

ผลสัมฤทธิ์และการยอมรับของผู้เรียนในการใช้สื่อการสอนที่พัฒนาขึ้น  
เพื่อให้ความรู้เรื่องการทำนมถั่วเหลืองเสริมแคลเซียม  
Effectiveness and Acceptance of Educational Media Modules  
in Educating Learners on Calcium-Fortified-Soybean Milk  
Cooking Methods

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### บทคัดย่อ

การรับประทานแคลเซียมไม่เพียงพอในแต่ละวัน จัดเป็นปัญหาทางโภชนาการที่สำคัญอย่างหนึ่งที่มีพบได้ในหลายประเทศ ในส่วนของประเทศไทยนั้น การรับประทานนมหรือผลิตภัณฑ์จากนมที่จัดเป็นอาหารที่เป็นแหล่งสำคัญของแคลเซียมถือเป็นปัจจัยสำคัญของการรับประทานแคลเซียมได้ไม่เพียงพอ อีกทั้งภาวะดื้อต่ออนม คือการที่ร่างกายขาดเอนไซม์ในการย่อยน้ำตาลแลคโตสเป็นอีกปัจจัยหนึ่งที่ส่งผลต่อการรับประทานนมและผลิตภัณฑ์จากนมได้น้อยลง การศึกษาในครั้งนี้ จึงมีวัตถุประสงค์ในการพัฒนาสื่อการสอนในรูปแบบของวิดีโอให้ความรู้เรื่องการทำนมถั่วเหลืองสูตรเสริมแคลเซียมเพื่อนำความรู้ที่ได้ไปใช้ในการปรุงนมถั่วเหลืองสูตรดังกล่าวด้วยตนเองในระดับครัวเรือน โดยการศึกษาในครั้งนี้ได้แบ่งขั้นตอนออกเป็น 2 ขั้นตอนหลักๆ คือ ขั้นตอนการออกแบบและพัฒนาสื่อการสอนจำนวน 2 ชุด และขั้นตอนในการทดสอบผลสัมฤทธิ์ของสื่อการสอนที่พัฒนาขึ้นในการให้ความรู้แก่อาสาสมัคร ซึ่งผลสัมฤทธิ์ของสื่อการสอนทั้ง 2 ชุดนั้นได้ทดสอบในอาสาสมัครจำนวน 50 คน อาสาสมัครได้รับการมอบหมายให้ตอบแบบสอบถามทดสอบความรู้เรื่องประโยชน์โดยทั่วไปของแคลเซียม (สื่อการสอนชุดที่ 1) และแบบสอบถามความรู้เรื่องวิธีการทำนมถั่วเหลืองเสริมแคลเซียม (สื่อการสอนชุดที่ 2) โดยทดสอบคะแนนความรู้จากการตอบแบบสอบถาม 2 ชุด ดังกล่าวก่อนและหลังรับชมสื่อการสอนเพื่อเปรียบเทียบคะแนนความรู้ที่ได้รับ ผลการศึกษาพบว่า คะแนนความรู้เฉลี่ยของอาสาสมัครเรื่องประโยชน์โดยทั่วไปของแคลเซียม และเรื่องวิธีการทำนมถั่วเหลืองเสริมแคลเซียมเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติหลังการรับชมสื่อการสอนเมื่อเปรียบเทียบกับคะแนนความรู้เฉลี่ยก่อนรับชมสื่อการสอน ( $p < 0.05$ ) นอกจากนี้ อาสาสมัครยังได้รับมอบหมายให้ตอบแบบสอบถามเพื่อประเมินความพึงพอใจที่มีต่อสื่อการสอนในด้าน

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ต่างๆ ทั้ง 2 ชุด ซึ่งพบว่าคะแนนประเมินความพึงพอใจเฉลี่ยในด้านต่างๆของอาสาสมัครที่มีต่อสื่อการสอนที่พัฒนาขึ้นทั้ง 2 ชุดอยู่ในระดับที่อาสาสมัครมีความพึงพอใจและให้การยอมรับ จากผลการศึกษาดังกล่าวจึงสามารถสรุปได้ว่า สื่อการสอนเรื่องการทำนมถั่วเหลืองเสริมแคลเซียมที่พัฒนาขึ้นมีประสิทธิภาพในการให้ความรู้และได้รับการยอมรับจากอาสาสมัครที่เข้าร่วมการศึกษา

## Abstract

Inadequate calcium consumption is one of nutritional problem commonly found in several countries. In Thailand, less consumption of milk and milk products, which are the main food sources of calcium, exacerbates the problem. In addition, lactose intolerance is another physiological disorder affecting the digestion of milk and milk products in human body. This study, therefore, aimed to develop the educational media (video) to educate people on the cooking methods of calcium-fortified soybean milk so that self-cooking at home could be practised. The research comprised of 2 phases of study; the instructional media module development, and the effectiveness assessment phases. The effectiveness of the developed educational media modules were evaluated by 50 participants using self-responding questionnaires to determine their knowledge scores on general benefits of the calcium and cooking methods of calcium-fortified soybean milk before and after viewing the educational media modules. Results revealed that participants' knowledge scores on general benefits of the calcium and cooking methods of calcium -fortified soybean milk were significantly improved after viewing the educational media modules. Moreover, satisfaction on the educational media modules was determined by the self-responding questionnaires, which indicated participants' satisfaction with the developed educational media modules. In conclusion, the developed educational media modules were effective and acceptable for teaching the cooking methods of calcium-fortified soybean milk.

**Keywords :** educational media, video media, calcium fortified soybean milk, beverage

## Introduction

Calcium is an essential mineral that plays important roles in the bone formation and other physiological functionings of the cardio-vascular and nervous systems (Theobald, 2005). Long-term inadequate calcium intake can lead to further complications throughout the life time, such as osteopenia and osteoporosis which impact on quality of life and increase risk of

disability (Warensjo, et al ; 2011). Recently, high prevalences of bone diseases have been reported in both high-income and low-income countries. In the US, an estimated 56.3 million older adults were reported to be afflicted with osteoporosis and low bone mass density (Wright, et al ; 2010). In Thailand, a nationwide survey reported that in the rural areas females were at a higher risk in having bone fracture than males, with the

prevalence of 19.3% and 24.7% of the fractures occurring at the femoral neck and lumbar spine, respectively (Limpaphayom, et al, 2001; Pongchaiyakul, et al, 2002). Food consumption is one of most important factors impacting on the bone density. Unfortunately, most reports showed Thai population have inadequate nutrient consumption that does not reach the Dietary Reference Intakes (DRI), especially for calcium which is essential in bone formation and prevention of bone loss in adult life (Ivanovitch, et al, 2014). Therefore, encouraging people to consume more food sources having high calcium, such as milk and milk products should be promoted. Unfortunately, the prevalence of lactose intolerance due to the lack of lactase enzyme to digest lactose was reportedly high in Thai population (Densupsoontorn, et al, 2004).

Educating people through the use of media is an effective strategy that enable them to acquire knowledge without attendance by improving the attractiveness of the pictures and contents that are inspiring (Hobbs & Frost, 2003; Chambers et al, 2006). In recent years, several forms of educational media have been developed to instruct learners on how to acquire knowledge and improve their skills on several topics. For examples, videogames that were effective in improving the learners' language skill, basic math skill, basic reading skill, and social skill (Griffiths, 2002), and the video games that enhanced the knowledge of youngsters at the high school level on renewable

energy (Pojprabun, Boonya, & Suratrungchai, 2016). Other study indicated that the people performances were better in remembering and understanding the contents with video media than without (Brecht, 2012). For several age groups including adults, teenagers, and children, studies also showed the effectiveness of being educated on several topics and skills through the media technology (Lauricella, Gola, & Calvert, 2011 ; Onyenemezu & Olumati, 2014; Pojprabun, Boonya, & Suratrungchai, 2016. )

Dietary calcium supplement and fortification of appropriate amount into foods and beverages was shown to be an effective way to improve dietary calcium intake and increase the amount of calcium consumption (Frost et al, 2007; Lee, Moore, & Radcliffe, 2015). In addition, calcium fortification can help people with lactose intolerance and medical history of milk allergy to achieve sufficient calcium intake even while avoiding the consumption of milk and milk products (Rafferty, Watson, & Lappe, 2011). Hence, dietary fortification of calcium in beverage is one of the convenient approaches to promote the increase of calcium consumption which can be easily carried out by home cooking. This research was a quasi-study aimed to develop educational media modules to educate the methods of calcium-fortified beverage practice by determined the knowledge gained and acceptance of the media.

## Method

This study can be divided into 2 phases

Phase 1 Development of questionnaires and the educational media modules

### 1.1 Survey on the most accepted and popular beverage

The sample of fortified beverage was selected by the survey questionnaires which included the list of beverages commonly found in the community and could be easily utilized in home cooking. A total of 496 participants in Bangkok and nearby areas were asked to choose their most favorite beverage from the list in the developed survey questionnaires (Malinauskas et al, 2007), and soybean milk was a beverage most chosen by the participants.

### 1.2 Development of educational media modules

1.2.1 Script writing (storyboard) for the educational media modules

Two educational media modules developed by the Institute of Nutrition, Mahidol University (INMU) covered the following topics:

Module 1: General benefits of calcium and principles of calcium fortification (estimated viewing length 15 minutes). This module begins by introducing the importance of calcium in health (ie., bone and teeth formations and maintenances), benefits of calcium supplementary diet, and the recommended appropriate amount of calcium consumption per day. The principles of calcium fortification to the snacks and beverage were introduced

using calcium triphosphate which was approved by the Thai Food and Drug Administration (FDA) at the dose of 0.26 g per portion size (approval code number 84/2557).

Module 2: Methods of cooking calcium-fortified soybean milk (estimated viewing length 9 minutes). This module introduced the methods of cooking calcium-fortified soybean milk step by step, beginning with preparations of the ingredients (soybean, calcium triphosphate, hot water, sugar, and pandan leaf) and the practical cooking steps. All cooking equipment and materials used in the developed media modules were provided by Nutritional Laboratory of INMU.

1.2.2 Production of educational media modules

All scenarios and video recording were conducted at the INMU. The leading presenter was a female officer at the INMU who introduced and guided the viewers through both developed educational media modules. Production of sound, background music, and dubbed voice/narration were added into the educational modules by means of computer graphic packages (Window Movie Maker 2012 [Microsoft Inc. Redmond, WA] and Adobe After Effect CS6 software program [Adobe Systems Inc. San Jose, CA]) under a close supervision by a team of professional computer graphic interface at INMU.

### 1.3 Development of questionnaires

1.3.1 Knowledge questionnaires

Two sets of self-administered questionnaires were developed specifically for each of the two educational media modules

to test knowledge improvement, i.e., a pre-test (before viewing the developed educational media) and a post-test (after viewing the developed educational media). The questionnaires for module 1 comprised of 6 close-ended questions (each with 4 choices) asking on general benefits of calcium and principles of calcium supplement. For module 2, seven close-ended questions (each with 4 choices) were developed to ask for knowledge on methods of cooking calcium-fortified soybean milk. Examples of questions were “What amount of calcium triphosphate that is suggested for fortification in snack or beverage in 1 portion?”, and “How much soybean weight (in gram) should be used for boiling with 45 liters of water?” Scoring method was 1 point for the right answer and 0 point for the wrong answer.

### 1.3.2 Satisfaction questionnaires

Five-level scale questionnaires were developed to ask for participants' satisfaction on the developed educational media modules. Nine self-administered-satisfaction questions were developed to inquire about participants' satisfaction on contents, visual and audio quality, and the overall satisfaction. The scorings of the questionnaire scales were: Like very much=5 points, Like=4 points, Somewhat like= 3 points, Dislike 2 points, and Dislike very much= 1. The cutoff criteria for average satisfaction score was 4.5-5.00=Like very much, 3.5-4.49=Like, 2.50-3.49=Somewhat like, 1.5-2.49=Dislike, 1.00-1.49=Dislike very much (Magpili & Tangonan, 2008).

All developed questionnaires were reviewed, commented on, and revised by experts in nutritional education at INMU. Once completed, all edited questionnaires and study protocol were submitted to Mahidol University Institutional Review Board (MU-IRB) for review and approval. The approved questionnaires were then pretested among 12 participants, who have similar and comparable demographic background with the intervention group, for their reviews, comments and clear understanding of the developed questionnaires.

Phase 2 Assessing the effectiveness (by knowledge scores) and acceptance (by satisfaction scores) of the developed educational media modules (Intervention)

### 2.4 Sample selection

This study was conducted at Division of Nutrition, Thammasat University Hospital, Faculty of Medicine, Thammasat University (Rangsit Campus). Fifty healthy participants were recruited to participate in this study following these inclusion criteria: age 18 or above, able to read and write Thai, and having willingness to study. Study exclusion criteria include: not completing all questionnaires, participants with mental disorder, and unable to participate throughout the study period.

### 2.5 Data collection

An introductory letter was sent to the Director of Thammasat University Hospital to provide information on the study protocol, informed consents, and asking for permission to use a meeting room and projector owned by

Division of Nutrition for conducting the study after the office hours. All participants had to sign the informed consents before participating in this study. Once all the prerequisites were completed, participants were re-invited to the next week session for one day at a meeting room in Division of Nutrition to complete the baseline and knowledge questionnaires for module 1 before viewing the developed educational media modules (pre-test). Next, participants attended a fifteen minute viewing of the developed educational media module 1 on general benefits of calcium and principles of calcium fortification. After finishing the viewing, all participants were asked to complete another set of knowledge questionnaire for module 1 (post-test to compare knowledge scores before and after viewing the developed educational media modules). Furthermore, participants were asked to complete satisfaction questionnaires to determine their satisfaction on the developed educational media module 1

On the next day, participants were re-invited to the same room again to complete knowledge questionnaires on the methods of cooking calcium-fortified soybean milk. After completing the questionnaires, participants attended a nine minute viewing the developed educational media module 2 Once the viewing was finished, participants were asked to complete another set of knowledge questionnaires for module 2 (to compare knowledge scores before and after viewing the developed educational media module 2) Furthermore, participants were

asked to complete a satisfaction questionnaires to determine their satisfaction toward the developed educational media module 2.

## 2.6 Data analysis

Generations and proportions of each age group, sex, and occupation were reported as percentage. Mean ( $\pm$ SD) of knowledge and satisfaction scores were reported. Simple paired t-test was used to compared the mean scores of the knowledge scores between pre-and post-intervention Statistical analyses were performed by using the Predictive Analytics Software Statistic (PASW) version 22 (SPSS Inc, Chicago, IL). Statistical significance was established at  $p < 0.05$ .

## Results

1. The developed educational media modules

The 2 educational media modules were developed. The topic of developed educational media module 1 was about general benefits of calcium and principles of calcium fortification (estimated viewing length 15 minutes) and the topic of developed educational media module 2 was about Methods of cooking calcium-fortified soybean milk (estimated viewing length 9 minutes).

2. The effectiveness and acceptance of the developed educational media modules

### 2.1 Baseline information of participants

The participants were composed of 44 females and 6 males. Most of them (40%) were in generation X (Gen X), and eighty-two percent of participants were salary earner (Table 1).

**Table 1** Baseline data of participants

Variables	N	Percent (%)
Age		
51-60 years (Baby boomers)	11	22
39-50 years (Generation X)	20	40
18-38 years (Generation Y)	19	38
Total	50	100
Sex		
Male	6	12
Female	44	88
Total	50	100
Occupation		
Salary earner	41	82
Student	4	8
Other	5	10
Total	50	100

## 2.2 Participant knowledge before and after viewing the developed educational media modules

### 2.2.1 Knowledge improvement on module 1

Participants' knowledge on general benefits of calcium and principles of calcium fortification (module 1) was determined by completing the developed knowledge questionnaires. Results indicated that participants' knowledge scores were significantly increased after viewing the developed media module 1 on the general benefits of calcium and principles of calcium fortification (Table 2).

**Table 2** Participants' knowledge scores on the general benefits of calcium and principles of calcium fortification before and after viewing the developed educational media module 1

Knowledge level	Pre-test	Post-test	Paired t-test p-value
Mean (SD)	2.16 (1.18)	4.12 (1.39)	<0.05*

Total score=6

\*Significant difference

When focusing on age groups, the results indicated the test scores of Gen X and Gen Y were significantly improved on the general benefits of calcium and principles of calcium fortification ( $p < 0.05$ ). However, the test score of the baby boomer generation (Gen B) was not significantly improved on the general benefits of calcium and principles of calcium fortification after viewing the developed educational media module 1 (Table 3). In addition, no significant difference of the test scores was found when comparison was made between sexes on the general benefits of calcium and principles of calcium fortification (data not shown).

**Table 3** Knowledge scores focusing on age groups (module 1)

Age group	Pre-test Mean (SD)	Post-test Mean (SD)	Paired t-test p-value
51-60 years (Baby boomers)	2.45 (0.82)	3.09 (1.04)	0.11
39-50 years (Generation X)	2.30 (1.17)	3.80 (1.40)	<0.05*
18-38 years (Generation Y)	1.84 (1.34)	5.05 (0.97)	<0.05*

Total score=6

\*Significant difference

### 2.2.2 Knowledge improvement on module 2

Participants' knowledge on the methods of cooking calcium-fortified soybean milk (module 2) was determined after completing the developed knowledge questionnaires. Results indicated that participants' knowledge scores were significantly increased on the methods of cooking calcium fortified soybean milk after viewing the developed educational media module 2 (Table 4).

**Table 4** Participants' knowledge scores on methods of cooking calcium-fortified soybean milk before and after viewing the developed educational media module 2

Knowledge level	Pre-test	Post-test	Paired t-test p-value
Mean (SD)	1.86 (1.39)	4.38 (1.23)	<0.05*

Total score=7

\*Significant difference

When focusing on age groups, the results indicated all age groups' knowledge were significantly improved on the methods of cooking calcium-fortified soybean milk (Table 5). However, no significant difference was found when comparison was made between sexes on the methods of cooking calcium-fortified soybean milk (data not shown).

**Table 5** Knowledge scores focusing on age groups (module 2)

Age group	Pre-test Mean (SD)	Post-test Mean (SD)	Paired t-test p-value
51-60 years (Baby boomers)	2.18 (1.17)	3.73 (1.49)	0.02
39-50 years (Generation X)	1.60 (1.57)	4.30 (1.17)	<0.05*
18-38 years (Generation Y)	1.95 (1.31)	4.84 (0.96)	<0.05*

Total score=7

\*Significant difference

### *2.3 Participants' satisfaction toward the developed educational media modules*

For the developed educational media module 1, the lowest satisfaction score was on the size and color of fonts used in the media (3.90), while the highest satisfaction score reported was the appropriateness of pictures (4.52). The overall satisfaction score for the developed educational media module 1 was 4.12. Results indicated most aspects of the developed educational media module 1 received the satisfaction score at “Like” from participants, excepted for the appropriateness of pictures that received the satisfaction score at “Like very much” (Table 6).

**Table 6** Satisfaction assessment on the developed educational media module 1

Assessment aspects	Scale*					Mean (SD)
	5 N (%)	4 N (%)	3 N (%)	2 N (%)	1 N (%)	
1. Contents						
- Attractiveness of contents	15 (30)	26 (52)	8 (16)	1 (2)	-	4.10 (0.74)
- Easy to understand	17 (34)	24 (48)	8 (16)	1 (2)	-	4.14 (0.76)
2. Visual and audio qualities						
- Size and color of fonts used in the media	9 (18)	28 (56)	12 (24)	1 (2)	-	3.90 (0.71)
- Appropriateness of pictures	29 (58)	19 (38)	1 (2)	1 (2)	-	4.52 (0.73)
- Attractiveness of pictures	13 (26)	25 (50)	11 (22)	1 (2)	-	4.00 (0.76)
- Graphic mobilization	13 (26)	25 (50)	11 (22)	1 (2)	-	4.00 (0.76)
- Audio quality	12 (24)	25 (50)	12 (24)	-	1 (2)	3.94 (0.82)
3. Benefit of media						
- Benefits of learning from the media	18 (36)	22 (44)	9 (18)	-	1 (2)	4.12 (0.82)
4. Overall satisfaction						
- Overall satisfaction toward the developed educational media module 1	18 (36)	22 (44)	9 (18)	-	1 (2)	4.12 (0.82)

\*Scale; 5=like very much, 4=like, 3=somewhat like, 2=dislike, 1=dislike very much

For the developed educational media module 2, the lowest satisfaction score was the attractiveness of pictures and audio quality (3.96), while the highest satisfaction score reported was benefits of learning from the media (4.36). The overall satisfaction score for the developed educational media module 2 was 4.32. Results indicated all aspects of the developed educational media module 2 received the satisfaction score at “Like” from participants (Table 7).

**Table 7** Satisfaction assessment on the developed educational media module 2

Assessment aspects	Scale*					Mean (SD)
	5 N (%)	4 N (%)	3 N (%)	2 N (%)	1 N (%)	
1. Contents						
- Attractiveness of contents	20 (40)	23 (46)	7 (14)	-	-	4.26 (0.69)
- Easy to understand	15 (30)	28 (56)	7 (14)	-	-	4.16 (0.65)
2. Visual and audio quality						
- Size and color of fonts used in media	13 (26)	28 (56)	9 (18)	-	-	4.08 (0.67)
- Appropriateness of pictures	16 (32)	26 (52)	7 (14)	1 (2)	-	4.14 (0.73)
- Attractiveness of pictures	11 (22)	28 (56)	9 (18)	2 (4)	-	3.96 (0.75)
- Graphic mobilization	12 (24)	31 (62)	7 (14)	-	-	4.10 (0.61)
- Audio quality	16 (32)	27 (54)	6 (12)	1 (2)	-	4.16 (0.71)
3. Benefit of media						
- Benefits of learning from media	22 (44)	24 (48)	4 (8)	-	-	4.36 (0.63)
4. Overall satisfaction						
- Overall satisfaction toward the developed educational media module 2	21 (42)	24 (48)	5 (10)	-	-	4.32 (0.65)

\*Scale; 5=like very much, 4=like, 3=somewhat like, 2=dislike, 1=dislike very much

## Discussion

Recently, many studies tried to design and develop teaching strategies to improve knowledge, skills, and performance of learners (Kimanuwat, Suratreungchai, Bumrerraj, 2016; Meesiri & Sriwichian, 2016). The results of this study showed the effectiveness of the developed educational media modules in giving knowledge on the methods of cooking

calcium-fortified soybean milk and applying the knowledge to the cooking of a healthy beverage at a household level to increase the amount of calcium intake. The results support the findings of previous studies which showed significant improvements in the knowledge acquired by participants through the use of video media as the main and supplementary tools for instruction (Berk, 2009; Hsin & Cigas, 2013). For age groups,

participants from the Gen B showed no significant improvement on knowledge after viewing the developed educational media module 1 on the benefits of calcium and principles of calcium supplement. This result revealed that increased age may cause the decline in the ability to absorb the new knowledge from the educational media module 1 which was rather lengthy and contained a considerable amount of calculations for calcium fortification (Scullin et al, 2011; Williams & Kemper, 2010). Overall, the results support the findings of previous studies that using media as educational tools was acceptable and satisfying to participants (Donkor, 2011)

Applying the calcium fortification to local food and beverage which are already familiar to local people was the right and essential strategy to improve nutritional status and resolve nutritional problems (Amoa-Awuua et al, 2007). This study aimed to educate and encourage the application of calcium triphosphate as supplementation in the most favored local beverage which is soybean milk. However, this may not be appropriate for people with chronic renal disease who must avoid food sources having a high level phosphate (Eddington et al, 2010), in which case other forms of calcium supplements should be considered. The two other most common and well-accepted calcium

supplements are calcium carbonate and calcium citrate. Both supplements have been shown to be equally well absorbed when taken with food (Heaney et al, 2001). Moreover, previous studies pointed out that a combination of exercise and calcium intake should be promoted as the way to improve bone mass density and strength because dietary calcium intake alone may not be sufficient in lowering the risk of bone fracture (Todd & Robinson, 2013; Bolland et al, 2015). The limitation of this study was that data on the actual practising test after viewing the developed educational media modules were not collected. Hence, the effectiveness of the media in promoting the practical skill has not been elucidated.

## Conclusion

The present study revealed significant improvement on the knowledge after viewing the developed educational media modules. However, the sample sizes in this study were limited to small groups; and therefore, the results cannot be generalized to all Thai population. In conclusion, the developed animated media modules were effective and acceptable for educating people on the methods of cooking calcium-fortified soybean milk.

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