 5 show two examples of this program.

Figure 3. Students' 24-hour activity in Day 75

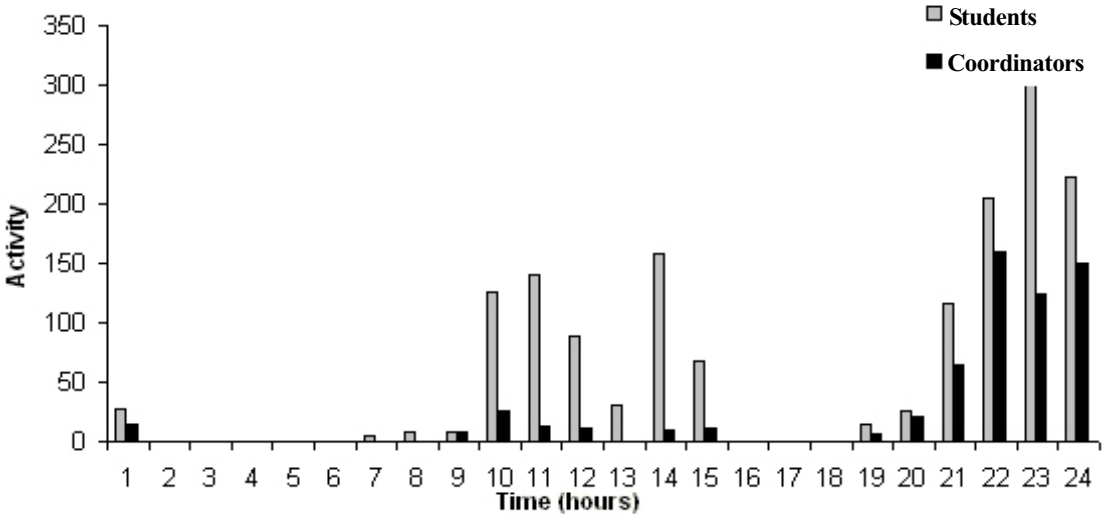


Figure 4. A tutor's activity and communication with the Forum in a sample day

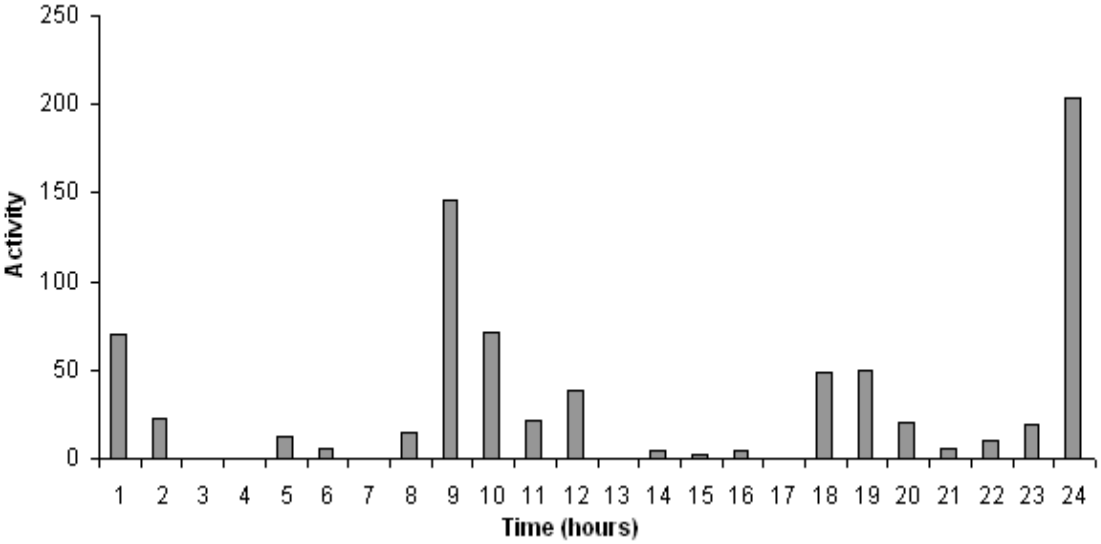


Table 4 shows the details of LCM program for the first 4-hour workshop. All activities and topics were divided into 10 sections. Time required to complete each section was determined considering its content and the number of mandatory activities. The class began at 8:30am and last until 12:30pm. In each section, the students had to do some activities, within a pre-determined time and in a specific sequence. Table 5 is similar to Table 4 and shows the course of the second workshop, including 31 activities with 500 scores.

Variety of activities and the use of Internet to find answers to some questions –which required writing a search strategy- kept the students fresh and made it possible to continue the workshops. The most important principle of the workshop was that the students knew that they had to do 60 activities by themselves in a limited time; this is unlike traditional classes in which students wait for the instructor to have educational activity.

An interesting feature of the workshop was that there were numbers of multiple choice questions, matching questions and short answer questions, for which students had limited time and limited tries to find the answers. This encouraged all group members to work hard on the computer and on the questions to find the correct answer. The sequence of activities in a workshop was sorted from easy to hard, and was designed so that each level was a pre-requisite for the next one; this helped shaping the learner's mental structure. When organizing the course, the tutor can easily relocate activities in the program to reach the best educational scenario.

Attitudes and Opinions

Table 6 shows that although it was our first attempt of instruction with this method, we were considerably successful in generating enthusiasm toward these topics among the students.

Problems and Weaknesses

1. Since some students had to attend parallel computer classes, the students' computer knowledge level was considerably diverse.
2. At the beginning, the students had little knowledge about medical terms and were not fluent in English; these were improved during the course.
3. About 60% of the students stayed in the dormitory with little access to the Internet, which restricted their activity. Those who lived in their homes in Tehran had no such problem.
4. During the course, the Internet connection of the University was being renovated; therefore, although the students had lots of extra time in the School and outside the workshop, they did not have the opportunity.

Table 4. Local Course Manager (LCM)- Course analysis (Workshop 1)

Section	Time	Activity	Q		CRQ		Slide No.	Total Activity	Total Point
			No.	Point	No.	Point			
1	8:30-8:45	Slide Slide Slide	0	0	0	0	3	3	0
2	8:45-9:00	Slide CRQ TF MQ MCQ MTF SAQ CEQ MCQE	6	30	2	50	1	9	80
3	9:00-9:15	Slide SAQ MCQE MCQE MTF	4	9	0	0	1	5	9
4	9:15-9:40	Slide CRQ Slide CRQ MQ SAQ Slide Slide Slide	2	8	2	30	5	9	38
5	9:40-10:00	Slide Slide Slide CRQ	0	0	1	20	3	4	20
6	10:00-10:45	Slide CRQ Slide Slide Slide MTF	1	3	1	5	4	6	8
7	10:45-11:30	Slide Slide CRQ	0	0	1	60	2	3	60
8	11:30-12:00	Slide Slide CRQ Slide	0	0	1	35	3	4	35
9	12:00-12:30	Slide Slide Slide Slide Slide Slide CRQ	0	0	1	50	6	7	50
10	End								
		Section Login						10	
Sum		60	13	50	9	250	28	60	300

Slide: Text pages; TF: True-false questions; MTF: Multiple True-false questions; MCQ: Multiple choice questions; MCQE: Open-ended multiple choice questions; SAQ: Short-answer questions; MQ: Matching questions; CRQ: Descriptive questions, the answer to which should be typed in the related field.

Table 5. Local Course Manager (LCM)- Course analysis (Workshop 2)

Section	Time	Activity	Q		CRQ		Slide No.	Total Activity	Total Point
			No.	Point	No.	Point			
1	8:30-9:00	Slide Slide Slide Slide Slide Slide SAQ MCQ MCQ MTF MCQE MQ CRQ SAQ MCQ	8	80	1	50	6	15	130
2	9:00-9:15	Slide Slide Slide Slide	0	0	0	0	4	4	0
3	9:15-10:15	CRQ Slide MCQ MTF	2	20	1	100	1	4	120
4	10:15-11:00	Slide CRQ	0	0	1	50	1	2	50
5	11:00-11:45	Slide Slide CRQ CRQ	0	0	1	100	2	4	100
6	11:45-12:30	Slide CRQ	0	0	1	100	1	2	100
7	End								
		Section Login						7	
Sum		31	10	100	6	400	15	31	700

Slide: Text pages; TF: True-false questions; MTF: Multiple True-false questions; MCQ: Multiple choice questions; MCQE: Open-ended multiple choice questions; SAQ: Short-answer questions; MQ: Matching questions; CRQ: Descriptive questions, the answer to which should be typed in the related field.

Table 6. Results of Information Technology (IT) class survey

	Questions	Answers				
		Agree	Disagree	No Opinion		
1	Novelty of issues for students	86%	13%	1%		
2	Interest to learn more advanced issues in this field	79%	18%	3%		
3	Positive change in students' attitude toward IT and its significance in medicine	87%	11%	2%		
		1 person	**2 persons**	**3 persons**	**No answer**	
4	Number of students preferably working on a computer in the workshop	35%	53%	11%	1%	
		Low	**Interme-diate**	**High**	**Very High**	**No Answer**
5	Usefulness of active learning with computer	11%	56%	31%	1%	1%
6	Course successfulness in educational group activities	6%	53%	35%	3%	3%

Conclusion

The effect of computer-assisted instruction on medical students' education cannot be denied (2). Adding collaborative learning to computer-assisted instruction can enhance students' learning, since they can have free discussion and express their opinions. Comparing to class environment, collaborative groups allow students to feel less stress and danger; therefore they can organize their thoughts better and lead the discussion (3). Computer-assisted collaborative learning and involvement in asynchronized electronic discussion groups is very helpful; groups with substantial discussion activity have been shown to have higher levels of knowledge production (4).

Studies show that the best performance in collaborative learning is achieved when classroom-based collaborative learning is integrated with Web-based collaborative learning (2).

Some studies confirm that students (especially social science students) still choose books rather than computer as their preferred learning tool (5). In medicine-related fields, however, the role of multimedia in learning may lead to different results. If elements of attraction and active learning are ignored in Web-based medical education, the students would certainly not show any interest.

Our study showed that combination of individual and group work in the class and on the Web, along with constant supervision by the tutors, can not only increase students' satisfaction level, but also achieve motivational-functional educational goals.

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