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Development of an E-learning Resource on Mobile Devices for Kinesiology: A Pilot Study

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Abstract. [Purpose] Although the potential use of mobile devices as new e-learning tools has been reported in various educational fields, there are not enough e-learning resources for mobile devices in physical or occupational therapy education. This article describes the results of development and students' use of a resource for physical and occupational therapy education. [Methods] We developed an e-learning resource for mobile devices as part of a kinesiology course. It was designed to help students acquire knowledge of the musculoskeletal system. The e-learning resource was provided to second-year physical and occupational therapy undergraduate students (n = 41) for 6 weeks of a 15-week course in kinesiology. After 6 weeks, the situation of use, students' levels of satisfaction, and comments were surveyed by questionnaire. [Results] The e-learning resource was text-based, and had many quizzes and tests. Approximately 70% of the students who had mobile devices used the resource on these devices at least once. Of these students, more than 80% were satisfied with it. The students used the resource on mobile devices at various locations. [Conclusion] Our e-learning resource for mobile devices could be used as a support tool to provide knowledge about the musculoskeletal system.
Key words: E-learning, Mobile learning, Education

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INTRODUCTION

In the educational curricula of healthcare professions including medicine and the allied health sciences, the amount of essential knowledge and skills has increased with the progress of medical science. As a result, there is more material for students to learn and less time to teach all of the essential material. Therefore, students have to spend more time outside the classroom engaged in independent learning to acquire essential knowledge and skills. Teachers and students are looking for ways to improve independent learning.

With advances in information and communication technologies, the use of such technologies has expanded in a broad variety of educational settings. This is especially true of e-learning. E-learning, also known as "web-based learning", "online learning", or "computer-assisted instruction", is defined as learning mediated by electronic means, such as the internet, intranets, or other multimedia materials[1)]. Internet technologies can provide information to many users simultaneously, anytime and anywhere[2)]. Hence, it is generally recognized that e-learning has the advantages of accessibility and flexibility. These advantages suggest that e-learning would be suitable for self-study because learners can independently control learning sequences, time, pace, and location of study.

In the past several years, with advances in the mobile and wireless technologies, the potential use of mobile devices (e.g., cell phones, laptop computers, hand-held devices) as new e-learning tools has been explored[3–5)]. Recently, mobile devices have become smaller and more portable. They have improved battery life, sufficient capacity to store information, and wireless web access[3,4)]. Compared with traditional personal computers, the characteristics of mobile devices allow users to access information conveniently and without the constraints of time and place[6)]. In this paper, we consider how mobile devices can enhance opportunities for self-learning, especially from the standpoint of convenient access to information.

Although the use of e-learning on mobile devices in medical education has been reported in previous studies, few studies have reported on physical and occupational therapy educations. Lindquqist et al.[4)] pointed out that further research is needed to present evidence of the benefits of e-learning on mobile devices in professional healthcare education, especially in fields such as nursing, and physical and occupational therapy. Because there are not enough e-learning resources for mobile devices in physical or occupational therapy education, development of the resources is essential to show the benefits of e-learning

Table 1. Students' characteristics (n=41)

	Yes Number (%)	No Number (%)
Have a desktop or laptop computer at home	40 (97.6)	1(2.4)
Have an iPhone or iPod touch	26 (63.4)	15 (36.6)
Have internet access from home	39 (95.1)	2 (4.9)
Have experience with e-learning	7 (17.1)	34 (82.9)
Have experience with e-learning on mobile devices	0 (0)	41 (100)

using mobile devices.

Physical and occupational therapists assess and treat patients with various movement disorders. To assess and treat movement disorders, therapists are required to have multidisciplinary knowledge of human movement. Universities, therefore, offer courses such as kinesiology as prerequisites for advancement into professional physical and occupational therapy programs. Kinesiology courses are designed to help students understand the comprehensive aspects of human movement, for example the structure and function of the musculoskeletal system. In kinesiology, students must acquire a great amount of information about the musculoskeletal system including each muscle's name, origin, insertion, innervation, and action. However, since there is not enough time to facilitate acquisition in the classroom, students have to use time outside school hours to acquire this knowledge. We expect that e-learning using mobile devices will become an auxilliary tool for the acquisition of this type knowledge, because it enhances opportunities for self-learning. Thus, we developed an e-learning resource for mobile devices to help physical and occupational therapy undergraduate students acquire knowledge on the musculoskeletal system in kinesiology. In addition, as a pilot study, we provided the e-learning resource to the students in the kinesiology course to explore whether the e-learning resource we had developed was useful. This paper describes the results of the development and the students' use of the e-learning resource on mobile devices.

SUBJECTS AND METHOD

The e-learning system developed for this study used a server/client based system. The server was an Xserver (Apple Inc. Cupertino, CA), and we used Handbook studio (Infoteria Co. Tokyo, Japan)—a web application—as the learning management system for creating, storing, managing, and delivering the e-learning materials. The software also allowed us to register students' information and to track and log their learning processes, such as length and frequency of use. For the client-based system, we chose to build the resource for use on the iPhone or iPod touch (Apple Inc. Cupertino, CA). We chose these mobile devices because they are portable, have a sufficient display size, and are easy to use, and the students could access the resource through a wireless internet connection and download materials to the devices for offline use. However, we also built a version for desktop and laptop computers so that students who did not own the mobile devices could use the resource. Handbook (Infoteria Co. Tokyo, Japan) was used to deliver the resource to the iPhone or iPod touch users, and the users of traditional computers could view the resource online using a web browser.

The e-learning resource was provided to all 41 second-year students of undergraduate programs of physical and occupational therapy during a kinesiology course in 2010 at Sapporo Medical University.The student characteristics are shown in Table 1. All except one of the students had a desktop or laptop computer: 39 were able to use the internet at home, and 26 students also had an iPhone or iPod touch. Furthermore, there were computer labs available for 24-hour use, and a wireless network enabled access anywhere on campus. None of the students had learned using mobile devices before, although seven had experienced e-learning.

The students were able to use the e-learning resource for 6 weeks of the 15-week course. At the start of the study, we distributed a user manual to the students. The use of the resource was not mandatory. However, all students were required to take an achievement examination at the end of the 6 weeks to measure their understanding of the knowledge of each muscle's name, origin, insertion, innervation, and action, regardless of use of the resource, because the examination scores are used to determine final course grades.

After 6 weeks, 41 students were asked to fill out a questionnaire surveying usage and satisfaction ratings, and inviting comments on the e-learning resource. The items on usage were the frequency of use, the devices used, the locations where it was used, and if it was used with other resources or not. The students' levels of satisfaction with the e-learning resource were rated on a 4-point scale (very helpful, helpful, a little helpful and not helpful). The students were also asked to comment on what features of the e-learning resource were good, and what ideas they had on improving the resource.All students provided their informed consent before filling out the questionnaire.

Although all of the students completed the questionnaire, we only analyzed the answers of the 26 students who had either an iPhone or iPod touch because this study was focused on e-learning as a resource for those devices.

RESULTS

The e-learning resource we developed was text-based, and was designed to help the students learn each muscle's name, origin, insertion, innervation, and action. Screen

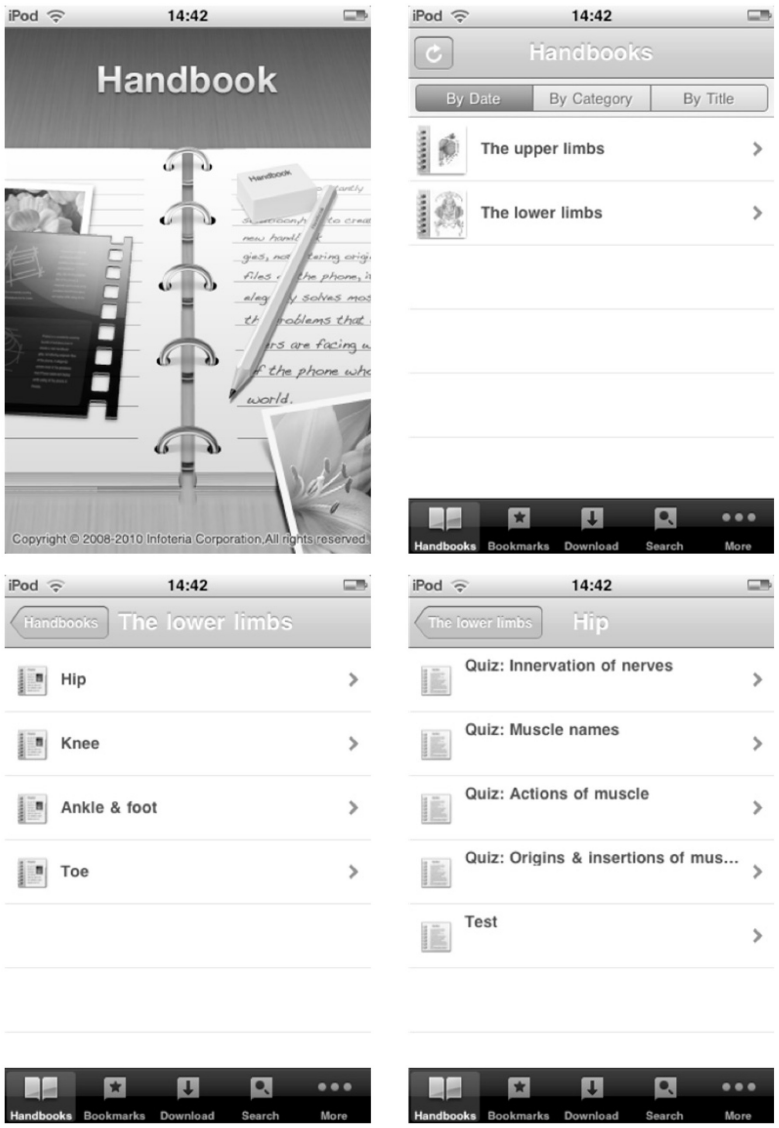

Fig. 1. Screen captures of the e-learning resource using the Handbook application on an iPod touch. Upper left: Starting menu. Upper right: Menu for selecting parts of the body, listing upper and lower limbs. Lower left: Menu for selecting the joints. Lower right: Menu for selecting quizzes and tests.
*All screen captures presented in Figure.1 have been translated into English. They were originally written in Japanese.

captures of the e-learning resource are shown in Figure. 1. After starting the Handbook application, parts of the body including upper and lower limbs are listed, and are clickable so that areas can be selected for study in more detail. For example, users can select a limb, then the joint, followed by the muscle's names, origins and insertions, innervation of nerves, and actions, one after the other. The resource has many quizzes and tests. In the quizzes, users can check help pages for information to help them answer the questions (Fig. 2). When the users try the quizzes again, the order of the questions is randomized. In the tests, users have to solve 25 questions without the assistance of the help pages. After solving 25 questions, the results are displayed on the screen and sent to the registered user's e-mail address.

Among the 26 students who had either an iPhone or iPod touch, 20 used the e-learning resource at least once during the 6 weeks. Of the 20 students who used the e-learning resource, most of them (18 of 20) chose to use the e-learning resource on the iPhone or iPod touch. The other 2 students used the e-learning resource on a desktop or laptop computer.The 6 students who never used the e-learning resource reported that they did not use it because they believed it was difficult to use.

Table 2 shows the results obtained from the 18 students who used the iPhone or iPod touch. Of the 18 students, 15 answered that they had used the e-learning resource "very

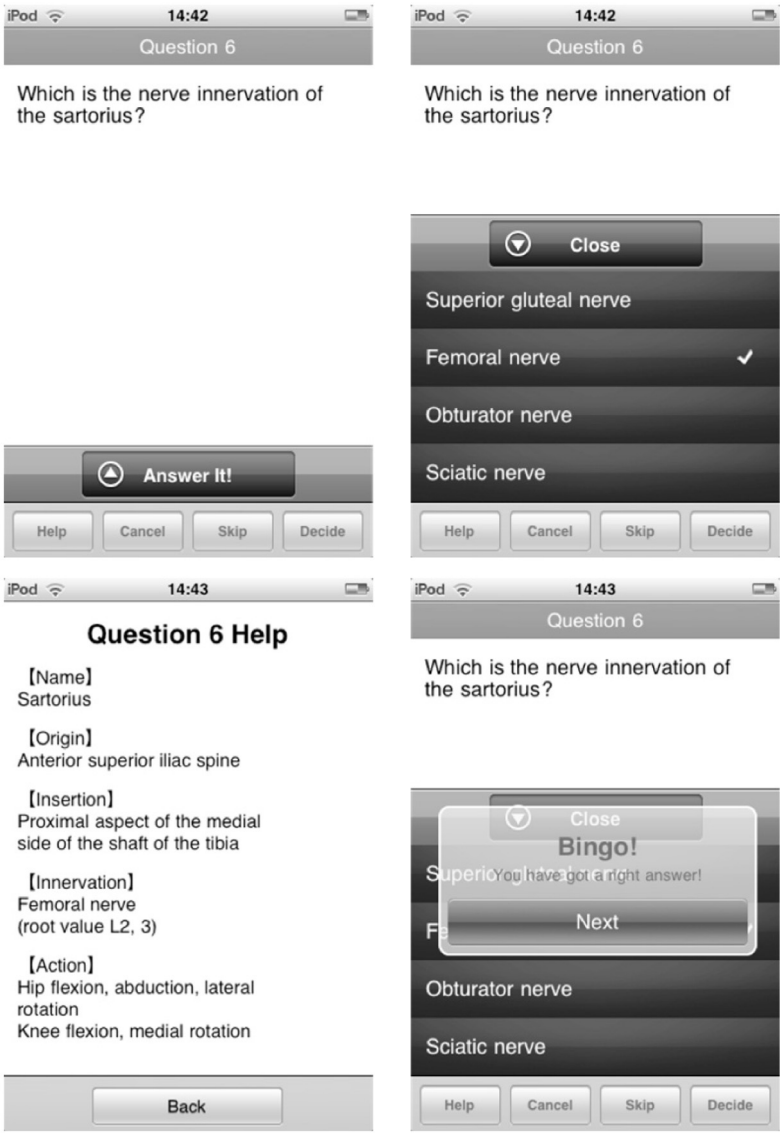

Fig. 2. Screen captures of quiz and help pages. Upper left: Example of a quiz about nerve innervation of the sartorius muscle. Upper right: Screen where answers are chosen. Lower left: Help page screen for the sartorius muscle. Lower right: Screen of the answer results.
*All screen captures presented in Figure. 2 have been translated into English. They were originally written in Japanese.

often" or "often". As for the locations where the e-learning resource was used, the students used the e-learning resource at various locations. At home (16 of 18) was the most common place, followed by on public transportation (10 of 18), places other than the computer labs on campus (10 of 18), and in the computer labs on campus (5 of 18). Among the 18 students who used the iPhone or iPod touch, 13 used the resource at more than one location. According to the responses collected, 17 reported that they used the resource with traditional learning resources. There was just one student who learned only through the e-learning resource. Most students (16 of 18) reported that the resource was "very helpful" or "helpful".

In regard to the students' comments, the quiz was rated as the best features of the developed e-learning resource. Some students said, "The quiz helped me learn a lot". Others said, "By answering the quizzes, I could check how much I had learnt". The mobile aspect of the device was also well received: "It was easy to access, and I could access it at any time and anywhere". Other comments concerning the good features of the resource were as follows: "When I could not answer a question by myself, the help page gave me enough information to answer the current question", and "Because I could study the same questions over and over, it helped a lot". As for the ideas for improving the resource, some students commented, "I wanted a better manual, more

Table 2. Results of the questionnaire obtained from the 18 students who used the iPhone or iPod touch

	Number (%)
1. How often did you use the e-learning resource?	
Very often	3 (16.7)
Often	12 (66.7)
Not often	3 (16.7)
2. Where did you use the e-learning resource? [a]	
At home	16 (88.9)
In the computer labs on campus	5 (27.8)
Places besides the computer labs on campus	10 (55.6)
On public transportation	10 (55.6)
Other	0 (0)
3. Did you use the e-learning resource with other learning resources?	
Yes	17 (94.4)
No	1 (5.6)
4. Satisfaction with the e-learning resource	
It was very helpful	3 (16.7)
It was helpful	13 (72.2)
It was a little helpful	2 (11.1)
It was not helpful	0 (0)

[a] The students could choose more than one option.

detailed instructions and guidance, or an easier to use application". Furthermore, one student commented, "Anatomical images were needed in the help pages".

DISCUSSION

In the present study, approximately 70% of the students who owned an iPhone or iPod touch used our e-learning resource on these devices at least once. In addition, more than 80% of those students answered that the resource helped them acquire knowledge of the musculoskeletal system. The findings imply that the majority of the students perceived our e-learning resource for mobile devices positively. On the other hand, 6 students never used the e-learning resource during the 6 weeks. The common reason they gave for not using the resource was that they believed it was difficult to use. All students were beginners at e-learning on mobile devices. According to previous studies[4,6–10], it has been reported that there are barriers to e-learning on mobile devices for beginners: e.g. lack of time to learn how to use the resource, difficulties installing software applications and lack of knowledge about handling mobile devices. The need for sufficient guidance, training, and support to overcome such barriers has also been indicated[4,9,10]. However, we neither guided the students on how to use the e-learning resource or on how to operate the device, nor were they given time to familiarize themselves with the e-learning resource before the study began. Therefore, the students might have judged the resources' usability only from the insufficient guidance given, before they had any experience with the resource. In fact, in the responses collected, there were student comments suggesting more detailed guidance be given. To help more students use the e-learning resource, sufficient training of students is needed.

Although there was just one student who learned using only the e-learning resource, most of the students did not learn using the resource exclusively, because of the type of e-learning materials available with the resource, which consisted of many quizzes and tests. Although there were help pages for the students to learn information they could not answer in the quizzes, this meant that they had to check the help pages while solving the quizzes. Because of this slightly complicated procedure, the e-learning resource might not be suitable for the early stages of learning. However, because of its repetitive nature, namely repeating the quizzes, the e-learning resource could be useful for retaining information in memory for longer periods of time. It seems that in the present study, the students who used the e-learning resource retained the acquired knowledge by using other resources as well.

As mentioned above, repetitive study is required to retain knowledge. To achieve this, it is important to have enough time for studying. Because mobile devices have the advantages of accessibility and flexibility, the users can access information conveniently without the constraints of time and place. Therefore, we expected that the students who used the iPhone or iPod touch for e-learning would be easily able to secure time for studying. The survey showed that many of the students who used the iPhone or iPod touch for e-learning used the resource at their homes and other locations. Moreover, the students noted that they could learn without the constraint of time and place on their comments.Although we did not measure the length and frequency of use of the e-learning resource, the results suggest that our e-learning resource would likely enhance self-learning for students with mobile devices.

Learning outcomes of e-learning is an important issue for teachers. There are several studies that have evaluated the learning outcomes of e-learning[11–14]. The majority of these studies report that the use of e-learning resources resulted in knowledge gains. However, when learning outcomes were

compared between e-learning and other educational methods, the results are often conflicting and inconclusive. For example, Mehta et al.[14] investigated the results of web-based education, and found that there was no statistically significant difference in test performance between web-based and traditional education. Bell et al.[11] also reported that the knowledge gains achieved by self-study via web- or print-based materials were similar. In contrast, Lipman et al.[13] demonstrated that internet-based instruction significantly improved medical students' understanding of ethical analysis compared with traditional classroom instruction. In addition, it also remains unclear whether the use of mobile devices for e-learning can produce greater knowledge gains than other educational methods.Although an achievement examination was carried out to measure the students' understanding levels at the end of the e-learning in the current study, we could not use the results to draw conclusions about the e-learning method due to the very limited sample.

There were several limitations of this study. First, this pilot study was not designed to collect strong evidence for the effectiveness of e-learning resources for mobile devices. For that purpose, a randomized, controlled trial with a large number of subjects should be conducted. Second, because students' responses were survey-based, there is the potential for inaccuracy in the responses. Analyzing log data of the students' learning processes is needed. Finally, because some students did not have mobile devices they may have been biased against using the e-learning resource.

In conclusion, we developed an e-learning resource for mobile devices for use in physical or occupational therapy education. It was designed to assist in the acquisition of knowledge on the musculoskeletal system in kinesiology. The results suggest that our e-learning resource for mobile devices could be used as a supporting tool for the acquisition of knowledge about the musculoskeletal system. Because of the limited number of well-designed studies on the effectiveness of e-learning on mobile devices, more studies should be conducted.

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