The Development of an Intelligent Self-learning Program in Dengue Mosquito and Hemorrhagic Fever Surveillance

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Abstract

The purpose of the study was to develop an intelligent self-learning system (ISLS) of dengue mosquitoes and hemorrhagic fever in Thailand. Authoware professional® version 7.1 was used to create the program with interactive multimedia functions. Basic knowledge and patient case video clips of dengue mosquito and hemorrhagic fever control were included in the system. Content validity and usability were assessed and changes were made based on recommendations before the production of the final version of ISLS. Pre-post tests were used to evaluate the effectiveness of ISLS in the enhancement of basic knowledge and skills. Thirty participants were allowed unrestricted access to the system. Basic knowledge scores in the post-tests were significantly higher than pre-test scores (p = 0.03), and the total scores of the post-tests were statistically significantly higher than the pre-test scores (p= 0.001). However, there was no statistically significant difference between pre-and post test scores in patient case management (p =0.115). The findings of this study illustrate that ISLS gives the opportunity for users to gain knowledge to a certain point but there still is a need for other resources to enhance basic knowledge and skills in dengue mosquito and hemorrhagic fever control, such as real-life experience and skills practice.

Keywords: Interlligent Self-Learning System (ISLS), Hemorrhagic Fever (HF), Dengue Mosquito, Surveillance

INTRODUCTION

Recently, there have been many published articles regarding the application of multimedia computer programs in dengue mosquito and hemorrhagic fever surveillance, for example the use of a computer simulation in mosquito identification in Thailand.[1] This included the development of a computer program called “Keymos.exe” to identify all 25 different species of mosquitoes living in Thailand. The structural function is divided into 2 different options. Firstly, it shows the external physical organs of different types of mosquitoes with written details such as scientific names. Secondly, the typing of a scientific name provides all details of mosquitoes, including the external organ structures, breeding habitats, and life cycles, all available in a number of languages. A number of limitations were noted, including an incomplete evaluation of the effectiveness of the program was not completely conducted. Another study developed a data-base system of mosquito breeding habitats called “Mosquito Information Retrieval System (MIRS)”. [2] Limitations of this included the program function and the usefulness of the program, and the computer system still needs to be evaluated. Notre Dame University produced a computer program called MODABUND that aims to provide basic information of mosquitoes, including breeding habitats, life cycles, types of mosquitoes, epidemiology, disease transmission, and surveillance and control programs

[3]. The overall results of the program were favorable and the computer systems enhanced the surveillance of insects by the development of an information based system and expert system.[4]

Recently, a computer-aided program was developed for dengue vector mosquito surveillance and control in Thailand. The program is made up of four sections, brief information about vectors, aid for calculating the survey data, aid for calculating insecticide usage, and aid for the management of the database of the survey data.[5] Most computer systems developed recently aim to present basic information, produce a database and search engine, and evaluate acquired information regarding insects, especially mosquitoes.[6] The structural functions of computer programs in knowledge enhancement and disease control skills in dengue mosquito and dengue hemorrhagic fever (DHF) for public health staff are still needed.[7]

As a result, the authors established an intelligent self-learning system (ISLS) to enhance basic knowledge and skills of dengue mosquitoes and hemorrhagic fever surveillance and control for health professionals such as public health staff, doctors, pharmacists, and nurses. The system utilized interactive multimedia functions for usefulness and effectiveness.

Objectives

- To develop an Intelligent Self-Learning System (ISLS) of Dengue Mosquitoes and Hemorrhagic Fever, Thailand

MATERIALS AND METHODS

The development of an intelligent self-learning system (ISLS) in dengue mosquito and hemorrhagic fever surveillance included:

Program Contents

The ISLS program contains seven sections (see figure 1-4):

1. Basic knowledge of dengue mosquitoes, such as life cycles, breeding habitats, biting behaviors, and feeding times
2. Dengue mosquito surveillance
3. Dengue mosquito prevention
4. Dengue fever prevention
5. Patient care related to dengue hemorrhagic fever
6. Patient case demonstration, for example multimedia video clips: 5 cases
7. Self-assessments including:
   a. Basic knowledge from section 1 to 5 via MCQ, fill in the blank, and true-false questions: 20 items
   b. Patient case management via short answers: 10 items

Process of ISLS development

The ISLS program was developed using the Authorware Professional® version 7.1, a software program that allows a number of icons to be incorporated into a logical flowchart to form interactive programs ideally suited to it. The advantage of Authorware Professional® for this project was that it allowed users to create, store, edit, and retrieve items of multimedia information, such as audio and video, within the interactive environment. Additionally, this software allowed the programmer to implement the object movement function to make the program more user-friendly.

ISLS Program Evaluation

Content validation

The contents of the ISLS program were validated by a tropical medicine lecturer, a clinical pharmacist, the headquarters of Disease Prevention and Control Department (DPC) Region 7, Ubon Ratchathani, Thailand, and a registered nurse. A number of changes were made based on their recommendations prior to further use of the ISLS program.

Usability test

The questionnaire survey adapted from Slocum and Beard [15] was implemented. Twelve hospital staff from Sapasithiprasong Hospital, Ubon Ratchathani, Thailand volunteered to participate in a pilot study and they were asked to evaluate the ISLS program function on such dimensions as quality of visuals,

ease of understanding, time required, and skills gained. All participants were exposed to the program and were invited to comment on it. Responses were made on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). Modifications to the program were made based on these comments.

Evaluation of the effectiveness of the ISLS program

It was a one group pre-/post-test design involving 30 participants, 15 general practitioners, 10 clinical pharmacists, and five registered nurses. The participants completed a one hour pre-test and were allowed to spend as long as they wanted on the program that was installed on computers in the laboratory for hospital staff. Two weeks later, they completed a one hour post-test. A total score equal to 30 were calculated via statistical analysis using means, SDs, maximums, minimums, and t-tests.

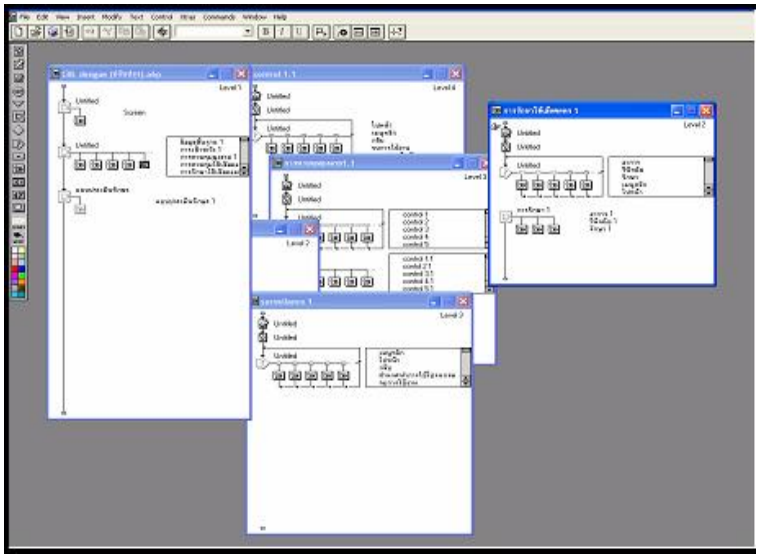

Figure1 Flow chart of ISLS structure

Figure 2 Front page

Figure 3 Main menu

Figure 4 Content of ISLS

RESULTS

The development of the ISLS program followed the guidelines of Alessi and Trolip (1991).[8] The process is outlined in figure 1 and included:

1) Definition of the learning process
2) Collection of the information
3) Writing of the ISLS tool
4) Design of the interactive multimedia
5) Preparation of the video multimedia tools.

The ISLS program was developed over a period of five months.

Evaluation of the usability of the ISLS program

The overall evaluation was positive. The participants commented about the time it took to complete the program session that they thought might be too long. They generally thought the ISLS program was well designed and possibly enhanced their basic knowledge and skills in dengue mosquito and hemorrhagic fever surveillance and control (see Table 1).

Table 1 Mean scores of ISLS program Usability Test (n = 12)

Questionnaire item[a]	Mean (SD)
I had no problem understanding the content	4.35 (0.89)
The computer-based design activity was appropriate to this activity	4.00 (0.50)
It was easy for me to know what I needed to do from the visuals presented on the computer screen	4.50 (0.43)
The computer project took a reasonable amount of time to complete	3.50 (0.89)
I felt adequately prepared to use the computer to complete the intelligent self-learning design project	4.25 (0.25)
The audio-visuals and video clips in the computer program were clear	3.65 (0.96)
I like the idea of using a computer to learn about dengue mosquito and hemorrhagic fever control	4.85 (0.02)
I will use the skills I gained from the program for dengue mosquito and hemorrhagic fever surveillance	3.80 (0.53)
The computer-based learning program made me more aware of dengue hemorrhagic fever patient care	4.00 (0.26)
I enhanced my knowledge of dengue mosquito and hemorrhagic fever surveillance by using the ISLS program	3.95 (0.36)

[a] *the questionnaire items were adapted from Slocum et al., 2005*

Evaluation of the effectiveness of an ISLS program

Thirty participants completed the ISLS session as part of the evaluation of the effectiveness. Comparisons of the participants' pre-and post-test scores showed that the latter were statistically significantly higher in basic knowledge of dengue mosquito and hemorrhagic fever surveillance and control, except the patient case examination (p = 0.003, 0.115, consecutively; see Table 2). Additionally, comparisons of the total scores between pre-and post-test scores indicated that the latter were statistically significantly higher (p = 0.001; see Table 2).

Table 2 Mean scores of pre-/post-tests (n= 30)

Assessments (scores)	Evaluation tests				
	Pre-test		Post-test	Max/Min	*p*-value
	Mean ± SD	Max/Min	Mean ± SD		(<0.05)
1. Basic knowledge[a] (20)	10.93±1.93	16/8	12.57±2.11	16/9	**.003**
2. Patient case[b] (10)	4.87±1.22	8/3	5.21±1.41	9/3	.115
3. Total scores (30)	15.8±2.42	21/11	17.78±2.40	23/13	**.001**

[a] *the assessment is based on contents from section 1 to 5*

[b] *the assessment is based on skills learning from section 6*

DISCUSSION

The authors found some difficulties in implementing some applications of Authorware software into the program, such as the software commands, readable codes, and computer written language. Thus, it was time-consuming for the developers to complete the program. There are software tools available to develop computer-based learning programs and use of these should be considered to enhance the program efficacy. Based on the contents of the program, all aspects related to dengue mosquito and dengue hemorrhagic fever management were fully covered, but self-prevention and community surveillance should be included. There should be more project workers from different professions to improve the program functions.

The result of the usability of the ISLS program was generally favorable except for some uncertainties about .time spent in the completion of the program session and the quality of audio and video clips. Alterations were made to rectify these issues. Five months was spent developing the ISLS program. Costs included the developers paying for software and multimedia, but the program can be used several times. The content of the ISLS program can be modified to other subjects within the same function structure, giving the investments long-term benefits. Some previous studies have indicated that interactive multimedia self-learning material can provide opportunities for users to gain knowledge and skills independently, some of which may not be available via textbooks and/or classes.[9-10]

Results of the evaluation of the program's effectiveness showed that most of the participants enhanced their basic knowledge regarding dengue mosquito and hemorrhagic fever surveillance and control (p = 0.003). A number of studies have demonstrated that the same or better scores can be achieved by the use of a computer self-learning program compared to more traditional methods of teaching and learning, such as taking a class lecture, joining a conference, or self-study.[11-15] This may be due to better opportunities provided by an interactive multimedia, user-friendly self-learning system to gain an knowledge.

Mean post-test scores were higher compared to pre-test scores, however, they were still low (17.78 out of 30). This indicates that a multimedia computer system alone may not be a good resource for learning, and other resources, such as real-life experience, demonstrations, and skill practice must be investigated.

The participants' performances in patient case management were not statistically significantly different between pre-and post-test scores (p = 0.115). This may indicate the necessity to be exposed to real-life patient care. Also, the inclusion of the multimedia video clips in the ISLS program may not appear to adequately improve the participants' skills in this area. Other external factors may affect the results, such as work experience, types of health professionals, routine work schedules, frequencies of an ISLS access, and participant motivation.

As a result, it is difficult to conclude whether the higher scores in basic knowledge in this study came from the program function itself. However, the program did give the opportunity for the users to gain an adequate knowledge to a certain point.

Suggestions

The study had a number of limitations. Firstly, the backgrounds of the participants were similar and more participants with different career backgrounds need to be included. These backgrounds should include public health participants, Disease Prevention and Control staff (DPC), and university and school staff. This would increase the reliability of the results of the evaluation of the program. Secondly, modification of the wash-out period after the completion of the program may be necessary. Evaluation should be measured at different stages, such as immediately after, one month after, and two

months after, to assist program developers to assess knowledge acquisition over a longer period of time. The program functions need to be adjusted frequently to limit some defects in the program to make it more efficient. Investment in the development of the ISLS program needs to be addressed. Only a few packages are available currently for some particular groups of people and increased budget would increase the availability of the program to a wider range of people. Finally, easy access to interactive self-learning systems needs to be provided through web-based access and programs online services so that more people will be able to increase their knowledge and become familiar with this type of learning method.

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