Effectiveness of postgraduate education in occupational medicine
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CHAPTER 7

General discussion

In this chapter I present a summary of the results of the studies included in this thesis and a discussion on the topics of problem-based learning and on design and outcome measurement of educational research. I shall go on to draw some general conclusions and finish with recommendations for the future of postgraduate education in occupational medicine and for further research.

Summary of study results

The studies described in this thesis are aimed at gaining more insight into factors determining the effectiveness of postgraduate education in occupational medicine. A secondary aim is to study the instruments and study designs for the assessment of effectiveness of education.

The studies show the following results:

The review of controlled evaluation studies on problem-based learning in continuing medical education shows that there is limited evidence to support the theory that problem-based learning in continuing medical education increases participants’ knowledge, participants’ performance and patients’ health. There is moderate evidence in the literature that participants are more satisfied with problem-based learning.

The evaluation of an educational programme on the occupational health management of patients with low back pain shows that after the programme, the participants’ scores in the knowledge test and on the performance indicators were significantly increased. We conclude that the educational programme contributes to the improvement of
the participants' knowledge of the guidelines on low back pain and to the improvement of the participants' application of the guidelines in daily practice.

A second evaluation of the same programme, this time in a quasi-experimental setting with a control group not receiving education, shows the same results: knowledge and performance in practice improved and are more in compliance with the guidelines.

In a third experiment, we studied an educational programme on guidelines for occupational health management of patients with mental health problems. In a randomized controlled design we evaluated whether or not a problem-based format would show a better outcome than a more traditional, lecture-based format. We concluded that both forms of postgraduate medical training are effective in increasing participants' knowledge and performance. We also concluded that, in spite of less favourable evaluations by the participants in terms of satisfaction, the problem-based programme appears to be more effective in improving performance than the lecture-based programme.

Subsequently we studied factors potentially predictive for successful learning in postgraduate medical education. Gender turned out to be related to an increase in performance, and both gender and learning style independently enhanced knowledge after postgraduate medical education on guidelines for management of mental health problems. In this study we found no interactions with course design (i.e. problem-based learning or lecture-based learning format).

**Problem-based learning**

One of the main focuses of this thesis is the question: Does the type of educational format make a difference? In particular: Is a problem-based format to be preferred to the traditional more lecture-based format? First of all, it can be unambiguously stated that the applied educational formats in the studies yielded positive results in the sense that both the participants' knowledge and performance were increased. A second conclusion is that the problem-based format seems to be
more effective than the lecture-based format when it comes to increasing participants’ performance. Thirdly, the problem-based learning format was less popular with the participants. Our conclusion contradicts most literature,¹ as our review showed that there is moderate evidence that participants are more satisfied with problem-based learning than traditional formats.²

How can these results be explained? Clearly there are significant differences between the lecture-based and problem-based programmes. First I shall explore some characteristics of problem-based learning in relation to the differences in performance outcome. I shall concentrate particularly on characteristics such as the application of problems and experiences of participants as a starting point in a training session, the effectiveness of small and self-directing groups and the role of the tutor as facilitator (CHAPTER 1). I shall go on to discuss the meaning of the differences in participant satisfaction.

The starting point of a problem-based group session usually is a clinical or practice-based problem, suggested in the learning materials.³ In our experiment, the educational designer chose the topic of the guidelines, and the group formulated their personal experiences on this topic in a brainstorming session. This approach usually cannot be employed in the undergraduate medical curriculum, as students often lack clinical experiences. In postgraduate education and CME however, it is advocated as a most important step, which should not be rushed.⁴ This step also helps doctors to decide whether they want to take on a learning task.⁵ A problem-based session in CME can begin and end with problems as they are actually experienced by the participants in their own daily practice. The problem-based learning theory claims that students acquire a deeper understanding and a better recall of information when relevant clinical problems are used. In CME this approach facilitates learning better than direct teaching.⁶ The use of problems from clinical practice as a starting point is consistent with the theories about the way in which doctors learn. Slotnick describes two learning strategies employed by doctors.⁷ For specific problems, doctors immediately make use of learning resources available to them, the Internet for example. This is comparable with the practice of evidence based medicine, which tries to integrate best
research evidence, clinical expertise and patient values. It is a search for ‘foreground’ information. Slotnick’s second learning strategy is associated with more general problems experienced by practising doctors. This strategy is more deliberative and uses both immediately available resources as well as those requiring more effort, for example a training course. In both strategies a clinical or practice problem is the start of a learning process. In Kolb’s experiential learning model, regularly used in adult education the important processes of reflection, conceptualization and generalization need prior personal experiences. This model is useful to understand the learning and working situation of the participants in postgraduate and continuing medical education. My conclusion is that using practice problems experienced by participants as the start of the problem-based educational session may be one of the factors explaining a better performance outcome, contrary to the literature. Other methodological problems of outcome research may have caused disappointing cognitive results of problem-based learning in the literature.

Discussing clinical problems in a small and self-directed group should activate prior knowledge. In our format the group sessions were chaired by group members. We found that the groups often came up with problems the educational designer could not possibly have thought of. The chair of the group also helped the tutor to play a more ‘free’ facilitators’ role. This can be difficult when the chair does not keep the learning process of the group on track and the tutor has little content knowledge.

In our experiment the tutor was a content expert (occupational physician) with educational experience. In problem-based learning, the role of the tutor is to be the facilitator of the educational process. The tutor should be active which does not necessarily contradict being learner-centred. However, tutor content expertise may positively influence the outcome of PBL. Tutors who have substantial content expertise, but are able to refrain from lecturing may be preferred above those without content expertise. Recent literature shows inconsistent findings as to this effect, but it cannot be excluded that this factor may have contributed to the positive effect in our study. After all, tutors should try to strike a balance between their role as educator of predominantly transmitting facts and their
role of stimulating in-depth learning and motivation. These aspects of problem-based learning are valuable and it is worthwhile monitoring them or using them as variables in a qualitative design.

In contrast with the problem-based learning format, in a lecture-based format it is not easy to get in touch with the actual problems of the learners and to access their learning questions. Of course, a good lecturer is capable of holding the attention of the student and can certainly teach background information. But if you, as the designer of an educational programme, ask a lecturer to address specific learning objectives, you always get the lecturer's interpretation of these objectives. Small group, self-directed learning and the tutor as facilitator of the problem-based learning session have in my opinion attributed to a better performance outcome in our studies.

What may have caused the relatively low level of participants' satisfaction with problem-based learning? Participants' level of satisfaction is a widely used variable for evaluation in education. However, it is not a variable that reflects the outcome of the learning process. Satisfaction is defined as a positive feeling from the participants about the learning situation, and as what has been learned and is probably based on whether their prior expectations have been met. Little is known about the exact meaning of "satisfaction" of participants of educational programmes. Therefore, I recommend further research into the meaning of 'satisfaction' as a standard in evaluation of education.

We have formulated the following possible explanations for the satisfaction ratings in our study. The lower satisfaction ratings in the problem-based group were partly due to the fact that the participants missed the input of the teachers who they regarded as important policy makers and opinion leaders. The recent introduction of mental health guidelines provides a good illustration of this attitude. The participants were keen to hear about them from a lecturer and did not want to have to puzzle them out for themselves. Possibly, their individual learning styles also played a part in this. Fifty nine percent of the participants had a reflective learning style which from a theoretical point of view at least, does not work very well with a problem-based learning format (40 %
reflective/abstract and 19% reflective/concrete). A third possible explanation is the burden of working and learning at the same time. The participants all carry a full work load with its inherent responsibilities. They see the one day in the week at the Netherlands School of Occupational Health as a day for themselves, and prefer to sit and listen, preferably without joining in too actively. But specifically problem-based learning is not possible without active participation. And so, these working participants experience an active problem-based learning programme as less attractive, although it is probably more effective.

**Research design and outcome measurement**

There are two major points of discussion regarding the design of our studies:

- **Research design.**
  - Choice of a (randomized) controlled trial or a qualitative design.

- **Outcome parameters.**
  - The value of performance indicators.
  - The inclusion of patients' health.

**Research design**

In an editorial comment, Prideaux stated that 'randomized controlled trials have important limitations in evaluating educational interventions', he did not, however, specify these limitations. He supports Norman and Schmidt who favour a more qualitative and theory based approach to the study of educational interventions. The reaction of Norman and Schmidt serves as an answer to Colliver's article, entitled: 'Effectiveness of problem-based curricula'. Colliver concludes that there is no convincing evidence that PBL improves knowledge base and clinical performance, at least not of the magnitude that would be expected given the resources required for a PBL curriculum. Prideaux also stated that the advocates of Best Evidence Medical Education 'have moved away from grading studies according to the gold standard of randomized control to a scheme based on criteria such as quality, utility and strength of evidence'. However, we don't see any signs that there is a real argument about the RCT providing evidence of the highest quality. I support the
general recognition that systematic reviews should not be restricted to randomized controlled trials only, but that other controlled studies should be used as evidence in a field like education where it is more difficult to perform RCT's than in healthcare.\textsuperscript{24}

The discussion seems to be centred on undergraduate medical education and on medical curricula as a whole. There are of course practical constraints in randomizing students to different curricula. However, it has been shown that also here it is possible to perform RCTs.\textsuperscript{25} In our studies on postgraduate medical education, we evaluated short courses on practice guidelines. In such a situation randomization is more practicable. Participants did not oppose randomization, although there was one participant who had been involved in clinical research and who argued that participants should have been asked for informed consent. We did not think that randomization was unethical because we assumed equal effectiveness of both programmes. We could also have offered two different educational formats without asking participants for informed consent if we hadn’t been performing a study. Moreover, it can be hypothesized that there are many different factors that can influence the outcome of an educational programme i.e. differences in gender, age, preference for an educational format, previous education, experience with problem-based learning, current situation at work etc. It is difficult to control all these factors in for example a quasi-experimental design or to adjust for these factors statistically. Therefore, only a randomized design can guarantee, to a certain degree, that these factors are equally divided over the groups. We do not think, as Norman and Schmidt do, that these studies are doomed to fail. With our studies we provided another argument that educational RCTs are feasible. However, the influence of potentially confounding factors, as mentioned above, should not be overestimated as our study on learning styles has shown. In these studies only a few factors predicted the outcome of the learning process. A quasi-experimental design would probably have led to the same results.

Of course, there are limitations of randomized controlled trials in educational intervention studies, when experimentation is unnecessary or inappropriate.\textsuperscript{26} In our literature study we argued that double blind allocation of participants is impossible. A solution to this prob-
lem is to present the educational programmes as being of equal effectiveness. Moreover, it is certainly possible to have single blinded studies in which those who assess outcomes are blinded to the group allocation of participants. Those who criticize randomized study designs argue that more can be learned from qualitative studies or the elaboration of the theory of learning. We cannot deny that this type of study can yield valuable and useful information to designers of educational programmes. Qualitative and theory based research can teach us much about the way education works or is perceived by participants. Oakley aptly summarized differences between health care and educational research, which may lead to different assessment of research-designs.\(^{27}\) She argues that educational interventions are usually broad, comprising many components. Therefore, studies of the process of the intervention can yield valuable insight into how a programme works. In addition, it is stated that usually there are multiple outcomes in educational research, which are not well defined. We used a traditional range of outcomes such as knowledge, performance and health of patients. It can easily be argued that education should also lead to better learning, or more professional satisfaction, or a different learning style. However, we think that whatever research design is used, outcomes should be defined as clearly as possible. None of these arguments opposes the idea that the ultimate proof of effectiveness has to come from controlled studies in which outcomes are assessed. We found that problem-based learning had a powerful effect on level of satisfaction. Therefore, it could be that a preference for one specific educational format influences the outcome. We suggest that in future research these preferences should be measured at baseline. In addition, these preferences could be taken into account when assigning participants to a group with an experimental educational format. However, such a 'patient' preference trial should be used cautiously, because it brings many methodological questions along with it.\(^{28}\)

**Outcome parameters**

In our studies, we used performance indicators as an outcome parameter for the performance of doctors in practice. It is widely accepted that improvement of performance in medical practice is the goal of education at postgraduate level.\(^{6,29,30}\)
However, performance is not easy to measure, compared to for example knowledge. It can be a time consuming operation as has been demonstrated in general medical practice, where performance was measured by observing videotapes of consultations.\(^{31}\) In non-educational research, performance indicators are also used, but then for example as indicators of quality of care, which is not very different from using them as an outcome of education.\(^ {32}\) In earlier studies on the quality of occupational health care, the use of performance indicators was described and evaluated positively.\(^ {33}\)

For pragmatic reasons we did not use observational methods in our studies. The measurement of performance was based on physician’s self-reports. It has been shown that self-reported performance tends to overestimate the real performance in practice.\(^ {34}\) To partially prevent self-report bias, the criteria used to assess performance were not revealed to the participants. The results were consistent with those from earlier experiments. Moreover, it was shown that a good performance measured by the same type of performance indicators, predicted a better outcome and a higher level of patient satisfaction in occupational health management of patients with back pain.\(^ {35}\) Therefore, we conclude that the performance scores did reflect the quality of performance in practice. However, the validity and reliability of performance indicators as an outcome measure need to be further explored. A comparison, for example, with other assessment methods such as videotaping consultations would contribute to further validation.

The topic of health outcome as an outcome parameter in educational research is discussed and supported in recent commentaries in *Medical Education*.\(^ {36,37,38}\) Prideaux states that patient health is influenced by a whole range of factors within and outside a doctor’s control.\(^ {18}\) Therefore, the possible effects of education are difficult to measure. In spite of a comprehensive educational programme, Smeele et al were not able to show the effects of their interventions at the level of patients’ health.\(^ {39}\) Yet, there is a strong support for measuring changes in patients’ health as the outcome of postgraduate education.\(^ {29}\) To a certain extent this is comparable to in-company training where the objective is to improve the results at work.\(^ {40}\)
General Conclusions

We showed that postgraduate training courses in occupational medicine increased participants' knowledge and performance significantly on comparison with no postgraduate education. In the literature we found limited evidence that problem-based learning in continuing medical education increases participants' knowledge, and performance and patients' health. There was moderate evidence in the literature that participants were more satisfied with problem-based learning. We could not replicate these results in a randomized controlled trial. The trial taught us that participants of a problem-based programme performed better than the participants of a lecture-based programme. However, the participants of the problem-based programme were less satisfied with the programme. Gender and learning style turned out to be variables independently related to an increase in knowledge (gender and learning style) and performance (gender). These relations were not influenced by course design.

This shows that different educational formats should be - and can be - evaluated in a randomized controlled design. The experiences are a stimulus to further study of the influence of participant's preferences on outcome, level of satisfaction with education and the measurement of patients' health as an outcome-measure.

Recommendations

Recommendations for postgraduate education or continuing medical education:

- Interactive educational formats, such as problem-based learning.
- The problem-based format may be used flexibly but should preferably include the following:
  - clear learning objectives,
  - group sessions starting with the problems and experiences of participants,
  - small groups, self-directed sessions,
  - a content and educational expert to facilitate the process.
- Giving course participants the opportunity to get better acquainted with the problem-based learning method.
• Educational programmes should have well-defined outcomes at the level of knowledge, performance and patient health.
• Educational programmes should be designed in such a way that participants are better able to implement the newly learned competencies.
• Educational programmes in occupational medicine should be evaluated by means of well-designed and validated tests.

**Recommendations for future educational research:**
• Studies on the influence of personal preferences on the outcome of learning.
• Studies on the feasibility of using a patient preference trial in the evaluation of education.
• The further validation of the use of performance indicators as a means of assessing outcome of education.
• The continuation of the summarization of the effects of diverse educational programmes and methods in systematic reviews containing the results of controlled studies.
• Strong support for the movement of Best Evidence Medical Education and the Campbell organisation in collecting evidence on the effectiveness of medical education.
• Future study of the meaning of participant satisfaction by means of qualitative research methods.
• Future study on which components of problem-based learning are the most useful and effective in postgraduate teaching by means of both quantitative and qualitative methods.
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