

An Edutainment Game Prototype for Sasang Constitutional Food Therapy

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Abstract

Objective : Recently many kinds of food therapies have sprung up to prevent or manage disease and to promote health. Seeing Korean history, the Korean medical doctors have been applying food therapy based on the thought that the dietary sources were as important as the medicine. Therefore, in this study, we designed a mobile edutainment game prototype with the goal of providing education about healthy food knowledge for users who belongs to different constitutional types.

Materials and Method : We adopted the Sasang Constitutional Medicine as the medical background knowledge for our edutainment game design. Based on the user study, we developed the process of edutainment system which is composed of 'My game', 'My constitution', and 'My food'. Among the whole process, we developed a prototype for the core module - the 'My game' part. This prototype used a jumping game for mobile devices that is composed of training, level 1 and level 2 stages.

Results : From the target user evaluation, it was proved that 1) in terms of the learning effect of healthy diet, the edutainment game we developed has a significant advantage over the conventional learning media, 2) after playing the edutainment game, the good and bad food identification accuracy based on picture and text format were increased by 44% and 42% respectively, and 3) target users perceived enjoyment while using this prototype, as well as showed positive intention to use this game as edutainment tool in the future.

Conclusion : We designed and developed mobile edutainment game prototype to educate healthy food knowledge based on Sasang Constitutional Medicine. Through user evaluation, we proved that our prototype enhanced healthy food knowledge and that user accepted the prototype as a beneficial edutainment tool.

Key words : Korean Medicine, Sasang Constitutional Medicine, Edutainment Game, User Study

I. Introduction

It has been revealed that there exists a link

between eating habits and chronic diseases (hypertension and hyperglycemia) or incurable diseases (cancer and diabetes)¹⁻³⁾. Recently, various kinds of food therapies - low sodium diet, low

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fat/cholesterol diet, high fiber diet in view points of western medicine and yin/yang diet, five elements diet, constitutional diet in view points of traditional medicine – have sprung up to prevent disease and to promote health⁴⁻⁶. Moreover It is part of medical treatment and is normally planned by a dietician and prescribed by a physician. For example, calorie controlled diet is applied to diabetic patients in order to control calories, carbohydrates, protein, and fat intake in balanced amounts to meet nutritional needs, control blood sugar levels, and control weight⁷.

Viewed historically, the Korean Medical (KM) doctors have been applying food therapy based on the thought that the dietary sources were as important as the medicine. Especially in the Sasang Constitutional Medicine (SCM), the food therapy gave differential treatments on the basis of four kinds of constitutional types: Taeyang, Soyang, Taeum, Soeum. According to SCM, people are different in their external appearance,

mental characteristics, disease symptoms, and life styles regarding their own constitutional types⁸).

Although, however, the information about Sasang Constitutional Food Therapy (SCFT) would be easily obtainable from internet or KM clinics, it is offered as the conventional learning methods such as expert’s advice, medical guideline, pamphlet, book, and web page. Since the SCFT information is primarily provided in a form of long list of food names which is quite boring and difficult to memorize, as shown in (Fig 1). Moreover, people may easily get confused when they trying to apply the SCFT knowledge in practice. From this point of view, a mechanism that can effectively deliver the SCFT knowledge and help people to remember them would be necessary in the modern society where health consciousness is quite high.

With the development of computing device, edutainment game has gained more attention and starts to stand at the center of the learning science. The enjoyment and readiness of using digital contents can be account for the effectiveness of edutainment game^{9,10}. At early stage, the focus of edutainment were once limited to the kids related topics. Nowadays, however, the researches from diverse backgrounds give increasingly attention to implement the edutainment concept into their own research domain. In addition, according to the advanced research, video games are efficacious to increase healthy diet knowledge and change dietary behavior¹¹).

In the Google Play Store and Apple App Store, lots of mobile applications are available for the sake of diet education. Among those applications, besides those exclusively designed for children, there are also quite a few diet education applications developed for adults. One explanation would be that compare with children, adults are more spontaneous to prevent chronic or incurable diseases and to keep healthy due to their health

음식과 생활습관	
내용에 좋은 음식	돼지고기, 생선(특리흰살생선), 새우젓, 굴, 래삼, 멧게, 조개(대합, 홍합은 제외), 전복, 팔, 녹두, 숙주, 참기름, 배추, 상추, 가지, 오이, 머위, 시금치, 더덕, 우엉, 브로콜리, 양상추, 지커리, 알로에, 결명자, 총자, 딸기, 참외, 매론, 파인애플, 토마토, 골드키위
내용에 해로운 음식	닭고기, 계란, 쇠고기, 우유(유제품), 개고기, 오리, 염소, 장어, 인삼, 홍삼, 꿀, 참깨, 아이스크림, 오렌지, 굴, 감(꽃감, 홍시), 망고, 자몽, 자두, 복숭아, 알배추, 당근, 팥잎, 고추, 우추, 파, 마늘, 가래, 술, 담배, 커피, 밀가루음식(과자, 피자, 리면, 빵), 튀김, 기름진음식
특히 주의하실 사항	밤늦게 식사하지 마십시오. 주무시기 전 3시간은 공복이셔야 합니다. 젓은 머리로 바람 쐬거나 주무시기 마십시오.
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Figure 1. The good and bad foods list for Soyang constitutional type provided by Korean medicine clinics.

consciousness.

Regarding SCFT, a typical applications is ‘Sasang Constitution and Life’, which can help users to diagnose their own the constitutional type through questionnaires, as well as provides users with textual information about the characteristics and the recommendation about good and bad foods for different constitutional types. However, this kind of application rely mainly on the wordy description to delivery SCM knowledge, which is quite boring and hard to remember¹²⁾.

Some other applications for this kind like ‘Eat Smart’¹³⁾, ‘Nutrition and Healthy Eating’¹⁴⁾ and ‘Healthy Food’¹⁵⁾ which help users to distinguish healthy food from unhealthy food and balance the nutrition for a meal. However, those games failed to provide users with tailored healthy information regarding their own physical characteristics.

Therefore, in an absence of edutainment games designed for delivering SCFT knowledge, as well as the motivation to overcome the limitations that exist in conventional healthy diet education applications. In this research, we aimed to design and develop a mobile edutainment game to help users to gain the SCFT knowledge effectively while make them enjoy the learning process, as well as to conduct the user evaluation in order to measure the actual learning effect and perceived enjoyment.

II. Materials and Methods

1. Target user group selection

As people get older, they tend to be more interest in safe and fresh food and give more consideration on balanced diet, but they become less interested in using smart phone to play games or to learn new things^{16,17)}. From this point of view, Korean adults aged between 35 to

45 with interest about healthy diet and have friendly attitude towards the KM were decided as the target user group for our game design. In order to make sure that all the participants in our study to be correctly selected from the predefined target user group, two kinds of criteria were implemented for selection process: First is that people who purchased organic foods from market or used organic food store at least once in the past two months. Second is that people who went to KM clinics or ate KM herbal medicine at least once in the past two years.

2. Target user study

In order to develop a better understanding of our target user group, a Contextual Inquiry (CI) was conducted on 9 target users whose demographic information are shown below (Table 1). Those 9 people are employed to find and extract user requirements and design implications.

Table 1. The summary of contextual inquiry

Session	Location	Users' Number	Age	Gender
1	home	3	35/43/38	M/M/F
2	office	3	45/38/42	F/M/M
3	home	3	35/39/41	M/M/M

3. System design & development

From the results of CIs, we drew some design implications for the prototype. Based on those findings, we designed the process of the edutainment system. Among the designed process of the system, we developed the key part of it as prototype using construct2 framework which is a powerful ground breaking HTML5 game creator designed specifically for 2D games¹⁸⁾. Thus the prototype edutainment game of this study can be accessible from internet browser which follows HTML5 standard.

4. User evaluation

We conducted the user evaluation on five Korean adults whose constitutional type is soyang whose demographic information are shown below (Table 2). And the constitutional type of whose is tested twice by the KM doctor and QSCC II (Questionnaire for Sasang Constitution Classification II)¹⁹⁾. The user evaluation was carried out in the order of pre-questionnaire, game playing(2 minutes for training, 4 minutes for level 1 testing, 5 minutes for level 2 testing), and post-questionnaire as shown below (Fig 2).

In order to compare learning effects between edutainment game and conventional tool, we employed another 5 subjects whose demographic information are also shown below (Table 2). Participants used the foods list as learning media which was shown in the (Fig 1) and memorized it for eleven minutes which are same time as the game playing session. Before experiments, we got user's consent, and all the information related to the subjects are anonymized as codes.

5. Data collection & analysis

In order to know the objective behaviors while playing developed prototype, we measured the

Table 2. The demographics of subjects in the user evaluation

Learning method	Users' Number	Age	Gender
Edutainment game	5	36/41/36/45/36	All male
Conventional tool	5	38/36/36/36/37	All male

number of trials, playing time, reached height of stage, the number of taken foods, success or fail of the stage in each 3 tests (Fig 2). From the collected data, we analyzed and compared the total/average number of trials, total/average playing time, highest/average height, percentage of completion, total/average number of taken foods.

In order to compare the learning effect between edutainment game and conventional tool, we measured users' ability of identifying good and bad foods in pre-questionnaire and post-questionnaire of two groups (Table 2). Each questionnaire is composed of 10 good foods, 5 bad foods, and 5 neutral food. And we analyzed the learning effect using inter group T-test on the accuracy of identifying good and bad foods in two questionnaires.

In order to know whether our target users are willing to use this prototype as an edutainment

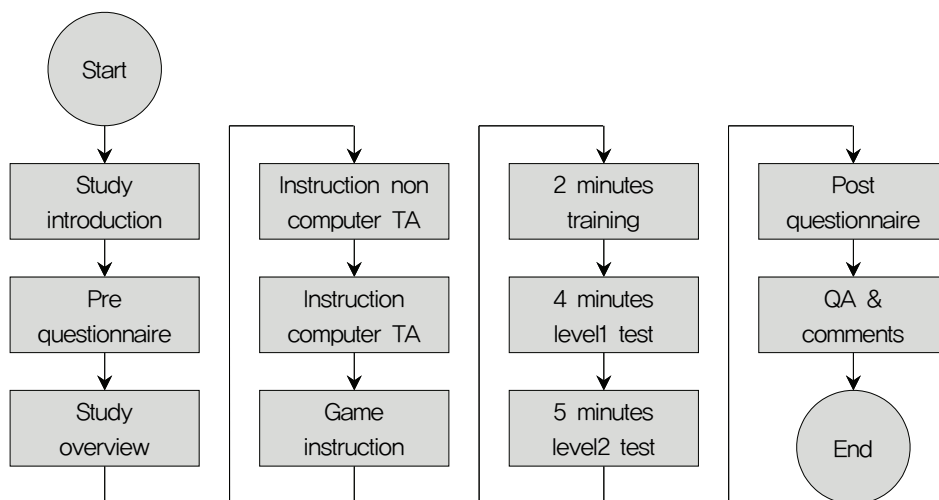


Figure 2. The process of user evaluation

system to gain healthy food knowledge in their real lives, we developed 18 questions to measure the learning effect, enjoyment, perceived ease of use, interface usability, and use intention using 7-point-likert scale questionnaire based on the Technology Acceptance Model (TAM)^{20,21}.

III. Results

1. Target user study

Through CI, we discovered that the target users 1) prefer to improve health through food therapy, 2) try to change dietary habit by eating healthy food, 3) search health information actively, 4) are bored with memorizing health information, and 5) have trouble in using collected health information in their daily life. In addition, users' favoured game features were also collected in the CI session.

From the results of CI, we drew some design implications for the prototype design, some important ones were that 1) mobile phone games would be an ideal media for the edutainment purpose, 2) each game stage should be designed that users can clear the mission within two

minutes, 3) game should have immediate feedback with reasonable metaphor, 4) game should provide different type of characters regarding constitutional types, and 5) game rules should be simple and control should be easy and intuitive.

2. System design & development

Based on the design implications, we designed the process of edutainment system - 'Healthy Food for Me' (Fig 3). In the process, 'My game' is a jumping game for users to learn good and bad foods based on their constitutional type. 'My constitution' is an e-questionnaire to help users to identify their constitutional type (Taeyang, Soyang, Taeum, Soeum). And 'My food' is a food list which contains the food information from the previous game stages. Among the whole process, we developed the core module which is marked using red-boxed (Fig 3).

In our edutainment game, three stages were developed for the soyang type only, which includes training, level 1 and level 2. We applied the 10 good foods and 5 bad foods which are studied in the advanced research²²⁾ and the game interface is depicted below (Fig 4). The mission of this game is to reach the destination by jumping

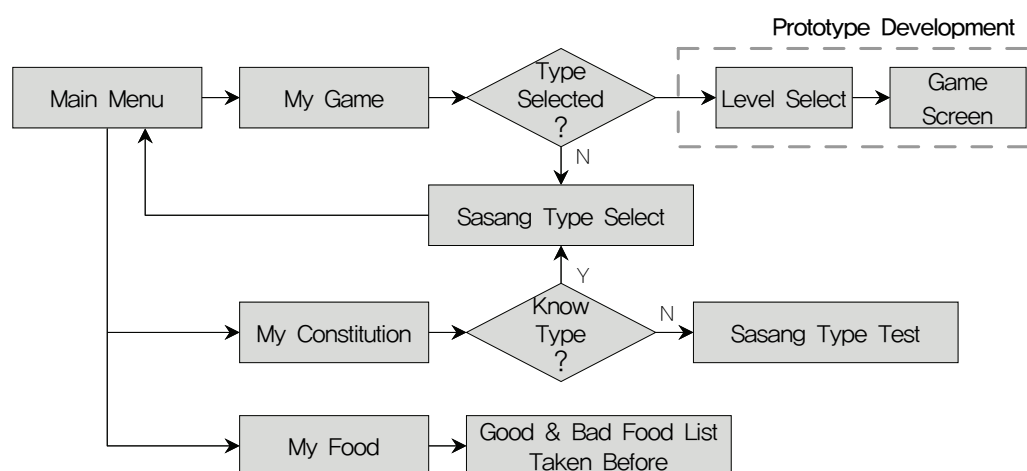


Figure 3. The process of edutainment system, which is composed of 'My game', 'My constitution', and 'My food'.



Figure 4. The screen capture of main game interface and level 2 game interface of 'Healthy Food for Me'.

before exhausted the limited health score. The rule of the game is very simple – if a user eats good food, user can jump higher and gain health points, on the contrary, if user eat bad food, user cannot jump and also lose health points.

3. User evaluation

In level 1 testing, the average mission completion percentage is 39.6% and average playing time per try is 27.06s. But in level 2 testing, average percentage of mission completion is 27.6% and average playing time per try is 24.70s. This result suggested that the level 2 is more difficult than level 1.

In order to measure the learning effect of our prototype, we measured users' ability of identifying good and bad foods in pre-questionnaire and post-questionnaire. the good and bad food identification accuracy based on picture was increased by 44%, and the accuracy based on the text was increased by 42% (Fig 5).

In order to compare the learning effect between edutainment game and conventional tool, we measured users' ability of identifying good and bad foods. From the results, it was found that the good and bad food identification accuracy based on the conventional learning tool was increased by 35%, while identification accuracy based on the edutainment tool was increased by 44% (Fig 6). In addition, in the T-test with 95% confidence interval, we found that there is no significant difference between the pre-questionnaire scores of two groups ($\mu_{\text{control}}=0.42$, $\mu_{\text{treatment}}=0.51$, $p\text{-value}=0.329$), which suggests that the control and treatment group have same previous knowledge about SCFT. However, the results showed that there is a significant difference on learning effect between the conventional learning tool and the edutainment tool ($\mu_{\text{control}}=0.71$, $\mu_{\text{treatment}}=0.94$, $p\text{-value}=0.016$). The edutainment game we developed has a significant advantage over the conventional learning method in terms of learning effect.

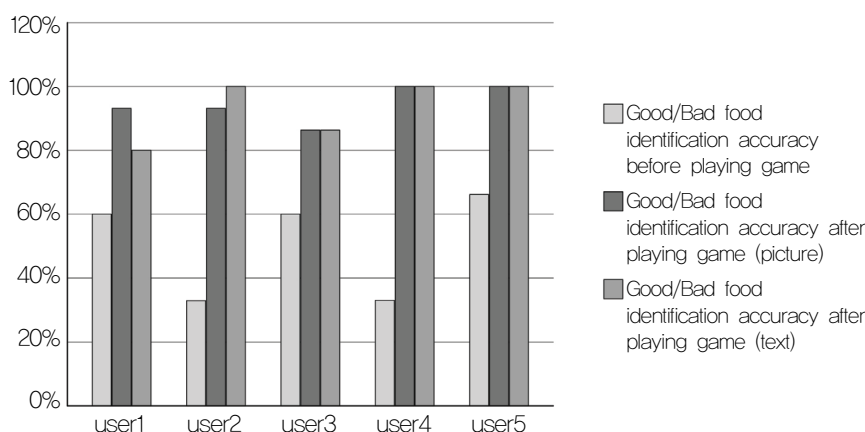


Figure 5. The identification accuracy of good and bad foods.

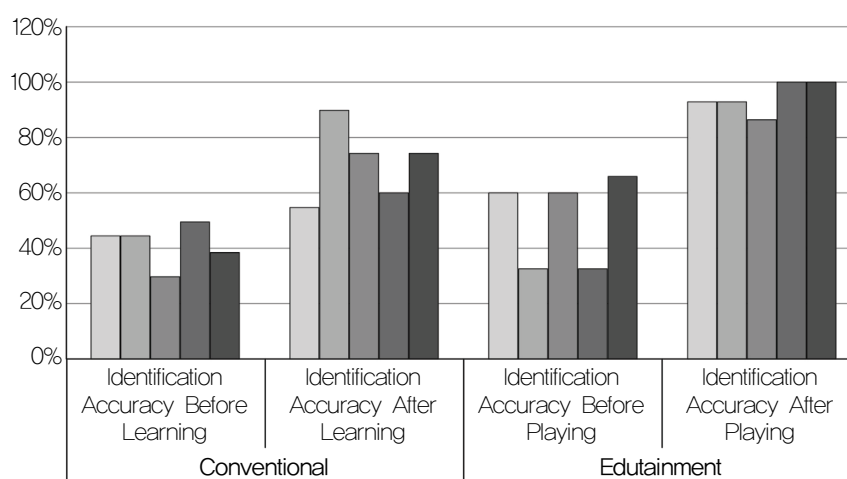


Figure 6 The identification accuracy comparison of conventional learning tool and edutainment tool.

IV. Discussion

From the analysis of questionnaire based on the TAM^{19,20}, it was found that users perceived positive learning effect and entertaining effect through this prototype (Fig 7). However, the score for interface usability is a little below average, which suggest that we should improve the game character control part and make the interface more friendly to use. Nevertheless, the targets users showed a positive acceptance of using this edutainment game as an edutainment tool in the future.

In order to explore the reasons why people give high or low score for each specific measure item, we recorded the good and bad incidents

while users were training or testing our prototype using think-aloud protocol. The most frequent bad incident was 'expressing negative effect or saying a problem'. But the most frequent good incident was 'expressing happy surprise'. Also, based on good and bad incidents, we drew some design implications to improve our prototype in the future. The main implications were 1) developing more game stages, and reduce the distance to destination for each stage, 2) reducing the food variety and stretching the platform in each stage, and 3) reducing the difficulty for the practice stage to let users to develop their own skill and know how to control the movement of character.

Admittedly, there are some limitations in our

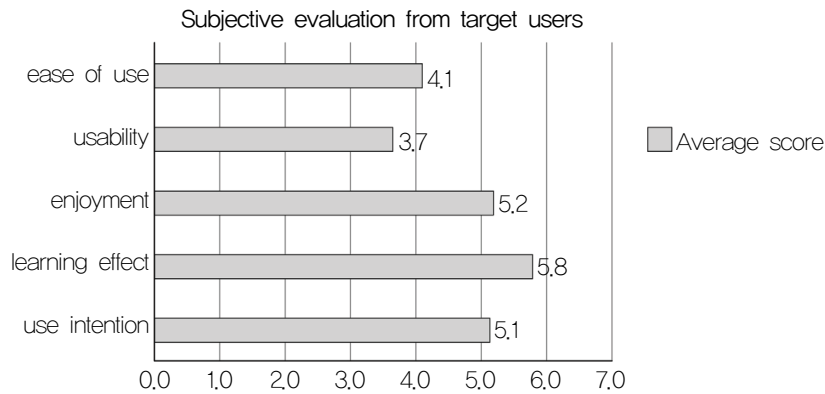


Figure 7. The analysis results of user evaluation – ease of use, interface usability, enjoyment, learning effect, and use intention.

research. First, we only developed the Soyang constitutional type for this prototype. Second, some functions in the whole process were not fully implement yet. Third, we employed small subjects to evaluate the prototype. In the future, we are going to fully implement all the design process for the ‘Healthy Food for Me’, as well as implement the implications extracted from user evaluation. Hopefully, this kind of edutainment tool will be very beneficial to the users who want to learn healthy diet knowledge with less effort and more fun.

V. Conclusion

In this study, we are motivated to develop the ‘Healthy Food for Me’– a kind of edutainment tool that can help users to gain healthy diet knowledge regarding their own constitutional type based on SCM Theory. From a user-centered perspective, the edutainment prototype successfully achieved our design purpose to help users to identify good and bad foods for their own constitutional type, as well as increase their awareness of diet habits while make them enjoy the learning process. Also, since it is a mobile phone application, users can use it in any environment during their leisure time to relax and

learn knowledge simultaneously. Our contributions are as follows: 1) Users significantly improved their capacity of identifying good and bad foods– from 50.7% to 94.7% after playing this edutainment game. 2) Users perceived enjoyment while playing this game. 3) target users showed a positive intention to use this edutainment game in future.

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