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Cindy E. Hmelo-Silver

The theme of this special issue is timely as the world becomes increasingly flat and globally connected (Friedman, 2007). By focusing on an international perspective in problem-based learning (PBL), it puts culture squarely in the center, whether it is a national or disciplinary culture. The articles in this special issue represent Thailand, South Africa, the Netherlands, the United Kingdom, and the United States. They represent disciplines that include engineering, business, hotel administration, social studies, and sport and exercise physiology. Student populations range from secondary school to postgraduate. It is clear from this collection that PBL serves diverse student populations who have differing needs. Some of the articles discuss the challenges that learners face, in particular, learning to do PBL, whether a result of prior knowledge, language, or experiences in schooling. A consistent theme throughout the special issue is that there are different models of PBL adapted to their local contexts and cultures.

Hallinger and Lu considered the challenges of adapting PBL design to the culture of East Asian higher education in Thailand. The article opens with an anecdote about using a Walmart business case in an Asian context that did not have experience with Walmart. One of the tenets of PBL is that problems should be authentic (e.g., Hmelo-Silver, 2004), but what is perceived as authentic is highly dependent on the learner's cultural and disciplinary context. For the business students in Thailand, Walmart did not meet those criteria adequately. In this research, PBL was conceived as a curriculum-wide intervention for a Graduate School of Business. A problem-stimulated model was selected to provide additional structure that would be more culturally congruent. Students worked in self-managing teams, so one of the adaptations was to distribute scaffolding among the problem materials. Problems were designed to fit the sociocultural context of Thailand and took into account the norms and organizational structures. Without such adaptation, it was unlikely that students would have been motivated to engage with the problems. In implementing PBL, the design team also had a challenge of resources largely being in English rather than in the students' native language. To manage this, Hallinger and Lu filled in with short lectures presented on a need-to-know basis after students had started

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working on a problem. Course evaluations showed growth in student perceptions of course effectiveness and engagement over time. This is important to note as it reminds us, it takes time for both students *and* faculty to adjust to new norms when one undertakes a new design. It also takes time to fine-tune the problems to accomplish the learning goals (Hmelo-Silver & Derry, 2007). An important next step for this research would be to better understand student learning outcomes as well as qualitative analyses to see how the PBL process plays out in this context.

Henry, Tawfik, Jonassen, Winholtz, and Khanna are situated in an undergraduate engineering course in the United States. Although PBL has been used fairly widely in the US, engineering is a novel application and designers need to consider the culture of undergraduate students as well as the culture of engineering education. It was an implementation designed for a single course. In comparison with the Hallinger and Lu study, Henry et al. took a qualitative stance at understanding their enactment of PBL. Although PBL is a good fit for the problem-solving nature of engineering, the authors also noted that there were several challenges in PBL in engineering. These challenges included building on prior knowledge, creative solutions rather than replicative solutions, adapting to the level of self-directed learning required in PBL, and collaboration. Based on this, the designers focused on two types of problems: decision making and troubleshooting, as most appropriate for how the engineering students would have to apply what they learned about materials science. One way in which this model diverged from the traditional PBL model (Savery, 2006) is that along with the problem materials, students received a guide with relevant concepts and chapters that covered those concepts. Students were also given a worked example of the first problem as a model. In this model, scaffolding was again distributed among problem materials, planning worksheet, and facilitators (Puntambekar & Kolodner, 2005). The authors note that this level of scaffolding is particularly necessary in an undergraduate course (see also Hmelo-Silver, Derry, Bitterman, & Hatrak, 2009 for another example of distributed scaffolding in an undergraduate course). The research was used for formative evaluation and adjustment of their PBL model. The interviews suggested that the students had difficulty with the PBL structure. Based on this, some lectures were planned to address student misconceptions and address issues of collaboration. As in Hallinger and Lu, the lectures were scheduled after students had grappled with the problem. The results of their qualitative analyses demonstrate the students experienced challenges in meeting the demands of PBL, similar to results that other researchers have identified (Evensen, 2000; Evensen, Salisbury-Glennon, & Glenn, 2001). One major complaint was that students wanted more structure, and these lectures were added in response. But once the students learned that the lectures would be coming, they knew that with lectures would come answers, so this had the effect of undermining some of the goals of PBL around constructing one's own knowledge through self-directed learning. These new

expectations clearly created culture shock for the students; it would have been interesting at the same time to understand how the facilitators were adapting to their new roles. There were hints that the faculty did not buy in, and so adding the lectures was the most comfortable modification. It is also noteworthy that the students questioned what they could learn from others in their group and did not always perceive that they were engaged in knowledge co-construction. It would be illuminating to triangulate the interviews with observations and analysis of group co-construction to examine the extent to which the students' perceptions actually matched what was happening in the group. An analysis of the actual collaboration might indicate whether students were accomplishing more or less than what they reported in the interviews. Finally, contributing to the engineering culture is the nature of the assessments. Alignment between learning activities (PBL, in this case) and assessments (e.g., examinations) is crucial for engaged participation (Hickey & Zuicker, 2005). A strength of this study is that the researchers were willing to be reflective in identifying the challenges that students faced.

Singaram, van der Vleuten, Muijtjens, and Dolmans focused on the challenges of using PBL with students whose first language is not the same language as instruction. This study was conducted with medical students in South Africa. The PBL model was at the curriculum level and was supplemented with a small number of lectures. The authors reported that earlier qualitative research in this context found that language and academic achievement hindered group process and achievement. In this study, the results were quite straightforward in that students' prior achievement and English as a first language (EFL) predicted student achievement. EFL negatively affected group motivation, possibly because the native English speakers may dominate the group, a question worthy of further research. The authors argue that diversity in academic achievement and English language proficiency is part of the postapartheid legacy in South Africa and thus lead to challenges that extend into higher education. This research is based on self-report questionnaires and it would be enriched through the addition of observational data. Although the paper provides some suggestions for dealing with these challenges, it would be helpful to obtain more specific information and to consider the important question of how literacy instruction might be integrated into a PBL curriculum.

Zwaal and Otting bring PBL to the study of hospitality management in the Netherlands with a higher education population. They address a deficiency that has been observed in the PBL process: generating possible explanations and constructing a schematic representation through the use of concept maps. They argue that these steps are overlooked and they propose concept mapping as a possible method to address this. The results do not show any compelling effects of the concept mapping intervention. This may be another case where it would take a longer time to see an effect. Students may have needed more than one block to adjust to what was already a complex instructional

intervention. It would also be worth examining the quality of the concept maps, and the concept mapping process to see if a high quality process of constructing concept maps produced the kinds of effects the researchers hypothesized.

Another attempt to scaffold brainstorming is examined in Smith and Cook's report. Smith and Cook studied undergraduate Sport and Exercise Psychology students in the United Kingdom. They used de Bono's Six Thinking Hats model as a way to encourage students to take multiple perspectives when brainstorming. This was in addition to their PBL model, which used extended problems after an introductory lecture. In this study, they found benefits in both class attendance and academic achievement. The authors attribute the scaffolding to increasing motivation to prepare ahead for the tutorial session and thus lead students to get more out of the tutorial sessions, with better ensuing achievement. It is not clear why there would have been an effect on attendance. Further research could examine why those effects occurred. It would also be interesting to look at the quality of how students used the Six Hats approach (i.e., the solution sheets) and how that related to achievement, particularly for less skilled students. Such research would help open up the black box of this scaffold.

Summers and Dickinson brought project-based instruction (PBI) into a United States secondary social studies classroom. They argue that the authentic inquiry characteristic of PBI is an excellent fit for the discipline of social studies as they took a longitudinal view of four years of implementation. Thus, context was both the implicit context of US secondary education but also explicitly the discipline of social studies. What is particularly intriguing about the these results, comparing two high schools in the same district, is that the results suggested benefits for minority and economically disadvantaged students on pass rates for state tests. A statistical analysis would be very helpful in understanding the magnitude and reliability of these findings. The authors did find, however, that English as the First Language (EFL) students were more likely to be retained in the first year of the PBI curriculum, consistent with the results of the Singaram study, suggesting that PBI or PBL may be challenging for students with limited language proficiency.

Together, this set of papers demonstrates that PBL is being used in a wide range of disciplines by an international PBL community. The two big themes that jump out of this special issue are the need to adapt to local contexts, whether that is cultural or disciplinary contexts (e.g., Hallinger and Lu, this issue; Henry et al., this issue; Summers & Dickinson, this issue). Some of these adaptations have included lectures—so this begs the question as to whether these are appropriately placed just-in-time information resources or whether they are undermining some of the goals of PBL as in the Henry et al. study—creating what Brown and Campione (1996) have called "lethal mutations." Further research is needed to understand the tradeoffs in different adaptations of PBL to understand which ones are pragmatically useful and productive, which ones may pit one goal against another (e.g., sacrificing self-directed learning goals as a tradeoff for more efficiency in content

coverage), and which ones no longer seem to be PBL. In some sense, these can be helpful in identifying a hard boundary, if indeed one exists (and they often don't, as found in Hmelo-Silver, Duncan, & Chinn, 2007).

Another theme that permeated these studies was a notion of distributed scaffolding (Puntambekar & Kolodner, 2005). The facilitator provides one important source of scaffolding, but several of these studies used other scaffolds as well—through structuring the problem, providing worksheets, creating concept maps (e.g., the Zwaal & Otting study), or encouraging multiple perspectives (as in Smith & Cook study's use of the Six Thinking Hats). Distributed scaffolding is particularly useful in thinking about how technology might play a role in PBL (e.g., Bridges, Botelho, & Tsang, 2010; Hmelo-Silver et al., 2009), particularly in extending the human facilitator as PBL is scaled to larger groups. But a word of caution is that we need to see both sides of the elephant as we try to understand how these adaptations and scaffolds help deal with the challenges in enacting PBL in diverse environments. To accomplish that, as a community, we need mixed methods that help us to understand not only what students learn, but how students learn and how facilitators use these new models and tools.

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