



# Computer-Assisted Instruction in Parasitology: A Cross-Over Design

Vivornpun Sanprasert BSc\*, Pornpun Jaratsing BSc\*\*,  
Issarang Nuchprayoon MD, PhD\*\*\*, Surang Nuchprayoon MD, MPH, PhD\*\*

\* *Inter-department of Medical Microbiology, Graduate School,*

\*\* *Lymphatic Filariasis Research Unit, Department of Parasitology,*

\*\*\* *Department of Pediatrics, Faculty of Medicine, Chulalongkorn University*

*We report here the results of the study using CAI compared to the hard copy for study of lessons in parasitology. We evaluated the CAI compared to hard copy lessons in 60 students, attending the third-year parasitology course at Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand. The students were randomly divided into two groups (30 each). The lessons tested were Ascaris lumbricoides and Enterobius vermicularis, which were prepared as CAI and hard copy form. Using a cross-over design, the first group was provided CAI form on the topic of A. lumbricoides, then switched to hard copy form on the topic of E. vermicularis. The second group was provided hard copy form on the topic of A. lumbricoides, then switched to CAI form on the topic of E. vermicularis. After 30 minute reading, the 10-multiple choice question test was provided for each topic. There was no significant difference of the scores between 2 groups. The most students (91.67%) had more satisfaction when using CAI compared to hard copy in terms of easy to use, convenient to use, less time consuming, more understandable, more attractive to read, and less stress for study. There were 32.8% students complaining that reading hard copy was boring. Other comments were stress when reading (2%), more difficult (17.2%) and more time needed to search specific information (17.2%), and wasting papers (17.2%). However, 58.6% still complained problems when using CAI. About 25% had physical discomfort (eg. Headache, eye pain), and 25% had difficulty to access to use CAI (eg. no computers available, problems with computer or network error). We suggested that instructors should create and improve CAI lessons in biomedical sciences both in quantity and quality (eg. content with details, pictures, narrations).*

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There is a revolution underway in education that involves a shift from the traditional lecture style of information toward a more active style of learning<sup>(1)</sup>. Many educators now believe that students must actively participate in the learning process for information to be truly understood and retained. Coincident with this revolution, there is an increased understanding that the body of knowledge in most professions, including biomedical sciences, has become too large to retain in the brains of individuals. Therefore, these concepts have opened the door to innovative, computer-based educational techniques.

Self-directed learning (SDL) has been adopted

to education in subjects in biomedical sciences. SDL will build up the knowledge and help the study outcome more efficient. Finally, individuals will be able to progress their study by themselves. One of the important tool that helps SDL among students is Computer aided/assisted instruction (CAI). Computers have been used to assist education by gathering all informations and data in the format that can be retrieved rapidly and easily, depending on the software used. Therefore, each individual can use the computers for SDL efficiently. In spite of enthusiastic endorsement and continued improvements in software, few studies of good design clearly demonstrate improvement in medical education over traditional modalities<sup>(2)</sup>. Based on its advantages, CAI has been applied to use in teaching in variety of subjects. It is expected that people can access the data and information through CAI conveniently with more details compared to hard copy or textbooks. Those

*Correspondence to : Nuchprayoon S, Lymphatic Filariasis Research Unit, Department of Parasitology, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand. Phone: 0-2256-4387, Fax: 0-2252-4963, E-mail: fmedstt@md2.md.chula.ac.th*



who develop software for CAI have the same objective that CAI can help the learning process more convenient and effective. However, in Thailand, there are limited data supporting the idea in biomedical sciences with rather complicated contents and novel for the new learners.

CAI has been assumed to have an increasing role in medical education, and becomes increasingly available. However, evaluation of these programs is primarily in beginning stages. Previous study reported that students could learn parasitology from computer-based instruction as effectively as from traditional lecture-based instruction, and they could do so in less time<sup>(3)</sup>. However, no such study is performed in Thai students. We report here the results of the study using CAI compared to the hard copy for study of lessons in parasitology.

## Material and Method

### Participants

Total of 60 students attending the third-year parasitology class at Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, were recruited for this study. All students had never read the lessons we used for the study before joining this study. The study was performed at the Computer Center, Faculty of Medicine, Chulalongkorn University. All participants were informed about the study as part of the CAI evaluation.

### Study design

Two topics of the subject "Parasitology", *Ascaris lumbricoides*<sup>(4)</sup> and *Enterobius vermicularis*<sup>(5)</sup>, were chosen for this study. The CAI format of both lessons was developed and the hard copies were printed out from the original files. Therefore, both CAI and hard copy had the same contents and pictures. We divided students into 2 groups (30 each) for the cross-over designed study: the first group used CAI-lesson for the topic "*A. lumbricoides*" then switched to use the hard copy lesson for the topic "*E. vermicularis*", the second group performed vice versa (Fig. 1). Each student had one computer to use during the study. Each group had 30 minutes for each lesson.

### Evaluation of efficiency of CAI

Efficiency of CAI was assessed by comparing students' performances on the 10-multiple choice question test after each lesson, maximum time allowed for completion is 10 minutes. We evaluated the outcome by comparing the score from each test.

### Evaluation of participants' satisfaction

A questionnaire was considered to be the method to evaluate the students' satisfaction. The questionnaire consisted of 3 parts: demographic background of participants, online learning experience, and satisfaction with the CAI. The satisfaction with the CAI comprised 18 items (13 rating scale questions, 2 checklist questions, and 3 open-ended questions). For each rating scale question, students were asked to provide a response on a 5 point rating scale from 'most disagree' (1 point) to 'most agree' (5 point). We also provided open-ended questions concerning the problems students encountered during study with CAI and hard copy. Students were also asked for the suggestions that might help improve their study.

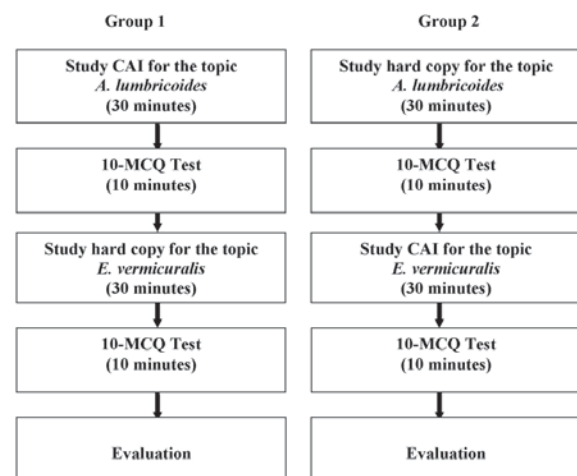
### Data collection and analysis

The data were recorded and analysed by using Microsoft® Excel 2000 version 9.0. Descriptive statistics were used to analyse the demographic characteristics and their overall satisfaction. Written responses from the open-ended questions were assessed using content analysis.

## Results

### Characteristics of study population

Out of 60 students, total of 58 students (26 males and 32 females) finished the study and 55 students returning the completed evaluation forms. Two students were late and therefore, did not finish the test in time. Therefore, we excluded from the study. The average GPAX of the participants was  $2.91 \pm 0.31$ .



**Fig. 1** Cross-over design for study of the CAI compared to hard copy lessons



**Table 1.** The score from multiple choice question test

Topic	<i>Ascaris lumbricoides</i>		<i>Enterobius vermicularis</i>	
Study type	CAI	Hard copy	CAI	Hard copy
Mean $\pm$ SD	9.03 $\pm$ 1.10	8.86 $\pm$ 1.21	9.13 $\pm$ 0.88	9.35 $\pm$ 0.85
Unpaired T-test, p=	0.56		0.35	

Interestingly, most students (53%) used less than 5 hours a week for self-study, 33% spent 5-10 hours a week, and 14% spent over 10 hours a week. One-third of the students used computer  $\frac{1}{2}$  - 2 hours a week and another one-third used 2 - 6 hours a week, about 12% used computer more than 6 hours a week, while the rest used less than  $\frac{1}{2}$  hour a week. Almost everyone (57 students) used to use Web Browser such as Netscape or Internet Explorer to access Web sites. Surprisingly, only 32% knew what CAI is, and 22% used to use CAI before participating this study.

#### **Well-performance of both tests**

The test results for both groups showed that the students could understand the contents of both lessons very well with the score about 90%. However, there was no statistical significant difference when compared study with CAI to hard copy (Table 1). There was no correlation between the sex with the effectiveness of CAI (data not showed).

#### **Participants' satisfaction**

We provided the evaluation form asking about participants' satisfaction and attitude concerning the use of CAI with the rating scale of 1-5 (Table 2). The average score was more than 4 in terms of: easy to use, convenient for searching, less time consuming, understandable, attracting. Participants also did not have much stress while using CAI (score 3.9).

#### **Suggestions and problems with CAI using**

Concerning the problems the students encountered when using CAI, 24/58 had no comments. Among the problems raised, about 25% of the students had problems of either headache, eye pain, or eye discomfort. Around 25% complained about accessibility of CAI, either no computers at home, computer hang, slow internet/network connection or network errors. Only a few (6.9%) thought that the contents on CAI and the format, as well as pictures would attract their attention.

The most comments concerning using hard copy (32.8%) were boring, not attractive. 17.2% thought that it needed more time to study and search the infor-

mation. 17.2% felt that it was more difficult to search the specific topic or issue of interest. However, 17.2% comments on wasting of papers when using hard copy, documents might be lost if it was not textbooks. Only 5.2% still thought that it was convenient to carry sheets and could study anytime and anywhere. Only 1 student complained of stress when reading hard copy. 17.2% did not have comments on using hard copy.

Almost all suggestion requested to improve CAI in biomedical sciences, both in quantity and quality. The quality should include content with details, beautiful detailed pictures, narration, and 3-dimensional pictures. The test questions for each topic with answers would be useful for self-study. However, students thought that self-study in some topics would not make them totally understood. Instructors were required to create CAI in many topics in the biomedical sciences.

**Table 2.** Attitude when using CAI for study

Preferable characteristics	Mean*	SD
CAI: easy to use	4.352	0.805
CAI: convenient to search data	4.491	0.635
CAI: less time consuming	4.527	0.663
CAI: understandable	4.036	0.719
CAI: attractive to use	4.436	0.660
CAI: no stress when using	3.927	1.034

\* rating by 5 point scale; 1: most disagree, 2: rather disagree, 3: neutral, 4: rather agree, and 5: most agree

**Table 3.** Attitude when using CAI compared to hard copy for the study

Characteristics	Mean	*SD
CAI: more convenient than hard copy	4.276	0.760
CAI: less time consuming than hard copy	4.293	0.773
CAI: more understandable than hard copy	3.466	0.863
CAI: more attractive to learn than hard copy	4.414	0.650
CAI: less stressful than hard copy	3.741	1.069
CAI: more satisfactory than hard copy	3.879	1.077

\* rating by 5 point scale; 1: most favor hard copy, 2: rather favor hard copy, 3: neutral, 4: rather favor CAI, and 5: most favor CAI



## Discussion

Parasitology is a morphologic science that require visual learning. Students need to develop the ability to identify the parasites. Using a microscope is usually time-consuming, and make it difficult for students to study the morphology of parasites. There are about 60 students in the class, but only 2-3 instructors are responsible for taking care of the students. Therefore, students usually have to wait for the assistance of the instructors in the microscopic studies.

It is inevitable that individuals can enhance the learning capacity through the use of computers. Various types of software have been developed for use to fulfill learning objectives and teaching efficiency in biomedical sciences including "question and answer" software, electronic books, tutorial type programs, and simulations<sup>(6)</sup>. However, evidence indicates that it is insufficient simply to make CAI materials available to students. Like a laboratory class, it must be fully integrated into a module if real benefits are to be obtained. Therefore, students need to be taught how to learn from CAI materials and how to integrate this learning tool in their learning strategy. Furthermore, teachers need to be supported not only with information about the availability of software but also, equally important, about how it can be integrated into modules. Most importantly, the more comprehensive research how CAI can best be utilized should be done.

Our study confirmed the statement that CAI is useful in education. Therefore, it is recommended to be developed and used widely. Although, the computer experience is correlated with time spent learning<sup>(7)</sup> and their satisfaction<sup>(8)</sup>, but we found that it was not correlated to their effectiveness of CAI. The data indicate that CAI is more attractive to be used and students gain benefit comparable to hard copy. However, it did not mean that students would be more successful than learning from hard copy or standard textbooks as showed in other studies<sup>(9)</sup>. This may due to the fact that the tested students have high potential and ability to learn, therefore, they can learn from any materials provided. Alternately, the questions in the test may be too straight forward, since we limited the time for doing the test after finishing the topics. Therefore, we only asked the knowledge related to the contents provided, not testing the application or other aspects. Of interest is that our study suggested that CAI may not be able to totally replace the hard copy or standard textbooks. The reason is that some students still preferred hard copy to CAI, since they could not rely on only computers which were not always acces-

sible. Some students were also used to reading hard copy, and not used to reading from the computer screen.

Current research suggests that computer-based books are valuable as an alternative educational medium<sup>(10)</sup>. It is accepted that Medical school faculty members are being asked to assume new academic duties for which they have received no formal training<sup>(11)</sup>, especially new computer-based instructional programs. In order to succeed at these new teaching tasks, faculty development through attention to the competencies needed by individual teachers, and to the institutional policies required to promote academic excellence.

As some professional schools have replaced microscopes for histology laboratory instruction with printed and electronic media, it is recognized that these media cannot replace experience with the microscope and that there is a cognitive dissonance of completely replacing microscopic study<sup>(12)</sup>. With a live or taped video demonstration on the first day of each exhibit, the students can easily identify exact field and the label features with little help from an instructor. However, they think that no resource is valued significantly more than the microscope exhibits, but the video demonstrations are valued significantly more than the printed atlas or atlas on CD. The advantages are (1) students' time is used efficiently, (2) only one slide set and a fourth as many microscopes need to be maintained compared with a traditional laboratory, and (3) one-of-a-kind slides derives from research activates provided for high impact learning. A study on CAI in histology, a morphologic science, shows that students who used at least 2 different CAI programs scored significantly higher on the final examination than those who used only the CAI tool designed by their site's instructor<sup>(7)</sup>.

In summary, while genuine materials for study are limited, CAI is useful in subjects related to medical education especially in parasitology, which has complex life cycles with detailed pictures and descriptions appropriate for self-directed learning. Comparable with the study from hard copy, students can use CAI to study more details on morphology of the parasites by click on a zoom-in or zoom-out and click on the internal organ to get more information. Most students prefer CAI to the traditional laboratory-lecture format although they feel that teaching by teachers will be more helpful. The well-designed and appropriately used CAI tool may help students achieve the better learning efficiency<sup>(7)</sup>. Multidisciplinary learning by the sharing



of resources has benefits to students. However, the integration of CAI into teaching programmes needs to be managed to take into account students' reluctance to rely on this method of instruction<sup>(13)</sup>.

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## โปรแกรมคอมพิวเตอร์ช่วยสอนในวิชาประวัติศาสตร์: การศึกษาแบบข้ามกลุ่ม

วิวรรณ สรรประเสริฐ, พรพรรณ จรัสสิงห์, อิศรางค์ นุชประยูร, สุรางค์ นุชประยูร

ผลการเปรียบเทียบการศึกษามหาวิทยาลัยในวิชาประวัติศาสตร์โดยใช้โปรแกรมคอมพิวเตอร์ช่วยสอน กับการใช้เอกสารปกติ โดยทำการศึกษาในนิสิตชั้นปีที่ 3 ที่ศึกษาวิชาประวัติศาสตร์ ของคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย จำนวน 60 คน ซึ่งได้ทำการจัดกลุ่มแบบสุ่มแบ่งนิสิตออกเป็น 2 กลุ่ม ๆ ละเท่ากัน (กลุ่มละ 30 คน) บทเรียนที่ได้เลือกมาทดสอบได้แก่ พยาธิไส้เดือนกลม และพยาธิเข็มหมุด ซึ่งได้จัดเตรียมบทเรียนทั้งใน รูปแบบโปรแกรมคอมพิวเตอร์ช่วยสอนกับการใช้เอกสารปกติ อาศัยการศึกษาแบบข้ามกลุ่ม กลุ่มแรกจะได้รับการสอนบทเรียนพยาธิไส้เดือนกลมด้วยโปรแกรมคอมพิวเตอร์ช่วยสอน แล้วจึงได้รับการสอนบทเรียนพยาธิเข็มหมุดโดยใช้เอกสารปกติ กลุ่มที่ 2 ได้รับการสอนบทเรียนพยาธิไส้เดือนกลมด้วยเอกสารปกติ แล้วจึงได้รับการสอนบทเรียนพยาธิเข็มหมุดโดยใช้โปรแกรมคอมพิวเตอร์ช่วยสอน ภายหลังการศึกษาแต่ละบทเรียนเป็นเวลา 30 นาที จะทำการทดสอบโดยใช้คำถามแบบตัวเลือก บทเรียนละ 10 ข้อ ไม่พบความแตกต่างอย่างมีนัยสำคัญระหว่างคะแนนของนิสิตทั้งสองกลุ่ม อย่างไรก็ตาม นิสิตส่วนมากพอใจโปรแกรมคอมพิวเตอร์ช่วยสอนมากกว่าเอกสารปกติ (91.67%) เนื่องจากใช้งานง่าย สะดวก ใช้เวลาน้อย เข้าใจได้ง่าย น่าสนใจ และไม่เกิดความเครียด ความคิดเห็นเกี่ยวกับการใช้เอกสารปกติได้แก่ เกิดความน่าเบื่อเมื่อใช้เอกสารปกติ (ร้อยละ 32.8) การเกิดความเครียดขณะอ่านเอกสารปกติ (ร้อยละ 2) ตลอดจนความยาก (ร้อยละ 17.2) การใช้เวลามากในการสืบค้นข้อมูลเพิ่มเติม (ร้อยละ 17.2) และการสิ้นเปลืองกระดาษของการใช้เอกสารปกติ อย่างไรก็ตามนิสิตร้อยละ 58.6 แสดงความเห็นเกี่ยวกับปัญหาของการใช้โปรแกรมคอมพิวเตอร์ช่วยสอน โดยในกลุ่มนี้ร้อยละ 25 ระบุถึงความไม่สบายทางกาย (เช่น ปวดศีรษะ ปวดตา) ร้อยละ 25 ระบุถึงการเข้าถึงได้ยากของโปรแกรมคอมพิวเตอร์ช่วยสอน (เช่น ไม่มีคอมพิวเตอร์ ปัญหาของเครื่องคอมพิวเตอร์ และการเข้าถึงระบบเครือข่าย) การศึกษาค้นคว้าครั้งนี้แสดงให้เห็นว่าผู้สอนควรสร้างและพัฒนาโปรแกรมคอมพิวเตอร์ช่วยสอนของบทเรียนในวิชาวิทยาศาสตร์สุขภาพ ทั้งในด้านการเพิ่มปริมาณและคุณภาพ (เช่น รายละเอียดของเนื้อหา รูปภาพ และการบรรยาย)