A pilot quasi-experimental study to determine the feasibility of implementing a partograph e-learning tool for student midwife training in Nairobi

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\begin{abstract}
Objective: The partograph is a tool used globally to record labour progress. Although it has the potential to improve maternal and neonatal outcomes, some midwives struggle with using it in practice. Training in partograph use is limited, and the theory is often divorced from practice. Innovative ways of improving training are urgently required. We therefore aimed to determine whether the use of an e-learning tool is beneficial for learning partograph skills.

Design: An uncontrolled before-and-after study was conducted, informed by Kirkpatrick’s four-stage model of evaluation; we report on the first two stages. We included a cohort of third and fourth year midwifery students who were studying at one university in Nairobi. The same hypothetical case scenario was used, pre- and post-implementation of the World Health Organization partograph e-learning tool, to assess students’ partograph completion ability. Views on the tool were also sought, using semi-structured questionnaires. Data were analysed using standard statistical techniques and framework analysis.

Findings: 92 (88%) students participated. Students expressed positive views about the e-learning tool. However, the mean post-intervention score (27.21) was less than half of the maximum obtainable score. There was some improvement in test scores; year three mean score pre-intervention was 21.39 (SD 5.72), which increased to 25.10 (5.41) post-intervention (paired-\textit{t} = 3.47, \textit{p} = 0.001); year four mean score pre-intervention was 24.39 (5.98) which increased to 29.30 (6.77) post-intervention (paired-\textit{t} = 3.85, df = 91, \textit{p} < 0.001). In the post-test, year four students scored higher than year three students (unpaired-\textit{t} = 3.28, df = 90, \textit{p} = 0.001). Students were unable to plot cervical dilatation correctly, once established labour had been confirmed.

Key conclusion: E-learning training is acceptable to student midwives and has the potential to be an effective means of teaching the practical application of the partograph. However, in this study, their inability to correctly plot transference from the latent to active phase of labour suggests that the partograph itself may be too complicated. Modifications and further evaluation of the e-learning tool would be required before any widespread implementation. Furthermore, students need the clinical support to operationalise their learning; educating qualified midwives and obstetricians to be positive role models when completing the partograph would be one potential solution. Further research is required, taking on board the recommendations from our pilot study, to investigate the impact of partograph e-learning on practice and clinical outcomes.
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Introduction

Maternal mortality in Kenya remains high, at a rate of 530/100,000 (World Health Organization, 2010a). One of the main contributors to this rate is prolonged labour. Diagnosing prolonged labour is important for reducing maternal and neonatal morbidity and mortality (Neilson et al., 2003). The partograph, which was developed in Africa, is a tool used to record labour progress, identify dysfunctional labours and prompt appropriate management (Philpott, 1972). Most partographs are those recommended by the World Health Organisation (WHO, 1994), which evolved from Philpott’s work in Zimbabwe in 1972 (Philpott and Castle, 1972). Many contain an alert line, representing cervical dilatation of the slowest 10% of the population, representing a progress rate of 1 cm/hour. Most charts also incorporate an action line, four hours to the right of the alert line, developed to identify primary inefficient uterine activity to prompt clinicians to consider oxytocin augmentation, caesarean section, or supportive treatment (Fig. 1).

The WHO (1994) concluded, from their study of 35,484 women in S E Asia, that the partograph was necessary for managing all labour and recommended its universal application. Its effectiveness, however, has been questioned in high-income countries (Lavender et al., 2008). Nevertheless, there is evidence to suggest that it may reduce morbidity in low income settings (Walls-Rodriguez et al., 1987; Pattinson et al., 2003; Kenchaveeriah et al., 2011), and some midwives in Africa have stated their belief in its ability to reduce mortality (Lavender et al., 2007). Despite being a simple paper record, health professionals find the partograph difficult to complete and current training may be inadequate (Lavender et al., 2011; Rotich et al., 2011). However, because of shortages of human resources, training in correct partograph use is challenging.

Given the challenges of learning in low resourced settings, e-learning may offer an opportunity to overcome potential barriers.
There are many benefits of e-learning, for both the teaching institution and the learner. e-Learning has been incorporated into the educational systems of several developing countries (Capper, 2001), as either a stand alone or blended approach to learning. The main attraction of e-learning is that it has the potential to overcome geographical access issues and cost barriers to learning (Gulati, 2008). The application of information technologies reduces the cost of reaching and educating a large number of learners who may otherwise lose out on education (Gulati, 2008).

A number of factors have driven universities in low-resourced settings to incorporate e-learning into their programme (Gulati, 2008); these have included greater access to information, more efficient means of communication, cost-effectiveness and increased opportunities for collaboration (Sife et al., 2007). The utilisation of e-learning is significant since it has the potential to support the updating of more midwives on a regular basis and also permits knowledge sharing. Partograph e-learning may be pivotal in improving recording skills and supporting midwifery practice. We therefore used the newly developed WHO partograph training tool (WHO, 2010b) to assess its feasibility in assisting student midwives in accurate recording of labour.

There were two study aims: to assess the acceptability of an e-learning tool as a method of learning about partograph use and to examine the potential for the e-learning tool to improve partograph recording skills.

Theoretical model

We drew on Kirkpatrick’s four-level model (Kirkpatrick, 1959), as a basis for evaluation of the e-learning programme. Although many other models have been used for the evaluation of health student training (Beech, 2008), many of which are considered more sophisticated (e.g. Kraiger et al., 1993), we chose this model as it supports an initial low cost evaluation in stage one, which progresses to more compelling results at each stage. Although the Kirkpatrick model was developed some time ago, it remains useful today, because of its simple, logical framework (Smidt et al., 2009). In this model, each successive evaluation level is built on information provided by the previous level. In this paper, we report on levels one and two of the evaluation. However, the remaining stages will be pursued, to assess the impact of the programme on clinical outcomes.

In level one, reactions to the e-learning programme were evaluated. This level enabled us to determine whether the students liked the tool and whether they believed it to be relevant to midwifery practice. According to Kirkpatrick, every programme should be evaluated at this level to provide an opportunity for making improvements to the training programme. Students’ reactions at this level had the potential to influence level two (the learning level). Although a positive reaction does not guarantee student learning, a negative reaction would reduce its possibility.

Level two involved assessment of the amount of learning that had occurred due to the e-learning programme. In keeping with the Kirkpatrick model, the level two evaluation used assessments conducted before training (pre-test) and after training (post-test). Assessing at this level moved the evaluation beyond student satisfaction and attempted to assess the extent to which students advanced in their skills and knowledge.

Level three measures the transfer that has occurred in learners’ behaviour due to the training programme, i.e. from classroom to clinical area. Evaluating at this level provides information on whether the new skills and knowledge are used in daily clinical practice. Although this level represents the truest assessment of the training programme’s effectiveness, it is too early for us to report on this.

Level four evaluation attempts to assess training in terms of results. In this study, improvements in maternity care and subsequent neonatal and maternal outcomes would be the most important findings. From an organisational perspective, this is the overall reason for the training programme, yet the most difficult aspect to address. Given the duration of our study, and the fact that this was preliminary work, our evaluation will not reach this level. However, on successful completion of levels 1–3, and further dissemination of the e-learning tool, this evaluation could occur in further study.

Methods

Design

We used a quasi-experimental design. Although randomised controlled trials are the gold standard for evaluating new interventions, existing resources, available sample size and study duration made this impractical. Practical barriers are recognised as a legitimate reason for using quasi-experimental designs (Eccles et al., 2003). Also, in a single-centre trial, it would be difficult to control the potential for contamination between groups; students, if randomised to receive the e-learning tool, may share this with others, thus diluting the intervention effect.

We therefore used an uncontrolled before-and-after design to determine the impact of the intervention. Although threats to internal validity are possible in such designs, we observed for trends and/or sudden changes throughout the study to gain confidence that any observed changes would be attributable to the intervention.

Ethical approval was gained from the University of Nairobi and the University of Manchester.

Setting

The study took place in the School of Nursing Sciences, University of Nairobi which runs a Bachelor of Science Nursing course, incorporating maternity care. While studying maternity care, students are referred to as student midwives; thus, in keeping with local practice this paper also refers to them as student midwives. In other settings, the term student nurse would most likely be used. The university is situated in an urban area, but students are clinically placed in a number of different facilities which are widespread (rural and urban). Students have a limited clinical maternity placement (12 weeks) which is not scheduled alongside theoretical learning. This makes it important to provide information in a memorable way to enhance learning. This study is preliminary, thus a formal sample size calculation was not required. The sample size was determined by the availability of students within the study period. Two cohorts were invited to participate; year four students had completed existing partograph training and year three students had not. This enabled assessment of the tool as a potential means of introducing the partograph and complementing existing teaching. Current partograph teaching is didactic and delivered in the format of large classroom based lectures. Partograph training is a particular challenge in this setting, where lack of resources limit the lecturers’ ability to provide a stimulating learning environment. The usual partograph teaching, in this university, involved a lecturer holding up the partograph in front of a classroom of up to a hundred students. Most students were unable to follow the plotting of the chart, when the individual components were pointed to by the lecturer.

A project team member (who was not the students’ lecturer) supplied students with written and verbal study information. Students were informed that their participation was voluntary;
that they did not have to take part; and that their participation would not influence the future teaching that they would receive. They were also advised that they could withdraw at any time without giving reason if desired. Written consent was obtained from all participants.

**e-Learning tool**

The partograph e-learning tool (WHO, 2010b) is a CD-ROM that was developed by the World Health Organization in collaboration with Maternal and Infant Health Project, Ukraine. The tool was developed further following feedback from international experts and fieldwork conducted in India and Ukraine. The text of the programme is in English. The opening screen asks for the name of the student. The students can work through the programme at their own paces, and can save and return to the programme whenever they want. The tool presents step by step instructions using audio, video and textual information. The menu allows clear navigation and a ‘help’ icon (Fig. 2). Exercises, demonstrations and case studies enable the students to interact with the tool and test their knowledge and practical skills (Fig. 3). Three different partographs are included on the tool, to reflect the three WHO partograph tools that are currently in practice (Mathai, 2009). On successful completion of the exercises a certificate can be printed, which includes the student’s name.

**Data collection**

Data were collected in 2010. All data collection was conducted by lecturers who were not employed in the School of Nursing, Nairobi, at the time of the study. All information and data collection tools were reported in English.

**Level one-reactions**

We used a specifically designed questionnaire, incorporating open and closed questions, to assess the students’ overall opinions of the training tool, immediately after its use. The questionnaire was informed by fieldwork carried out by the WHO and focus group discussions (Lavender et al., 2011), thus providing content validity. The questionnaire included visual analogue scales, multiple choice and open-ended questions. It was a simple, short tool which took only 5–10 minutes to complete and was piloted prior to use.

**Level 2- learning**

We used a before-and-after evaluation of the training tool, using a hypothetical case scenario of a woman with an uncomplicated pregnancy and labour. The same case scenario was used at both time points. Students plotted labour observations on the partograph illustrated in Fig. 1. We used a marking grid, for consistency; this was a pre-defined and pre-tested grading criterion sheet, which enabled objective scoring of the labour recordings. The first assessment took place immediately prior to using the tool. The second assessment took place three months post-intervention, with the same students and using the same case scenario. Two assessors (KL, TL) were used to maintain consistency and equity in the awarding of marks and to avoid interpreter bias.

**Analysis**

Quantitative data were entered into an SPSS 16 data file for descriptive and inferential analysis. Descriptive statistics were estimated for baseline data. Interval data were compared before and after the intervention using a paired t-test. Unpaired t-tests

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Fig. 2. Training tool menu.
were used to compare differences in case scenario scores between the cohorts of students (years three and four).

An interpretive approach to analysis of open responses was conducted. We adopted the Framework Approach which was developed specifically for the analysis of applied research (Ritchie and Spencer, 1994). This approach allows for the inclusion of a priori as well as emergent concepts. Analysis proceeded from familiarisation with the data, through indentification of a thematic framework, indexing, coding, charting and interpretation (Ritchie and Spencer, 1994). This approach allowed us to map the range of student responses, find associations and relate the emerging themes to the study aims. Transcripts were independently coded by two people (TL, KL). Data were managed manually. An audit trail was kept throughout the process to ensure rigour (Seale, 1999). This rigorous approach to analysis adheres to well established guidelines for qualitative analysis (Carter, 2004).

Findings

Of the 105 students invited to participate, 92 consented (88% response rate). Within this cohort, 46 (50%) were third year students who had not yet had a maternity placement or partograph training and 46 (50%) were fourth year students who had received partograph training and had been exposed to maternity care. Baseline details for participants are in Table 1.

Following the intervention, participants were asked to report their views on using the partograph tool (level one evaluation). Of the 92 who completed the intervention, 84 (91%) returned a questionnaire; 43 year three students and 41 year four students. Questionnaires came from 29 male and 55 female students; all indicated that they were internet users. Seventy-four (88%) students stated that they use the internet frequently. The remainder stated that they use the internet ‘rarely’. When asked about partograph use, unsurprisingly the majority of third year students had never used one (n=31), as they had not yet had their maternity placement. Of the fourth year students, 17 indicated that they used the partograph frequently, 23 stated they used it occasionally and one stated that they never use it.

To gauge students’ views of the tool, they were asked to record, on a 10-point visual analogue scale, the extent to which they agreed (or disagreed) with a number of statements (Table 2). With regard to ‘relevance to practice’, ‘ease of completing’, ‘likeability’ and ‘appearance’, students tended to score positively. The third year students found the tool more difficult to complete than the fourth years.

Students were also questioned about the amount and content level of the information. With regard to the content, all students indicated that it was ‘about right’. In terms of the amount of information, 73 (87%) stated that it was ‘about right’; five stated that there was ‘too much information’ (all third year students); and six stated that there was ‘too little’ information (all fourth year students).
year students). The year four students qualified their answer by recommending that the exercises incorporated into the tool be greater in number and more challenging.

Assessing the impact of the e-learning tool involved a comparison of mean test scores before and after the intervention, using a paired t-test. All participating students completed the pre and post-test (n=92). Students received a mark for each correctly entered clinical observation recorded on the partograph, as instructed by the case study. The maximum overall score that could be obtained was 67, which was broken down according to the individual partograph components. The total score for the assessment was compared, as were the individual components. Disappointingly, the overall mean post-intervention score (27.21) was less than half of the maximum obtainable score. Table 3 presents the year three students pre and post-test results; there was some improvement in test scores; the mean score pre-intervention was 21.39 (SD 5.72), which increased to 25.1 (5.41) post-intervention (paired t=3.47, p<0.001). Table 4 presents the year four students pre- and post-test results; the mean score pre-intervention was 24.39 (5.98) which increased to 29.30 (6.77) post-intervention (paired t=3.85, p<0.001). There was a statistically significant improvement in scores on the first assessment and overall scores for year three and year four students. Year four students also showed statistically significant improvements in third and fourth assessments.

An unpaired t-test was used to compare differences in test scores between the cohorts of students (years three and four), for the pre- and post-assessment. Scores for year four students were significantly better than those for year three students pre-intervention for birth (unpaired t=3.47, df=57.7, p<0.001), fourth stage (unpaired t=2.52, df=59.4, p=0.02) and overall score (unpaired t=2.46, df=90, p=0.02), but post-intervention only for fourth stage (unpaired t=2.34, df=42.6, p=0.02) and overall (unpaired t=3.28, df=90, p=0.001).

Open responses

The thematic framework was developed using items related to the questions posed, common themes emerging from familiarisation with the transcripts and discussions amongst the research team. Qualitative findings mainly related to what students liked and disliked about the partograph e-learning tool.

The majority of responses were positive; several students made comments such as ‘everything is likeable’, ’it was fun filling it’ and ‘the tool was awesome!’ Students clearly welcomed the on-line learning. One student, for example, stated:

I loved the visual aspect whereby even if you can’t understand the theory, you can still learn by seeing...I love using the computer to learn so the tool suits me’ [participant 79, Year 3] To learn so the tool suits me’ [participant 79, Year 3]

Positive responses related to practice relevance, being flexible to individual needs and specific content benefits. Examples of student quotes to illustrate this are in Table 5.

There were few negative comments. Much of the criticism about the tool related to the content. For all students who made a negative comment (n=16), this tended to be related to the level of content, as opposed to the process. Some students (n=8), suggested that they could have been challenged more through the on-line exercises that were incorporated in the programme; exercises were considered ‘too few’ and ‘too simple’ (Table 5). Several students (n=9) commented on the fact that the programme was not easily transferable from one computer to the next.

Students also recommended the development of additional e-learning programmes, e.g. postnatal care, gynaecological cancer,
Table 5
Qualitative themes and example quotes.

<table>
<thead>
<tr>
<th>Positive responses</th>
<th>Practice relevance</th>
<th>Flexible to individual needs</th>
<th>Specific content benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>The tool is easy to understand because it gives simple guidance on how to fill the partograph; [Participant 20, Year 3]</td>
<td>‘Easy to Understand and Information could be easily picked and applied in practice.’ [Participant 1, Year 4]</td>
<td>‘It is attractive, easy to follow and the training was all my own pace. I could reuse at any time and redo the training if felt not very satisfied. The systematic explanation and summary of the basic concepts into contractions, drugs etc make it very easy to revise.’ [Participant 33, Year 4]</td>
<td>‘The thing I liked about the tool is that I can do the learning at my own convenience. If I do not understand something it’s easy for me to go back and confirm about it’ [Participant 87, Year 3]</td>
</tr>
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<tr>
<th>Negative responses</th>
<th>Content deficiencies</th>
<th>Technical issues</th>
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<tbody>
<tr>
<td>‘The videos were a bit short and repeated … It is not challenging. It’s too easy’ [Participant 29, Year 4]</td>
<td>‘More exercises on how to fill the different parts of the partograph is desirable’ [Participant 74, Year 3]</td>
<td>‘The tool is not well arranged in a stepwise fashion. One can jump into doing exercises without having gone through the tool’ [Participant 11, Year 4]</td>
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</table>

Discussion

This study aimed to determine whether the use of an e-learning tool is acceptable and beneficial for learning partograph skills. Despite no previous experience of e-learning, students liked using the tool, acknowledging its potential to increase knowledge and improve practice. They particularly liked having the opportunity to work at their own pace and being able to use the tool for revision. These findings resonate with others, who found that such flexibility was considered important to qualified clinicians (Andrusyszyn et al., 1999; Kozlowski, 2002; Attack, 2003) and students (Thurmond et al., 2002; Parker et al., 2005), increasing their satisfaction with the learning environment. In our study, the inability to start the learning on one computer and then re-access it on another hindered this flexibility; this technical issue needs correcting prior to further implementation of the tool.

Pre-test scores were low, even for those who had already been trained in partograph use and had completed a labour ward clinical placement, i.e. fourth year students. One would have expected these students to score higher than the third years, which was not the case. This suggests that conventional training, which involved didactic lectures to large groups of students, was not effective. Furthermore, it would appear that partograph recordings may not improve following clinical placements.

Although some improvements were made to scores following introduction of the e-learning tool, the overall scores remained disappointingly low. The overall mean score (third and fourth year students) post-test was 27.21, which was only 40% of the maximum score available. Although this was a preliminary study, and therefore we did not pre-define an ‘acceptable’ score, this score was lower than that which the team had expected. Ideally one would aim for a score nearing 100%, given that consistency is sought for individual recording of observations amongst midwives. Realistically, however, this may be unachievable; therefore further work is needed to determine acceptable score parameters. This work could include the employment of consensus methods, to reach agreement from international users of the partograph on scoring levels. Moreover, research is required to determine any relationship between training scores and competency in using a partograph in practice. This would be important in ensuring that training standards reached a level that did not compromise care and subsequent outcomes. We would recommend that this be carried out as part of level three of the Kirkpatrick Framework (Kirkpatrick, 1959).

Students improved when plotting the first clinical assessment, post-test, but struggled when plotting the second assessment. The students’ lowest scores related to this second assessment which required transference of the measurement of cervical dilatation from the latent to active phase on the partograph. This is an aspect of labour recording that even qualified nurses have found challenging, in the UK (Lavender and Malcolmson, 1999) and in East Africa (Lavender et al., 2007). However, there have been some debates regarding whether or not the latent phase of labour should be included on the partograph (Dujardin et al., 1995; Kwast et al., 2008). This, and other debates regarding labour observations, has led to the development of partographs containing different layouts (Mathai, 2009). Three different partographs were included in the e-learning tool. Although fourth year students were instructed to use the partograph that they use in practice and third year students were told which partograph they would use in practice, we were unable to establish whether this was what they actually did. Nevertheless, the difficulties experienced by the students offer additional support for the use of the simplified partograph (WHO, 2010b), i.e. one that does not include a latent phase. A recent randomised controlled trial (Kenchaeveriah et al., 2011), conducted in India with over seven hundred women, has demonstrated that a partogram without a latent phase can significantly reduce the number of caesarean sections performed.

Our findings also provide important guidance to maternity educators on areas to target when teaching partograph skills. Our findings were fed back to the local educators, who have been able to provide additional educational support to students, in the form of mentoring, during clinical placements.

Students recommended the development of e-learning programmes in other areas of health care, e.g. emergency obstetrics; this confirms that they liked this method of learning. However, implementation of e-learning must be based on evidence that this method not only enhances the learning experience, but is also effective in improving knowledge and skills. We were not able to demonstrate this within our study.

If such tools were to be implemented in Kenya, one would have to ensure that all students had equal access to computers and all students had basic computer skills; these have been the most frequently reported barriers to online learning (Kozlowski, 2002). Students in our study had different online experiences; some had their own computers and others had to travel long distances to the university for access, for example. Given that the
senior students requested more challenging exercises, consideration should be given to the development of tools that facilitate learning at different levels.

Within quasi-experimental designs, there are greater threats to internal validity (Cooke and Campbell, 1979) than in randomised controlled trials. The uncontrolled before-and-after design, used in this study, limits the study findings as one cannot state with any certainty that the observed improvements were solely due to the intervention (Eccles et al., 2003). For example, we do not know whether the pre-test prompted students to engage with additional information pertaining to the partograph, as a result of being motivated by the study. We did, however, try to minimise potential threats to internal validity by ensuring that there was no known historical reason why the student sample would react differently to other students (e.g. no extraordinary lectures had taken place); including a whole cohort of student who were typical of other students (age, gender, and educational ability); and carrying out the pre and post-test in the same environment, facilitated by the same personnel and under the same conditions.

This small, single-centred study did not enable us to observe the impact of e-learning on clinical practice or on clinical outcomes. Large, definitive studies should consider factors that we have learned in our pilot. To ensure rigour such studies should also incorporate a control group of students not receiving the training. Ensuring all students have a basic level of computer skills; displaying a single partograph on the tool; creating more challenging practice exercises; making it compulsory to complete exercises prior to moving to the next stage in the programme; ensuring that a certificate cannot be printed until all exercises are completed; and enabling the programme to be transferable between computers are important recommendations. The relationship between the knowledge obtained in the university and that which is supported in practice, also requires investigation. This is important, as the information provided in class did not improve the ability of the fourth year students. Our study used hypothetical case scenarios; observing students in practice may have provided useful insight into the impact of the clinical environment on learning.

Conclusion

Students liked the e-learning tool, which improved some of their recording skills. However, on assessment of partograph use, post-test scores were disappointing low. Students’ inability to correctly plot transference from the latent to active phase of labour suggests that the partograph itself may be too complicated. Although we believe that the tool has the potential to support students practice, modifications and further evaluation are required before any implementation. However, students need the clinical support to operationalise their learning; educating qualified midwives and obstetricians to be positive role models when completing the partograph would be one potential solution. Further research is required, taking on board the recommendations from our pilot study, to investigate the impact of e-learning on practice and clinical outcomes.

Competing interests

The authors declare that they have no competing interests.

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