นิพนธ์ต้นฉบับ

The effectiveness of Computer Assisted Instruction (C.A.I.) on self-study among students in Nuclear Medicine.

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The purposes of these studies were to establish a Computer Assisted Instruction (C.A.I.) of "Thyroid Functions and Diseases," to compare pre-study and post-study test scores of medical students, and to compare the medical student opinions on the use of C.A.I.

The investigator constructed the C.A.I. The sample group was composed of 18 fifth-year medical students in their first semester of the 1992 academic year at the Faculty of Medicine, Siriraj Hospital, Mahido University. They were selected by GPAX 2.5-3 for the 1991 academic year and then divided into three groups of six students each. Experimental Group I studied by listening to a lecture, followed by using the C.A.I. lesson. Group II studied by using the C.A.I. Group III studied by reading textbooks only. The students knowledge of the subject matter was tested immediately before and after their study periods. Following the study and testing, Groups I and II completed a questionnaire regarding their opinions on using C.A.I. Mean standard deviation, the Kruskall-Wallis One-Way Analysis of Variance by Ranks, and the Mann-Whitney U Test were applied to analyze the collected data.

The results were as follows :

1. There was no significant difference between the students of groups I and II at 0.05 in pre-study and post-study test scores, and in their opinions on using C.A.I. This meant that the C.A.I. effectively complemented the traditional model of teaching medical students.

2. The mean scores of student Groups I and II were higher than those of Group III. This suggested that studying with the aid of C.A.I. had a tendency to be more effective than solely reading textbooks.

Key words : Computer Assisted Instruction

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นุชรี ปุตระเศรณี, ร่มไทร สุวรรณิก. ประสิทธิผลของการใช้บทเรียนคอมพิวเตอร์ช่วยสอน (ซีเอไอ) เพื่อเสริมในการเรียนรู้ด้วยตนเองของนักศึกษาแพทย์ ชั้นปีที่ 5 ในสาขาวิชาเวชศาสตร์นิวเคลียร์ ภาควิชารังสีวิทยา คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล. จุฬาลงกรณ์เวชสาร 2537 มีนาคม; 38(3): 129-135

การวิจัยนี้มีวัตถุประสงค์เพื่อสร้างบทเรียนคอมพิวเตอร์ช่วยสอนเรื่อง *"THYROID FUNCTION & DISEASES"* และเปรียบเทียบคะแนนการทดสอบก่อนเรียน ภายหลังการเรียนระหว่างนักเรียนแพทย์ที่ ได้รับการสอนเสริมด้วยบทเรียนคอมพิวเตอร์ช่วยสอน กับนักศึกษาแพทย์ที่ศึกษาค้นคว้าจากเอกสารทาง วิชาการ และความคิดเห็นต่อการเรียนโดยใช้บทเรียนคอมพิวเตอร์ช่วยสอน

ผู้วิจัยได้สร้างบทเรียนคอมพิวเตอร์ช่วยสอน กลุ่มตัวอย่างได้แก่นักศึกษาแพทย์ชั้นปีที่ 5 ภาคเรียน ที่ 1 ปีการศึกษา 2535 ของคณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดลจำนวน 18 คน โดย เลือกจากนักศึกษาแพทย์ที่มีเกรดเฉลี่ยระหว่าง 2.5-3 แบ่งกลุ่มนักศึกษาแพทย์ออกเป็น 3 กลุ่ม ๆ ละ 6 คน โดยให้กลุ่มทดลองที่ 1 เรียนจากอาจารย์ และเรียนเสริมด้วยบทเรียนคอมพิวเตอร์ช่วยสอน กลุ่มทดลองที่ 2 เรียนด้วยบทเรียนคอมพิวเตอร์ช่วยสอนเพียงอย่างเดียว และกลุ่มทดลองที่ 3 ศึกษาจากเอกสารทางวิชา การด้วยตนเองให้นักศึกษาแพทย์ทั้ง 3 กลุ่ม ทำแบบทดสอบก่อนเรียน และเมื่อเรียนเสร็จแล้วทำแบบ ทดสอบหลังเรียนทันที พร้อมทั้งกลุ่มทดลองที่ 1 และ 2 ตอบแบบสอบถามความคิดเห็นต่อการใช้บทเรียน คอมพิวเตอร์ช่วยสอน สถิติที่ใช้ในการวิเคราะห์ข้อมูลคือ ค่ามัชฌิมเลขคณิต ค่าส่วนเบี่ยงเบนมาตรฐาน *The Kruskall-Wallis One-Way Analysis of Variance by Ranks* และ *The Mann-Whitney U Test.*

ผลการวิจัยสรุปได้ดังนี้

1. ผลการเปรียบเทียบระหว่างนักศึกษาแพทย์กลุ่มที่ 1 และ 2 ปรากฏว่าคะแนนก่อนเรียนหลัง เรียน และคะแนนความคิดเห็นไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.05 ซึ่งแสดงว่าบท เรียนคอมพิวเตอร์ช่วยสอนที่มีประสิทธิภาพที่จะใช้สอนเสริมนักศึกษาแพทย์

2. ผลการเปรียบเทียบคะแนนระหว่างนักศึกษาแพทย์ทั้ง 3 กลุ่ม ปรากฏว่านักศึกษาแพทย์กลุ่ม ที่ 1 และ 2 มีคะแนนเฉลี่ยสูงกว่า กลุ่มที่ 3 นั่นคือ มีแนวโน้มว่าบทเรียนคอมพิวเตอร์ช่วยสอนจะมี ประสิทธิภาพดีกว่าการศึกษาจากเอกสารทางวิชาการด้วยตนเอง

Computer Assisted Instruction (C.A.I.) has had an educational role since the 1960's when the University of Illinois made a C.A.I. terminal available to students. This developed into the C.A.I. system known as "PLATO." Nowadays, this C.A.I. program is considered to have been most effective when used on main-frame computers. [2,11]

In about 1971, the University of Texas innovated C.A.I. for use with minicomputers by linking computers with televisions and using English language. That program was called Time Shared Interactive Computer Controlled Information Television (TICCIT) and was one of the more successful early C.A.I. programs. [2,11] Since 1977, the advent of low-cost, modular microcomputer technology has helped to create new interest in the use of C.A.I. to create medical simulations and instructional packages for teaching and evaluation.

For Thailand, since 1986 there has been use of inexpensive microcomputers for displaying data in both Thai and English, presenting colour pictures on monitors, imaging graphics uploaded from scanners, imaging animations, and presenting auditory information. Computers are capable of being used with other equipment such as slide projectors, video tape recorders, video laser disks, and CD ROM. Most important is their simplicity of use and ability to manipulate large amounts of data. [3] Computers are, therefore, particularly important in medical education because they are adaptable to distinctions between individuals. [4-8] Pisonthi Chongtrakul, MD, Faculty of Medicine, Chulalongkorn University, developed the computer system called "CHULA C.A.I." to support study of medical curriculum. Because of its abilities, the researcher regeards C.A.I. as a method of instruction suitable for integration into medical education in the Faculty of Medicine, Siriraj Hospital, Mahidol University.

The topic "Thyroid Function and Diseases," written by Prof. Romsai Suwanik, was made into a C.A.I. lesson. The lesson contained general information about thyroid glands, along with supplemental exercises for the medical students. In addition to adding to the students knowledge, the system would drive or stimulate their eagerness for additional information, thus it would eventually refine an individuals self-directed learning ability. [4-8]

This sort of education, as described above, has been so helpful that we have consequently applied it for use in the Section of Nuclear Medicine in order to find a solution for the future production of educational media.

Objectives of the research

1. To construct a C.A.I. lesson on Thyroid Function and Diseases.

2. To compare test scores before and after studying among three groups of medical students. The first group studied by listening to a lecture and then using the C.A.I. lesson. The second group used the C.A.I. lesson only. The third group only read textbooks.

3. To compare the opinions and the attitudes of the first two groups of students toward the use of C.A.I.

Materials and methods
Materials :

1. The C.A.I. lesson Thyroid Function and Diseases was written by Prof. Romsai Suwanik and compiled into the CHULA C.A.I. system of Pisonthi Chongtrakul, MD.

2. Four 32 bit, 80386-33 computers, complete with ancillary equipments, in the Faculty of Medicine, Chulalongkorn University were used.

3. The sample group for this research were fifth-year medical students in the Faculty of Medicine, Siriraj Hospital, Mahidol University. They were in their first semester of the academic year of 1992. The 18 volunteer students had the following prescribed qualifications :

- studying in their fifth year at the Faculty of Medicine, Siriraj Hospital, Mahidol University.
- having GPAX 2.5-3.
- having no prior experience of thyroid studies in the Section of Nuclear Medicine.
- being able to adhere to technical experiments without waste of study time.

4. Test papers and questionnaires

4.1 The test papers for the pre-study tests and post-study tests were the same. They were multiple choice and were designed to test memory recall and com prehension.

4.2 The questionnaire used a rating scale with five levels as follows :

5 - strongly approve of the use of C.A.I.
4 - approve somewhat
3 - have no opinion
2 - disapprove somewhat
1 - strongly disapprove

Methods :

1. Selection of volunteer students who were qualified under specific requirements and who were enthusiastic about cooperating in the research.

2. Testing the volunteer students before their study period.

3. The student sample was divided into three groups, each of which had six students, as follows :

3.1 Group I studied by listening to a regular curriculum lecture on thyroids at the Faculty of Medicine, Mahidol University. This was followed by use of the lesson Thyroid Function and Diseases at the Computer Unit, Faculty of Medicine, Chulalongkorn University.

3.2 Group II studied by using only the C.A.I. lesson Thyroid Function and Diseases .

3.3 Group II studied only by reading textbooks.

The three groups were equally given two hours for the C.A.I. studies and the technical papers.

4. Once the studies were complete, all three volunteer groups were immediately tested.

5. Volunteer Groups I and II immediately completed a questionnaire regarding their opinions on using C.A.I. as an instruction tool.

The manipulation of the C.A.I. lesson.

Most important of all was the selection of proper software for control of the computers and their dispalys. The CHULA C.A.I. program was selected to control the Thyroid Function and Diseases lesson. The reasons for this selection were :

1. The CHULA C.A.I. program is easy to use. Teachers and students alike, with no knowledge of computer programming, can operate it.

2. There are eight different sub-programs in CHULA C.A.I., and the students can select one or more of these according to their needs, or to adapt the program into variable features.

3. The Formative Evaluation Program (FEP)within the CHULA C.A.I. program represents an evaluative and progressive formality intended to help arbitrate the students defects, as well as to help both the students and teachers find a method to acquire the objective knowledge. There are also lessons in the form of multiple choice questions, and these are intended to assist the memorization of answers by alternating selections of A, B, C or D. The program will repeat, as many as five times, those questions which had been incorrectly answered. The program will also keep records of the students grades and study periods.

4. The system can be used in both Thai and English, as well as being flexible in the designation of characters, choices of character sizes, and colours.

5. It can introduce graphic images and animations to couple with the functional lessons.

6. It has the capacity to be linked to other multimedia equipments such as video tape recorders, slide projectors, CD-ROM, video laser discs, etc.

7. Most importantly, it is the CHULA C.A.I. program which was created by Thai researchers Pisonthi Chongtrakul, MD., and Vichai Patipaporn. Thais can be proud of this accopmplishment and additional such work should be encouraged.

Thus the C.A.I. lesson on Thyroid Function and Diseases was constructed based on the Forative Evaluation Program (FEP) in the CHULA C.A.I. system which the students would spend two hours studying. The lesson was divided into nine chapters with five exercises periodically inserted between chapters shown in figure 1. The medical students could choose either the texts or the exercises to study or to work out.
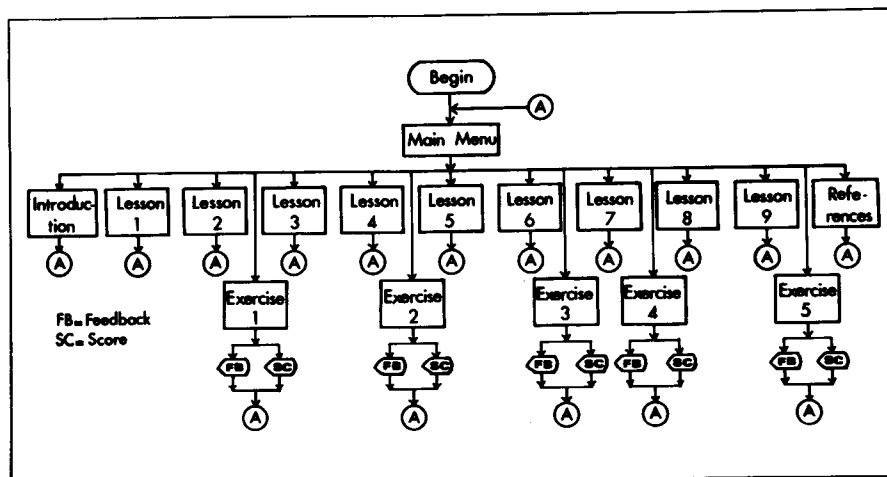

Figure 1. Flowchart of the C.A.I lesson on thyroid function and diseases.

Results

1. The results of statistical analysis of pre-study tests of the three groups indicated that the first group scored an average of 23.00 graded (S.D. = 4.00), the second group scored 23.17 graded (S.D. = 4.58), and the third group scored 23.00 graded (S.D. = 3.58). There was not a significant difference (Kruskall-Wallis One-way ANOVA by Ranks, P > 0.05) which shows that the three student groups had basically equal pre-study knowledge and thus were qualified for further experiment.

2. The results of statistical analysis of the post-study tests of the three groups indicated that the first group scored an average of 31.33 graded (S.D. = 3.87), the second group scored 30.67 graded (S.D. = 3.47), and the third group scored an average of 27.50 graded (S.D. = 3.58). This was a significant difference (Kruskall-Wallis One-way ANOVA by Ranks, P > 0.05), and this indicates that the three groups of students acquired unequal amounts of knowledge during their studies. Our analysis indicated how each group differed.

3. The results of statistical analysis of each group is displayed in Table 1.

3.1 Table 1 shows that medical student Groups I and II, both of which studied the C.A.I. lesson, acquired equal knowledge and there was not a significant difference between them (Mann- Whitney U Test, P > 0.01). This demonstrates that C.A.I. lessons have a high level of efficiency.

3.2 The two groups of medical students which studied via use of the C.A.I. lessons achieved more than the group which solely studied textbooks. When comparing the average grades of the three groups, it is evident that the average grades of the third group are the lowest. This is evidently indicative that learning through C.A.I. lessons is more efficient than self-study via textbooks only.
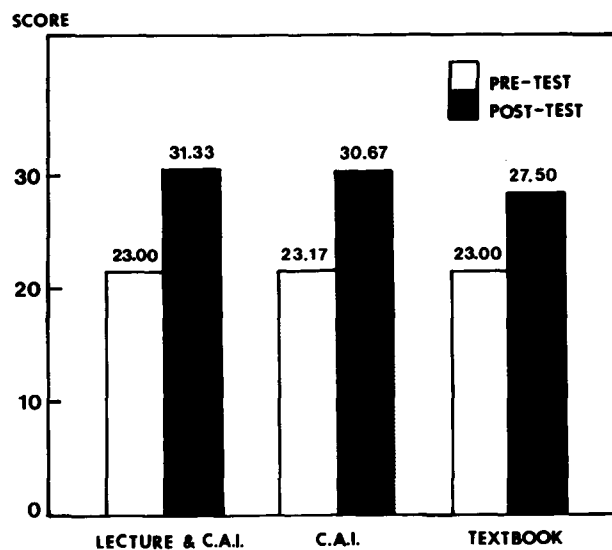

Figure 2. Comparison of average Scores between pre-study and post-study results among the three groups.

Table 1. Comparison of Post-study Scores Among the Three Groups

Student Group	N	X	S.D.	P-value
Group 1 Lecture & self-study C.A.I.	6	31.33	3.87	0.268 [a]
Group 2 Self-study C.A.I.	6	30.67	3.47	0.013 [b]
Group 3 Textbook	6	27.50	3.90	0.008 [c]

a   Comparison between Group 1 and Group 2
b   Comparison between Group 2 and Group 3
d   Comparison between Group 1 and Group 3

4. Comparisons of the comments of both groups of students which made use of C.A.I. are as follows:

- On comments on the usefulness of learning by C.A.I. : There was no significant defference (Mann-Whitney U Test, P > 0.05)

On comments on the structure of the program presentation of the C.A.I. lessons : there was no significant difference (Mann-Whitney U Test, P > 0.05)

These findings show that both groups had virtually the same comments.

Discussion

1. The results of this research reveals that post-study grades of the medical students of both groups which used the C.A.I. lessons did not significantly differ and were higher than the grades of the third group who used only the textbooks. This is likely due to the increased efficiency of studying Thyroid Function and Diseases via C.A.I. lessons in which the study sections encompassed thyroid glands departing from normal anatomy and physiology, thyroid hormones, physical examination, diagnosis and therapy, and including general studies concerning the thyroid gland. These studies allowed the medical students to gradually learn the data. The CHULA C.A.I. system also increases student interest in the subject by posing questions, graded collection, etc. With heightened interest, the study was more enjoyable.

Consequently, C.A.I. study programs such as Thyroid Function and Diseases are believed to be suitable for use by teachers for the following reasons :

1.1 The medical students will acquire equal levels of knowledge.

1.2 It reduces the teachers burdens so they are available to develop their own studies and teaching skills, as well as to do further research on technical matters.

1.3 It is an effective solution to the problem of teacher absence due to illness or involvement with other important tasks such as inspection tours abroad, attending technical meetings, and taking leave.

1.4 It is an effective solution to medical students failure to update their studies.

2. Through this research, it is apparent that the opinions expressed towards the C.A.I. lessons by the medical students of the first and second group did not differ at all. This is possible because :

2.1 The medical students of both groups were from the same institute of education.

2.2 C.A.I. lessons represent a new method of learning and teaching, and they are rather different from more conventional methods. The C.A.I. lessons are unique and innovative, and the students enjoy them and are enthusiastic to the benefits they receive.

2.3 Lessons by C.A.I. systems can be taken at any speed, slow or fast, dependent on individual student ability to learn. However right or wrong their exercise answers may be, the students are steadily confident in their responses.

Conclusion

This research has revealed that C.A.I. lessons can be used as an important educational media to strengthen medical students studies, and to help them enjoy the learning program. Hence there should be further innovation and production of more extensive C.A.I. systems so teachers are able to use them as a media of learning and teaching. Use of the C.A.I. method would also help solve failures to update the learning material. Additionally, studies by use of C.A.I. systems helps relieve teachers of their heavy load of duties that prevent them from further studies and the development of additional lessons.

Acknowledgments

References

1. Prescott C. Computer Assisted Instruction and Storyboard. Paper presented at The Development of Medical Communication, Faculty of Medical Siriraj Hospital, Mahidol University. 3-6 April, 1989. 121-37.

2. Savananong T. Computer Assisted Instruction (C.A.I.). Comput Rev. 1985 Sep; 3 (32) : 57-67.

3. Laisnitsarekul B, Varavithya C, Chongtrakul P. Formative Evaluation Program . Chula Med J 1986 Oct; 30(10) : 1051-62.

4. Chongtrakul P, Opasawong S, Rachatapiti B, Laisnitsarekul B. A comparative study of scholastic achievement of medical students with and without Formative Evaluation Program. Chula Med J 1987 Feb; 31(2) : 155-62.

5. Chongtrakul P, Jaroongdaechakul M. Attitude of third year medical students toward the use of microcomputer for self study in Pharmacology. Chula Med J 1987 Dec; 31(12) : 945-53.

6. Chongtrakul P, Boonyaratavej P, Desudchit T, Laisnitsarekul B. Formative evaluation program with computer-slide projector interface box. Chula Med J 1987 Dec; 31(12) : 1007-15.

7. Chongtrakul P, Jaroongdaechakul M. Clinical simulation program for rational drug prescription. Chula Med J 1988 Apr; 32(4) : 395-409.

8. Chongtrakul P, Jaroongdaechakul M. Appropriate coureware design for medical C.A.I.. Chula Med J 1988 Aug; 32(8) : 703-11.

9. Benjawongkulchai S, Laisnitsarekul B. S.C.A.I.: Authoring system for Computer Assisted Instruction. Chula Med J 1987 Oct; 31(10): 829-44.

10. Benjawongkulchai S, Laisnitsarekul B. S.C.A.I.2 : A new version of an authoring system software for computer assisted instryction in medicine. Chula Med J 1990 Jan; 34(1): 73-80.

11. Abdulla AM, Watkins LO, Henke JS, Frank MJ. Usefulness of Computer-Assisted Instruction for medical education. Am J Cardiol 1984 Oct; 54(10): 905-7.

12. Boyer AL, Kleffner J, Mok EC. Computer assisted instruction for radiotherapy residents. Int J Radiat Oncol Biol Phys 1984 Dec; 10(12): 2345-49.

13. BrattE, Vockell E. Using computer to teach basic facts in the nursing curriculum. J Nurs Educ 1986 Jun; 25(6): 247-51.

14. Chabot J,Marsac J.Computer-assisted teaching in pneumology. Application to the diagnosis of pulmonary opacities. Rev Fr Mal Respir 1983; 11(2): 157-65.

15. Eisenberg H, Gordon S. Computer assisted teaching program : a pulmonary patient management problem. Int J Clin Monit Comput 1987; 4(4): 195-7.

16. Goodman J, Blake J, Lott M. C.A.I.: a strategy for retaining minority and academically disadvantaged students. Nurs Educ 1990 Mar-Apr; 15(2): 37-41.

17. Gordon S,Eisenberg H.Computer-based instruction in clinical medical education :a pulmonary medicine self-assessment. Int. J Clin Monit Comput 1987; 4(2): 111-3.

18. Lowdermilk DL, Fishel AH. Computer simulations as a measure of nursing students' decision-making. J Nurs Educ 1991 Jan; 30(1) : 34-9.

19. Luker KA, Caress AL. The development and evaluation of computer assisted learning for patients on Continuous ambulatory peritoneal dialysis. Comput Nurs 1991 Jan-Feb; 9(1): 15-21.

20. Koch B, Guice R.Teaching electrocardiography : computer assisted learning vs lecture method. Aust J Adv Nurs 1989 Jun-Aug; 6(4) : 33-9.

21. Koch EW, Ramkin JA, Steward R. Nursing students' preferences in the use of computer assisted learning. J Nurs Educ 1990 Mar; 29(3):122-6.

22. Schwartz MW, Hanson CW. Microcomputers and computer-based instruction. J Med Educ 1982 Apr; 57(4): 303-7.

23. Siegel S. Nonparametric Statistics for the Behavioral Science. New York : McGraw-Hill, 1956.

24. Wong TK.Drug calculations for nurses a computer assisted learning application. Nurs Educ Today 1990 Aug; 10(4): 274-80.