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University Teachers' Conceptions of Their Role in Teaching Problem-Solving

Natia Bendeliani

Eötvös Loránd University, Hungary

ORCID: https://orcid.org/0009-0005-3311-9301

Tibor Bors Borbély-Pecze

Eötvös Loránd University, Hungary

ORCID: https://orcid.org/0000-0002-5304-9356

Abstract

Equipping young adults with problem-solving skills is critical in today's knowledge economy. Universities have increasingly adopted approaches like problem-based learning (PBL) to foster critical thinking and independent learning. However, while extensive research exists on the benefits of PBL, less attention has been given to studying tutors' conceptions about their role from a phenomengoraphic research perspective. This study addresses this gap by investigating university tutors' conceptions of their roles in teaching problem-solving skills within a PBL environment. Data from interviews with 15 tutors identified a progression of conceptions, from creating a safe learning environment to fostering independent learners. Each conception affects practices in tutorial groups, shaping inquiry depth, collaboration quality, and transferable skills development. The findings highlight the importance of understanding tutors' roles in enhancing the potential of PBL to equip students with essential problem-solving skills. By uncovering the diverse ways tutors conceive their role, this research offers actionable insights for academic developers and educators aiming to refine teacher training programs and foster student-centred learning in higher education.

Keywords/key phrases: problem-solving, student-centred learning, higher education, role of teacher, problem-based learning

1. Introduction

In today's rapidly evolving "knowledge economy," the skill of memorising facts and procedures is insufficient in itself. The Organization for Economic Co-operation and Development (OECD) (2018; Foster & Piacentini, 2023) identifies complex problem-solving as one of the most sought-after skills for graduates in fields requiring advanced expertise, such as management, technology, and professional work. Similarly, the European Skills Agenda underscores the necessity of fostering

transversal skills, including decision-making, problem-solving, communication, adaptability, etc. and calls on higher education institutions to address this gap (European Commission, 2016, 2020).

Although universities are trying to respond to this challenge to equip students with problem-solving skills, misconceptions and challenges occur about how it should be taught (Van Merriënboer, 2013, Dolmans et al., 2015). Approaches such as interdisciplinary learning, inquiry-based learning, and problem-based learning (PBL) have recently been gaining prominence. PBL in particular has drawn significant attention for its potential to develop critical thinking, independent learning, and transferable problem-solving skills. Rooted in student-centred learning pedagogy, PBL requires students to engage with real-world problems, fostering deep inquiry and self-directed learning (Dochy et al., 2003).

Despite the growing emphasis on PBL, there are notable gaps in understanding how tutors' conceptions of their roles influence its implementation. Research highlights that teachers' beliefs and attitudes significantly shape their instructional strategies and student outcomes. Foundational studies in this area have established key theoretical frameworks that continue to inform contemporary research (Chan & Elliot, 2004; Trigwell et al., 2002). However, little attention has been given to how PBL tutors perceive their roles and how these perceptions impact the development of students' problem-solving abilities (Hendry, 2009, Chng et al., 2011, Azer 2005). While factors such as institutional support and student dynamics are significant in the PBL environment, understanding tutors' conceptions is crucial. This understanding helps address the challenges of implementing PBL effectively and enhances its potential to equip students with skills demanded by the modern workforce.

This study is particularly relevant for educators, academic developers, and policymakers interested in enhancing teaching strategies for skill development in higher education. Understanding the developmental spectrum of PBL tutors' roles can inform teacher training initiatives, ensuring that tutors are well-equipped to help students transition from structured learning environments to becoming independent problem-solvers. For individual tutors and higher education teachers, this research provides a reflective lens to evaluate and refine their practices, fostering a deeper commitment to student-centred learning.

2. Theoretical Framework

2.1. Conceptions of Teaching and Learning

Conceptions of teaching and learning form the foundation of this study, providing a lens through which to understand teachers' conceptual understanding of certain phenomena. The relationship between beliefs and practices has been a focal point of educational research. Kwan and Kember (2000) highlighted this connection, building on Kember's (1997) model, which demonstrates how academic conceptions of teaching influence teaching approaches.

Teaching approaches are typically categorised as content-centred or learning-centred. Content-centred approaches prioritise the transmission of material, focusing on delivering knowledge efficiently. Learning-centred approaches, by contrast, emphasise facilitating student learning and fostering independence. Interviews conducted by Kwan and Kember (2000) revealed two corresponding conceptions of teaching: "Teaching as the transmission of knowledge," which aligns with content-centred approaches, and "Teaching as learning facilitation," which aligns with learning-centred approaches. Their findings showed a strong alignment between beliefs

and practices, with 88.9% of lecturers who viewed teaching as knowledge transmission adopting content-centred approaches and 87.5% of those emphasising facilitation adopting learning-centred approaches. These findings underscore how teachers' conceptions serve as a cognitive framework that influences not only their instructional choices but also student engagement and learning outcomes (Postareff & Lindblom-Ylänne, 2008).

This theoretical grounding establishes the relevance of studying tutors' conceptions, as it allows us to examine how their implicit beliefs contribute to PBL facilitation. However, this study does not seek to determine a correlational relationship between conceptions and practice but to broaden the discourse on how tutors understand their own roles in PBL and contribute to deeper pedagogical reflection. Instead, we focus on mapping different levels of awareness of tutors' conceptions.

2.2. Variation Theory of Learning and Its Role in Higher Education Teachers' Professional Development Research

Variation theory (VT) of learning explains how individuals come to perceive, understand, and experience a phenomenon by recognising its critical aspects through structured variation (Marton, & Booth, 1997). It is grounded in the idea that learning occurs when learners discern essential features by experiencing differences and contrasts in relevant dimensions. Variation theory has become a foundational framework in pedagogical research, providing educators with valuable insights into how students learn by identifying which aspects of a concept need to be highlighted through variation (Kullberg et al., 2024). By systematically varying instructional approaches, teachers can enhance students' engagement and deepen their conceptual understanding. Variation theory of learning, emerging from phenomenography, focuses on mapping different ways people understand phenomena and has implications for pedagogical design in higher education (Åkerlind, 2015). This theory conceptualises learning as a qualitative change in how learners experience or perceive a situation, defined by the critical aspects they simultaneously focus on and discern (Marton & Pong, 2005). By exposing learners to specific patterns of variation and invariance, they can better discern critical aspects, enhancing their professional capabilities to handle novel situations.

This theory's development led to studies on teachers' professional development. Similar to how VT helps educators understand how students perceive concepts differently, it can also reveal how teachers experience teaching practices in different ways (Lo, 2012). This perspective is particularly useful for professional development programs, as it helps tailor training initiatives by addressing the variations in teachers' pedagogical understanding and instructional strategies. Thus, Variation Theory is not only a tool for improving student learning but also an essential framework for understanding teacher cognition and professional growth, making it a versatile approach to education research and training (Åkerlind, 2015).

This research, grounded in variation theory and the phenomenographic research approach, and supported by the conceptions of teaching and learning framework, seeks to understand problem-based learning (PBL) teachers' conceptions of their role in order to discern qualitatively different understandings of a phenomenon. The study aims to form and construct a framework that can be used as a self-evaluative tool for educators, while also serving as a valuable asset for academic developers to assess tutors' existing conceptions and design tailored professional development programs.

Beyond addressing PBL tutors specifically, this research extends to higher education teachers more broadly, offering insights into teaching problem-solving and the role of educators in facilitating the learning process. By deepening their understanding of these concepts, higher education teachers can refine their instructional approaches and enhance their effectiveness in supporting student learning.

3. Research Objective and Question

The primary objective of this research is to explore the qualitative variations in university teachers' conceptions of their role in facilitating problem-solving within PBL tutorials. Using a phenomenographic approach, this study seeks to identify commonalities within these variations and examine how different conceptions are hierarchically related, from least to more complex understandings. Rather than focusing on disciplinary differences or experience levels, the study investigates how tutors experience and interpret their role in distinct yet interconnected ways, shaping their instructional strategies and student interactions. The outcome will be a developmental framework that helps teachers situate their own conceptions within a broader spectrum of awareness and understand pathways for growth in their facilitation of problem-solving in PBL contexts.

Research Question: How do university teachers conceptualize their role in the process of facilitating PBL tutorials?

4. Research Design

4.1. Phenomenography

Phenomenography is a qualitative research approach that explores variation in how people experience and conceptualize aspects of their world (Yates et al., 2012; Åkerlind, 2005). It focuses on a second-order perspective, examining individuals' conceptions rather than the phenomena themselves. Phenomenographic research emphasises the importance of variation in findings, with each unique statement considered valuable, regardless of frequency. The results are interpreted as revealing the collective experience of the phenomenon rather than individual perspectives. Unlike methods that simply categorise participants' views, phenomenography explores the relationships between these categories and the meanings embedded within them, offering deeper insights into the complexities of the phenomenon (Marton & Pong, 2005). This approach moves beyond generic 'right' or 'wrong' answers to highlight specific aspects and layers of understanding (Åkerlind, 2005).

> Different ways of understanding are sometimes described as being more or less ‘complete’. What is meant by this is that in the way phenomenography undertakes its analysis, every way of understanding discerns some aspects of the phenomenon but not other aspects. So, in this sense, every way of understanding discerns something important about the phenomenon, but not everything that is important about the phenomenon (Åkerlind, 2025, p. 32).

Phenomenographic research has demonstrated its utility in planning academic development programs (Åkerlind, 2015; Booth & Ingerman, 2015; Wright & Osman, 2018). By capturing a range of conceptions, this methodology helps educators and institutions evaluate and enhance teachers' understanding of critical teaching phenomena. The outcome space generated through

phenomenography serves as a reflective tool, enabling teachers to recognise their current conceptions and identify areas for growth (Green, 2005). This theoretical and practical application of phenomenographic research enables us to study PBL tutors' conceptions.

4.2. Participants of the study

The study was conducted among PBL tutors at Linköping University in Sweden. Over the years, PBL has been integrated into several programs across four faculties, making the university a pioneer in this pedagogical approach. The sample included 15 PBL tutors from diverse disciplinary backgrounds, ensuring a broad representation of perspectives. The selection of participants was determined by the number of tutors who agreed to participate in the study. While the initial goal was to capture a diverse range of experiences, we found that data saturation was reached within this sample. It also aligns with research design norms, where the sample size usually ranges from ten to twenty participants. The sample included both male (6) and female (9) tutors, with teaching experience ranging from less than 10 years to over 30 years. The academic qualifications of the participants varied, including professors, associate professors, and senior lecturers, representing fields such as Biomedical and Clinical Sciences, Behavioural Sciences, Health Sciences, and Computer Sciences.

4.3. Data collection and analysis

Data was collected through in-person, semi-structured interviews, allowing for flexibility in probing participants' experiences while ensuring consistency in key themes. Interviews lasted between 45 minutes to 1 hour and focused on tutors' conceptions of their role in PBL tutorials.

The research followed the set of guidelines to analyse phenomenographic data. Several authors were revised and revisited as there is not one fixed guideline for analysing phenomenographic data. Finally, we relied on Åkerlind's (2025) revised steps to analyse data, which is stated in her recent book "Phenomenography in the 21st Century: Investigating Human Experience of the World". As there are two schools in phenomenographic analysis to condense data, we employed more of a 'transcript as a whole' approach (Green, Bowden, 2009). Each transcript was read and understood as a complete conversation. "Meaning-laden" statements for the phenomena were highlighted and kept together, and a short summary of the interview was written. This way, we were able to capture the interviewees' conceptions better, taking into account their context, background, and the flow of the conversation. After familiarising ourselves with the data and identifying the meaning units, we clustered similar ways of experiencing the phenomenon. By contrasting and comparing the groups, we formed categories of description. The final step was to structure the outcome space, which in phenomenographic research means arranging categories hierarchically to show relationships and levels of completeness in understanding.

The possible bias of the researchers was mitigated by conducting dialogic reliability checks with prolific phenomenographic researchers, ensuring that the emerging categories and outcome space were critically reviewed and refined.

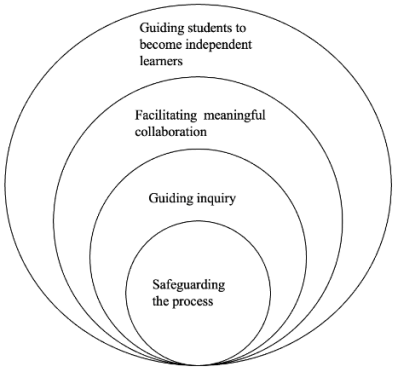
5. Results

Tutors conceived their role in four qualitatively distinct ways: (1) safeguarding the process, (2) guiding inquiry, (3) facilitating meaningful collaboration, and (4) guiding students to become

independent learners. Figure 1 illustrates how these conceptions form hierarchically inclusive categories, meaning that each subsequent category builds upon and integrates the critical aspects of the previous ones, creating a more comprehensive understanding of the phenomenon. While category 1 is considered the least complex and category 4 the most complex, this should not be interpreted as a ranking where one category is superior to another. Instead, as phenomenographic researchers suggest, these categories complement and complete each other rather than being distinct or sequential stages (Åkerlind, 2005).

The findings of this study are structured as a hierarchical outcome space, reflecting qualitative variations in tutors' conceptions of their role in facilitating problem-solving in PBL tutorials. In line with phenomenographic principles, these categories are not isolated or independent but inclusive, meaning that a tutor holding a conception in a less complex category may not yet discern all the aspects of problem-solving facilitation that are incorporated in the more complex categories. However, this does not imply a linear progression; rather, each category represents a distinct way of experiencing PBL tutoring, contributing to a broader understanding of facilitation in this context.

FIGURE 1. TUTORS' CONCEPTIONS OF THEIR ROLE



Source: The figure was developed by the authors

5.1. Safeguarding the process – Category 1

This foundational category reflects the most basic level of tutor involvement in the PBL process. Tutors focus on creating a secure learning environment where students feel confident in the group work process. By providing clear guidelines, setting agendas, and maintaining structure, they aim to reduce students' anxiety and build trust within the group. As one tutor described:

> *"The main responsibility of a tutor is to make the group feel secure that they are on the right track. So basically, the tutor's role is to give confidence to the group… I mean, you need to do some sort of contract with the group, but that is more formal, but you also need to do a sort of psychological contract with the group so that the group trusts…" (Response N13).*

This category represents the least complete conception of a tutor's role, emphasising the importance of structure and stability. However, tutors in this category do not yet discern the broader aspects of facilitation, such as guiding intellectual inquiry or fostering deeper collaboration. Their focus remains on process management rather than actively shaping student

engagement with the content. While this provides a necessary foundation, students may become overly reliant on structured guidance and hesitate to take initiative in problem exploration.

5.2. Guiding Inquiry – Category 2

The second category highlights the tutors' role in stimulating critical thinking and reflective inquiry. Tutors actively engage students by posing thought-provoking questions and modelling reflective practices. As illustrated in the quotations below, they move beyond structuring the process to encouraging students to explore problems in depth.

> *"So I would say… if I had to pin it down, I would be the one asking questions to help the students to think and to sort of Socratic thinking, Socratic questioning. Where in order to get deeper into the problem, you ask questions to get deeper into the problems and help you reflect" (Response N15).*

This category expands on the first by adding complexity to the tutors' role by acting as a facilitator of inquiry. PBL tutors who hold this conception about their role tend to master the skills of asking critical questions. However, they find it difficult to balance this role by assisting students to reach the final goal or the final solution of the problem.

5.3. Facilitating Meaningful Collaboration – Category 3

This category emphasises the importance of fostering productive group dynamics. Tutors aim to help students move past surface-level discussions to engage deeply with each other's ideas. As one tutor shared:

> *"It's a lot about just learning PBL structure and working in a group. A lot of the students have bad experiences with group work. And I say group work, okay, you do this, and you do that, and these students never help. However, I need to get the students to understand that they are here to help each other and that when they meet, they will reach further than if they separate and do one thing each. I don't want them to only report what they read in the previous week, but to share the knowledge and participate in knowledge construction by meaningful communication" (Response N11).*

This role includes guiding students to engage critically with peers' contributions and promoting a collaborative environment that builds on earlier conceptions. Tutors in this category enable students to co-construct knowledge through dialogue and teamwork. In practice, guiding meaningful collaboration requires a facilitator who administers the process (category 1) and who can guide inquiry (category 2). In practice, it involves helping them revisit previous discussions, wrap up where they left off, and recognise what they might have overlooked. Tutors can encourage deeper engagement by reminding students of past arguments, prompting connections between different perspectives, and guiding them to critically assess their reasoning. At the same time, this process must not turn into a rigid structure where students simply report their readings or prior conclusions. Instead, the goal is to encourage active knowledge construction through ongoing reflection and discussion.

5.4. Guiding Students to Become Independent Learners – Category 4

The final category represents the most complex and inclusive conception of the tutor's role. Tutors focus on helping students become independent learners capable of self-organising, self-evaluating, and transferring their skills beyond academic contexts. As one tutor expressed:

> *"So I mostly want to make sure that students develop their own capacities for guiding their own work. That's the whole point of PBL, as I see it. So, I want to ensure that they can self-organise, self-evaluate and become reflexive learners. That's the most important task" (Response N3).*

This category integrates and transcends the previous roles, emphasising self-reflection, autonomy, and lifelong learning. Tutors in this conception emphasise that their role is not to control or limit students' learning paths but to create an environment where they are encouraged to explore topics of personal interest within the discussion. This means allowing students to self-organise their learning process and recognise how their interests connect to the broader problem under investigation. This conception also acknowledges that while structure, inquiry, and collaboration are all critical aspects of PBL facilitation, they must ultimately serve the broader goal of developing self-directed learners.

6. Discussion

The findings of this study align with and extend prior research on the roles and conceptions of tutors in PBL. The four identified categories – safeguarding the process, guiding inquiry, facilitating meaningful collaboration, and guiding students to become individual learners, resonate with existing frameworks, but also offer unique perspectives as they demonstrate tutors' expanding awareness of their role. By illustrating how different conceptions of facilitation build upon one another, this framework offers a novel, self-evaluative tool for tutors to reflect on their practice and develop a more nuanced understanding of problem-solving instruction.

A limited focus on only one category of facilitation, without recognising the broader interconnected aspects of tutoring in PBL, may constrain both instructional effectiveness and student learning outcomes. When tutors do not discern the more complex dimensions of facilitation, they may unintentionally restrict students' ability to engage in deep, independent problem-solving. For instance, if a tutor primarily focuses on safeguarding the process, students may become overly reliant on structured guidance and fail to develop critical inquiry skills. Conversely, if a tutor focuses solely on guiding inquiry but neglects collaborative dynamics, students may engage in deep questioning yet struggle to co-construct knowledge effectively within the group. Similarly, if meaningful collaboration is emphasised without fostering student independence, learners may become skilled in teamwork but lack the ability to regulate their own learning beyond structured discussions. This suggests that PBL tutoring is most effective when tutors recognise how these conceptions build upon one another, ensuring that students develop not only structured problem-solving habits but also the ability to think critically, collaborate meaningfully, and take ownership of their learning. Without this integrative awareness, students may engage with problems in a fragmented manner, limiting the transformative potential of PBL as a learning approach.

The role of ensuring a structured and secure learning environment is consistent with findings by Maudsley (2002), who identified that PBL tutors often prioritise creating a supportive space

where students feel confident and focused. This role is particularly critical in the initial stages of PBL, as students acclimatise to self-directed learning. However, Maudsley also noted that some tutors struggle with knowing when and how to intervene, which aligns with the challenges observed in this study. The emphasis on structure and security in the "safe" role might be more pronounced in contexts where students are new to PBL methodologies or lack prior exposure to collaborative learning frameworks.

The category of guiding inquiry reflects a shift from a structured approach to one that emphasises critical thinking and reflection. Hendry (2009) identified similar roles, where tutors focus on posing timely questions and guiding students through deeper explorations of problems. This aligns with the notion of "Socratic questioning," highlighted in this study as a method for encouraging students to critically analyse problems. However, while Hendry emphasised the importance of tutors' content knowledge, this study reveals a balance between subject expertise and the ability to facilitate independent inquiry without providing direct answers. The findings also correspond to Savery (2006), who argues that effective facilitation requires an understanding of how to promote self-directed learning while maintaining engagement.

The role of fostering collaboration builds on research by Li and Chen (2018), who found that PBL tutors often oscillate between directive and supportive roles. This study's emphasis on ensuring deep, meaningful group discussions contrasts with the more directive tendencies observed in some cultural contexts, such as China, where tutors often dominate the learning process due to traditional hierarchical teacher-student relationships. The tutors in this study demonstrated a more facilitative approach, ensuring that discussions were student-led while challenging students to justify their ideas and engage with one another critically. While it may not always be possible to directly adopt methodologies from one cultural context to another, exposure to different conceptions of tutoring—such as the emphasis on collaborative, student-driven learning observed in this study—can help teachers from diverse backgrounds expand their awareness of facilitation. Recognising these variations allows educators to critically reflect on their own teaching philosophies and consider how elements of PBL facilitation might be meaningfully adapted within their own institutional and cultural frameworks.

The most complex category — guiding students to become self-directed learners — reflects the ultimate goal of PBL as a pedagogical approach. This resonates with Biggs and Tang's (2007) work on fostering deep learning through self-regulation and reflection. The findings also extend Hendry's (2009) research, which highlighted the importance of helping students transfer skills beyond the immediate academic context. Tutors in this study emphasised the transformative potential of PBL, encouraging students to reflect on their learning processes and consider how their problem-solving skills could be applied in real-world scenarios.

7. Implications of the study

One of the key applications of this study lies in academic development programs, where frameworks such as the one presented in this research are often used to explore variations in educators' conceptions of their roles. By applying phenomenographic principles such as fusion, contrast, and variation, academic developers can help tutors discern critical aspects of their facilitation role and expand their awareness of how different dimensions of PBL tutoring interact (Maron et al., 2004, Åkerlind, 2008). Fusion allows tutors to integrate multiple aspects of facilitation, moving beyond procedural guidance to fostering inquiry, collaboration, and

independent learning. Contrast helps tutors recognise differences between facilitative strategies, prompting reflection on their existing practices and identifying areas for growth. By structuring training programs around these principles, institutions can enhance tutors' ability to engage with students in more meaningful and adaptive ways.

Beyond tutor development, another important application concerns student learning outcomes. The study highlights how tutors' conceptions shape the depth of student engagement, critical thinking, and problem-solving skills in PBL. Tutors who primarily focus on structuring the process may provide stability but risk limiting students' autonomy, while those who recognise the interconnectedness of structure, inquiry, collaboration, and independence can help students develop self-directed learning skills. Academic institutions can use these findings to design training initiatives that align tutor facilitation strategies with desired student learning outcomes, ensuring that students are supported in progressively taking ownership of their learning.

8. Limitations and Future Directions

While this study offers valuable insights into PBL tutor conceptions, several limitations should be acknowledged. First, the sample size could be expanded to capture a broader range of variations in tutor perspectives. A larger and more diverse sample may reveal additional nuances in how tutors conceptualize their role across different institutional and disciplinary contexts.

Second, as with any qualitative study, potential bias exists in the form of self-reported data from tutors. Tutors' descriptions of their facilitation practices may not always align with their actual behaviours in PBL tutorials. Future research could triangulate findings by incorporating student perspectives, peer observations, or tutor reflections over time to gain a more comprehensive understanding of how tutor conceptions translate into practice. Additionally, this study captures a single point in time, offering a static perspective on tutor conceptions. A longitudinal study could examine how tutor conceptions evolve with training, experience, and ongoing professional development.

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Conflict of Interest

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Ethics statement

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Data Availability

Data supporting the conclusions of this study can be made available upon reasonable request from the corresponding author.

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Corresponding Author

The corresponding author for this manuscript is Natia Bendeliani who can be contacted by email via bendeliani.nattia@gmail.com.