Journal of Evaluation in Clinical Practice
International Journal of Public Health Policy and Health Services Research

Journal of Evaluation in Clinical Practice ISSN 1365-2753

A novel Internet-based blended learning programme providing core competency in clinical research

Yukio Tsugihashi MD MPH,[1] Naoki Kakudate DDS PhD MPH,[2] Yoko Yokoyama MPH PhD,[5,6] Yosuke Yamamoto MD PhD,[2] Hiroki Mishina MD MPH,[1] Norio Fukumori MD,[3] Fumiaki Nakamura MD,[3] Misa Takegami RN MPH PhD,[6] Shinya Ohno MPH,[7] Takafumi Wakita MA,[8] Kazuhiro Watanabe PhD,[9] Takuhiro Yamaguchi PhD[10] and Shunichi Fukuhara MD DMSc FACP[4]

[1]Researcher, [2]Senior Lecturer, [3]Postgraduate, [4]Professor, Department of Healthcare Epidemiology, Graduate School of Medicine and Public Health, Kyoto University, Kyoto, Japan
[5]Research Fellow, the Japan Society for the Promotion of Science, [6]Research Fellow, Department of Preventive Medicine and Epidemiology, National Cerebral and Cardiovascular Center, Osaka, Japan
[7]Postgraduate, Department of Pharmacoepidemiology, Graduate School of Medicine and Public Health, Kyoto University, Kyoto, Japan
[8]Associate Professor, Faculty of Sociology, Kansai University, Osaka, Japan
[9]Associate Professor, Showa Pharmaceutical University Education Center for Clinical Pharmacy Practice, Tokyo, Japan
[10]Professor, Division of Biostatistics, Tohoku University Graduate School of Medicine, Miyagi, Japan

Keywords
blended learning, clinical research, education, evidence-based medicine, health care professionals, Internet-based programme

Correspondence
Professor Shunichi Fukuhara
Kyoto University Graduate School of Medicine and Public Health
Department of Healthcare Epidemiology
Yoshida Konoe-cho, Sakyo-ku
Kyoto 606 8501
Japan
E-mail: fukuhara.shunichi.6m@kyoto-u.ac.jp

Accepted for publication: 29 September 2011

doi:10.1111/j.1365-2753.2011.01808.x

Abstract

Rationale, aims and objectives We developed a novel Internet-based blended learning programme that allows busy health care professionals to attain core competency in clinical research. This study details the educational strategies and learning outcomes of the programme.

Method This study was conducted at Kyoto University and seven satellite campuses from September 2009 to March 2010. A total of 176 health care professionals who had never attempted to attain core competency in clinical research were enrolled. The participants were supplied with a novel programme comprising the following four strategies: online live lectures at seven satellite campuses, short examinations after each lecture, an Internet-based feedback system and an end-of-course examination. We assessed the proportion of attendance at the lectures as the main outcome. In addition, we evaluated interaction via the feedback system and scores for end-of-course examination.

Results Of the 176 participants, 134 (76%) reported working more than 40 hours per week. The mean proportion of attendance over all 23 lectures was 82%. A total of 156 (89%) participants attended more than 60% of all lectures and were eligible for the end-of-course examination. A total of the participants accessed the feedback system 3564 times and asked 284 questions. No statistically significant differences were noted in the end-of-course scores among medical doctors, pharmacists, registered nurses and other occupations.

Conclusions We developed an Internet-based blended learning programme providing core competency in clinical research. Most busy health care professionals completed the programme successfully. In addition, the participants could attain the core competency effectively, regardless of their occupation.

Introduction

The concept of evidence-based medicine is widely accepted in medical practice [1–3], and health care professionals must respond to clinical questions in such situations on a daily basis [2,4]. Health care professionals must therefore be capable of evaluating and using clinical evidence appropriately and independently [1–3]. In Japan, however, few health care professionals are equipped to deal with such situations [4,5].

Previous research indicated that Japanese clinicians and hospital managers were interested in learning and conducting clinical research [6,7]. To respond to such interests, several graduate schools in Japan, such as the School of Public Health in Kyoto University and The University of Tokyo, have started to provide

educational courses related to clinical research [5]. However, health care professionals with busy practices often face problems with programme accessibility. A new educational system is therefore needed, designed for busy health care professionals interested in attaining core competency in clinical research while working full-time.

Internet-based learning has been applied in medical education [8–12], offering great advantages in saving both time and costs compared to classes that require commuting to a particular school [8,9]. In addition, several studies have reported that Internet-based learning is as effective in educating participants as traditional live lectures [10,12–15]. However, both learners and instructors had difficulty maintaining their sense of commitment to Internet-based learning due to a lack of interactivity and personal contact [16]. As a result, Internet-based learning courses are likely to have a higher dropout rate than live courses [17]. According to McLaren [18], persistence, as measured by completion percentage, was significantly higher for live courses (127/139, 91%) than Internet-based learning courses (81/152, 53%) in the case of an undergraduate business statistics programme. Additional studies regarding medical education reported that Internet-based courses for more than 4 weeks with voluntary participation were less sustainable (62–74%) [19–21]. To improve upon the shortcomings of Internet-based learning, a blended programme mixing live lectures with Internet-based learning appears most preferable [16,22,23]. However, to date, a well-designed Internet-based approach to learning clinical research has not been evaluated.

We developed a novel Internet-based blended learning programme with online live lectures at satellite campuses so that busy health care professionals could achieve core competency in clinical research. The purpose of this study was to report on the educational strategies and learning outcomes of this programme.

Methods

This study was conducted from September 2009 to March 2010. All participants were supplied with a novel Internet-based blended learning programme that provided core competency in clinical research. Cornerstones of the programme are provided in Table 1. This study was approved by the institutional review board of Kyoto University, Japan, and all participants provided written consent.

Participants

This study enrolled 176 health care professionals working in clinical settings who had never attempted to attain core competency in clinical research. All participants submitted written permission from their superiors allowing them to participate in the study. Open recruitment was performed through a web site.

Setting

This study was conducted at one main campus (Kyoto University) and seven satellite campuses in Japan. The satellite campuses were located in Hokkaido (two sites), Fukushima, Tokyo, Mie, Hiroshima and Ehime Prefectures (one site each). Six campuses were university related and the other two sites were private medical facilities.

Table 1 Cornerstones of a novel Internet-based blended learning programme providing core competency in clinical research

Cornerstones	
Participants	Health care professionals in clinical settings
Setting	
Main campus (1)	Kyoto University (Kyoto)
Satellite campuses (7)	Hokkaido University (Hokkaido) Hokkaido Center for Family Medicine (Hokkaido) Fukushima Medical University (Fukushima) Tokyo office of Kyoto University (Tokyo) Mie University (Mie) Hiroshima University (Hiroshima) Sato cardiovascular clinic (Ehime)
Educational strategies	Online live lectures (one lecture: 60 minutes, total 23 lectures) Short examination after each lecture Internet-based feedback system End-of-course examination
Duration	7 months
Frequency	One Saturday afternoon per month
Outcome measures	Lecture attendance Interaction via the feedback system (the number of access, questions) Scores for end-of-course examination
Participation fee	None

Internet-based blended learning method

We developed a novel Internet-based blended learning programme to provide core competency in clinical research. The following four educational strategies were adopted with the intent that busy health care professionals would continue to learn and successfully complete the programme:

1 Online live lectures at satellite campuses: an Internet-based video conference system (®Powerlive, Logosware Co. Ltd, Tokyo, Japan) was adopted to deliver lectures using ®PowerPoint presentations (Microsoft Corporation, Redmond, WA, USA) with narration by the teacher from the main campus to the seven satellite campuses. Participants attended lectures at the campus nearest their home. A total of 23 lectures were held, with 12 devoted to designing research and 11 to statistical analysis. The lecture titles are provided in Table 2. Each lecture lasted 60 minutes and was provided in two to four sections one Saturday afternoon per month for a total of 23 hours over 7 months.

2 A short examination after each lecture: a computer-scored short examination with five multiple-choice questions was conducted to evaluate the participants' comprehension of each lecture. Lecture attendance was admitted when a score for the short examination was more than 60%.

3 Internet-based feedback system: access to personalized web sites was provided for all participants as Internet-based feedback systems. Preview materials for the lectures and results of the short examinations were individually delivered to the participants via the personalized web sites. The participants were able to ask questions on the lectures through the web site. In addition, instructors responded to the questions using this system.

Table 2 Lecture titles for online live lectures (23 total)

Designing research (d)	Statistical analysis (s)
d-1. What is clinical research?	s-1. Discussion between a clinician and a statistician
d-2. Structure a research question from your clinical question	s-2. Sample size calculation
d-3. Making a conceptual model	s-3. Adjustment for confounding factors
d-4. Confounders	s-4. Reliability and validity of outcome measures
d-5. Overall image of research design	s-5. Introduction to statistical inference
d-6. Methodology in clinical research	s-6. Ways to summarize data
d-7. Cohort study	s-7. Correlation and regression
d-8. Case control study	s-8. Introduction to stratified analysis
d-9. Outcome measure 1	s-9. Analysis of randomized controlled trial
d-10. Outcome measure 2	s-10. Introduction to regression models
d-11. Randomized controlled trial	s-11. Analysis of research to evaluate a diagnostic process
d-12. Research design in evaluation of diagnostic process	

4 End-of-course examination: participants who attended at least 60% of all lectures were eligible to take the end-of-course examination. This computer-scored examination comprised 50 multiple-choice questions scored on a 100-point scale. Five clinical researchers, six graduate students majoring in clinical epidemiology and one social psychologist prepared the examination. The questions were based on information from textbooks in clinical research [24].

Baseline measures

Baseline characteristics of this study were compiled using self-report questionnaires. In addition to demographic data including gender, age, occupation and working institution, total weekly working hours were also evaluated.

Outcome measures

As a main outcome measure, the proportion of attendance at each lecture was calculated to assess the programme sustainability/persistence of programme participants. Each lecture attendance was admitted when a score for the short examination was more than 60%. Besides, the proportion of participants who attended at least 60% of all lectures and were therefore eligible for the end-of-course examination was calculated. In addition, the number of participants' access to the Internet-based feedback system was measured in order to evaluate interactivity between participants and instructors. The number of questions on the lectures via the system was also counted. Furthermore, total scores from the examination were compared among medical doctors, pharmacists, registered nurses and other occupations.

Statistical analysis

The difference in mean scores of the end-of-course examination among the four different occupations was compared using one-way analysis of variance. Statistical significance level was set at 5%. All analyses were performed using STATA, version 10.1 (StataCorp LP, College Station, TX, USA).

Table 3 Participant characteristics

Characteristic	Percent (%)	*n* (of 176)
Gender		
Male	54	95
Age (years)		
<24	5	8
25–29	24	43
30–34	27	47
35–39	19	34
>40	25	44
Occupation		
Medical doctor	35	62
Pharmacist	24	42
Registered nurse	13	22
Physical therapist	5	9
Dietician	5	9
Clinical engineer	5	8
Other*	14	24
Occupation site		
University hospital	38	67
Teaching hospital	11	19
Other hospital	3	5
Clinic	21	37
Other	9	16
Unknown	9	15
Total weekly working hours		
<19	9	15
20–39	7	12
40–59	44	78
60–79	22	38
>80	10	18
Unknown	9	15

*Other occupations: public health nurse, medical technologist, dentist, practical nurse, occupational therapist, clinical research coordinator, artificial limb fitter (judo therapist), medical social worker, researcher, acupuncturist.

Results

Participant characteristics

Table 3 details the characteristics of the 176 participants. With regard to occupations, 62 (35%) were medical doctors, 42 (24%) were pharmacists, 22 (13%) were registered nurses and 50 (28%) were other occupations. Total weekly working hours of 40–59, 60–79, over 80, below 19 and 20–39 hours were reported in 78 (44%), 38 (22%), 18 (10%), 15 (9%) and 12 (7%) participants, respectively. We were unable to determine working hours for the remaining 15 (9%). A total of 134 participants (76%) worked more than 40 hours per week.

Lecture attendance

The mean proportion of attendance over all 23 lectures was 82% (range: 73–87%). Figure 1 shows the proportion of attendance at

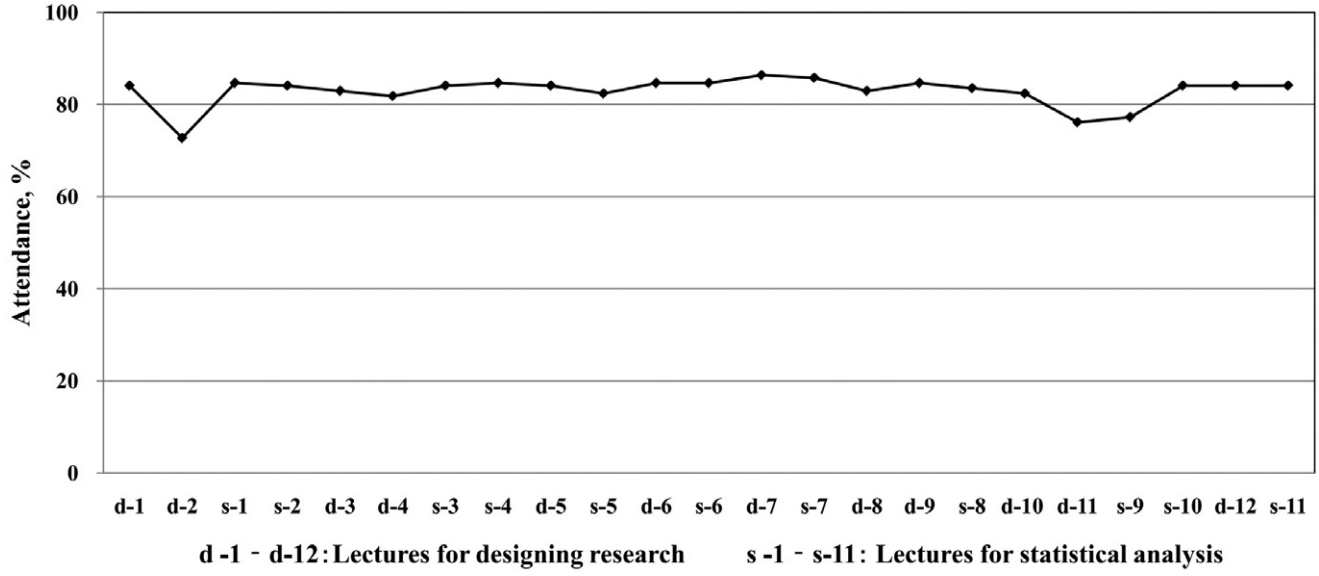

Figure 1 Percentage of attendance at the lectures. Each dot represents the percentage of attendance at each lecture. 'D-1–d-12' means lectures for designing research, and 's-1–s-11' means lectures for statistical analysis.

Table 4 End-of-course examination results

Occupation	No. of examinee	Exam mean (±SD)	*P*-value*
Medical doctor	42	74.3 ± 9.6	0.11
Pharmacist	41	69.6 ± 11.1	
Registered nurse	21	69.2 ± 16.6	
Others	44	68.0 ± 13.9	
Total	148	70.4 ± 12.6	–

*One-way analysis of variance.

each lecture. Of the 176 total participants, 156 (89%) attended more than 60% of the lectures and were therefore eligible to take the end-of-course examination. Of the 20 participants who dropped out of the programme, 13 (65%) were medical doctors, 1 (5%) was a pharmacist, 1 (5%) as a registered nurse and 5 (25%) were listed as having other occupations.

Interaction via an Internet-based feedback system

A total of 176 participants accessed the web site 3564 times from September 2009 to March 2010 (509 times per month). By using the system, the participants asked 284 questions related to the lectures. Instructors reviewed and answered the questions on the system or explained the answers at the next lecture.

End-of-course examination results

Table 4 shows the results of the end-of-course examination. The mean scores for medical doctors, pharmacists, registered nurses and others were 74.3 ± 9.6, 69.6 ± 11.1, 69.2 ± 16.6 and 68.0 ± 13.9 points, respectively. No statistically significant difference was observed in the scores among the occupations.

Discussion

In the present study, we developed a novel Internet-based blended learning programme to provide core competency in clinical research. A combination of educational strategies was adopted to enable busy health care professionals to continuously participate in the programme and learn the contents effectively. Online live lectures at satellite campuses, short examination after each lecture, an Internet-based feedback system and an end-of-course examination were included. Of the 176 participants, 134 (76%) worked more than 40 hours per week. The mean percentage of attendance at the lectures was 82%, and most 156 (89%) attended at least 60% of all the lectures. No statistically significant differences were noted in the end-of-course scores among medical doctors, pharmacists, registered nurses and other occupations. Based on these findings, we concluded that most busy health care professionals were able to complete the programme successfully. In addition, the participants could attain the core competency effectively, regardless of their specific occupation.

Because the participants were busy health care professionals with difficulty securing sufficient time for learning, we focused on assessment of attendance at the lectures as a measure of programme sustainability. Recent studies have demonstrated that various online lectures were as effective as live lectures in providing education if the participants completed the programmes [10,11,13–15]. However, persistent attendance at asynchronous online lectures (53–74%) was found to be lower than that with live lectures (91%) if participation was voluntary and the duration was more than 4 weeks [18–21]. In our study, the mean proportion of attendance was 82%, suggesting that our novel Internet-based blended programme may be more sustainable for busy health care professionals than an Internet-based course using non-interactive

multimedia. We believe that we achieved such high sustainability for the following three reasons. Firstly, interactivity between participants and instructors was encouraged by the Internet-based feedback system. A total of 176 participants accessed the web site 3564 times and asked 284 questions to the instructors using the system. Indeed, Cook previously showed that cognitive interactivity is one of the most effective instructional methods of Internet-based learning [25,26]. Secondly, participants were able to interact with other participants at satellite campuses. Lastly, participants were able to secure time to attend lectures by obtaining permission from their bosses.

Regarding the educational effect of the knowledge provided, no significant difference was noted in scores among medical doctors, pharmacists, registered nurses and other occupations, suggesting that all participants in this programme were able to obtain sufficient knowledge and education equally. The educational effect can be explained by several reasons. The short examination after each lecture helped promote a better understanding of the material. Programme participants were also able to obtain feedback to questions from instructors through the Internet-based feedback system. According to a previous study, feedback was associated with improvement in learning outcomes [26]. Participants were able to prepare for the lectures using materials provided through the system.

Several limitations to the present study warrant mention. We evaluated programme sustainability using non-equivalent comparisons, including assessments of heterogeneous participants, contents, lecture duration and frequency. However, considering that most of the learners in these studies were voluntary participants, we believe that the observed sustainability may be an accurate reflection of potential real-life sustainability. In addition, in assessing the educational effect on knowledge, we did not evaluate the difficulty level of the examination. Therefore, further research is needed to test the reliability and validity of the end-of-course examination. Further, a longitudinal follow-up study will be necessary to evaluate the long-term learning outcomes of this programme.

Acknowledgements

The authors would like to thank the organizers at each campus. The authors also thank all the participants who contributed their time and effort to our study. This study was supported by a grant-in-aid from the Ministry of Health, Labour and Welfare in Japan, 'Development of Clinical Research Fellowship' (Grant no: H21-007).

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