Original Article

Internet and Computer Use by Medical Students in Traditional and Problem Based Learning Systems

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ABSTRACT

Objectives: To validate the hypothesis that to achieve self-directed learning targets, medical students in Problem-Based Learning (PBL) curriculum would have higher levels of computer literacy and make greater use of the Internet compared to their counterparts in a traditional curriculum

Design: A questionnaire based study

Setting: Arabian Gulf University (AGU), Manama, Bahrain and the Medical School, University of Udine, Italy, during the academic year 2003-2004

Subjects: Years 2-4 medical students of AGU (PBL curriculum) and Year-3 medical students of MSU (traditional curriculum)

Main Outcome Measures: Comparison of computer ownership and literacy, and Internet usage among students in PBL and traditional curricula

Results: There was a high degree of computer literacy and ownership in both settings. The number of PBL students using word processing software was significantly higher (AGU 70.9% vs. MSU 34.7%; $p < 0.05$). The commonest Internet use was e-mail to chat with friends (> 90% in both institutions). Majority of the students obtained up to 40% of learning information online (MSU 93.9% vs. AGU 74.2%; $p < 0.01$). There was a significant increase from year 2 - 4 in the number of AGU undergraduates getting 40-60% of learning information online ($p < 0.01$). Access to original scientific literature as evidenced by websites visited and usage of Adobe Acrobat Reader® was lower among PBL students (MSU 51% vs. AGU 23.2%; $p < 0.05$).

Conclusion: For appropriate utilization of IT as an enriching PBL tool, more careful planning, integration and adequate guidance of the students with emphasis on content is needed.

KEY WORDS: computer, Internet, medical education, problem-based learning

INTRODUCTION

The use of computers and the Internet has dramatically revolutionized the ease with which information can be accessed. In medical education, there have been several attempts to use the Internet in diverse ways, including teaching, delivery of educational materials, as a source of materials for research and for the conduct of examinations[1-6]. The medical field is dynamic with new discoveries, diagnostic methods and management protocols constantly emerging. Medical students need immediate access to this rapidly expanding information and while the Internet provides the gateway, the onus still rests on the teacher to direct the students to sites where reliable and current information can be accessed.

This explosion in biomedical knowledge has also resulted in a change in the delivery of medical education and the rapid shift from traditional educative approaches to a non-didactic problem-based philosophy seen in the 1990s perhaps represents a strategy by which both students and teachers can cope with and hopefully manage this ever-expanding arena of information[1,7,8]. In the lecture-based traditional teaching system students are passive recipients of information whereas in a Problem-Based Learning (PBL) curriculum they are active participants in the learning process with emphasis on self-directed learning[9-11]. In the PBL curriculum, students take responsibility for their own learning through small group discussions during which problems are identified and learning objectives generated[12;13]. The students are expected to use diverse learning resources to gather relevant information and literature and prepare these in a concise manner for group discussion.

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With such emphasis on information gathering and evaluation, the Internet therefore becomes a potential powerful learning resource for the student. It could therefore be hypothesized that, in order to achieve their self-directed learning targets, medical students in the PBL curriculum would be expected to have higher levels of information literacy and information technology as well as make greater use of the Internet compared to their counterparts in a traditional curriculum. Although there are reports evaluating Internet and computer usage among medical students who were either in a traditional or PBL curricula[2;14-17], there are no direct comparative studies of medical students in these two curricula, in terms of computer and information technology (IT) utilization. Therefore, in this study, we compare Internet and computer usage among students in two medical schools with different education methods (PBL Vs. traditional curricula).

SUBJECTS AND METHODS
Study Setting

The study was carried out during the academic year 2003-2004 at the Arabian Gulf University, Manama, Kingdom of Bahrain and the Medical School, University of Udine, Udine, Italy; two medical schools with history of collaboration. The Arabian Gulf University (AGU) was established in 1982 and has utilized the PBL curriculum since its inception. The medical curriculum is divided into a pre-medical phase (Year 1), a three year pre-clerkship phase (Year 2-4) and a two year clerkship phase (Year 5 & 6). In the three year pre-clerkship phase, the learning strategy is organized around integrated organ/system units and taught using a PBL approach. The students in the PBL curriculum were exposed to basic medical sciences (anatomy, biochemistry and physiology) as well as the laboratory and clinical sciences from Year 2 - 4. The student population comprises of nationals of the Gulf Cooperation Council (GCC) countries namely Saudi Arabia, Bahrain, Kuwait, Oman, Qatar and United Arab Emirates (UAE). There are 632 medical students in the College of Medicine and Medical sciences (CMMS) and only one third (33.1%) are male. The Medical School, University of Udine (MSU), was established in 1987 and uses a traditional lecture-based curriculum. The six-year undergraduate medical program consists of a three year pre-clerkship phase and a three year clerkship phase. In the traditional curriculum the first two pre-clinical years were dedicated to the basic medical sciences while exposure to laboratory medicine and aspects of clinical medicine only started in Year 3. The medical school has 543 students (39.4% male and 60.6% female). During the study period,

it was ranked number one in the Italian National Survey of University Performance and the survey scoring parameters included productivity, teaching, research, profile of Faculty and international collaborations[18].

Study Subjects and Recruitment Procedures

Pre-clerkship phase students comprising 279 (Year 2: n = 99; Year 3: n = 93 and Year 4: n = 87) at AGU and 75 Year 3 students at MSU were recruited for the study. The decision to include only the Year 3 students in MSU was an attempt to compare students who were to a large extent being exposed to similar learning contents.

Verbal consent was obtained from all participants after informing them that participation was entirely voluntary, completely anonymous and was solely for research purpose without any bearing on their assessment. The questionnaire was distributed during a routine laboratory session; the students were given 20 minutes to complete it, and were requested to submit the finished questionnaires before leaving the laboratory.

Questionnaire Design

The pre-tested, anonymous questionnaire, comprising of 19 closed ended items, organized in sections related to formal training in computer use, ownership of laptop or personal / desktop computers (PC), types of software utilized, use of e-mail communication for personal or learning purposes, search engines utilized and websites visited. Questions related to frequency of utilization were rated using a Likert-type scale ranging from 1 "never"; 2 = not every week; 3 = once a week; 4 = more than once a week to "5 "everyday".

Statistical analysis

For clarity and consistency in the analysis, an acceptable threshold level of usage was set in advance. This acceptable threshold included: usage at least once a week for Word processing, web surfing and e-mail programs, and usage at least once a month for presentation, database software and Adobe Acrobat Reader®.

The data were entered in Microsoft Excel® and analyzed using SPSS version 12 statistical package. Statistical significance was calculated using Chi squared test.

RESULTS
Student responses

Out of 279 questionnaires distributed to AGU students, 155 (55.5%) were returned and analyzed. This comprised of 56/99 (56.6%) for Year 2, 36/93 (38.7%) for Year 3 and 63/87 (72.4 %) for Year 4.
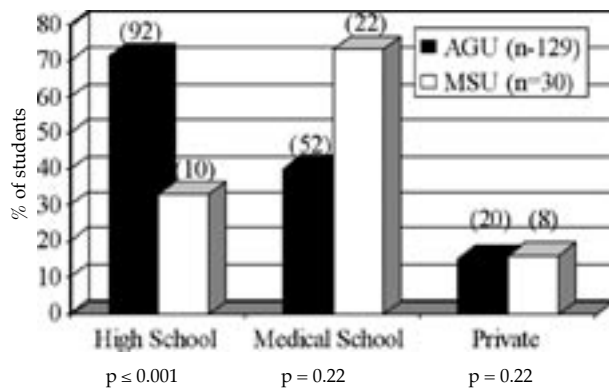
A: Where the training was received

Fig. 1: A: Actual number of students (in parenthesis), indicates that some students received training in more than one setting. A significantly higher number of AGU students obtained computer training in high school while majority of MSU students had training at the university.

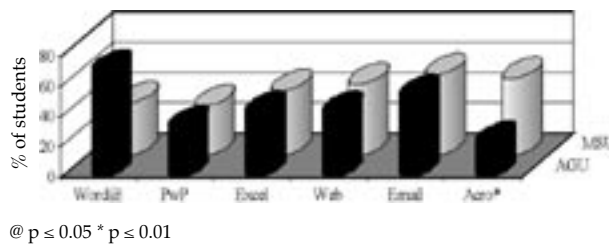C: Computer software usage

@ p ≤ 0.05 * p ≤ 0.01

Fig. 1: C: Statistically significant differences were observed with usage of Microsoft word® (higher at AGU) and Acrobat reader® (higher at MSU).

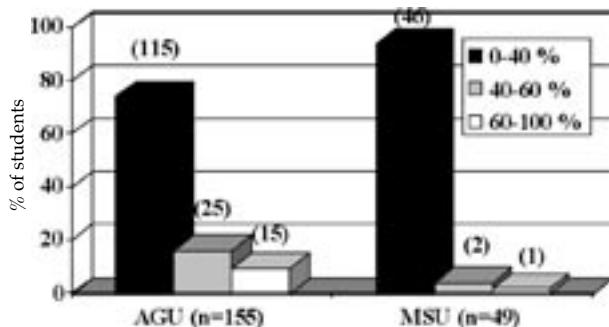B: Use of Internet source in medical learning

Fig. 2: B: In both institutions, most students obtained between 0-40% of learning information on the Internet. Actual number of students in each grouping is shown in parenthesis.

At MSU there were 49 (65.3%) respondents. The proportion of female students in the study group was comparable in both settings (63.6% at AGU Vs. 58.6% at MSU).

Formal computer training

The majority of AGU students (83.2%) had received formal training in computer use compared to 61.2% at MSU (p = 0.049). In addition, the data indicates that AGU students received formal computer training earlier in their educational curriculum (71.3% at high school; Fig. 1A). However, at MSU, the university appears to play a major role in this respect as 73.3% received formal computer
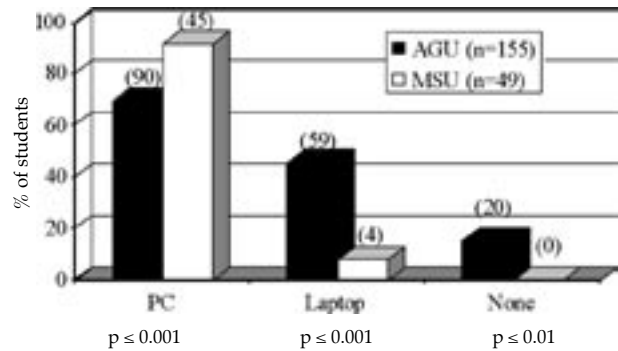
B: Type of computer owned

Fig. 1: B: Actual numbers of students shown in parenthesis reflects dual ownership of PC and laptops by some students. PC ownership was significantly higher among MSU students while a significantly higher number of AGU students owned laptops.
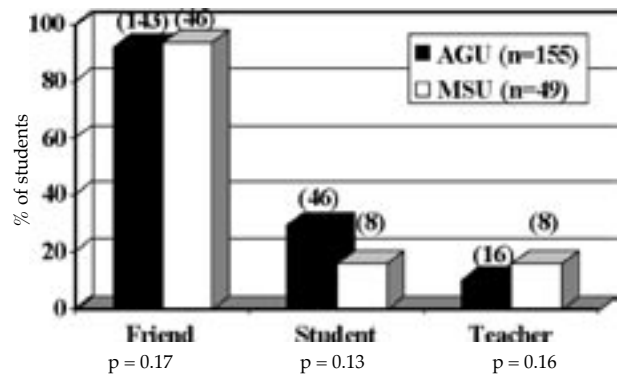
A: Use of e-mail to communicate

Fig. 2: A: Numbers in parenthesis represent actual number of students. Majority of students in both institutions used e-mail to communicate with friends.

training in the Medical school. It is interesting to note that in both settings about 16% students utilized private sector tutoring to obtain formal computer literacy.

Computer ownership

Level of computer ownerships in both settings was very high (100% in MSU and 84.5% in AGU). Ownership of PC was significantly higher at MSU, while laptop possession was significantly higher among AGU students (p < 0.001; Fig. 1B)

Computer utilization

The students were asked about their utilization of various computer software including those for word processing, power point presentation, databases and Internet applications such as e-mail, web surfing and Acrobat Reader®. Microsoft Office® was the dominant package utilized by the students in both settings. Usage of Microsoft Word® based on the acceptable predefined threshold was significantly higher among AGU undergraduates (110/155; 70.9%) than MSU students (17/49; 34.7%; p < 0.05). Although the usage of other software such

as Microsoft PowerPoint® and Microsoft Excel® was less than 50%, no difference was observed in the two settings (Fig. 1C).

Among the applications used on the Internet, Acrobat Reader® was the only software that showed a significant difference in utilization. On the basis of the predefined acceptable threshold, 51% of MSU students used Acrobat Reader® compared to 23.2% at AGU (p < 0.01)

Purpose of Internet access

The commonest utilization of the Internet was for e-mail in both settings (Fig. 2A). Over 90% of students in both institutions used the e-mail for social communication with friends while 46 AGU (30%) and 8 MSU (16.3%) students used this tool to communicate with their peers for educational purposes. Only 16 AGU (10.3%) and 8 MSU (16.3%) students used e-mail to communicate with their teachers.

To assess the use of Internet as a resource tool, the students were asked to quantify how much of their medical learning information was obtained online. Fig. 2B shows that in both settings majority of the students obtained up to 40% of medical learning information online (MSU 93.9% vs. AGU 74.2%; p < 0.01). Thus it appears that more students in a lecture-based system were obtaining up to 40% of learning material from the Internet. From Year 2 to Year 4, we observed an increase in the number of AGU undergraduates getting 40-60% of medical learning information online which was statistically significant (p < 0.01).

The most commonly used search engine was Google followed by Yahoo. Analysis of sites visited was grouped within four major headings: medical (sub-grouped as sites of scientific publications and sites of medical organizations / bodies), news, socio-political and leisure. The number of students accessing medical and leisure sites was significantly higher at MSU. For sites of scientific publications, The National Library of Medicine (NLM) PUBMed Medline was visited by 38 students (30 from MSU). Although the overall number of students from both institutions was very low, The World Health Organization (WHO) and National Institutes of Health (NIH) USA websites were the top medical organization sites visited (accessed by 9 and 2 students respectively).

DISCUSSION

The way technology impacts delivery of education and student learning has been categorized as the 3Cs: computation (the technology and its power), communication (Internet and e-mail) and collections (network databases)[19]. In this study, we have examined aspects of these 3Cs to determine whether differences in IT utilization exist among preclinical students in terms of the educational philosophy of their medical schools.

The rapid increase in the availability, affordability and power of computers describe computation which is the first element of the 3Cs. The high level of computer literacy and ownership among students in both settings is in keeping with this element. However, while most AGU students obtained formal computer training at high school level, the university was the main provider of computer literacy training for MSU undergraduates. In the European study (Survey of European Universities Skills in ICT of Students and Staff)[20], an average of 42% (range: 23- 58%) of new university entrants stated high school as the main source of their computer literacy. This compares unfavorably with the 70% observed in our study for AGU students coming from six different GCC countries (Fig. 1A). This should serve as a stimulus to the European Union policy makers to actively support programs aimed at promoting computer training at high school level.

The availability of computer education as part of the academic curriculum does not appear to completely marginalize private sector input as up to 16% of students in each setting still received private tutoring. Various factors such as the desire for personalized tutoring, to focus on specific areas of deficiencies or enthusiasts wanting to gain in-depth knowledge may account for students seeking private tutoring in computer education. The high level of computer ownership seen in both settings (AGU 84.5%; MSU 100%) was comparable. This is similar to 74% in Jordan, 71.7% in Denmark but considerably higher than 56% in Malaysia, 26% in Nigeria and 8.9% reported in Turkey[16;17;21-23]. Laptops are getting smaller in both size and weight but bigger in computational capability thus making them extremely attractive (despite the higher cost) to people on the move or where space is at a premium. In addition to Bahrain, nationals from the other five GCC countries are represented in the AGU student population. For these highly mobile students who travel back to their home countries during weekends or holidays but live in hostel accommodation on campus, the laptop probably represents a convenient cost-effective alternative to the PC. Furthermore, the high level of affluence in the region can also explain the significantly higher number of laptop ownership among AGU students.

The self-directed learning philosophy of the PBL curriculum as applied at AGU[24;25] requires that students acquire, appraise and present information necessary for problem solving. The significantly high

utilization of Microsoft Word® among students in the PBL curriculum reflects the fact that this was the software of choice for the preparation of material for discussion at small group tutorials. Many scientific publications are available for download in Acrobat Reader® format which is more printer and reader friendly than the HTML format. Therefore, usage of this software was selected as an indirect measure of access to scientific publications. With the high premium placed on self acquisition of knowledge from diverse sources in PBL, it was surprising that the utilization of this software was significantly lower among AGU students. It is possible that AGU undergraduates were less familiar with Acrobat Reader® and therefore downloaded publications in the HTML format or have been using the software without paying attention to its commercial name. However, this scenario seems unlikely because analysis of questions about the specific websites visited confirmed that a significantly higher number of MSU students accessed scientific publications probably as a reflection of the research oriented faculty recommending original articles as reference material for the students.

The second element of the 3Cs is communication. Online communication with friends using e-mail was the commonest indication for Internet access by both AGU and MSU students. This is in keeping with findings from other studies[16,23,26-28] thus underscoring the universal human need to communicate[29]. The use of the Internet and e-mail as an information and communication channel has been successfully established in many universities[1,3,5,30]. The high degree of e-mail usage in both settings further supports the notion that educators should actively promote the integration of E-communication as an additional tool to enhance interactions of faculty and students[23].

Access to information represents the final element of the three Cs (collections). Medical information is now available on the web in readily searchable and retrievable formats. In both institutions majority of students obtained up to 40% of medical learning information online. While the number of AGU students who make greater use (40-60%) of the Internet increased from Year 2 to Year 4, we were unable to determine if MSU students also showed a similar pattern as only Year 3 students were included in the study. Nevertheless, it appears that the PBL students appreciated the huge potential of the Internet as a useful educational resource tool and therefore utilized it more as they progressed through the curriculum. This may also indicate their maturity in finding a proper balance among the various educational resources available. However, guidance by faculty as well as continued provision of

training in search strategies would help to motivate the PBL students discover the usefulness of the Internet as an resource tool early in their medical training. Additionally, the input of the faculty to provide direction in the choice of websites visited and analysis of information obtained online remains crucial as this is a skill that would remain useful to the students in their future practice as doctors. We are currently following a cohort of students as they progress in their medical education to examine the changes that occur in their usage of the Internet as a resource for learning.

In this study students from two diverse cultural settings were compared, thus introducing potential confounding factors, which might influence the observed behaviors independent of the educational systems. However, the students' behaviors demonstrated more similarities than differences suggesting that the contribution from these confounders is negligible, with the major diversity being the different educational system. However, even when the latter is considered the differences we expected to see as educators were not apparent. This is in line with data suggesting evidence of absence[19;31-33] in aspects of students' outcome when lecture-based and PBL curricula are compared. Information technology represents a powerful tool which has the potential of enriching any learning experience. However, for its appropriate utilization in a PBL curriculum there is a call for a motivated faculty to place emphasis on the content available to the students rather than on the technology *per se*. By doing so the major educational goals of PBL represented by the interdisciplinary approach and self-directed inquiry will be preserved.

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