Will The Virtual Patient Make The PBL-Case Fly?
Decision-Making Elements In Web-Based PBL-Cases

Pedagogiskt docenturarbete

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**INTYG**  
**PEDAGOGISK REFLEKTION**

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**Motivering:**  
I denna reflektion granskas vardagsarbetet med web-baserade utgångspunkter för PBL i basgrupp i relation till vad forskningsbaserad litteratur säger om design av basgruppsscenarier i allmänhet och av virtuella patientfall för lärande i synnerhet. Det är en mycket insiktsfull text som pekar ut tänkbare områden för uppdatering och utveckling av existerande web-baserade fall. Samtidigt är det en klarsynt reflektion över de särskilda hänsyn som behöver tas när det gäller design av fall som ska användas av studenter på tidiga terminer. Texten har stor potential för fortsatt utveckling av existerande fall och är av allmänt intresse för alla lärande och basgruppshandledare.

**Undertecknad tillstyrker att den pedagogiska reflektionen/analysen uppfyller de för docenturansökan uppsatta kriterierna.**

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Will the virtual patient make the PBL-case fly?

Decision-making elements in web-based PBL-cases

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Background

Problem-based learning (PBL) was initially introduced in medical education to bridge the gap between basic science and clinical training [1]. PBL is a case-based educational strategy, where learners are presented with a problem [2]. PBL is usually set in a small group and a tutor facilitates the learning process. The multi-faceted and practical problem encourages the learners to build on prior knowledge and arouses their interest in the envisaged situation and the related material. Explaining the problem to one another allows learners to learn from each other and increase their understanding of the problem. The use of prior knowledge facilitates comprehension of new information and situational interest will drive the learner to seek knowledge [3]. Overall, the learning process in PBL is self-directed and problem-oriented. There is evidence that well-crafted problems are as important for learning as the tutor’s conduct [4]. Ideally, the problem should be authentic, relevant, engaging, interesting, instructional and build upon the learners’ level of prior knowledge [3, 5].

The pre-clinical curriculum of the medical program at Linköping University is a hybrid model that includes small group PBL sessions, didactic lectures, seminars, and skills training. PBL-cases make up approximately 30% of the formal teaching time during the first years of the medical program. Already in 1999, all paper-based PBL-cases of the medical program at Linköping University were replaced with web-based, multimedia-enhanced cases. The design of the web-based PBL-cases has not changed despite significant developments in the field of information technology during the last 20 years. The web-based PBL-cases have an open inquiry approach and can only proceed in one direction as the story gradually unfolds. The design of the cases is instructional; photos, microscopy and radiology images, and mechanistic cartoons are used to guide the learners towards the intended learning objectives. After having studied the relevant background material individually, the PBL group meets, the case is opened and the knowledge acquired is applied to the case. All cases are followed by a short summary that includes follow-up of the patient’s history and highlights important biological mechanisms that emerge from the case. While the introduction of web-based cases increased learners’ engagement compared to paper-based PBL-cases, there
have been concerns that the web-based cases have had a negative impact on self-directed learning [6].

**Dolmans’ seven principles of effective PBL-case design**

1. *The contents of a case should adapt to students’ knowledge.*
2. *A case should contain several cues that stimulate the students to elaborate.*
3. Present a case in a context that is relevant to the future profession.
4. Present relevant basic sciences concepts in the context of a clinical problem to encourage integration of knowledge.
5. A case should stimulate self-directed learning by encouraging students to generate learning issues and conduct literature searches.
6. *A case should enhance students’ interest in the subject-matter, by sustaining discussion about possible solutions and facilitating students to explore alternatives.*
7. A case should match one or more of the faculty objectives.

The effect of the inclusion of branched PBL-cases with decision-making on principles in italics are discussed in detail.

The concept of virtual patient (VP) typically takes the form of a web-based piece of software that presents an interactive case for medical training, education, or assessment [7]. During the progression of the case, learners are required to respond to questions or make decisions [8]. A typology of VP design around four different categories (general, educational, instructional design and technical) has been proposed [8]. VP activities can take many forms and be used in many ways including small group activities [9]. Like PBL-cases, VPs present a clinical problem for learners to solve or manage, and promotes development of problem-solving skills [10]. One common form of VP is the branched case where each response/decision made by the learners may have consequences and result in different outcomes as the case progresses [8]. The replacement of linear, paper-based PBL-cases with branched, web-based VP PBL-cases, the latter of which require the learners to actively discuss and negotiate the case, can improve learning performance in mid-stage undergraduate medical learners [11].
Problem

The purpose of this reflection is to better understand if the inclusion of decision-making branched elements in web-based PBL-cases can be positive for learners during their first year of undergraduate medical education. I will reflect upon three of the principles outlined by Dolmans et al (1997) for effective PBL-case design [12], that will be directly affected by the inclusion of branched decision-making elements in the case. The starting point for my reflection is the use of decision-making branched elements in PBL-cases used in the first year of medical education.

Reflection

The curricula of the medical education at Linköping university have, since the start in 1986, been problem-based and aimed at training doctors that have the necessary knowledge, skills and attitudes to treat patients; to this end, clinical reasoning is considered a crucial competence [13]. The PBL-cases used at our faculty are static, web-based cases, with a linear design where additional information about the patient and biological processes gradually unfolds. It can be hypothesized that the inclusion of virtual patients or, more specifically, interactive cases with branched decision-making elements would stimulate discussions and increase learners’ engagement and, in the long run, improve learners’ capability of clinical reasoning [14, 15]. In addition, the inclusion of decision-making may also appeal to the current learner population with a high level of new media literacy [16].

Prior knowledge

One challenge in the design of PBL-cases is to accurately adapt the case to learners’ prior knowledge, in particular in the case of first year students, whose prior knowledge of medicine and basic science is relatively limited. The patient and her story can be used as a vehicle to deliver pathophysiological mechanisms rather than being the focus of the case, to better adapt to the prior knowledge of novice learners [8]. To overcome the relatively limited medical knowledge among learners, the designer of the case should focus on the narrative rather than the clinical findings. There may also be concerns that a first-year learner lacks the substantial level of medical knowledge required for effective decision-making. However, there is evidence that learners adopt a non-analytical process, which is
less dependent on medical knowledge than an analytical approach, in clinical reasoning at an early stage of their education [17, 18]. A branched case with elements of decision-making can be designed to encourage initial non-analytical processing, provided that the activity is rich in feedback and instructions to the learners.

**Elaboration**

The PBL-case provides details (cues) of the patient’s complaints and symptoms. These details are used by the learners as triggers for discussion. In a branched case involving decision-making, triggers will also include consequences of decisions for learners to elaborate on [9]. Learners will also have to debate which of the limited number of available options to pursue and discuss how to handle the consequences of a certain decision. The debates that surround decision-making have been reported to be critical in the learning process [9]. The discussions and debates may result in better understanding of the new information presented to learners by the case [19], and also support the learning process according to Schmidt’s activation-elaboration hypothesis [3]. If the case has a branched design, triggers can be reenforced by linking them to branches where decision-making is needed. Hence, the instructional design of the case/VP can be used for nudging learners [8]. It is difficult to see that the inclusion of decision-making in PBL-cases will have any detrimental effects on PBL group activities such as the initial discussion and search for explanations. However, I think that it is important that the designer considers the prior knowledge of the students and adjusts the level of difficulty of the branches, as well as the number of branches, accordingly. In the first year of medical education small group cases should be stream-lined and free from any excessive text or material to reduce the risk of cognitive overload that otherwise may be a barrier to engagement [20].

**Interest in the subject-matter**

A case should maintain discussion about possible solutions and encourage learners to explore alternative solutions. Interest in the topic of the case will increase the willingness to learn [21]. It has been shown that VPs promote engagement in small group learning [20]. It has also been reported that branched web-based PBL-cases with decision-making are more engaging than linear web-based cases without decision-making [11]. It is likely that the use of cases with branched elements and decision-making support learning by the situational
interest hypothesis [3]. The need to choose one of several options at branches of the case may raise the learner’s awareness about the knowledge gap between what he/she knows and what he/she wants to know about the subject-matter. The inclusion of decision-making in PBL-cases will make learners make mistakes – a process that may cause discomfort and interfere with the group dynamics. If the errors are followed by targeted feedback, errors can aid in the process of constructing and retain knowledge [22]. It is possible that the potential discomfort of error-making will out-weigh some of the advantages of including decision-making in PBL-cases in early-stage medical education.

### How to make the web-based PBL-case fly

- **Adapt the case to learners’ prior knowledge**
  For novice learners focus on the narrative rather than clinical findings. Consider the timing of the case in relation to other teaching activities in the same subject.

- **Design cases that encourage discussions**
  Incorporation of questions such as “What else do you want to ask” or “What do you want to examine next?”, followed by feedback to the learners as the case unfolds.

- **Pick an interesting topic and make the cases relatable to the learners**
  Update the cases on a regular basis and make sure that the cases are contemporary.

### Conclusion

The design of most PBL-cases used in the module Immune Infection and Barrier (IBI), which I teach, have remained unchanged since the introduction of multi-media enhanced web-based PBL-cases in 1999. Even if the content of the PBL-cases is good, many of them have aged, which I think is reflected in at least three different aspects: Many cartoons and films are old, the patients’ names do not really match their age, and the patients do not reflect the heterogeneity of today’s society. It is possible that an update of the PBL-cases in general could improve learners’ ability to identify with the cases and facilitate the adaption to their prior knowledge as well as increase their interest. One can also argue that an aged appearance is a minor problem if the intra-structural design of the case is satisfactory. However, I think that it is important that the learners can relate to the cases and find them relevant.
During my experience as a PBL-group facilitator, I have recognized that learners tend to miss clinical triggers, such as “negation of neck stiffness” in a case of influenza and “spontaneous abortion” in a case of rheumatic disease. This is most likely a result of inadequate adaption of the case to the learners’ prior medical knowledge, in combination with learners’ prior knowledge of the case in relation to other teaching activities; they just want to get to the point. I think that including decision-making in PBL-cases as described by Poulton et al should be considered when current cases are up-dated. By adding elements of decision-making, triggers can be highlighted, and the engagement of the learners will most likely increase, also self-assessment can be swiftly incorporated in the process. IBI has one module in the first and one in the second year of the medical program. I think that linear cases with elements of decision-making could be of relevance during the first year when basic immunology is learned. In the second year when disease mechanisms are in focus, branched cases with elements of decision-making are more appropriate, since second year learners should keep training their skills in clinical reasoning. First year learners, on the other hand, are founding their medical knowledge.

A case with decision-making is in general more complex, and the inclusion of decision-making elements, may make it harder to adapt the PBL-case to the learners’ prior knowledge. Also, the potential benefits of decision-making PBL should be weighed against the cost of educating tutors and potentially increased requirements of maintenance of PBL-cases.

References


