

Design of a Blended Learning Course for Training Community Healthcare Providers on eHealth-enabled Newborn Hearing Screening

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ABSTRACT

Objectives. We present in this article the design and evaluation of a blended learning approach for training community healthcare providers in performing newborn hearing screening (NHS).

Methods. We developed a blended learning course for training community healthcare providers on eHealth-enabled NHS, following Bloom's revised taxonomy of educational objectives. The training involved three components: computer-based training (CBT), face-to-face (FTF) training, and on-site coaching. We used surveys and post-training interviews following Level 1 Kirkpatrick's training evaluation model to get initial feedback on the training program.

Results. Thirty-one community healthcare providers from five rural health units and a private hearing screening center, with a mean age of 42.2 ± 12.0 years, participated in the pilot. 93.5% of the participants agreed that the program content met stated objectives and was relevant to their practice. The length of the course was perceived to be adequate. Overall satisfaction with the program was rated at 8.5 ± 0.9 (with ten as the highest). The majority expressed that the CBT and FTF course were satisfactory at 93.5% and 100%, respectively. All participants agreed that the course enhanced their knowledge of newborn hearing screening and telehealth. Positive reviews were received from participants on the use of CBT to improve theoretical knowledge before FTF training. Participants declared that FTF training and on-site coaching helped improved NHS skills and implementation.

Conclusion. Competent community healthcare providers are critical to strengthening the performance of the health system, and advances in the education and technology sectors offer promising potential in upskilling local healthcare providers. The increasing access of Filipino healthcare providers to improved information and communications technology (ICT) is a significant catalyst for pedagogical innovation, like the use of blended learning in the continuous professional development of health practitioners. As ICTs gradually penetrate the health sector, the challenge we now face is not whether but how we can use innovations in education strategies to benefit healthcare providers.

Keywords: *blended learning, course design, newborn hearing screening, eLearning, computer-based training*



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INTRODUCTION

Competent local primary care providers, as frontline health workers, are critical to strengthening the performance of the health system. However, training has become complex and expensive, limiting health workers' access to continuing professional development. This situation aggravates existing challenges posed by resource- and support-limited environments often present in primary care.¹ While there are development programs for specific health practitioner groups, advocacy for most health professionals to work together to achieve more extensive individual and population health goals falls short.² The World Health Organization (WHO) noted an increasing mismatch in the healthcare workers' competencies against the individual and population health needs.³ This discrepancy can be associated with the static, fragmentary, and sometimes outdated curricula that educate healthcare workers.

Alongside shifts in the health system, the education sector is also challenged by the increasing volume and access to information brought by information and communication technologies (ICTs). In 2005, the Organization for Economic Cooperation and Development called on universities and other educational institutions to reconsider their task to produce competent members of society, considering continuous technological advancement, which contributes to the development of educational innovations and approaches needed by the education sector.^{4,5} An example of this innovation is eLearning—the use of the internet and computers in delivering learning activities.⁶ Electronic learning (or eLearning) has gained attention among health education scholars and practitioners because of its promising potential to alleviate gaps in educating healthcare workers.⁷⁻⁹ In brief, eLearning is beneficial not just because it can transcend spatial and temporal boundaries but it can also promote individual and collaborative learning and use up-to-date information.⁹⁻¹² Subscribing to eLearning mode, although beneficial, can also be costly because of technological requirements and maintenance and can sometimes promote feelings of isolation among its learners.¹² These challenges are not unknown to Filipinos given the technological and infrastructural challenges¹³ that limit the use of interactive eLearning in educating health workers in remote and isolated areas. In such a setting, a blended learning approach, a combination of traditional and technology-based education, can be maximized.

Blended learning combines traditional face-to-face and online learning approaches, either through asynchronous or synchronous eLearning.¹⁴ It offers a promising alternative to health education.¹⁵ Although it has shown rapid growth and utilization in education^{16,17}, it is not as simple as combining the two latter approaches since it is highly context-dependent, making generalization across disciplinary domains challenging¹⁸. This notion suggests that implementing blended learning in one discipline does not guarantee success

in another domain. More than the computers and internet used for blended learning, we agree with Laurillard¹⁹ that determining the most appropriate way to deliver a specific topic and how our technology can enhance our teaching approaches should take precedence.

We present in this article our design of a blended learning approach to training community healthcare providers in performing newborn hearing screening. We proceeded in four steps. First, we reviewed the literature to elaborate and clarify ideas about what *blended learning* means and what it entails. Our review was rather selective since our goal was to provide a modest picture of the literature about blended learning relevant to the knowledge and skills needed in newborn hearing. We then reviewed existing training program designs about telehealth and newborn hearing screening. Third, we discussed in greater detail how we applied the concepts of the blended learning approach—using Anderson and colleagues' extended version of Bloom's taxonomy²⁰—highlighting the selection, sequence, blend of training objectives, and instructional and evaluation activities. We then presented participants' initial feedback on the training program. We concluded by discussing the considerations and implications of using the blended learning approach.

Interrogating the blended learning approach

There are contestations among education scholars concerning the way blended learning is understood. Blended learning is an approach that systematically combines online and face-to-face learning activities to deliver efficient and meaningful educational interaction among learners, educators, and available resources.²¹⁻²³ This learning approach has gained considerable attention^{16,17} because it has synthesized the benefits of online and face-to-face approaches into one learning approach^{12,21,24}. However, this explanation was criticized by scholars, claiming that understanding blended learning as a particular form of traditional teaching strategy with technology as an add-on may be limiting.²⁵

Several scholars explained that blended learning is beyond the media used to deliver learning activities. On the one hand, blended learning can be understood as a combination of web-based technologies, pedagogical approaches, and instructional technologies, either with face-to-face instructor-led training or with actual job tasks.²⁶ This conceptualization suggests that blended learning can be done by chunking learning programs into modules to determine the best platform for various learning activities.²⁷ Other scholars, on the other hand, suggest that blended learning centers on the intended focus of learning, which can be competency-, attitude-, or skills-driven.²⁸ This conceptualization of blended learning posits pedagogy, learning, and resources as if they were the same type. These two conceptualizations suggest that blended learning can consist of almost anything, thus making the discussion more complicated.

While the conceptual debates on blended learning appear to be convoluted—which may cause scholars to abandon the

term entirely—Oliver and Trigwell, in 2005, suggested that rather than focusing on the “blended” component of blended learning, we should underscore the “learning” component instead.²⁵ Emphasizing the learning component brings the learning theories to the center, serving as a basis for blended learning. Of relevance is the variation theory of learning, which posits that variation must be experienced by the learner for the learning to occur. Experiencing variation is essential for discernment to occur. Discernment is described, in simple terms, as experiencing an aspect of the world against previous experiences, which are more or less different.²⁹ Learning occurs through the discernment of the critical elements of various backgrounds. Against this backdrop, Oliver and Trigwell argued that using ICTs, along with other traditional learning approaches, makes it easier for learners to experience variations in learning specific topics.²⁵ They stressed further that the crucial aspect of blended learning is not the blend of media but rather “the attempt to help the students experience the critical patterns of variation in topics” through different media and learning activities.

The Hearing for Life (HeLe) Project: Increasing the Rates of Newborn Hearing Screening with Novel Technologies and Telehealth

A blended learning course was designed and developed as part of the Hearing for Life (HeLe) project, which seeks to increase newborn hearing screening rates in selected rural health facilities in the Philippines.³⁰ The HeLe is led by the University of the Philippines (UP), in collaboration with the University of California, under the Commission on Higher Education (CHED)-Philippine California Advanced Research Institute (PCARI).

HeLe was proposed to support the Republic Act (RA) 9709 or the Universal Newborn Hearing Screening and Intervention Act of 2009. The National Newborn Hearing Screening Reference Center (NHSRC), based at the UP Manila National Institutes of Health, is deputized by and with the Department of Health (DOH), certifies personnel and their facilities to be official service providers for newborn hearing screening and intervention. While RA 9709 was enacted years before, reach among Filipino newborns is limited and implemented mostly in large (private or government regional) hospitals or smaller private facilities in the city or provincial centers that can purchase imported hearing screening devices. Vendors of these devices train health personnel in the use of their hearing screening devices. Prior to the HeLe implementation, data from NHSRC showed that there were 309 facilities certified to offer newborn hearing screening and intervention—of which none is a government rural health unit (RHU). To fully universalize newborn hearing screening in the Philippines, we advance the need to reach the rural areas, considering the current fertility rate in the country. While national fertility data from 1993 to 2022 suggests a decreasing trend (4.1 children per woman in 1993 vis-à-vis 1.9 children per woman in 2022), the

disaggregated data reveals that women in the rural areas have higher birth rates (2.2 children per woman) than those in the urban centers (1.7 children per woman).³¹ Among others, HeLe sought to further capacitate primary care facilities in rural areas (i.e., RHUs and/or lying-in clinics) to scale up the coverage of newborn hearing screening services even in hard-to-reach and isolated areas of the country.

HeLe developed novel technologies: a standards-based hearing screening device that is seamlessly linked to an electronic medical record and telehealth technologies. The project sought to demonstrate that government primary care health centers can become NHSRC Category A Newborn Hearing Screening Centers (i.e., centers that can provide hearing screening and could also provide for the preventive aspect of hearing impairment).³² Consistent with the spirit of the law, these community centers are within the locale where mothers and their newborns reside. Once adequately equipped with trained staff and the correct equipment, these readily accessible centers will encourage early screening of more newborns. The HeLe project aims to address both requirements of a Category A Newborn Hearing Center.

With the explosion of new knowledge, the health system is strained anew with twin responsibilities of care delivery and the need for health staff to be updated with new information and new processes in care delivery. The health professionals are often pulled out of these primary care health centers to attend training programs held in centralized locations; services are thus sacrificed. Hence, a blended learning strategy was proposed to deliver needed cognates and maximize the limited face-to-face events to sessions meant specifically for skill-building on innovative solutions for newborn hearing screening.

METHODS

The training component of the HeLe project centered on conceptual and practical discussions on using newborn hearing screening devices and how eHealth can strengthen the newborn hearing screening service in local health settings. Hence, in designing the course, we built on the training programs (Table 1) offered by the NHSRC³³ and the National Telehealth Center (NTHC)³⁴, both of which are under the National Institutes of Health, the University of the Philippines Manila (UP Manila). As mentioned, the NHSRC was established through the Philippine Republic Act 9709 and is the lead agency in training healthcare providers on newborn hearing screening³⁴.

We combined the topics listed in Table 1 to develop a training program that may allow learners to experience varied learning activities, adopting principles of andragogy. We designed the blended learning course following the theoretical perspectives of the variation theory of learning, and Bloom’s revised taxonomy of educational objectives, to guide the selection of appropriate delivery methods and sequencing of learning activities (i.e., the blend of the learning activities).

Anderson et al. extended Bloom's original one dimension of educational objectives taxonomy into two distinct dimensions: the knowledge and cognitive process dimension.²⁰ The knowledge dimension classifies the subject matter content, while the cognitive process dimension categorizes what is to be done with or to the subject matter content. On the one hand, the revised knowledge dimension consists of four major categories: factual, conceptual, procedural, and metacognitive. On the other hand, the cognitive process dimension includes remembering, understanding, applying, analyzing, evaluating, and creating. Discussing the background in the revision of Bloom's taxonomy is beyond the scope of this article. Nonetheless, the revision highlighted the distinction between the nature of the subject matter and the active cognitive processes involved in facilitating learning.

By subscribing to the revised Bloom's taxonomy, the design of the blended learning course was sequenced to engage learners' lower- and higher-order thinking skills. Table 2 details the different objectives of each component of the blended learning course. We then plotted these objectives against a two-dimensional taxonomy table to demonstrate where the objectives are placed in the intersection of knowledge and cognitive process dimension. Education scholars³⁵⁻³⁷ utilized this taxonomy table to enable the design of appropriate assessment, instruction, and evaluation methods in relation to certain knowledge types and required cognitive processes of the subject matter content. As seen in Table 3, the objectives of the three components of the blended learning course covered lower- to higher-order thinking skills and factual to metacognitive types of knowledge. Computer-based training (CBT) focuses on remembering and understanding factual and conceptual knowledge. The basic concepts about the project (Obj. 1.1), newborn hearing screening (Obj. 1.2), and eHealth (Obj. 1.3-1.5) are reviewed during the computer-based training so that the face-to-face (FTF) training can focus on developing the skills of the learners in using the HeLe technologies (Obj. 2.3-2.7), in analyzing ethical and legal issues (Obj. 2.2), in interpreting readings of HeLe device (Obj. 2.4), and in formulating plans for project implementation (Obj. 2.8). Also, the learners review the subject matter content discussed during the computer-based training (Obj. 2.1) to facilitate the transition to face-to-face training. To complete the learning activities, the trainers of the blended learning course conduct on-site visits to health facilities, among others, to ensure continued use of HeLe technologies (Obj. 3.1), and to assist in the implementation and revisions of the project implementation plan (Obj. 3.2).

We designed the instructional methods and evaluation tools based on the educational objectives per component of the blended learning course (Table 4). The lectures in the CBT program are delivered online via Moodle technology, where the learners are enrolled and engaged remotely. Each module has a unit examination that the learners must complete before moving to the next unit or module. A pre-test and a post-test were administered to assess learners' improvements in

Table 1. Topics under Newborn Hearing Screening and Telehealth Training

Newborn Hearing Screening Training	
1.	Introduction to Republic Act 9709, Universal Newborn Hearing Screening and Intervention Act of 2009
2.	Hearing Screening and Diagnostic Modalities in Determining Hearing Loss in Infants
3.	Available Interventions for Hearing Loss in the Philippines
4.	Newborn Hearing Screening Using Otoacoustic Emissions (OAE)
5.	Newborn Hearing Screening Using Automated Auditory Brainstem Response (AABR)
6.	Reporting and Registry
Telehealth Training	
1.	The Ethical-legal aspects of eHealth in the Philippines
2.	Using an Electronic Medical Record: Community Health Information Tracking System (CHITS)
3.	Telemedicine and the National Telehealth Service Program
4.	Basic Computer Literacy and Troubleshooting

Table 2. Objectives of the Different Components of Newborn Hearing Screening Blended Learning Course

1. Computer-Based Training (CBT)	
1.1.	Recognize the historical background and importance of newborn hearing screening in the Philippines
1.2.	Recognize and classify methods in newborn hearing screening
1.3.	Recognize and interpret relevant ethical and legal principles in the practice of eHealth in the Philippines
1.4.	Recall and explain the use of the electronic medical record Community Health Information Tracking System (CHITS) and telehealth platform National Telehealth System (NTS) as supporting tools for newborn hearing screening services
1.5.	Recall and summarize how to use CHITS, NTS, and HeLe Device.
2. Face-to-Face Training (FTF Training)	
2.1.	Explain the basic concepts of newborn hearing screening, the Universal Newborn Hearing Screening and Intervention Act, and the Hearing for Life (HeLe) Project
2.2.	Analyze and critique case studies regarding the application of eHealth using relevant ethical and legal guidelines in the practice of eHealth and telemedicine
2.3.	Use HeLe Device
2.4.	Differentiate and evaluate the results of the newborn hearing screening device (HeLe Device) against <i>pass</i> criteria
2.5.	Use the Community Health Information Tracking System (CHITS) to maintain records of newborns for hearing screening
2.6.	Use the tele-audiology module of the National Telehealth System (NTS)-Telemedicine in referring newborns to a higher category facility
2.7.	Demonstrate ability to troubleshoot potential technology problems; differentiate well-functioning HeLe technologies (HeLe Device, CHITS, NTS) against malfunctioning ones; and evaluate the technical status of HeLe technologies
2.8.	Formulate a HeLe Project implementation plan for each health facility by organizing available resources and checking their potential feasibility
3. On-Site Coaching	
3.1.	Use HeLe technologies in newborn hearing screening
3.2.	Organize the workflow to accommodate newborn hearing screening service; check the appropriateness or feasibility of the project implementation plan; and generate draft policies and procedures based on the project implementation plan.

Table 3. Taxonomy Table of the Blended-Learning Course's Objectives

	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	Objectives 1.1, 1.2, 1.3, 1.4, 1.5					
Conceptual Knowledge	Objectives 1.2, 1.3, 1.4, 1.5, 2.1			Objective 2.2	Objective 2.2	
Procedural Knowledge				Objectives 2.3, 2.5, 2.6, 2.7, 3.1	Objectives 2.4, 2.7	Objectives 2.4, 2.7
Metacognitive Knowledge					Objectives 2.8, 3.2	Objectives 2.8, 3.2

First row: Cognitive Process Dimension; First Column: Knowledge Dimension. Refer to Table 2 for the list of objectives

Table 4. Instructional Methods and Evaluation Strategies for the Components of the Blended Learning

	Objectives*	Instructional Methods	Evaluation Strategies
Computer-Based Training	1.1-1.5	Lecture	Written examination (Pre-test, Post-test, Unit quiz)
Face-to-Face Training	2.1	Lecture	Written examination (Pre-test, Post-test)
	2.2	Lecture and small group discussion	Case study analysis
	2.3-2.7	Lecture and skills demonstration	Skills return demonstration
	2.8	Small group discussion	Creation of project implementation plan
On-Site Coaching	3.1-3.2	Coaching	Debriefing and focus group discussion

Refer to Table 2 for the list of objectives

their knowledge and understanding of the basic concepts of newborn hearing screening and eHealth. For face-to-face training, we utilized different participatory instructional techniques to emphasize the application of what was learned during the CBT. In addition to traditional lectures that aim to reinforce what was learned in the CBT component, we used small group discussions to encourage analysis of eHealth ethics cases and the development of a project implementation plan. Demonstration and return demonstration were also used to teach and evaluate skills using HeLe technologies. Lastly, the trainers visited the health facilities in the on-site coaching sessions. They encouraged the learners to use the HeLe technologies in their practice in the community to build their capacities further. This stage of the blended learning course focuses on assisting the learners in implementing the project in the health facility. Hence, several debriefing sessions and focus group discussions were facilitated.

Following Kirkpatrick's evaluation model, we used qualitative and quantitative evaluation methods to get feedback on the training program. In this article, we presented the Level 1 Kirkpatrick training evaluation results—Participant's Reaction.³⁸ For Level 1, we measured participants' reactions to the training course and methods, its relevance to their practice, and their satisfaction with the program using self-administered questionnaires and post-training interviews.

Ethical Considerations

Ethical approval was obtained from the University of the Philippines Manila Research Ethics Board before its implementation.

RESULTS

We conducted a pilot of the blended-learning course on newborn hearing screening (NHS) and telehealth among 31 community healthcare providers from five rural health units and a private hearing screening center. Most of the participants were midwives (13, 41.9%), followed by doctors (8, 25.8%), nurses (8, 25.8%), and medical technologists (2, 6.5%). Twenty-three (74.2%) were female, and 8 (25.8%) were male. The mean age of the participants was 42.2 ± 12.0 years.

The results of the first-level Kirkpatrick evaluation indicated that 29 of the 31 participants (93.5%) declared that the program content met the stated objectives and their needs, and that the course length was adequate. On a scale of 1 to 10, with ten being the highest, overall satisfaction with the program was rated at 8.5 ± 0.9. Most participants expressed satisfaction with the CBT and FTF course at 93.5% and 100%, respectively. All participants agreed that the course enhanced their knowledge of NHS and telehealth. 93.5% (29 of 31) participants declared that the blended training program provided content relevant to their practice.

Based on the post-training surveys, 54.8% (17 of 31) of the participants stated that computer-based training was at least of the same quality as face-to-face training. Participants said CBT and FTF training increased their confidence in performing NHS. 67.7% (21 of 31) reported feeling confident they could perform NHS after the CBT. 51.6% (16 of 31) believed that they could conduct NHS and use the HeLe systems (i.e., documentation using electronic medical record and referral via the electronic referral system) after CBT. Although more than half of the participants reported that

CBT increased their confidence and ability to do NHS, the majority (16, 51.6%) noted that there is still a need for face-to-face training, especially practicum and/or return demonstration, to gain or improve NHS-related skills. After the face-to-face training sessions, 30 (96.8%) participants declared that they could successfully enroll and document the NHS in CHITS, while 29 (93.5%) believed that they could successfully refer a patient using the HeLe referral system. Twenty-eight of the 31 participants (90.3%) believed that they could demonstrate proper use of the hearing screening device after FTF training.

Participants of the course reported that completing the CBT before the FTF training made the lecture and skills demonstration during the FTF course easier to understand. CBT was considered a practical preparatory course before the FTF training sessions. Participants reported that CBT could reduce the training time, especially on theoretical aspects of learning. However, FTF training sessions were perceived as crucial to learning the skills for conducting the hearing screening. Participants were also appreciative of the on-site coaching provided. They reported that on-site coaching allowed them to see what aspects or skills need to be improved after handling patients. Participating municipal health officers also expressed satisfaction with on-site coaching as it provided opportunities to ask questions and guidance on implementing and integrating NHS in their clinic workflow successfully.

DISCUSSION

We crafted this three-component, blended learning course to enable community healthcare workers to experience variations in learning experiences. These variations are considered valuable in building learners' proper knowledge and skills in using eHealth-enabled tools in newborn hearing screening. A critical aspect of the course we developed is the computer-based training portion, apart from the traditional face-to-face training and on-site coaching sessions, which enabled us to alter the traditional educational paradigm. Scholars observed that using ICTs promotes new forms of teaching and learning, which may produce new forms of relations, behaviors, and ways of thinking.³⁹ In some studies, the use of such tools in teaching and learning seems to occur rather slowly in educational programs that use face-to-face teaching exclusively, like nursing.⁴⁰ Yet, we regard the use of blended learning courses as an opportune move, utilizing technological and pedagogical advances in education. ICTs are being used in lower-middle income countries like the Philippines for continuing education of healthcare workers, along with its clinical services provision.⁴¹ This is true despite the costs and logistical barriers imposed by traditional face-to-face learning, especially for those in far-flung areas.⁴² Using technologies, we shortened the duration of face-to-face training since the computer-based training already covered the fundamental concepts of the course content. In effect, we were able to allocate much of the learning activities of

the face-to-face training toward skills development. Despite favorable results in the use of online learning⁴³, the learners still see it as a complement to traditional face-to-face learning and not an alternative⁴⁴⁻⁴⁸.

Given the nature of the topics covered, we view our blended learning course as suitable to address our educational objectives. We first considered using a purely computer-based learning mode for the training to further increase the reach of our course, even to those in the remote areas of the country.^{49,50} However, given the infrastructural challenges in the Philippines, which limits the use of ICTs for health⁵¹, we did not pursue this plan and instead explored the possibility of combining online and traditional teaching approaches. Nevertheless, we consider this development as an open case—whether or not our design is feasible for the HeLe Project and perhaps can be adapted to other technology-based health projects. Bringing computer-based training even to remote areas of the Philippines may be challenging, yet we argue that it is doable.

Adding technologies to the traditional educational paradigm holds great potential for advancing improved teaching and learning experience. In developed countries, for instance, sophisticated virtual simulations, in both asynchronous and synchronous modes, offered promising prospects for continuing education of health professionals.^{52,53} The challenge of subscribing to high-fidelity e-learning materials is that it requires a larger bandwidth to work effectively⁴⁶, which in the Philippines remains a concern⁵⁴. Regardless of the nature of technological innovation in health professions education, however, we underscore that coherent educational planning is vital in applying technological resources in view of the intended educational goals.

CONCLUSION

Competent community healthcare providers are critical to strengthening the performance of the health system, and advances in the education and technology sectors offer promising potential in upskilling local healthcare providers. HeLe demonstrated how a blended-learning design can be used to deliver new knowledge and skills to healthcare staff and to provide training to a wider audience through its computer-based learning module. The increasing access of Filipino healthcare providers to improved ICT is a significant catalyst for pedagogical innovation, like the use of blended learning in the continuous professional development of health practitioners. As ICTs gradually penetrate the health sector, the challenge we now face is not whether but how we can use innovations in education strategies to benefit healthcare providers.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

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