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IT-based activity in physiology education: an experience from a developing country

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Submitted 7 August 2007; accepted in final form 30 October 2007

Kommalage M, Gunawardena S. IT-based activity in physiology education: an experience from a developing country. *Adv Physiol Educ* 32: 81–85, 2008; doi:10.1152/advan.00067.2007.—Information technology (IT)-based components are included as active learning activities in medical curricula that have been shown to be more effective than most passive learning activities. In developing countries, these activities are not popular compared with developed countries. In this study, an IT-based assignment was carried out in physiology for undergraduates in Sri Lanka. We assessed certain basic IT capabilities before the assignment and found that the capability of using MS Word, e-mail, and the internet was limited to 68.3%, 62.0%, and 49.2% of students, respectively, with 40.8% of students having some other IT capabilities. We found a considerable variation in IT capabilities among the students, which depended on IT learning at schools and the geographical locations where students came from. The main source of IT knowledge for students was an introductory IT course given in the medical school with the second source being private IT learning centers. Response to the IT-based assignment was very poor. The reasons for poor participation included a lack of time due to parallel subjects, poor IT knowledge, and poor IT resource availability. However, students were willing to have optional IT-based components and were aware that IT knowledge is important for medical students as well as doctors. This study shows the importance of improving IT knowledge in students and the need of improving IT resources in medical schools. With these improvements, physiology education can be enriched with more interactive IT-based learning activities, which help students to acquire knowledge more efficiently and effectively in developing countries like Sri Lanka.

information technology-based physiology

INFORMATION TECHNOLOGY (IT) has infiltrated into virtually every aspect of almost all fields, helping to easily accomplish a given task with an interactive and user friendly interface. In medical education, without exception, IT helps in teaching-learning activities to a great extent. Internet-based medical literature, electronic teaching environments, multimedia applications, and computer-simulated self-study materials are considered as commonly used IT-based educational tools. These activities have several advantages, such as facilitation of active and interactive learning, helping to overcome some geographical barriers, and allowing learners to use learning material whenever they have time. Most IT-based activities are generally considered more efficient than most traditional teaching-learning activities (2, 6, 7, 12, 23, 27).

IT knowledge among medical undergraduates and healthcare workers is higher in developed countries (5) compared with developing countries (8, 15), making it easy to add IT-based components in medical curricula at either the undergraduate or

postgraduate level in developed countries (3, 4, 16, 21, 26). In developing countries, however, these activities are not popular, mainly due to limitations in facilities like the availability of computers and internet connections (1, 20, 24). In Sri Lanka, IT-based components are not included in medical curricula in most medical schools, and experience with IT-based activities in medical schools is limited. The case is same for most developing countries, and publications on this topic from developing countries are limited (22). In this article, we describe our experience about the addition of a new IT-based component in physiology education in a Sri Lankan medical school.

MATERIALS AND METHODS

This study was conducted with first-year medical students in the Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka. The undergraduate course in this medical school runs for 5 years. The first 2 years consist of anatomy, biochemistry, and physiology. This study was conducted during an IT-based assignment in physiology. Before the assignment, basic IT knowledge was assessed by a questionnaire. The assignment was then carried out for 12 wk. After the assignment, another questionnaire was given to assess the opinions of students about the assignment.

Several aspects of IT knowledge that could be important for the planned assignment were assessed in the preassignment questionnaire. These were the following:

1. Ability to prepare documents using MS Word.
2. Composing and sending an e-mail.
3. Browsing the internet and finding required information.
4. Other IT abilities (collectively).

Students were asked to grade their ability using MS Word, e-mail, and the internet on a scale of 1 to 5 (where 1 = “cannot do at all” and 5 = “can do with full confidence”). The component of “other IT abilities” was assessed using “yes or no” options.

Gender, the geographical area where students studied before entering medical school, and from where students acquired IT knowledge were asked as descriptive information. Whether they had any IT learning in the school was specifically asked. Students’ opinion about the addition of an IT-based component to the curriculum were asked. Their opinions about IT relevance for doctors as well as for medical undergraduates were also assessed.

The assignment consisted of seven segments related to the following lecture topics in physiology:

1. Recognition of antibodies
2. Hypersensitivity reactions
3. Anemia (part 1)
4. Anemia (part 2)
5. Breakdown of red blood cells and jaundice
6. Blood grouping (part 1)
7. Blood grouping (part 2)

After each of the above lectures, students were given a simple but specific IT-based assignment related to the lecture, e.g., to read a content page of a website (exact URL was given) and summarize the contents in 5–10 sentences in MS Word and e-mail it to a given e-mail

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address. Some assignments included an internet search for specific information. All assignments were optional, and students were informed that everybody would receive feedback from the teacher after their answers had been assessed.

After completion of the whole assignment, another questionnaire was given to assess the students' opinion about the given assignment. Ten specific questions were formulated after discussion with a group of students about the assignment. Students were asked to provide their response on a scale of 1 to 5 (where 1 = strongly agree to 5 = strongly disagree).

RESULTS

One hundred twenty-five students responded to the pre-assignment questionnaire in a batch consisting of 153 students (return rate: 81.6%); 44.8% of the students were male and 55.2% of the students were females. Students who responded "I can do without help" and "I can do with full confidence" were considered as the capable group since they could perform a task without help. Those responded with "I can't do at all" and "I can do with somebody's help" were considered as the incapable group. IT abilities not related to the usage of MS Word, e-mail, and the internet were considered as other IT abilities. Collectively, those who said "yes" for other IT abilities were considered as capable for other IT abilities, whereas those said "no" were considered as incapable. The results showed that MS Word is the program that most students are capable of using (Table 1).

IT abilities were compared with the geographical area where students studied before they entered medical school. Geographical areas were categorized into three groups: *group A* (Galle and Matara), *group B* (Hambanthota, Monaragal, and Badulla), and *group C* (Kalutara and Ratnapura). All other areas, where only a few students came from, were considered as the "other" geographical category. These categories were based on economic development of the administrative district and the Z-score cutoff marks for the entrance to medical school from that administrative district. (The Z-score is the score achieved by students at the university entrance examination. Z-score cutoff marks to enter medical school are generally correlated with the economical and educational development of the district). Of the 125 respondents, 56 students (26 men and 30 women) belonged to *group A*, 44 students (19 men and 25 women) belonged to *group B*, 19 students (7 men and 12 women) belonged to *group C*, and 6 students (4 men and 2 women) belonged to the "other" area category.

Fifty percent of the students studied IT at school in *category A*, whereas only 34.1% and 22.2% students learnt IT at school in *categories B* and *C*, respectively. Ability of MS Word usage showed a significant difference in geographical area categories ($P < 0.05$ by χ^2 -test). There were no significant differences in

e-mail, internet, and other IT abilities in geographical area categories (Table 2). IT scores were calculated considering all tested parameters in IT knowledge. A formula was used giving certain points for each assessed capability. Students who responded with "I can do with full confidence" for MS Word, e-mail, and internet usage were given 12 points for each component. (As an example, those who are fully capable in all 3 components received 36 points.) Those who had other IT abilities were given 30 points. Students who responded with "I can do without help" and "I can do with somebody's help" for MS Word, e-mail, and internet usage were given 9 and 6 points for each component, respectively. Those who responded with "I can't do at all" and those who do not have other IT abilities were not given any points for the respective component. In the formula, equal weight was given to MS Word, e-mail, and Internet usage and relatively more weight was given to the other IT component. Knowledge of other IT abilities was given more weight because having knowledge in other IT components rather than the "basic" can be considered as being more fluent in IT. There was a high possibility of having capabilities of several IT components for those in the "yes" group for other IT abilities.

IT scores did not show any differences in geographical area categories or with gender. IT scores showed a significant difference in the group of students who studied IT in school over those who did not ($P < 0.05$ by χ^2 -test). The results also showed only 40.9% of the students had studied IT in school.

In any of the tested IT components, neither IT scores nor any tested opinion showed significant differences with gender (Table 3). Women showed a significantly lower exposure to IT at school ($P < 0.05$ by χ^2 -test), with only 29.4% of women having studied IT at school, whereas 57.1% of men had studied IT at school.

As to where students had learned IT, most gave different sources, such as school, private institutes, and the introductory IT course in medical school (Fig. 1). The most-mentioned single source was the introductory IT course in medical school (74 students of 125 students total). The least-mentioned source was IT studies at school (33 students of 125 students total).

In regard to curriculum changes, 76.8% of the students gave a positive opinion for adding IT-based components to the curriculum, whereas only 19.2% of the students gave a positive opinion for adding a compulsory IT component to the curriculum. In regard to the need for IT-based knowledge, 96.0% of the students gave a positive opinion for "doctors need IT knowledge," whereas 93.6% of the students gave a positive opinion for "medical undergraduates need IT knowledge." These opinions did not show any correlations with IT scores or geographical area categories.

Student participation in the assignment was very poor. Maximum participation was five students (for the first assignment), and the last assignment had only two participants. There were 153 first-year medical students to whom the assignment was given. The attendance for the assignment-related lectures was ~90%.

The postassignment questionnaire was designed mainly to assess the reasons for the poor participation. A total of 148 students responded to it (return rate: 96.7%). Students were asked to express their opinions on the given statements on a scale of 1 to 5 (where 1 = strongly agree and 5 = strongly disagree). The most agreed statement was "Students have more

Table 1. IT capabilities

| IT Abilities | Capable | Incapable |
|--------------------|------------|------------|
| MS Word | 84 (68.3%) | 39 (31.7%) |
| E-mail | 75 (62.0%) | 46 (38.0%) |
| Internet | 59 (49.2%) | 61 (50.8%) |
| Other IT abilities | 51 (40.8%) | 74 (59.2%) |

Values are numbers of students (of 125 students total). Shown are each tested information technology (IT) knowledge component with numbers of capable and incapable students.

Table 2. *IT capabilities among students in each geographical area*

| Geographical Area Category | MS Word | | Internet | | E-mail | | Other IT Abilities | |
|----------------------------|-------------|------------|------------|------------|------------|------------|--------------------|------------|
| | Yes | No | Yes | No | Yes | No | Yes | No |
| A | 43 (78.2%) | 12 (21.8%) | 27 (50.0%) | 27 (50.0%) | 34 (63.0%) | 20 (37.0%) | 21 (37.5%) | 35 (62.5%) |
| B | 22* (50.0%) | 22 (50.0%) | 19 (44.2%) | 24 (55.8%) | 26 (61.9%) | 16 (38.1%) | 16 (36.4%) | 28 (63.6%) |
| C | 14 (77.8%) | 4 (22.2%) | 10 (58.8%) | 7 (41.2%) | 12 (63.2%) | 7 (36.8%) | 11 (57.9%) | 8 (42.1%) |

Values are numbers of students (of 125 students total). Geographical area categories are as follows: Galle and Matara (A); Hambanthota, Monaragal, and Badulla (B); and Kalutara and Ratnapura (C). The ability of MS Word usage showed a significant difference in geographical area categories ($P < 0.05$ by χ^2 -test). *Usage of MS Word in area B was significantly less than that in the other two area categories. There were no significant differences in e-mail, internet, and other IT abilities in geographical area categories.

work to do in the other two parallel subjects,” and the second most agreed statement was “Students do not have adequate time to complete the assignment” (Table 4). The statement “I don’t have good internet access” received 2.46/5. The statement “I am poor in handling computers, e-mail, and other IT aspects” received 3.03/5 in the scale. The negative statement “I think I don’t learn much from IT/computer-based activities” was the most disagreed statement, which gave 3.38/5 in the scale. The statement “Computer/IT activities are fun” showed the greatest agreement, with 1.86/5 in the scale.

DISCUSSION

This assignment was a new exercise in this medical school and was not compulsory. We found that the participation was very poor for this physiology assignment. Participation was poor due to lack of available time, which is likely to be due to workload in parallel subjects, as both were mentioned by students as the main reasons in postassignment questionnaire. It is generally an accepted fact that the medical curriculum is “bulky” and “tough.” While we were conducting the study, participated undergraduates were preparing for the second MBBS examination, which is a barrier examination. There are compulsory assessments at the end of each term, and marks obtained from them will account for 20% of marks for the second MBBS examination. There are compulsory activities in each week in each subject, such as tutorial classes and practical classes. So, a constant effort and focusing are needed to keep pace with academic activities. Students play less attention on optional activities like this assignment and spend more time in preparing for compulsory activities like practical and tutorial classes. Previous studies have shown a similarly poor response of participants at early stages of introduction of novel activities in medical curricula (9, 10).

Poor participation in the assignment was also due to poor IT knowledge. Only 68.2% of the students had the capability of working with MS Word in our study population, and internet

browsing capability was limited to 49.2% of students. This is a big difference compared with developed countries, where 100% of students have IT education in school. Earlier studies have reported that in some universities in developed countries, almost 100% of first-year undergraduates have knowledge of MS Word (some studies were done even several years ago) (14). IT knowledge and capabilities were poor as a whole in our study population. Other than that, there were greater variations in IT knowledge and capabilities among individuals, which is probably true for all universities in Sri Lanka and developing countries; 78.2% of the students coming from a certain geographical area had MS Word capability, whereas only 50.0% of the students coming from some other area had this capability. This could be due to poor IT education in some schools. In this study population, 40.9% of the students had some type of IT education at school. Only 22.2% of students coming from some underdeveloped geographical areas had IT education in schools. The present study showed that the geographical area where students studied before entering medical school has a significant impact on MS Word capability. The IT score, which is a collection of all tested IT knowledge components, showed a significantly high score in students who studied IT in school compared with those who did not. It is possible that those who acquired some IT knowledge in school had more chance to use other opportunities such as IT facilities in medical school (the introductory IT course as well as self-study) to further improve their knowledge. Probably, the reason for not seeing geographical differences in e-mail and internet capabilities is the introductory IT course or self-study at medical school. IT resources in medical school give students a chance to learn e-mail and internet usage, which are easier to learn than MS Word usage. Another possibility for poor IT

Table 3. *Gender differences in IT knowledge*

| IT Component | Men | | Women | |
|--------------------|------------|------------|------------|------------|
| | Yes | No | Yes | No |
| MS Word | 36 (66.7%) | 18 (33.3%) | 48 (69.5%) | 21 (30.5%) |
| Internet | 33 (63.5%) | 19 (36.5%) | 26 (38.2%) | 42 (61.8%) |
| E-mail | 31 (57.4%) | 23 (42.6%) | 44 (65.6%) | 23 (34.4%) |
| Other IT abilities | 17 (30.4%) | 39 (69.6%) | 34 (49.2%) | 35 (50.8%) |

Values are numbers of students (of 125 students total). Percentages given in parentheses for each IT component were calculated for each gender separately.

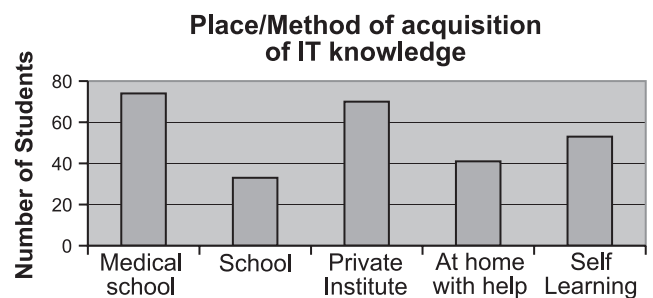


Fig. 1. Where students learned information technology (IT). Most students gave different sources, such as school, private institutes, and the introductory IT course in medical school. The most-mentioned single source was the introductory IT course in medical school, and the least-mentioned source was IT studies at school.

Table 4. *Answers to the postassignment questionnaire*

| Question | Grading |
|--|---------|
| 1. Computer/IT activities are more fun. | 1.86 |
| 2. I think it is not important for second MBBS examination. | 3.38 |
| 3. I don't have available time for these activities. | 1.69 |
| 4. These assignments are difficulty to answer. | 3.31 |
| 5. I don't have good computer access. | 2.79 |
| 6. I don't have good internet access. | 2.46 |
| 7. I don't want to do it, since it is optional. | 3.06 |
| 8. I am poor in handling computer, e-mail, and other IT aspects. | 3.03 |
| 9. I have more work to do in other two subjects. | 1.56 |
| 10. It was not clear what I suppose to do. | 3.12 |
| 11. I like reading books/notes rather than IT-based activities. | 3.11 |
| 12. I think I don't learn much from IT-based activities. | 3.38 |

Student opinions on the given statements are on a scale of 1 to 5 (where 1 = strongly agree and 5 = strongly disagree).

knowledge is the deliberate avoidance of IT studies or paying less attention on IT studies at schools and paying more attention to the academic subjects due to the highly competitive nature of the university entrance examination. The study shows the importance of including IT components in the Sri Lankan school curriculum, which will help students to improve basic IT skills. When they come to higher education institutes like universities they can improve the knowledge further and face IT tasks easily. This is probably true for other developing countries as well.

Lack of resources was another reason for the poor participation in the assignment, as mentioned by the students. There is a considerable deficiency in resources in developing countries compared with developed countries. A recent study of first-year medical undergraduates in Austria showed that almost all students (94%) had access to a privately owned computer, which was either owned by the students themselves (74%) or shared with family members or roommates (20%) (14). Because of these facilities, the majority of students are capable of using a computer or a web-based educational tool before they enter medical school in developed countries. In developing countries, the situation is not so satisfactory with regard to computer usage or web-based education. (5, 14). Computer and internet availability are very low in developing countries like Sri Lanka. Most students used the computer center in the medical school, which contains only 30 computers. Among them, only 18 computers were connected to the internet when we carried out this study. The facility has to be shared among ~800 undergraduates. The internet connection was a 64-kb/s line, which was shared among all computers in the student computer center and some computers in other places in the medical school. Although we did not investigate this in the present study, students can hardly afford a personal computer in Sri Lanka due to poor economical status. It is a well-known fact that resources are not equally distributed among schools in Sri Lanka as well as in most other developing countries. The condition is worse with the unequal distribution of IT resources like internet connections within the county due to political, economical, and social reasons.

Poor internet browsing capability and e-mail capability among students probably reflected the poor internet availability and affordability in the whole country. This may also be due to the lack of computers and poor internet connection in the

student computer center in this medical school. Hostels attached to this medical school do not have common computers or any type of internet connection. The situation may be similar in most developing countries with poor resources.

We did not find a significant difference in self-rated IT knowledge in relation to gender, which is not the case in most similar studies in other countries where men seemed to be more capable in IT (14, 17). The only difference seen here was that, as a percentage, more male students had IT studies in school than female students.

The present study also shows that the introductory IT teaching activity in the medical school was the commonest single source of IT education for students. This highlights the importance of having an introductory IT course for medical undergraduates. IT education in school is poor, and students do not get an equal chance due to big variations in educational facilities throughout the county. IT teaching-learning activities for new-entrant medical undergraduates need to be more flexible to cater to the needs of the wide variety of students depending on baseline IT knowledge. Students should be categorized depending on their IT knowledge and taught according to their needs. Improvement in resources such as computer and internet availability in medical schools is not easy in countries like Sri Lanka, which has limited funds due to economical and political reasons.

The willingness to participate in IT-based activities was high among students, although they wanted to have them as an optional component. We also feel that it is not reasonable to include compulsory IT-based activities because of the large variations in IT knowledge among students. One important fact is that students wanted IT-based activities included in the curriculum. It is necessary to modify the activities to make them more attractive to students. Student participation in IT-based activities could be improved by allocating dedicated time for IT-based activities and by improving facilities in the student computer center in the medical school.

Well-designed IT-based components can be effectively used as active learning activities. Even though there is no direct evidence from previous studies showing that students proficient in IT knowledge are more competent in physiology, it has been shown that active learning activities are more effective than most passive learning activities in medical curricula (6, 7, 12, 23, 27) as well as physiology education (13, 18). There are previous studies showing the effectiveness of IT-based teaching-learning activities over traditional teaching-learning activities in medical curricula (11, 19, 25). So, we can replace some traditional passive learning activities with IT-based active learning activities. We believe that with the improvement of IT knowledge in undergraduate students and improvement of IT facilities in medical school in developing countries like Sri Lanka, physiology education can be enriched with more interactive as well as active IT-based learning activities, which help students to acquire medical knowledge more efficiently and effectively.

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