Computer-based medical education in Benha University, Egypt: knowledge, attitude, limitations, and suggestions
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Introduction

Computer-assisted learning applications in medical education have been developed to enhance traditional educational strategies and to provide new learning strategies that promote continuous self-learning. This would help students to remain up to date with medical sciences, which show rapid and considerable development every day [1]. The introduction of a basic knowledge computer course along with provision of computer and internet access for medical students at their entry to medical school would enable them to develop and progressively improve their competence and use [2]. The use of computerized information systems by medical professionals has been proven to improve the quality of medical care as it helps to update their knowledge and to use evidence-based diagnosis and treatment [3]. A study carried out in the USA reported that 80% of medical practitioners believed that the use of electronic information resources helps improve patient care [4]. Computer and information technologies help physicians restore clinical data of patients, medical records, referral notes, discharge summaries, and financial reports for hospitals [5]. Medical professionals from different countries can interact and communicate with each other.
through video conferences and this allows for exchange of information and experiences [6]. Searching Medline, medical journals, and textbooks is a useful method in learning and research [6,7]. It is thus essential for medical students to learn how to search using web-based search tools to find high-quality information resources [8].

Medical education aims to enhance students’ ability to maintain and update their medical knowledge by becoming lifelong learners by providing them with adequate skills to seek information and use original scientific sources [4]. Both information processing and information technology are considered important tools for self-learning [9].

Many studies in different countries have been carried out to explore the ability of fresh medical students to use electronic scientific resources in their medical education. In Malaysia, Nurjahan and colleagues found that half of the medical students considered their computer skills adequate. Students were familiar with skills such as word processing, e-mailing, and surfing the internet as they used them in their daily activities [10]. In India, most undergraduates (87%) and postgraduates (100%) medical students had computer knowledge through self-learning, and internet surfing and e-mail were the most common purposes for the use of computers [11]. However, different results were obtained from a survey conducted in a resource-poor setting in one of the Universities in Nigeria, where computer utilization and use of information technology were poor among the students surveyed [5].

In Egypt, a cross-sectional study to assess computer literacy in undergraduate medical students in Cairo University showed that 95% of students were computer literate and at least 60% had used the internet regularly during the last 2 weeks, but for noneducational purposes [12]. A multicenter cross-sectional study was carried out on undergraduate students in ten Egyptian medical schools and reported that only one-fifth of students were aware of online courses and only 6.5% of them had actually enrolled [13]. However, data on perception and utilization patterns of computer and information technologies among medical students are still scarce.

This study aimed to assess basic computer knowledge and attitude toward the inclusion of computer and electronic information resources in medical education among second-year medical students in Benha Faculty of Medicine, Qalubeya Governorate, Egypt. In addition, it aimed to identify students’ reported limitations and obtain their suggestions for the successful use of computer and electronic information resources in the educational process.

Second-year students are candidates for a computer learning course in Benha Faculty of Medicine. This course was carried out by the investigators of the study and aimed at familiarizing the students with basic knowledge of computer and information technologies available in Benha Faculty of Medicine and their applications in the educational process. The course included 30 theoretical teaching hours spread across 1 h/week. Different teaching aids were used such as power point presentations and videos. The main contents of the course included general concepts of computer hardware, software and Information Technology (IT), information networks, the different uses of IT particularly in education, health, safety, and finally environmental aspects related to IT use and information security. The evaluation of the course was based on a one-hour written exam at the end of the year.

Of the students who attended the course and agreed to participate in the study (n = 410, total number of second-year students), 141 completed the questionnaire before the course (response rate = 34.4%). However, this number was increased to 235 (57.3%) at the post-test stage.

A structured questionnaire was designed on the basis of a comprehensive review of the related literatures [12]. The questionnaire collects information on the sociodemographic characteristics of study participants (age, sex, and residence). In addition, the questionnaire comprised 21 items covering the following aspects:

1. Basic knowledge of the use of computer tools and applications (six items): This included six closed-ended questions (yes/no) on the use of basic tools such as the mouse and the keyboard, use of softwares and applications including word processing, internet, e-mail, and trouble-shoot methods.
2. Attitude toward the inclusion of computer in medical education was determined by students’ agreement or disagreement to the given statements (five items): these comprised questions on the importance of owning a computer, inclusion of a computer course in the medical curriculum, web-based learning and computer-based lectures, and examinations versus conventional methods.
3. Limitations to computer usage in medical education (seven items): students were required to ‘agree’ or ‘disagree’ with the statements presented. These included inadequate number of computers, computer labs, lack of IT staff, time shortage, large number of students, lack of internet access, and unclear course outline.
4. Suggestions to enable the use of computer in medical education (three items): students were required to ‘agree’ or ‘disagree’ with the statements presented. These included provision of computer labs to accommodate large numbers of students, inviting IT staff to support computer course, and allow for free university internet access.

A pilot study was carried out on 10 students and their questionnaires were not included in the study. This pilot

<table>
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<th>Participants and methods</th>
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<tr>
<td>This one-group pretest–post-test study targeted second-year students in Benha Faculty of Medicine, Qalubeya Governorate, Egypt, during the academic year 2014/2015.</td>
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study aimed to test the questionnaire and was useful in assessing the clarity of the questions and estimating the time spent to answer them. This helped to reduce potential misunderstanding as well as nonresponse to questions.

**Validity and reliability**
Tools were tested for content validity by three experts in the field of Medical Education in the Faculty of Medicine Benha University, and modifications were made accordingly. All tool components were tested for reliability using the test–retest method to ascertain consistency: Student’s knowledge of computer tools and application, \( r = 0.87 \); attitude toward the inclusion of computer in medical education, \( r = 0.72 \); limitations to computer usage in medical education, \( r = 0.75 \); and suggestions of students, \( r = 0.81 \).

**Ethical considerations**
The Research Ethics Committee in Benha faculty of medicine approved the study design. All participants signed a written informed consent before enrollment into the study. The consent included all details of the study (title, objectives, methods, expected benefits and risks, and confidentiality of data).

**Statistical analysis**
The collected data were summarized in terms of mean ± SD for quantitative data and frequency and percentage for categorical data. McNemar’s test was used to compare paired proportions. A \( P \) value less than 0.05 was considered statistically significant. All statistical analyses were carried out using the computerized Statistical Package for Social Science (SPSS, version 16.0 for Windows, SPSS Inc., Chicago, Illinois, USA).

**Results**
Table 1 shows that the majority of students were familiar with use of the mouse and keyboard, basic word processing, internet and web searching, and e-mail both before and after the educational course. There was a significant increase in the proportion of students who were familiar with software programs other than the word processing and trouble-shoot methods after the course (\( P<0.001 \)).

There was a significant increase in the proportions of students who agreed on owning a computer (\( P=0.008 \)), inclusion of computer skills course in medical education, downloading lecture handouts, and computer-based examinations (\( P<0.001 \)) after the course compared with before the course (Table 2).

Table 3 shows that the most frequently reported limitations for the inclusion of computer in medical education before the course were the inadequate number of computer labs in the college, lack of IT staff mentoring, large numbers of students, unclear course outline, and lack of internet access (\( P<0.001 \)), whereas the lack of central computers in the college was more frequently reported after the course (\( P<0.001 \)).

**Discussion**
Educational technologies have enhanced teaching and learning in medical education, and it will continue to evolve and become further integrated into all facets of our professional and personal settings. Often, there is a ‘cultural lag’ in appropriately pairing novel technology with effective use, making it essential that medical educators be confident that educational theory guides and supports their use of technology [1]. The present study aimed to compare the basic computer knowledge among second-year medical students in Benha Faculty of Medicine and their attitudes toward the inclusion of computer in medical education both before and after their regular computer course.

This study passed through two stages: pre-education and post-education stages. There was an increase in the number of students involved in the post-education stage. This increase might indicate that the students have realized the importance of a computer course. Also, it might indicate that the computer course had a positive impact on the students and stimulated them to contribute toward the study. The medical graduate attributes required by the National Authority for Quality Assurance and Accreditation of Education emphasize the importance of continuous medical education and necessi-
Lack of access to a central computer or internet access at home
Unclear course outline
Lack of central computers in the college
Time shortage of medical students
Large numbers of students
Lack of IT staff mentoring
Web-based learning should replace text-based methods in medical education
Examinations have to be computer based

Inadequate numbers of computers and labs in the college
Lack of IT staff mentoring
Large numbers of students
Time shortage of medical students
Lack of central computers in the college
Unclear course outline
Lack of access to a central computer or internet access at home

There is also variation in the skills of the use of different programs. For example, a study among Malaysian final-year medical students showed that more than 90% of students were competent at word processing, e-mailing, and surfing the internet. However, only 60.2% reported using computer graphics and 87.2% could not create a home page without help [15]. Meanwhile, in another study, smaller proportions of students in a Malaysian institution reported adequate skills at word processing (55%), e-mailing (78%), and usage of the internet (67%) [10]. In India, 87% of undergraduate medical students had computer knowledge [11]. Studies in developed countries indicated that level of computer literacy ranged from 93 to 96%, and focused mainly on use of the internet [16,17], whereas a study from a resource-poor area in Nigeria reported a literacy level of 58% among first-year clinical and nursing students [18].

Several studies have shown a wide variety in the use of computer technology in medical education that could be attributed partially to different attitudes toward computer usage. In the present study, we found a positive attitude, particularly at the posteducation stage, toward owning a computer, formal inclusion of an information technology course in the medical curriculum, downloading lecture handouts, and computer-based examinations. In contrast, there was a wobbling attitude among students both before and after education on replacing text-based learning methods with web-based learning methods. This could be because of several reasons, such as a preference to obtain information from textbooks, summary, schemes, etc., which represent the standard means of learning throughout the school years. Use of printed papers enables the student to make his/her notes,

### Table 2. Students’ attitudes toward the inclusion of computers in medical education as identified by students at pre-education and posteducation sessions (N=141)

<table>
<thead>
<tr>
<th>Attitudes</th>
<th>Pre-education</th>
<th>Posteducation</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical students should own a computer</td>
<td>Agree 132 (93.6) 140 (99.3) 0.008*</td>
<td>Disagree 9 (6.4) 1 (0.7)</td>
<td></td>
</tr>
<tr>
<td>Computer skills learning courses have to be included in the medical curriculum</td>
<td>Agree 104 (73.8) 118 (83.7) &lt;0.001*</td>
<td>Disagree 37 (26.2) 23 (16.3)</td>
<td></td>
</tr>
<tr>
<td>Web-based learning should replace text-based methods in medical education</td>
<td>Agree 69 (48.9) 70 (49.6) 1.00</td>
<td>Disagree 72 (52.1) 51 (36.2)</td>
<td></td>
</tr>
<tr>
<td>Downloading lecture handouts will maximize learning</td>
<td>Agree 104 (73.8) 118 (83.7) &lt;0.001*</td>
<td>Disagree 37 (26.2) 23 (16.3)</td>
<td></td>
</tr>
<tr>
<td>Examinations have to be computer based</td>
<td>Agree 78 (55.3) 90 (63.8) &lt;0.001*</td>
<td>Disagree 63 (44.7) 51 (36.2)</td>
<td></td>
</tr>
</tbody>
</table>

*Obtained using McNemar’s test.
*Significant.

### Table 3. Limitations against the inclusion of computers in medical education as identified by students at pre-education and posteducation sessions (N=141)

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Pre-education</th>
<th>Posteducation</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate numbers of computers and labs in the college</td>
<td>Yes 119 (84.4) 102 (72.3) &lt;0.001*</td>
<td>No 22 (15.6) 27 (27.7)</td>
<td></td>
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<tr>
<td>Lack of IT staff mentoring</td>
<td>Yes 107 (75.9) 81 (57.4) &lt;0.001*</td>
<td>No 34 (24.1) 60 (42.6)</td>
<td></td>
</tr>
<tr>
<td>Large numbers of students</td>
<td>Yes 117 (83.0) 104 (73.8) &lt;0.001*</td>
<td>No 24 (17.0) 34 (26.2)</td>
<td></td>
</tr>
<tr>
<td>Time shortage of medical students</td>
<td>Yes 108 (76.6) 103 (73.0) 0.06</td>
<td>No 33 (23.4) 31 (27.0)</td>
<td></td>
</tr>
<tr>
<td>Lack of central computers in the college</td>
<td>Yes 74 (52.5) 107 (75.9) &lt;0.001*</td>
<td>No 67 (47.5) 24 (21.4)</td>
<td></td>
</tr>
<tr>
<td>Unclear course outline</td>
<td>Yes 98 (69.5) 69 (48.9) &lt;0.001*</td>
<td>No 43 (30.5) 72 (51.1)</td>
<td></td>
</tr>
<tr>
<td>Lack of access to a central computer or internet access at home</td>
<td>Yes 59 (41.8) 41 (29.1) &lt;0.001*</td>
<td>No 82 (58.2) 100 (70.9)</td>
<td></td>
</tr>
</tbody>
</table>

*Obtained using McNemar’s test.
*Significant.
which makes learning easier. Also, the majority of our participants were from rural communities, where there is no easy access to the internet to download lectures and most of them did not own a computer and could pay for internet access on a regular basis. Slightly more than half of the students agreed upon changing the exams to web-based examinations (55.3%). However, this proportion increased significantly after the computer course. The possible explanation for these findings is the students’ misconception of technical and financial limitations of implementation. Also, the students were not trained on this type of examination during their school years, which might reflect negatively on their performance and results. These findings are in agreement with one study in India, which reported that health and financial resources in developing countries are limited, unevenly distributed, and act as a barrier to web-based education [19]. Also, this limitation is supported by reports indicating that students may not perform as well on computerized examinations compared with hard copy examinations [20,21]. However, Hallgren et al. [22] reported that computer-based examinations were effective in improving students’ scores on anatomic landmark exams.

The most valuable achievement of the computer course was that it could – to some extent – correct the misconception of students about the major barriers that may hamper the formal inclusion of computer and IT in the medical curriculum. From their point of view, the students initially considered that inadequate number of computers and labs in the college were the most important barrier against the inclusion of computer in medical education (84%), followed by a large number of students (83%), lack of IT staff mentoring (75%), an unclear course outline (69.5%), and finally limited internet access at home (41.8%). After attending the course, there was a significant decrease in the previous proportions. However, the lack of central computers in the college was more frequently reported as a barrier after the course. This could be explained by the lack of knowledge of the role of central computers and how to use them in their study such as the digital library, contact with their teachers, and obtaining educational materials.

We cannot ignore that time shortage and condensed curricula are important barriers confronting medical students. In addition, Egypt is a developing country facing several financial problems and overpopulation. These obstacles exert a negative impact on the educational process and graduate’s attributes especially of practical colleges. However, we believe that it will be cost-effective if we provide our students with sufficient numbers of computer labs, IT staff, e-resources in the libraries, and a formal advanced IT course. With some sort of organization and cooperation between the faculty of medicine and other relevant faculties such as computing and information, engineering, and education, we can combine the expertise of technologists with the expertise of medical educators to develop an innovative e-learning approach to medical education. A study in Nigeria reviewed that the applications of tele-medicine may have a more profound impact on developing countries than on developed countries [5].

Some of the constraints that hinder the use of computer-based education in resource-limited countries are also common in other high-income countries. A study of the limitations of computer-assisted science education in public schools in Kingdom of Saudi Arabia showed that there is still a need for more teacher training, more readily available, technical support staff, as well as provision of adequate numbers of computers and computer labs. Therefore, the problem is not limited to the lack of resources but also involves the appropriate utilization of available resources [23].

On asking our study participants about their suggestions to overcome these obstacles, most students, before and after the computer course, mentioned provision of computer labs that accommodate large numbers of students and inviting IT staff to support the development of clear and proper course outlines. They also suggested the provision of free university Wi-Fi areas in libraries for training and easy access to the reading materials.

**Study limitations**

The main limitation of this study was the high nonresponse rate particularly in the pre-educational phase of the study, which probably reflects insufficient knowledge among the students of the possible role of computer-assisted education in improving the learning process. A low response can affect the generalizability of a study. However, the high rate of computer knowledge reported in this study, which was comparable with previous studies on Egyptian medical students, provided obvious support for the introduction of computer in medical education. This can be emphasized further by carrying out a larger scale study involving students from different grades including postgraduate students.

**Conclusion and recommendations**

Medical students in Benha University have sufficient knowledge of computer basics and do support the inclusion of computers in medical education. A well-defined curriculum on computer sciences focusing on the
applications of computers in the educational process would overcome some of the practical constraints facing medical education in resource-limited Universities with large numbers of students. This might help to improve the quality and skills of future graduates of Egyptian Universities.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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