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สาขาวิชาเทคโนโลยีสารสนเทศทางธุรกิจ คณะบริหารธุรกิจ มหาวิทยาลัยเทคโนโลยีราชมงคล
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วารสารไทยเภสัชศาสตร์และวิทยาการสุขภาพ 2561;13(4):171-178.

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บทคัดย่อ

Abstract

วัตถุประสงค์: เพื่อ 1) ทดสอบประสิทธิภาพของสื่อมัลติมีเดียแบบมีปฏิสัมพันธ์ เรื่อง การดูแลสุขภาพช่องปากของผู้สูงอายุ 2) เปรียบเทียบผลสัมฤทธิ์ทางการเรียน (คะแนนการทดสอบ) ระหว่างสื่อมัลติมีเดียกับการเรียนแบบธรรมดา เมื่อเรียนจบแล้ว และ 3) ศึกษาความพึงพอใจของผู้ใช้ **วิธีการศึกษา:** กลุ่มตัวอย่างเป็นผู้สูงอายุใน ต.ปราณบุรี อ.ปราณบุรี จ.ประจวบคีรีขันธ์ โดยการสุ่มตัวอย่างแบบง่าย จำนวน 60 คน จัดเข้ากลุ่มทดลองที่ใช้สื่อมัลติมีเดีย 30 คน และกลุ่มควบคุมที่เรียนรู้อย่างแบบเดิม 30 คน ได้พัฒนาสื่อมัลติมีเดีย เรื่องการดูแลสุขภาพช่องปากของผู้สูงอายุ แบบทดสอบผลสัมฤทธิ์ทางการเรียน และแบบสอบถามสำรวจความพึงพอใจ ประเมินประสิทธิภาพสื่อมัลติมีเดีย ด้วยเกณฑ์ E1/E2 > 80/80 และเปรียบเทียบผลสัมฤทธิ์ทางการเรียนหลังเรียนระหว่างสองกลุ่มด้วย independent t-test **ผลการศึกษา:** สื่อมัลติมีเดียแบบมีปฏิสัมพันธ์ที่สร้างขึ้นมีประสิทธิภาพ (E1/E2 = 82.27/80.33) เมื่อจบการเรียนรู้พบว่าคะแนนผลสัมฤทธิ์ทางการเรียนของกลุ่มที่ใช้สื่อมัลติมีเดีย สูงกว่ากลุ่มควบคุม ($P < 0.001$) และผู้ใช้มีความพึงพอใจต่อสื่อมัลติมีเดีย ในระดับมาก **สรุป:** สื่อมัลติมีเดียแบบมีปฏิสัมพันธ์เรื่องดูแลสุขภาพช่องปากของผู้สูงอายุที่สร้างขึ้น ช่วยให้ผู้ใช้เรียนรู้เกี่ยวกับการดูแลสุขภาพช่องปากได้อย่างถูกต้องและสามารถนำไปใช้งานได้จริง

คำสำคัญ: สื่อมัลติมีเดียแบบมีปฏิสัมพันธ์, สุขภาพช่องปาก, ผู้สูงอายุ, ไทย

Objective: To 1) determine efficiency of the developed interactive multimedia on oral health care for the elderly, 2) compare learning achievement (test after learning the interactive course with traditional learning, 3) to determine satisfaction on the interactive course among the learners. **Method:** The samples were 60 elderly in Pranburi district, Prachuapkhirkhan province, selected by simple random sampling. They were assigned to experimental (test) group (interactive multimedia course) and control group (traditional learning materials), 30 participants each. We developed the interactive multimedia course on oral health care for the elderly, learning achievement test, and 3) satisfaction questionnaire. Learning efficiency was tested using the E1/E2 criterion of > 80/80. Test scores at post-learning between the two groups were compared using independent t-test. **Results:** The interactive multimedia course was efficient with E1/E2 of 82.27/80.33. At post-learning, learning achievement scores in the test group was significantly higher than that in control group ($P < 0.001$). Learners were satisfied with the interactive course in a high level. **Conclusion:** The interactive multimedia course on oral health care for the elderly was efficient and applicable.

Keywords: interactive multimedia course, oral health care, elderly, Thai

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Introduction

Proportion of the elderly has been ever increasing especially in Asia. In 2015, of about 633 millions in the south-east Asian (ASEAN) countries, there were about 59 millions of those aged 60 or older, or 9% of the population.¹ Of all ASEAN countries, elderly society has been found, with the highest proportion of the elderly, in Singapore, followed by Thailand and Vietnam. As the second most number of elderly in ASEAN, population structure of Thailand has dramatically changed with a growing number of the elderly and shrinking proportion of newborns and young individuals. These have resulted in an apparent longer life expectancy of Thai people and a larger number of Thai elderly.¹

The transition to the aging society could lead to serious economic and societal problems. All parties in Thai public

health system has been prepared for the upcoming challenges the elderly population has presented. Dental public health for the growing elderly population is no exception. There have been some measures to handle the elderly dental health services. Oral health problems among the elderly include dental and root caries, gingivitis, tooth loss, and denture wearing.² These dental problems grant an urgent need for dental attention.

Dental problems in the elderly are based on two main causes. First, dental and gingival diseases are common and could lead to infection of the mandibular molars which could further cause other complications.³ The second cause was more age-related where teeth and enamel are worn out because of a life-time grinding. In addition, poor oral hygiene

could harbor virulent microbes which could spread and cause infections in various internal organs including heart, lung, intestine, liver, kidney and joints.

It has been known that oral care is critical for good health especially in the elderly. Therefore, more thorough and continuous oral care for the elderly is needed. Based on a survey on health and welfare by the National Statistical Office of Thailand in 2015, low level of dental health promotion and service was found with 8.2% of the informants received dental health promotion and 5.5% received dental care.⁴ Among those receiving dental care promotion and service, there were more women than men. More importantly, proportion of individuals receiving dental care service was reversed with increasing where the elderly had the lowest service rate. The causes of this low service rate could be multi-facet in nature. Among various factors that affected rate of access to the dental care service, information support could be a crucial one.

At present, a vast number of information technology have boosted the information dissemination to diverse populations. Information technology has been considered a strategic tool for almost all aspects of development in all countries. In education development, the National Education Act B.E. 2542 (1999), and its amendments in B.E. 2545 (2002) and B.E. 2553 (2010) had encouraged the use of information technology in all levels of education, both formal and informal.⁵ Learning and learning platform in the age of information technology consists of more use of computer and internet network. Government plays a crucial role in the promotion and support of developing learning materials including textbooks, handbooks, media, other printing materials and technology-based learning materials and devices. Each of all learners should be given an opportunity to learn by ways that best suit their learning ability. Ultimately, learners have the right to the training to acquire knowledge and skill in using educational technology for their independent life-long learning.

According to the new learner-centered learning concept, each of all every individuals has the potential to learn and improve themselves. Educators must allow the learners learn naturally at their fullest learning capacities. With the aides of information and communication technology, learning process has evolved and the learning is more efficient.⁶ These learning modalities include, but not limited to, online distance learning, virtual reality, and interactive multimedia courses. It has been long known that the most familiar form of interactive

multimedia courses to the educators is computer-assisted instruction or CAI. The advantages of CAI have been realized including the interaction between learners and course content, timely fashion feedbacks, and individual's independent learning schedule. As a result, CAI is suitable as an interactive, independent learning modality that could foster the learner-centered learning ability of individuals regardless of their age.

It had been of great concern to develop learning materials in the form of CAI for the elderly. A research aiming at laying a foundation and development of electronic systems to promote quality of life in the Thai elderly, called e-Services for Ageing Society, was conducted in 2014.⁷ The project aimed to develop electronic-based health promotion and care service for the elderly. These included understanding on physical defects and abnormalities, and physical and psychological needs of the elderly to maintain or even better their daily living. All learning in this project was rendered through applications. The researchers had developed electronic applications for the elderly including an android application to prevent forgetting mobile phone and a computer program for the elderly communication and information center.

At the moment, no CAIs or applications had been developed to help the elderly learn about their oral health care. With a limited access to traditional health education, the elderly lacked the opportunity to learn and improve their oral health. Worse oral health problems among the elderly were found, and consequently more oral care and associated societal expenditures were realized. With the need to improve understanding about oral health among the elderly, our present research aimed to test the effectiveness of the newly developed interactive multimedia learning course. To achieve a better learning efficiency, this course content and navigation allowed the learners to interact for immediate feedback as opposed to the usual passive learning. The interaction also allowed for analysis so that further content and navigation could be adjusted according to learning capacity of each individual learner. Specific objectives of this study were to 1) determine the learning efficiency of the interactive multimedia course on oral health care for Thai elderly based on the 80/80 criterion, 2) compare learning achievement (test scores) between the interactive multimedia course and traditional printed learning materials, and 3) assess the satisfaction of the learners on the interactive course. If found efficient, the interactive multimedia course on oral care in the elderly could

be more applied on the nationwide population of the elderly. Such understanding could lead to a better oral care practice among the elderly.

Methods

In this experimental research, we tested the effectiveness, learning efficiency and learner's satisfaction on an interactive multimedia course among the elderly. The learning efficiency of the interactive multimedia course was tested against the E1/E2 set criterion of 80/80.⁸ In the experimental or test group, the participants received the interactive multimedia course while those in the control group received traditional printed learning materials.

We compared learning achievement between the two groups using scores at the post-learning test using the test we developed. Finally we determined satisfaction of the users of the interactive multimedia course using the questionnaire we developed.

Study population and sample

Study population was the early elderly (age 60 to 69 years) living in Pranburi sub-district, Pranburi district, Prachuabkhirikhan province. Of the total of about 600 elderly individuals in the study area, a sample of 60 elderly individuals (30 for each group) was selected based on the following inclusion criteria. Participants had to be 60 to 69 years of age. They had no physical disability or defects; however, they had to have oral health problem. In addition, they had to be literate on Thai reading.

There were 80 elderly adults who met the criteria mentioned above. Based on the 80 individuals as the study population frame with a sampling error of 5% and confidence level of 95%, the Krejcie & Morgan's sample size estimation suggested a sample of 60 participants (30 in each group).⁹ Participants were assigned to each group by simple randomization. Participants in the experimental or test group received the interactive multimedia course on oral health care for the elderly; while those in control group did not.

Research instruments

The instruments included an interactive multimedia course on oral care for the elderly, questionnaire on learning efficiency and questionnaire on satisfaction on learning.

As the study intervention, the interactive multimedia course on oral care for the elderly had been developed with the following steps. The course content was borrowed from the handbook of promoting oral health care in the elderly of the Department of Health, Ministry of Public Health. In terms of learning process, the developers followed the Bloom's learning theory and the learning of the elderly to achieve an efficient interactive learning material best suitable for the elderly. For the practical steps of interactive learning, Gagne's steps guided the development. First, learners needed to be excited to learn the subject. Second, objectives of learning were clearly provided, especially the specific learning points. Third, pre-learning test was placed to verify the existing knowledge about the subject. Fourth, the interactive multimedia content was presented. Fifth, the interactive learning was guided and stimulated to encourage the learner to bring their existing knowledge while navigating through the course content. Sixth, feedback and response on learning was further stimulated. Seventh, the learner was fed back with how far the learner was to the goal of learning. Eighth, in addition to one the pre-learning test, mid- and post-learning tests were also provided. Ninth, the last component of interactive learning was summarizing the content for post-session review.

In terms of course content and presentation order, five learning units of oral care for the elderly were developed. These included 1) oral health problems among the elderly, 2) root decay or caries, 3) periodontal problems, 4) oral health promotion, and 5) oral care product selection for the elderly.

The interactive multimedia course was developed based on the following concepts and tools. First, storyboard and work plan were applied by the use of the Macromedia Authorware®. This software program allowed the development of still pictures, video clips, sound, moving pictures and texts. It also was used to create tests and interactive interphases.

This interactive multimedia course was then evaluated for agreement on oral health care content and learning process by three experts. Specifically, they were asked to rate four attributes of the interactive multimedia course including interaction, content, graphic and design, and technique. For content, it was evaluated on how much the course allowed participation of the learners, difficulty level suitable for the learners, easiness to use, and clear language. Regarding interaction or interactive interface, four aspects, namely participation allowance for the learners, difficulty level suitable for the learners, easiness to use, and clear language were

included. In terms of graphic and design, four aspects included fonts, pictures, activities, and graphics. In terms of technique, the aspects of good technical design, good teaching design, and creativity and new concept.

Each expert was instructed to rate their opinion on a 5-point rating scale ranging from 1-least agreed, to 2-less agreed, 3- moderately agreed, 4- highly agreed, and 5-extremely agreed. Based on the total score of 5 points, overall level of opinion could be categorized as the least, less, moderate, high and extreme agreement to the statements (1.00 - 1.49, 1.50 - 2.49, 2.50 - 3.49, 3.50 - 4.49, and 4.50 - 5.00 points, respectively).¹⁰

The interactive multimedia course on oral health care was tested in the preliminary sample for learning efficiency. The test was done in three phases including individual test, small-group test and field test (3, 10 and 30 individuals, respectively). These individuals took the interactive multimedia course like participants in the actual experiment. Based on the E1/E2 of 80/80 learning efficiency criterion E1 was the learning achievement from tests 1 – 5 (percentage of correct answers from 5 post-class tests) and E2 was the one from the 6th or last post-course test.⁸

Regarding **the test on learning achievement** of the interactive course, eight steps were involved. First, literatures on test making were reviewed. Second, content of oral health promotion was obtained and studied. Third, relevance of oral health promotion content was specified and learning objectives were made. Fourth, learning achievement test was created as a set of 30 4-choice questions covering all the oral health promotion and learning objectives. Fifth, the content validity of each question of the learning achievement test was examined using the index of congruence by three experts. Revision was made according to the experts' suggestions. Questions with the index of 0.5 or higher were chosen and 20 items were retained for the final version of the test. Sixth, the final 20 questions were further tested in five individuals comparable to the target participants. Seventh, scores from the testing in the sixth step were determined for item difficulty (p), discrimination power (r), and internal consistency reliability of the learning achievement test. Questions with item difficulty index of 0.20 – 0.80 and discrimination power of 0.20 - 0.44 were retained. As a result, all 20 items were retained. With the format of the answer of "yes/no," the internal consistency reliability was acceptable with a Kuder-Richardson coefficient

of 0.75. Last, the final version of the learning achievement test was prepared for the target participants.

In terms of **the questionnaire on satisfaction** in using interactive multimedia of oral health promotion, it was developed via the following steps. First, literatures on questionnaire measuring satisfaction were reviewed. Attributes of satisfaction based on study objectives and conceptual framework were identified. Questions, both close- and open-ended, to measure the satisfaction attributes were formed. These questions were examined by the experts. This set of questions was then revised according to the expert's suggestions. The revised questions were further tested by three experts for content validity using the IOC. Questions with IOC of 0.5 or higher were considered having content validity and were retained in the questionnaire. This set of questions was further revised according to the expert's advice and proven if the revision was appropriate. The questionnaire was tested with 30 individuals (field test) comparable to target participants. The internal consistency reliability was high with a Cronbach's alpha coefficient of 0.85. The final version the questionnaire was prepared for use in the experiment. In the final form of this satisfaction questionnaire, three dimensions of satisfaction on the interactive course were measured including 1) content of the course, 2) graphics and design, and 3) interaction. With three questions for each dimension of satisfaction, the questionnaire contained a total of 12 questions. The response format was Likert-type rating scale ranging from 1-least satisfied, to 2-less satisfied, 3-satisfied, 4-more satisfied and 5-most satisfied.

In the final set of questionnaire, the first section asked the participants about their demographic information. The second part consisted of questions about satisfaction. The last part contained open-ended questions allowing for suggestions for the improvement of the interactive course.

Experiment and data collection procedure

The interactive multimedia learning experiment was conducted from May to June 2017. The classroom was prepared and the interactive course was installed in the computer. The participants were assigned into either the test group (interactive multimedia course) or control group (usual traditional learning with no interactive multimedia course). The learning experiment in the **test group** was conducted first. To best offer the interactive course materials and a close learning facilitation in the test group (30 participants), three consecutive

learning sessions were offered to each sub-group of ten individuals. The course consisted of five learning units of which the first four units took 45 minutes per unit and the last unit took 60 minutes to finish, resulting in a total of 240 minutes of learning. These five learning units were placed on five different visits with one or two days of no learning between consecutive learning units. With five learning visits and one post-learning test visit, a total six visits were made. With such scheduled experiment, each sub-group spent 10 – 12 days in the learning experiment.

At each learning unit visit, participants were asked to complete a pre-learning test of 20 questions which took about 30 minutes. After the instruction, the participants learned about oral health care with the interactive multimedia course. Post-learning test for the learning unit was completed. Once all learning five units were completed, a comprehensive post-learning test of 20 questions with a 40-minute test time was placed. Once all learning and test were done, participants were asked to complete the satisfaction questionnaire.

For the **control group**, two sub-groups of 15 participants each were formed. Unlike the test group, the control group was offered the traditional printed learning materials of oral health (no interactive multimedia course). Similar to the test group, the course in the control group also consisted of five learning units of which the first four units took 45 minutes per unit and the last unit took 60 minutes to finish, resulting in a total of 240 minutes of learning. These five learning units were placed on five different visits with one or two days of no learning between consecutive learning units. With five learning visits and one post-learning test visit, a total six visits were made. With such scheduled experiment, each sub-group in this control group, like the test group, also spent 10 – 12 days in the learning experiment. Similar to the test group, participants in the control group were asked to complete the pre-learning test, learn about oral health care with the traditional materials, complete the post-learning test for each learning unit, complete the comprehensive test, and the satisfaction questionnaire.

Statistical analysis

Demographic data of participants were presented as mean with standard deviation and frequency with percentage. Scores of pre- and post-learning tests were presented as mean with standard deviation. Scores of pre- and post-learning tests in the test group (interactive multimedia course)

were compared with paired t-test. Scores of post-learning tests between the two groups were compared by independent t-test. Scores of satisfaction were presented as mean with standard deviation and frequency with percentage.

Results

In terms of the expert opinion on the attributes of the interactive multimedia course on oral health care, the interaction aspect was rated as the highest agreement (a mean score of 4.67 ± 0.48 of 5 points), where the rest, i.e., content, graphic and design, and technique aspects were rated as high (mean scores of 4.33 ± 0.55 , 4.10 ± 0.61 and 3.85 ± 0.46 points, respectively).

Based on the 80/80 learning efficiency criterion, learning efficiency was found to be borderline satisfying by individual test, small group test, and field test (70.66/78.33, 70.40/81.00, and 82.27/80.33, respectively). Since greater number of individuals taking the test, learning efficiency of the field test (82.27/80.33) was more reliable. Percentages of correct answers were higher than the criterion of 80/80 both from the post-class test (tests 1 – 5) (20.57 of 25 points, or 82.27%) and post-course test (16.07 of 20 points, or 80.33%).⁸ This demonstrated that the interactive multimedia course on oral health care was efficient enough to use in the experiment participants.

Table 1 Learning efficiency of the interactive multimedia course in the field test (N = 30).

| Test | Total score | Average score | % | E_1/E_2 |
|-----------------|-------------|---------------|-------|-------------|
| In-class test | 25 | 20.57 | 82.27 | 82.27/80.33 |
| Post-class test | 20 | 16.07 | 80.33 | |

Among the participants in the test group (interactive multimedia course) (N = 30), there were women than men (18 and 12 respectively). The majority were in their 60 – 62 years of age (18 or 60.0%), followed by 63 – 65 years (27.0%), and 66 years or higher (13.0%). Participants in the control group (traditional learning materials) were comparable with their counterparts in terms of demographic characteristics.

Among these participants using the interactive multimedia course, the mean score of pre-learning test (6.07 ± 2.36 points) increased to 13.23 ± 2.08 points with statistical significance (paired t-test = 35.28, df = 69, P-value < 0.001).

For participants using the traditional learning materials (control group), their mean score of pre-learning test (5.90 points) was comparable to 6.07 points of those using interactive multimedia course (test group). Their mean score at post-learning in the control group also increased (9.03 ± 2.53 points) but significantly lower than that in the test group (13.23 ± 2.08 points) (independent t-test = 6.11, df = 89, *P*-value < 0.001) (Table 2).

Table 2 Mean scores at post-learning test between the two groups.

| Groups | Mean | S.D. |
|------------------------|-------|------|
| Test group (N = 30) | 13.23 | 2.08 |
| Control group (N = 30) | 9.03 | 2.53 |

Independent t-test = 6.11, df = 89, *P*-value < 0.001.

In terms of satisfaction on the interactive multimedia course on oral health care, participants who used the course reported high level of satisfaction on all aspects, i.e., content, graphic and design, and interaction, as well as the overall measure (Table 3).

Table 3 Satisfaction on the interactive multimedia course among participants (N = 30).

| Aspects | Mean | S.D. | Satisfaction level |
|-----------------------|------|------|--------------------|
| 1. Content | 4.31 | 0.53 | High |
| 2. Graphic and design | 4.26 | 0.49 | High |
| 3. Interaction | 4.43 | 0.47 | High |
| Average | 4.33 | 0.50 | High |

Discussions and Conclusion

Fuller In terms of the expert opinion on the attributes of the interactive multimedia course on oral health care, the interaction aspect was rated as the highest agreement (a mean score of 4.67 ± 0.48 of 5 points), where the rest, i.e., content, graphic and design, and technique aspects were rated as high (mean scores of 4.33 ± 0.55 , 4.10 ± 0.61 and 3.85 ± 0.46 points, respectively).

In this randomized controlled trial study, we found that the interactive multimedia on oral health care for the Thai elderly was efficient and satisfactory. In terms of the expert's opinion on efficiency of four aspects of the course, three of them, content, graphic and design, and technique were rated as high and interaction aspect was rated as highest.

For the opinion of 30 individuals in the preliminary field test, efficiency of the course based on the correct answers of the test, efficiency from tests during five classes (E1) of 82.27% was surprisingly higher than that from post-learning test (E2) of 80.33%.

Both 82.27% and 80.33% were obviously higher than the criterion of 80/80. However, the unexpected lower percentage at post-learning was noteworthy. It could be attributable to the fact elderly learners had cognitive deficit especially short-term memory and focus. Therefore, they could have had hard time to carry out tasks that need interactive interpretation and a lengthy time. Hence, the lower percentage of correct answers.

The 82.27/80.33 measure which met the 80/80 set criterion was consistent with many other successful learning courses for Thai population. The work of Panpum and Sriurai. (2014) demonstrated that the interactive multimedia course entitled "science experiment on android operating system for grade 2 primary school students" had efficiency of 81.00/89.75 which met the 80/80 criterion.¹¹ Another study entitled "Development of visual world model for interactive multimedia instruction on exploring the computer world," found that the interactive multimedia course was efficient with a measure of 86.92/84.42 which met the 80/80 criterion.¹²

Our interactive multimedia course was efficient since the mean score at post-learning in the test group was significantly higher than that in the control group (traditional learning materials) (*P*-value < 0.001). We postulated that the interactive course allowed learners to control their own learning process, and receive the real-time feed-back from the course. These attributes of the course could stimulate and interest the learners.

Expectedly, learning achievement in the test group was higher than that in the control group. This was consistent with certain previous studies. For example, interactive multimedia was superior to printed media in terms of learning achievement among primary and secondary school students.¹³ Furthermore, learning achievement through interactive multimedia with different narration techniques among Maejo University students was higher than other traditional learning modalities.¹⁴ Students also showed higher level of learning attitude, positive feedback, and realization of the value of the learned content.¹⁴ Another study on computer-assisted instruction as a learning resource in fixed prosthodontics among dental students found that students using the interactive multimedia course had post-learning scores higher

than those learning with traditional lecture.¹⁵ In addition, 95% of the students using the interactive course were satisfied, focused and interested more with the learning process.¹⁵

In terms of satisfaction of the elderly participants, there were highly satisfied with all three aspects of the course including content, interaction and graphic and design. Specifically for the content aspect of the course, it was found that the interactive course were rated highest for learner participation allowance, easiness to use, and difficulty level suitable for understanding. For the interactive interface, the participants reported that the course was efficient. This was consistent with a study entitled "The development of user interface interactive for perception and utilization in working age (45 - 65 year)," where they found that there was a need to improve the user interface to help access to the content to be comparable to the familiar turning pages of the book.¹⁶ In terms of design, the users in our study also wanted all components on the screen to be symbol-oriented rather than simple text-based instruction, and more explanations under the figures. For the interactive interface, the users wanted more control on the course.

In terms of graphic and design, all four aspects were rated as highly satisfied. Fonts were rated with the highest satisfaction for the adequately large fonts which were highly critical for the elderly's viewing. As suggested by a study on the elderly with diabetes, multimedia course should use fonts and pictures large enough for the elderly to clearly view the content.¹⁷ They also found that fonts should be simple and easy to read, activities should be incorporated in the course content to stimulate learning, and pictures or graphics should be used for better understanding.¹⁷

According to the interactions, all four aspects, i. e. , participation allowance for the learners, difficulty level suitable for the learners, easiness to use, and clear language, were at least in high level of satisfaction, where the participation allowance was rated as the highest satisfied aspect. We postulated that participation with the learning process was the core of learning achievement especially for the elderly who were concerned with their own dental problem, the much-needed oral health care and the related quality of life. Our concept was consistent with a study on the factors affecting quality of life of the elderly.¹⁸ They found that factors pertaining to oral health was related to the elderly's quality of life. This was because ability to chew, smile and laugh was considered crucial for their life. In addition, a study demonstrated that

learners with interactive multimedia course were significantly more involved and interested in the learning process than those with no interactive course.¹⁹

This study was of course with certain limitations. With a limited resource of computer sets, a few small groups of participants were set and therefore a longer duration of experiment was required. Since some elderly participants faced commute problems or were not available on the appointed visits, appointments could not be scheduled as planned and the alternate plan was needed. With varied levels of computer skill among the elderly, a longer time and closer help were needed to help participants get acquainted to the interactive multimedia course.

Based on the study conduct and results, recommendations are as follows. For the course application, even though the interactive multimedia course helped the elderly better learn and understand the content, those having difficulty reading still preferred listening to the narrations to reading text or seeing pictures. Regarding future development, learning style and process suitable for the elderly using interactive multimedia should be further studied. Problems and effect in real life application of interactive multimedia learning among the elderly should be investigated. A network of the elderly to share the learning should be established and tested for its efficiency. Factors affecting learning habit of the elderly should be further studied so that an interactive multimedia with better user interphase and more appropriate learning duration could be developed.

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