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Problem-Driven Approaches in Consumer-Targeted Informative E-Health

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Abstract: Problem-driven approaches such as problem-based learning (PBL) and its hybrid extensions have been widely used in medical and health-related training among health professionals. Do such approaches give added value for consumer-targeted informative e-Health design? PBL approaches may be rewarding at higher cognitive levels; however, too extensive orthodox modeling or format recommendations may be a threat to innovative product design and new insights. The main ideas of PBL-connected ideologies may be useful in the health sector and in consumer-targeted digital applications: constructive, self-directed, collaborative, and contextual learning represent aspects that are plausible in consumer-targeted eHealth area. Creative problem-solution scenarios require intellectual activity and may hence attract consumers and increase customer activity if the substance knowledge frame is supported, appears well-known, and is understandable for the consumers. This study considers these items in a theoretical problem analysis as part of a design science approach with contextual literature.

Keywords: Instructional digital media, problem-driven approach, health care

Introduction

Instruction models that emphasize problem-solution structures are well known and actively applied in medical training among health professionals and these approaches take also some place in e-Health design. The designer often develops problem and solution spaces in parallel with creative design (Dorst & Cross, 2001). There are different strategies for problem-solving algorithms. Some problem-based design approaches rely on the principles of problem-based learning (PBL) (e.g., Walker et al., 2010). PBL has gained popularity in medical schools (e.g., applications targeted for health professionals or students) but has also moved into other disciplines (Johnson & Finucane, 2000). In the medical field, not all PBL-connected programs follow the principles of the pure, original PBL model

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and emphasis in health care is more focused on prevention, health care delivery, and "wellness" instead of problems (Camp, 1996). Today, many training programs or informative online solutions are targeted for health service users and PBL-emphasized techniques are offered also for these target groups. Hence, reconsideration is needed in terms of in which way applied problem-driven approach could be of added value in consumer-targeted applications. This research consists of a contextual literature review and critical analysis and focuses on this question: In which way and in which areas could problem-driven approaches such as PBL and its hybrids be useful in consumer-targeted informative applications in e-Health? This article focuses on the different cognitive levels of learning, adaptation possibilities, and challenges within, and comprises design-based research that concentrates on the questions of the theoretical design phase, its methodology choices, and connected creative insights.

The problem-driven approach in learning and connective design

PBL strives for a proper understanding of phenomena, effective problem-solving and collaboration skills, enhanced motivation, self-directedness, and flexible knowledge-capturing (Hmelo-Silver, 2004). PBL underlines student activity and students' reasoning iterations done by themselves or in small collaborative groups (Hmelo-Silver, 2004; Knowlton, 2003). It is claimed that even if in PBL it is tried to handle process and content as equal aspects, students do not always master needed theoretical knowledge on the substance task in question. However, problem-solving ability requires relevant factual knowledge base (Gwee, 2009; Norman, 1997). Different specialties and individual products have their own integrated missions in e-Health design; problem-solving processes are not straightforward even in a same specialty area. "Problem-solving is domain-specific" (Knowlton, 2003), personal control comprises typically problem-solving styles (Wu et al., 1996), and different types of problems require different kinds and levels of knowledge and capabilities (Savage, 1990). Evidence-based instructional strategies are needed to show "which facets of PBL are important for particular kinds of outcomes" (Hmelo-Silver, 2004). There are pure and hybrid PBL models, and different institutions have

their own variations (Pawson et al., 2006). Problem-solving techniques in the health sciences utilize also other approaches, like e.g., case-based reasoning (e.g., Bichindaritz & Marling, 2006). To select the best PBL-approach, it is essential to evaluate who the students and the main learning tasks are (Takahashi & Oku, 2009). However, there is no evidence that PBL improves knowledge base or performance (Colliver, 2000; Newman, 2003), and measurement procedures suffer from problems of validity (Belland et al., 2009). There is little or no difference between knowledge acquisition among students from a PBL curriculum and from a traditional approach (Cunnington et al., 1996). "The impact of PBL depends on the tutors' quality and the students' motivation"; often, blended PBL is more successful than simply a traditional PBL course (Woltering et al., 2009). Students may feel stressed until they are familiar with the PBL process (Wood, 2003). Under some circumstances "PBL may do best outside of medical education and allied health" (Walker & Leary, 2009). PBL belongs to "minimally guided techniques," which are less effective than direct instructions, and novice learners are not always able "to integrate the new information with their prior knowledge" (Kirschner et al., 2006). Self-directedness may be demanding for younger users; hence, PBL should be tailored to the developmental level of the learners (Hmelo-Silver, 2004). PBL techniques are typically resource-intensive and require prioritizing (Wood, 2003). Healthcare practice needs, no doubt, other options for adult education as well (e.g., Pijl Zieber, 2006).

The problem-driven approach in e-Health environments

E-PBL is PBL in an online environment (Wheeler, 2006). Technology plays a role in adapting PBL for specific disciplines (Hmelo-Silver, 2004). PBL as a learner-centered approach has also been successful in digital educational applications (e.g., Sayed et al., 2012) and in consumer-targeted e-Health. Chan et al. (2009) noticed that the PBL approach motivated critical thinking in a health information promotion project among students. There are PBL-led game applications for younger user groups (e.g., Farrell et al., 2011). In health related consumer-targeted design, problem-driven approach may however be a suitable option for the following reasons:

- Consumers have their own health-related interest areas, questions, and problems (real problems exist),
- Customers often have previous knowledge of their problems, which increases their sophistication level,
- Digital applications often support self-directness and independent learning in this field.

The problem-driven approach and cognitive levels in digital instruction

Levels of knowledge acquisition; knowledge frames for problem solving

Informative e-Health consists of domains from which users typically seek answers to their health problems. Developing problem-solving abilities requires a relevant knowledge base (Norman, 1997). In knowledge acquisition, the major challenge is to find the proper information about the task in question (West, 2009). Often the main problems are connected with quality or clarity of given information; the offered information domain may be too huge, too detailed, or on the other hand too superficial or unclear. When the main purpose of the application is information delivery, clarity, trustworthiness, and optimal information richness are essential features for success. Novice learners can feel overloaded by PBL in an online environment (Jung et al., 2011). Many health consumers are novices in health affairs when it comes to information gathering and filtering; hence direct instruction and presentation may be the most useful ways at this level. This means that problem-driven approaches are not very suitable for this stage in consumers' health training and management, whereas the product quality — the content quality of given information — is critical.

Levels of knowledge processing; problem-solving

In this context knowledge processing means the need for an intensive support in knowledge management. Ill-structured cases require applications that could offer intensive guidance and support in the upper cognitive skills and connected thought processes. The user has to analyze the given

information when trying to apply it and needs space for one's questions (symptoms, optional treatments, and interventions). Such analytical steps prompt self-diagnostics and problem-solving. PBL techniques attempt to foster higher-order cognitive thinking skills (Weiss, 2003) and inspire to creative idea communication (Starko, 2005). Solutions that support upper cognitive levels are e.g., applications that deal with a challenging, specific disease, or problem area (e.g., diabetes, musculoskeletal disorders). In addition to method selections there is also need for creative design insights when planning efficient process support. Several products designed for patients' self-health management contain aspects that are typical for PBL approaches: peer support (small groups), online consultation with health professionals (tutors), and problem-solving toolkits for self-paced learning (self-directedness). Building online teams, however, requires more effort than building face-to-face teams (Savin-Baden & Wilkie, 2006). Process quality is critical in this step (access and quality of consultancy or tutoring). Many informative e-Health domains have a peer group support option (i.e., patients with the same health problem). However, expert tutors are generally more effective than non-expert tutors (e.g., Eagle et al., 1992). The impact of PBL, depends on the tutors' quality and the students' motivation (Woltering et al., 2009). Hence, in the health sector, peer support should always be complemented by professional expertise. Blended models with self-regulative online training periods and traditional consultancy with health professionals are natural choices in this area (e.g., patients with chronic diseases typically have ongoing consulting interventions with professionals). Digital products may intensify these consultancy appointments by enhancing patients' knowledge processing with problem-solving toolkits and offer in this way equity for communication processes, which is one aim of PBL-connected philosophies. PBL-connected ideology underscores intense self-management (self-regulation) and cooperation. If solutions and training formats generally offer more space for customers' own thinking and questions, this may also promote more balanced communication between health professionals and consumers. PBL approaches emphasize connected training programs. These should also cover health professionals, just to motivate them to accept the idea of more dialog-emphasized communication. Problem-driven approaches or

their hybrids may work well in levels, which require more sophisticated thinking procedures, but only if patients' knowledge level of substance area is intensively supported. Also, following an orthodox PBL approach too intensively may only give designers an extra burden as a necessary frame or method to follow. It is important for the designer to have the freedom to test also all kinds of new ideas in a novel design area. The design environment is more constructive if there is enough flexibility for all kinds of hybrids; for example, blended PBL may be better than traditional PBL courses (Woltering et al., 2009). In PBL, there are many models for the actual problem-solving process. In the health area, the process from the initial problem to the completed problem may be less straightforward. Hence, every case needs a problem-solution process that is contextual enough, meaning that general guidelines may offer only a rough idea as a foundation and require validation of its specific purpose.

Levels of creating and evaluation; creative problem-solving

The level of "creating" requires support systems that can enhance one's health status in the long view (efficient decision-making, discipline strategies, motivational aspects). The customer has to define how to develop new kinds of self-curative practices, how to change health-related behaviors, and how to self-evaluate progress. This level of continuity requires professional help, but also eagerness for intense personal considerations and interventions which require intellectual activity and creative problem-solving. When service users realize that their active undertakings and creative inputs are wanted aspects, this may motivate them towards better customer activity. Thus, problem solution at this level, means striving for better health status with more balanced cooperation accentuating, however, the customer's role and independent contribution in the process. This requires as well solid substance knowledge and its support, but especially, "enough space" for consumer's own opinions and insights.

Taxonomical stage (Newcomb-Trefz)	**Activity/emphasized PBL element, PBL intensity recommendation (-, +)**	**Applicative support/task** (instructional responsibility)
Remembering (knowledge)	*Health information acquisition* (substance knowledge domain) **(-)**	Content quality of information/ substance knowledge of prevention, curative actions; prerequisite for PBL-approaches
Processing (comprehension, application, analysis)	*Contextualization to health status* (problem-solution domain)/ authentic tasks, problem-solving skills, real problems **(++)**	Professional tutor support, individual processing/tools for interaction and self-processing
Creating (synthesis)	*Changes in health-related behavior* (solution domain)/learner activity & commitment, goals & creativity **(++)**	Professional tutor support, individual processing/tools for discipline techniques and space for consumer's contributions
Evaluating	*Progress in self-evaluation* Ownership & development **(+)**	Tools for self-evaluation, feedback system

Table 1: Examples of the supporting tools' functions and intensity in PBL emphasized design

Table 1 gives an example of the functions an application could offer in each cognitive category. An emphasized PBL element is also mentioned in each category using taxonomy by Newcomb-Trefz (1987). The usefulness of a problem-driven approach is estimated as most rewarding in areas of knowledge processing (contextualization or problem-solving) and creating (changes in self-health management or creative problem-solving) because in these levels, problem-solution scenarios may support ideology and connected plans in a plausible way. However, at the beginning, intense substance knowledge is needed as a requirement for problem-solving procedures in general and this knowledge acquisition is most successful using direct instruction methods (level of knowledge).

Discussion

The ideology behind the PBL approach contains aspects that are aligned with common targets in health care. In PBL, learning is a constructive and active process with purpose to foster self-directed learning skills and "learner ownership of the process" (e.g., Hmelo, Silver, 2004, Pijl Zieber, 2006). Problem solving in general makes activities interesting and intellectually challenging, but problem solving which allows or requires also creative contributions, is more interesting. Creative contributions require enough independency. In health sector, independency in problem-solving is possible if it is connected with more intense substance knowledge base and this knowledge is likely more understandable if it is presented for consumers using direct instructional methods. Hence, problem-driven approaches in consumer targeted applications may be rewarding if designed in a way which attracts users, allows possibilities for creative and independent procedures, and supports these activities by offering substance knowledge deep enough. These requirements make design efforts also in this area more challenging but may mean also more customer activity when it proceeds successfully. Design that supports consumers' abilities for independence and intense cooperation with health professionals is welcome, but also requires that health professionals understand and accept such ideas. Hence, effective training programs for health professionals and program members are required for success (e.g., Gwee, 2009). Health consumers need enough "space" for individual insights and opinions, but also a well-functioning feedback system. The idea of building "a problem-solution frame" for self-health management is not irrational. In curative processes, the question is also about realistic problematic scenario planning, especially in decision-making of upper cognitive levels. Health professionals or training consultants may work as tutors and peer groups with the same problem could offer motivating support. Blended models give many possibilities for traditional PBL elements (small tutored groups, collaborative peer support); therefore, models that integrate digital applications with different kinds of offline activities offer possibilities for these kinds of approaches. In addition, hybrids that combine PBL models and task-based learning (e.g., Takahashi, 2008) or case-based reasoning might offer useful combinations.

The overall strategic selections dictate which solutions work best. It is useful that "an innovation is not evaluated and understood in isolation, but rather as an integral part of the context" (Jacobs, 2000). Innovative product design means contextual considerations when it comes to design strategies and connective selections. "PBL can take many forms of both processes and products" (Knowlton, 2003). It is meaningful to consider case by case if a problem-driven approach is a useful starting point or frame model and to assess which kinds of good insights the PBL approach or related extensions may offer to a design strategy. Design-based research that in this context also "bridges theory and practice" (Dolmans et al., 2005) is also necessary in eHealth. The mission of the product dictates what kind of pedagogical approach makes sense and is of added value; too guiding models may frustrate designers as well as users, making designers blind to novel approaches and limiting their own insights. Also, in this way, "an overemphasis on rigor can lessen relevance" (Hevner et al., 2004) or too rigid methodology choices may disturb creative insights in design. It is important to assess which kinds of values will be selected as frame values to the design and connected training and how these values reflect to training process and evaluation. Following quality led questions are useful when evaluating design strategy choices. Do embed ideological aspects or techniques of the PBL approach enhance, support, or strengthen these areas and in which way implemented?

Mission view: How the training is targeted and what is its mission?

Process view: In which way does the planned training format fulfill its mission best?

Product view: What kind of toolkit or product supports the planned training in an optimal way?

Customer view: In which way are customers' needs and substance knowledge level supported?

Efficiency view: How the efficiency of the training campaign or format is guaranteed?

Ethical view: What kinds of ethical considerations should be undertaken?

Image view: In which way will connected image issues be evaluated?

Conclusion

Instead of problems, the new direction in health-related information delivery underlines terms such as prevention, health care delivery, and "wellness" (Camp, 1996). However, creative problem-solution approaches represent intellectual activity and can hence increase customer activity if the substance knowledge level of customers is supported at the same time. PBL is based on four insights on learning: constructive, self-directed, collaborative, and contextual learning (Dolmans et al., 2005) and these represent aspects that are also plausible in health related digital products. Also, the problem-solution approach is not illogical for use in health management. Constructivism contributes to the idea of a more equal learning process, learners' actions, and ownership of the learning process (Gijselaers 1966). Consumer-targeted e-Health applications are attempting to enhance customers' knowledge level and hence consumers can be more equal partners with health professionals when it comes to decision-making and problem-solving in their health processes. PBL lays emphasis on pragmatism and collaboration; "joint activity" in problem solving" (e.g., Hmelo-Silver, 2004, Pijl Zieber, 2006). These ideas bring more equity to health communication between health professionals and consumers when customers' ideas and concerns get more weight in communicative processes, producing more patient-focused health care. When applying these ideas to digital design, the designer has to ensure enough space for his or her own ideas even if PBL would be the selected, inspirational source for design. In spite of that inspirational problem focused model frames are welcome to the area.

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