The Problem With Problems in Problem-Based Learning: Difference Between Problem Explaining Versus Problem Solving

Lisette Wijnia

Department of Psychology, Education and Child Studies, Erasmus University Rotterdam, The Netherlands, wijnia@fsw.eur.nl

Follow this and additional works at: https://hpe.researchcommons.org/journal

Part of the Health and Physical Education Commons

Recommended Citation


Available at: https://hpe.researchcommons.org/journal/vol2/iss2/1

This Editorials is brought to you for free and open access by Health Professions Education. It has been accepted for inclusion in Health Professions Education by an authorized editor of Health Professions Education.
The Problem With Problems in Problem-Based Learning: Difference Between Problem Explaining Versus Problem Solving

In problem-based learning (PBL), small groups of students are presented with a problem before they receive any other curriculum input on that topic.1,2 Although PBL is a popular educational method in the health professions and other domains, its effectiveness has been heavily debated. An important point of debate is whether or not it is effective to let students engage in problem-solving activities at the start of the learning process with limited prior knowledge.3 According to cognitive load theory (CLT), novice learners always require explicit instruction that explains all the targeted concepts and procedures without a need for learners to infer anything on their own.4 Only after learners have obtained task-specific knowledge, this explicit guidance can be removed in further instructional phases. Alternatively, from a PBL-perspective, learners’ engagement with problems, such as generating explanations, will facilitate further learning instruction, because these activities will activate their prior knowledge and trigger their interest.5

Researchers from both sides of the debate have found evidence for their claims.6,7 These contradictory results have made it difficult to come to a better understanding of each other’s findings. Although, the debate often focuses on the amount of instructional guidance that is present,3,8 one thing that is often ignored is that the interpretation of “problems” and “problem-solving” differs vastly in the context of CLT versus PBL-research. Perhaps some of the contradictory results can be explained by these different interpretations.

Within CLT-research, the main goal of instruction is the acquisition of domain-specific knowledge.4 Therefore, engaging in problem-solving activities is only effective when this results in learning the correct problem-solving procedure. Problem-solving activities, in this context, usually consist of finding solutions to conventional problems that contain a description of given facts and a question without the final solution or outcome.7 For example, the problem statement could be to calculate how far someone has travelled by bike, using “givens” such as the person’s average speed in kilometers per hour and the time he/she spent cycling. Based on what is known about the functioning and structure of human memory, CLT-researchers argue that it is ineffective for novice learners to explore or solve problems on their own without explicit instruction.3 Whereas long-term memory is practically unlimited, students have a limited working memory capacity for dealing with new-to-be-learned information.9 Solving problems without sufficient prior knowledge will therefore result in investment of time and mental effort on processes that might not be relevant for learning.3 Instead, it is better to give novice learners worked examples, which provide step-by-step instructions on how to solve a problem. In support, Van Gog et al.7 demonstrated that, for the acquisition of domain-specific knowledge, studying worked examples before engaging in problem-solving practice was more effective than solving problems before studying examples. Potential explanations suggested for these results were novice learners’ inability to recognize their deficiency in solving the problem and reduced motivation caused by failed problem-solving attempts.

The problems and problem-solving activities used in CLT-research on worked examples, differ however from the problems and the problem analysis activities performed in PBL. Although the terms “problem” and “problem solving” are often used when describing the PBL method1,10 they are quite misleading. The word “problem” points people to thinking that there is something to be solved or an outcome to be predicted.11 However, in PBL, the problem is usually a description of a phenomenon or event in daily life that needs to be explained by use of prior

http://dx.doi.org/10.1016/j.hpe.2016.09.004
2452-3011/© 2016 King Saud bin AbdulAziz University for Health Sciences. Production and Hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
knowledge and common sense.\textsuperscript{2,6} Consider for example the red blood cell problem used in research by Schmidt and colleagues: “A red blood cell is put into pure water under a microscope. The red blood cell swells rapidly and eventually bursts. Another red blood cell is added to a solution of salt in water and it is observed to shrink”.\textsuperscript{6} Notice that in this description the \textit{outcome} of the phenomenon is already known. Students are not asked to predict what would happen if a red blood cell is put in various water solutions, instead they are asked to come up with a tentative explanation of processes, mechanisms, and principles underlying these phenomena. Other examples of these types of problems can be found in the context of problem-based science and psychology education.\textsuperscript{12,13}

In other words, the problem and the learning activities proposed to deal with them differ in the two strands of research. In CLT, problems need to be solved with the instructional goal of learning the correct problem-solving procedure.\textsuperscript{4,7} Alternatively, in PBL the “problems” are mainly used as a “trigger” aimed to prepare students for future learning.\textsuperscript{5,11} For the advancement of research examining the (in)effectiveness of PBL, we need to take a step back. We need not only take into account differences in the instructional aim of the problem activities,\textsuperscript{4} but also differences in the type of problem-activities, namely: predicting the solution versus explaining the solution or outcome.

Perhaps some of the mixed results found in prior research\textsuperscript{5,7} can be explained by the difference between \textit{predicting} versus explaining. In future research, we therefore need to consider how the difference in type of problem-activities affects the effectiveness for obtaining different instructional goals, such as prior knowledge activation, motivation and interest, and learning. Additionally, the efficiency in which learning outcome are achieved needs to be considered (e.g., mental effort experienced or time-on-study). If we succeed in contrasting the different types of problem-solving activities, we might be able to bridge gap between research on CLT and PBL.

**Disclosure**

**Ethical approval**

N/A.

**Funding**

None.

**Other disclosure**

None.

**References**

11. Plowright D, Watkins M. There are no problems to be solved, only inquiries to be made, in social work education. \textit{Innov Educ Train Int} 2004;41:185–206.

**Lisette Wijnia**

\textit{Department of Psychology, Education and Child Studies, Erasmus University Rotterdam, The Netherlands}

\textit{Roosevelt Center for Excellence in Education, University College Roosevelt, Utrecht University, The Netherlands}

\textit{E-mail address: wijnia@fsw.eur.nl}