EGLĖ MISIŪNAITĖ-BAČIAUSKIENĖ

INTERDISCIPLINARY PROBLEM-BASED LEARNING OF STUDENTS

SUMMARY OF DOCTORAL DISSERTATION

SOCIAL SCIENCES, EDUCATION (S 007)

Kaunas
2020

KAUNAS UNIVERSITY OF TECHNOLOGY
LITHUANIAN SPORTS UNIVERSITY
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This doctoral dissertation was prepared at Kaunas University of Technology, Faculty of Social Sciences, Arts and Humanities, during the period of 2014–2019 a joint Kaunas University of Technology, Lithuanian Sports University and Šiauliai University (and Lithuanian University of Educational Sciences) PhD study programme.

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INTRODUCTION

Reasons for the Study. Disciplinarity and interdisciplinarity have become competing concepts in the educational discourse of the 21st century. There have been observed more and more efforts to theoretically and empirically investigate and legitimate interdisciplinary curriculum, interdisciplinary research objects and interdisciplinary research methodologies. In the context of disability of traditional educational discourse, researchers and universities make attempts to conceptualise new techniques of knowledge construction, because changes in the world order (e.g., the increasing complexity of the world) require organising new kind of knowledge, whereas the structures of disciplinary knowledge are regarded as outdated and are expected to surrender their place to new relevant forms of interdisciplinary knowledge (Moore, 2008; Newell, 2010).

Problem-based learning is one type of interdisciplinary curriculum, which generates scientific discussions regarding its validity, multiple forms, goals, variability and complications of the learning process, controversial roles and experiences of students and teachers, structure of learning environments, efficiency, etc. Newell (2010) states that educational experiences have to be projected in a way that ensures the ability of a graduate to solve new complex problems. Interdisciplinary problem-based learning that trespasses "territories" of disciplines and develops interdisciplinary understanding of complex problems is possible only after the ideologies of higher education curriculum have been reviewed, which implies qualitatively different configurations of curriculum goals, content, process, student and teacher roles. The significance of problem-based learning has been getting stronger with the increasing number of research studies, which have been able to substantiate the statement that learning while solving complex, ill-structured real-world problems contributes to the development of the identity of self-directed learner and his/her lifelong learning skills. This answers the goals of European research and study area. Moreover, interdisciplinarity has become a synonym to innovation, and interdisciplinary learning has emerged as an inseparable component of higher education (Newell, 2010; Repko, Szostak, Buchberger, 2014; Spelt, 2015). The imperative to apply problem-based learning also derives from changes in management and management education. The requirements for managers embrace abilities to collaborate in interdisciplinary teams and networks, efficiently manage projects and resources, solve complex problems as well as to think in a systemic, analytical, critical and creative way, see problems in a multidimensional perspective, integrate multidisciplinary knowledge and experiences, rely on value-based orientations, possess self-reflection skills, efficiently communicate in multicultural environments, etc. (Hallinger, Bridges, 2007). Acting in a complex fluid social reality (Bauman, 2015), educational leaders have to make decisions that address different expectations, values and policy of groups with

different identity. Therefore, they have to be able to analyse complex dynamic situations from multiple perspectives and synthesise interdisciplinary solutions. In the context of such challenges, university studies in education management inevitably go through considerable transformations: from theoretical explanations about education management there is a radical turn to solving ill-structured and unstructured real-life problems in heterogeneous multidisciplinary student groups. For this reason, in the discourses of higher education policy and practice, problem-based learning has been more and more frequently perceived not as a radical innovation of curriculum design but as one of routines of a study process.

In the scientific discourse, problem-based learning is articulated as a learning model with multiple forms (e.g., constellations) (Savin-Baden, 2014). The previous research on problem-based learning disclose the complexity and contextuality that derive from the chosen philosophical paradigm, conceptual attitudes of problem-based learning, the type of analysed problems, learning goals and the context of the application (field of study, interdisciplinary links, etc.). Such a *dispersed* theoretical conception of problem-based learning is a prerequisite in itself for the investigation of problem-based learning, despite the increasing volume of research. Moreover, most of the research focuses on the theoretical conception of problem-based learning and students' learning outcomes (Hung, 2011), whereas the investigations on the process of problem-based learning, particularly focusing on the microlevel, are limited. At the first sight, "saturated" discourse of problem-based learning lacks research, where problem-based learning is revealed from the perspective of *interdisciplinarity*, i.e., as a learning process, which activates interdisciplinary thinking, encourages the integration of multidisciplinary attitudes and leads towards comprehensive interdisciplinary understanding of complex problems. Problem-based is frequently treated as a pedagogical approach that offers opportunities for students to engage in interdisciplinary learning or as a type of interdisciplinary learning (e.g., Savery, 2006; Savin-Baden, Major, 2004), but there is no penetration into the interdisciplinary dimension of problem-based learning. According to researchers (e.g., Spelt, Biemans, Tobi, Luning, Mulder, 2009), the research on interdisciplinary learning in higher education is scarce and limited as well. Stentoft's belief (2017) that problem-based learning *per se* "is not by default supporting interdisciplinarity" (p. 58) causes controversy. Therefore, it is necessary to search for a form of problem-based learning, which supports interdisciplinarity. Although problem solution and knowledge construction make an integrated two-way process, these processes are usually analysed separately in the scientific research (Wu, Wang, 2012). One more approach of theoretical thinking is related to the conversions of tutor's roles in the process of problem-based learning. Opposing theoretical positions of Kirschner, Sweller and Clark (2006) as well as Hmelo-Silver, Duncan and Chinn, (2007), which are linked to

an active role of the tutor in the process of problem-based learning, Savin-Baden (2016) suggests a paradoxical idea of "value of stuckness", claiming that having eliminated or reduced to minimum their support, tutors are able to help students to get involved in problem-based learning, cross learning "thresholds", because over-scaffolding inhibits students' learning, guiding them into transitional states, limiting their possibilities for transformation, impoverishes experiences of problem-based learning and does not leave space for performativity. According to the researcher, higher education has to accept a challenge to prepare students for the Barnettian changing supercomplex world as well as situations of unpredictability and uncertainty (Savin-Baden, 2016). Such a radical suggestion calls for a return to scientific discussion of Kirschner et al. (2006) and Hmelo-Silver (2007) about the role of tutor and for an empirical research on problem-based learning, where the tutor support is eliminated or minimised.

Responding to the imperatives to bridge the gap of empirical research studies on interdisciplinary problem-based learning in the scientific discourse, it is meaningful to raise the question: ***what process of problem-based learning allows achieving interdisciplinary understanding?***

The goal of the research: to disclose students' interdisciplinary problem-based learning process.

The object of the research: students' interdisciplinary problem-based learning.

Pursuing the goal of the research, the following **objectives** were formulated:

1. To conceptualize interdisciplinary problem-based learning of students;
2. To justify the methodology of empirical research on the process of students' interdisciplinary problem-based learning;
3. To disclose the process of students' interdisciplinary problem-based learning, revealing the construction of interdisciplinary understanding.

The dissertation is based on the following **conceptual approaches**:

- The epistemological considerations in *constructivism* rely on the idea that meanings (i.e., concepts, mental representations) are created by individuals with unique experiences (Berger, Luckmann, 2011) and the interpretations of reality are grounded on and limited by individual understanding.
- *Social constructivism* regards knowledge as one that is interactively constructed in social practices, when some interpretations are prioritised, whereas others are suppressed (Holstein, Gubrium, 2008). Following such a perspective, a researcher aims to identify different understanding of phenomenon under the research and diverse experiences of reality (Patton, 2014).

- *The theory of cognitive development* (Piaget, 1929; as cited in Savin-Baden, Major, 2004) claims that any new information can be interpreted only in the contexts of pre-existing knowledge and shared perspectives. The prior cognitive structures are seen as an essential prerequisite for meaningful learning. Students start interdisciplinary problem-based learning, possessing individual cognitive structures and pre-existing knowledge Savin-Baden, Major, 2004).
- *The theory of hybrid problem-based learning* (Barrows, 1986) defines problem-based learning by distinguishing two conceptual features, i.e., students' *self-directedness* and solving *ill-structured* problems. Contextualising interdisciplinary problem-based learning, students' self-directedness (group and individual) and solving of complex, ill-structured problems are regarded to be fundamental. The idea of tutor elimination and minimal support is related to the value of "stuckness", which encourages possibilities for transforming primary understanding, enriches problem-based learning experiences, opens possibilities for performativity and creates prerequisites for preparing to live in a changing and supercomplex world as well as for situations of unpredictability and uncertainty (Savin-Baden, 2016).
- *Theory of integrated* or *synthetic interdisciplinarity* (Barry, Born, Weszkalnys, 2008) regards disciplinary integration as a way for constructing a holistic understanding of complex real-world problems. The synthesis of interdisciplinary knowledge is a capacity of higher level, which requires skills of integrating knowledge and modes of thinking striving for a deeper, broader understanding of multi-dimensional phenomena and meaningful learning (Boix Mansilla, 2016).

The research methodology. *The analysis of narrative (traditional) literature* is applied in this research to conceptualise interdisciplinary problem-based learning, i.e., a large array of scientific research published in the scientific journals with high citation index, monographs or collections of articles is analysed. Seeking to answer the question what process of students' problem-based learning allows achieving interdisciplinary understanding, *the strategy of multiple case study* (Stake, 1995; Merriam, 1998) is employed. The instrumental case study focuses on the generation of qualitative data to reveal theoretical insights based on these data. The qualitative research data are collected from several information sources: interviews, artefacts (reflections, reports) created by the students in the process of problem-based learning and the researcher's field notes that were made while observing problem-based learning in the student groups. *An individual in-depth interview* is applied to collect the students'

attitudes towards interdisciplinary problem-based learning, the process of constructing interdisciplinary knowledge as well as towards experiences in problem-based learning. The data that was accumulated during the interview disclose students' personal interpretations and experiences in problem-based learning and essential moments of interdisciplinary knowledge construction. In semi-structured *written reflections*, students describe their daily problem-based learning experiences and changes in their understanding. Structured reports on problem-based learning record the formation of multidisciplinary and interdisciplinary understanding in student groups while addressing an interdisciplinary problem and integrating a scenario of group solution. The researcher's field *notes* are taken while observing critical incidents, which occur in the problem-based learning situations of each researched group. To analyse the research data, *the qualitative content analysis* is applied.

The research process. The process of the research embraces three stages (see Fig. 1).

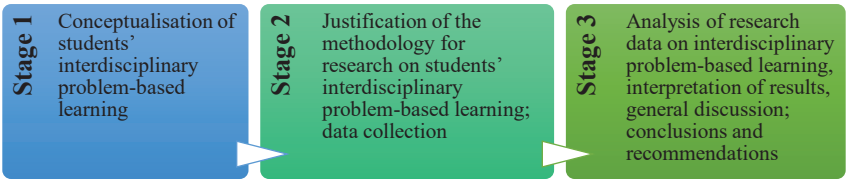

Fig. 1. Stages of the research

Scientific novelty and theoretical significance. The present research provides for the taxonomy of concepts of problem-based learning, systemised dimensions of problem-based learning and phases of the process. The analysis of the discourse of interdisciplinary learning highlighted the concepts of interdisciplinarity, interdisciplinary thinking, knowledge and understanding. Having integrated the processes of problem-based learning and interdisciplinary learning as well as their conceptual features, the process of interdisciplinary problem-based learning, which allows achieving interdisciplinary understanding, was reconceptualised. Moreover, the typology of disciplinary, multidisciplinary and interdisciplinary knowledge that was constructed in the process of interdisciplinary problem-based learning was developed and rearticulated. Striving for compatibility with the learning paradigm that is broadly articulated in the educational discourse, a new approach is applied: a theoretical focus is on self-directed interdisciplinary problem-based learning of students rather than the creation of interdisciplinary problem-based learning environment, what is typical for the educational research. The theoretical insights based on the instrumental multiple case study increase the discourse of interdisciplinary problem-based learning and illuminate problems of theoretical (ideal) and practical (real)

learning. The four modifications of interdisciplinary problem-based learning, which were identified in the present research, manifest different students' attitudes to problem-based learning being implemented as innovation.

Practical significance is grounded on the functionality of theoretical model of interdisciplinary problem-based learning process, i.e., it may be implemented in various institutions of higher education and the typology of disciplinary, multidisciplinary and interdisciplinary knowledge may be applied for the assessment of outcomes of student problem-based learning. The research discloses "non-ornamented" reality of interdisciplinary problem-based learning and complications at the beginning of implementation of this innovation. The conducted analysis of scientific literature and the results of empirical research allowed formulating recommendations for heads of departments in charge of study processes and quality in higher education institutions as well as for groups of teachers and separate teachers who apply problem-based learning.

1. CONCEPTUALISATION OF STUDENTS' INTERDICIPLINARY PROBLEM-BASED LEARNING

1.1. Theoretical discourse of problem-based learning

The analysis of problem-based learning discourse facilitates synthesis of the concept of problem-based learning, fundamental dimensions and decomposition of structure of problem-based learning process. Different conceptions of problem-based learning are analysed, their taxonomy is devised, an in-depth analysis of the essential dimensions of problem-based learning: problem, its typology, features (difficulty, complexity, structuredness, etc.), design, group and individual learning while solving problems, the problem of self-directedness, tutor roles and types of scaffolding are elaborated on in this part. The conceptual features of problem-based learning have influence on the understanding of interdisciplinary problem-based learning as a specific type of problem-based learning. Based on the idea of multiplicity of problem-based learning constellations[1] (Savin-Baden, 2014), a theoretical assumption is formulated that different problem-based learning constellations cannot be realised by observing the same structure of problem-based learning process. Therefore, when seeking to conceptualise interdisciplinary problem-based learning, it is necessary to analyse *interdisciplinarity,* which is an essential element that modifies the process of problem-based learning.

[1] The notion of a constellation was adopted "to reflect the idea that problem-based learning is complex, comprising multiple constantly changing elements" (Savin-Baden, 2014, p. 197).

1.2. Theoretical discourse of interdisciplinary learning

In order to understand the discourse of interdisciplinary learning, this part focuses on the analysis of typologies of interdisciplinarity, concepts of interdisciplinary thinking and understanding, as well as knowledge and theoretical attitudes towards the interdisciplinary integration of knowledge as an essential process of interdisciplinary learning, its strategies and interdisciplinary collaboration. In the scientific discourse, many attempts to systemise various forms of disciplinarity (monodisciplinarity, multidisciplinarity, interdisciplinarity, transdisciplinarity) reveal dimensions of interdisciplinarity and identify its different types (Klein, 2010; Lattuca, Voight, Fath, 2004) have been made.

In the context of interdisciplinary problem-based learning, interdisciplinarity is perceived as *instrumental*, i.e., empowered for solving complex and ill-structured real-life problems. Knowledge integration or synthesis is understood as a fundamental feature of interdisciplinarity (Barry et al., 2008), whereas students' capacity to synthesise or integrate is perceived as an objective of interdisciplinary higher education. Interdisciplinary thinking is constructed through a gradual process, i.e., by analysing multiple theoretical approaches, while identifying conflicting ideas and rejecting unsuitable theories (Lattuca et al., 2004). Nikitina (2005) identifies three essential cognitive movements, which are performed by "interdisciplinary mind" integrating knowledge of different disciplines: coping with monodisciplinary thinking, efforts to achieve temporary integration of ideas and critics of this integration. With the help of various learning forms, it is expected to create sustainable interdisciplinary links, integrate the knowledge of problem space and crystallize interdisciplinary understanding. Nikitina (2006) identifies three essential strategies for interdisciplinary teaching and learning: contextualising, conceptualising and problem-centring. Moreover, interdisciplinary learning is inseparable from collaboration because multidisciplinary, interactive social space that is saturated with ideas is necessary for making interdisciplinary links. Boix Mansilla, Lamont and Sato (2016) conceptually develop three dimensions of interdisciplinary collaboration, i.e., cognitive, emotional and interactive, which are of utmost importance to the success of the collaboration. Conceptualising interdisciplinary problem-based learning in the present research, the theoretical position of integration as a holistic understanding of complex real-world problems constructed in the social interaction is followed.

1.3. Interdisciplinary problem-based learning that enables the construction of interdisciplinary knowledge

An in-depth analysis of the epistemological coherence between problem-based and interdisciplinary learning, the structure of interdisciplinary problem-based learning is substantiated, and the structural levels of disciplinary,

multidisciplinary and interdisciplinary knowledge that is constructed in the process of problem-based learning are distinguished. While conceptualising the construction of interdisciplinary knowledge in the process of problem-based learning, the paradigms of "routine" interdisciplinarity and mixed problem-based learning, which acknowledge the value of disciplinary knowledge and derive interdisciplinarity from integrated multidisciplinary group discourse, are followed.

Interdisciplinary learning is not a spontaneous process that occurs in the process of problem-based learning (Stentoft, 2017), regardless of independent structure of problem-based learning. The striving for interdisciplinary integration complicates problem-based learning, changing its goals and structure. The comparative analysis of the processes of problem-based and interdisciplinary learning allows defining interdisciplinary problem-based learning as a *process* that consists, foremost, of six iterative phases of group and individual learning (see Fig. 2). The essential cognitive processes that are occurring in the process of interdisciplinary problem-based learning embrace the processes characteristics of these forms of learning: identification of problem, deconstruction, comparison and systematisation of diverse information, consideration of disciplinary insights, integration of insights and formulation of critical position. Integration occurs in each phase of learning, i.e., clarifying a problem, formulating questions, creating theoretical explanations and frameworks, combining methods, choosing instruments, using analytical categories and evaluating the contribution of interdisciplinary attitude (Bergmann et al., 2013). Moreover, the meta-cognitive process is as well important in the process of interdisciplinary problem-based learning, which embraces continuous reflection and self-evaluation.

On the basis of theoretical insights of Biggs and Collis (1982), Ivanitskaya et al. (2002) and Boix Mansilla and Duraising (2007), the structural levels of interdisciplinary knowledge (unistructural, multistructural, relational and extended abstract) are reconceptualised in this research. Relational and extended abstract interdisciplinary knowledge are perceived as types of interdisciplinary knowledge of qualitative (deep) level, which are distinguished by students' capacity to integrate knowledge of two or more disciplines, understand their strengths and limitations in a specific problem space (relational), form the structure of interdisciplinary knowledge that integrates concepts, theories, paradigms or methods of different disciplines, apply this structure of interdisciplinary knowledge to find solutions to new interdisciplinary problems (extended abstract). The understanding of interdisciplinary ill-structured and complex problems from real-life at qualitative (deep) level is an essential objective of interdisciplinary problem-based learning (see Table 1).

Table 1. The relationship of SOLO taxonomy, interdisciplinary problem-based learning and interdisciplinary knowledge construction (reconceptualized by the author following Biggs and Collis, 1982; Ivanitskaya et al., 2002; Boix Mansilla, 2007; Boix Mansilla, Duraisingh, Wolfe, Haynes, 2009)

Phases of learning	Structural level of learning	Interdisciplinary problem-based learning and student's capacities	Outcomes of interdisciplinary problem-based learning
		Disciplinary knowledge	
Quantitative phase	Unistructural/ *disciplinary*	When solving a problem, a student applies knowledge of one relevant discipline, relies on one aspect of information, i.e., on one concept, one theory or method.	Narrow declarative and procedural disciplinary knowledge limited to one problem that is being solved.
	Multistructural/ *disciplinary*	When solving a problem, a student applies knowledge of one relevant discipline, relies on several relevant aspects of information, i.e., two or more concepts, theories or methods, but does not integrate them.	Declarative and procedural disciplinary knowledge related to one problem that is being solved and embracing several relevant aspects of information.
Qualitative phase	Relational/ *disciplinary*	When solving a problem, a student applies knowledge of one relevant discipline, integrating several aspects of information to create a coherent, meaningful structure around a problem; s/he understands the strengths and limitations of the created theory that is explaining the problem.	Disciplinary knowledge that embraces one problem, critical thinking skills, some metacognitive skills, some epistemological beliefs.
	Extended abstract/ *disciplinary*	When solving a problem, a student generalises the structure of disciplinary knowledge, where disciplinary concepts, theories, paradigms or methods are integrated; s/he applies the created abstract theory to solve new multi- and interdisciplinary problems.	Developed and well-structured disciplinary knowledge, critical thinking skills, metacognitive skills, progressive epistemological beliefs, ability to transfer disciplinary knowledge to other contexts (to solve similar problems).

Table 1 (continued)

Phases of learning	Structural level of learning	Interdisciplinary problem-based learning and student's capacities	Outcomes of interdisciplinary problem-based learning
		Multidisciplinary knowledge	
Quantitative phase	Unistructural/ *multidisciplinary*	When solving a problem, a student applies knowledge of two or more relevant disciplines, relies on one aspect of every relevant discipline, i.e., on one concept, one theory or methods.	Narrow declarative and procedural multidisciplinary knowledge, limited to one problem that is being solved.
	Multistructural/ *multidisciplinary*	When solving a problem, a student applies knowledge of two or more relevant disciplines, relies on two or more concepts, theories or methods of every relevant discipline, but does not integrate them.	Declarative and procedural multidisciplinary knowledge, related to one problem that is being solved and embracing several relevant aspects of information of different disciplines.
Qualitative phase	Relational/ *multidisciplinary*	When solving a problem, a student applies knowledge of two or more relevant disciplines, integrating several aspects of information within the framework of every relevant discipline to create a meaningful multidisciplinary structure around a problem; s/he understands the strengths and limitations of multidisciplinary understanding of the problem.	Multidisciplinary knowledge that embraces one problem, critical thinking skills, some metacognitive skills, some epistemological beliefs.
	Extended abstract/ *multidisciplinary*	When solving a problem, a student generalises the structure of multidisciplinary knowledge, where disciplinary concepts, theories, paradigms or methods are within the framework of separate disciplines are juxtaposed; s/he applies the created abstract multidisciplinary theory to solve new multi- and interdisciplinary problems.	Developed and well-structured multidisciplinary knowledge, critical thinking skills, metacognitive skills, progressive epistemological beliefs, ability to transfer multidisciplinary knowledge to other contexts (to solve similar problems).

Table 1 (continued)			
Phases of learning	Structural level of learning	Interdisciplinary problem-based learning and student's capacities	Outcomes of interdisciplinary problem-based learning
Interdisciplinary knowledge			
Quantitative phase	Unistructural/ *interdisciplinary*	When solving a problem, a student relies on one aspect of information, i.e., one interdisciplinary concept, one interdisciplinary theory.	Declarative and procedural interdisciplinary knowledge, limited to the problem that is being solved.
	Multistructural/ *interdisciplinary*	When solving a problem, a student relies on two or more aspects of information, i.e., disciplinary and interdisciplinary concepts and (or) theories and (or) disciplinary methods; s/he attempts to make weak interdisciplinary links.	Primary interdisciplinary knowledge, related to the problem that is being solved.
Qualitative phase	Relational/ *contextual interdisciplinary, limited to one problem*	When solving a problem, a student integrates knowledge of several disciplines (and interdisciplines) to create a meaningful interdisciplinary structure around a problem; s/he understands the strengths and limitations of contextual interdisciplinary understanding of the problem.	Basic interdisciplinary knowledge that embraces one problem, critical thinking skills, some metacognitive skills, some epistemological beliefs.
	Extended abstract/ *interdisciplinary, extended to other problems*	When solving a problem, a student generalises the structure of interdisciplinary knowledge, where concepts, theories, paradigms or methods of different disciplines (and interdisciplines) are integrated; s/he applies the created abstract interdisciplinary theory for finding solutions to new interdisciplinary problems.	Developed and well-structured interdisciplinary knowledge, critical thinking skills, metacognitive skills for the reflection of the process of interdisciplinary knowledge formation, progressive epistemological beliefs, ability to transfer interdisciplinary knowledge to other contexts (to solve other problems).

According to the conceptual features of problem-based learning (complexity and structuredness of the problem, synergy of individual and group learning, integration of theoretical approaches) and conceptual features of interdisciplinary learning (interdisciplinary problem, critical analysis of multidisciplinary approaches and their integration, reflection on new interdisciplinary understanding), the interdisciplinary problem-based learning in this research is defined as *a process*, which consists of six iterative phases of group and individual learning to solve an interdisciplinary problem, i.e., it embraces: (i) primary analysis of the problem (i.e., articulation of facts, concepts, theories and methods), (ii) identification, deconstruction of interdisciplinary problem and generation of multidisciplinary ideas related to the problem, (iii) critical analysis of multidisciplinary insights, (iv) integration of multidisciplinary insights while creating alternative problem solving scenarios, (v) construction of integrated, interdisciplinary group solution based on interdisciplinary understanding, and (vi) reflection on new understanding of interdisciplinary problem (see Fig. 2). The theoretical insights of Repko et al. (2014) are significant in conceptualising the interdisciplinary problem-based learning process.

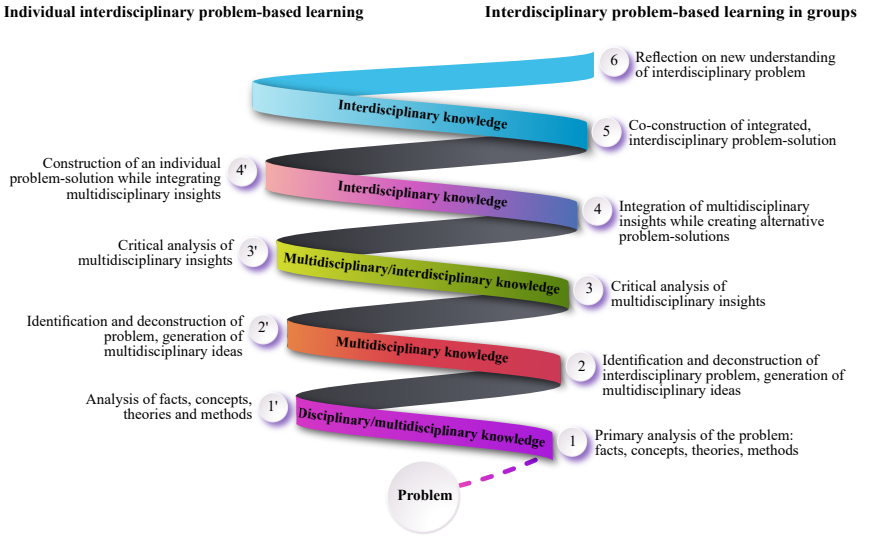

Fig. 2. Interdisciplinary problem-based learning of students

The structure of the process of interdisciplinary problem-based learning in this research is treated as an ideal (but not the only) *form* for the construction of

interdisciplinary knowledge. So far, the scientific discourse has not provided the answer to the question *how* students construct their interdisciplinary understanding in the process of problem-based learning, i.e., how in each phase of the problem-based learning, disciplinary, multidisciplinary and interdisciplinary knowledge is systemised and integrated. The group as well as individual problem-based learning processes, which are divided into stages based on theoretical logic, and the trajectory of knowledge construction maturing from disciplinary and multidisciplinary to integrated, interdisciplinary knowledge are explicated (see Fig. 2).

2. METHODOLOGY FOR EMPIRICAL RESEARCH ON STUDENTS' INTERDISCIPLINARY PROBLEM-BASED LEARNING

The present research is grounded on the relativist *ontology*, interpretative and constructivist research paradigms and epistemological relativism. Following these philosophical approaches, the research process, research data and interpretations are treated as discursive, dialogic and possible to be reconstructed including new contexts, insights or recognising other meaningful links. In accordance with the goal of this research to reveal the students' interdisciplinary problem-based learning process, which allows achieving interdisciplinary understanding, the following *research questions* are formulated*:* (i) how does interdisciplinary problem-based learning of students occur; (ii) how do students construct their interdisciplinary understanding in the process of problem-based learning.

The research questions include two processes of synchronous and asynchronous nature, i.e., problem-based learning and construction of interdisciplinary knowledge, and create prerequisites for consideration on how cognitive, metacognitive, emotional and social processes are interrelated in the process of interdisciplinary problem-based learning (Dolmans, Schmidt, 2006, p. 334) to identify problem-based learning configurations that derive from various learning "steps", spontaneous and (or) (un)consciously controlled group movements, to analyse what integrative strategies students endeavour to apply and how they succeed in this, how these strategies contribute to the co-creation of meaningful scenario for solving a problem. Interpretative and constructivist research paradigms predetermine choices of research strategy, research methods and procedures for sampling.

Seeking to ensure the coherence of philosophical research approaches, the strategy of the case study suggested by Stake (1995) was chosen as a fundamental one. Stake (1995) links the qualitative case study with constructivist and existential philosophy, claiming that the researcher interprets the reality and constructs new knowledge revealing a multi-dimensional attitude towards the investigated objects, which is found in certain contexts (Stake, 1995). Aiming to investigate students' problem-based learning that enables the construction of

interdisciplinary knowledge, an *instrumental* case study is chosen, which allows formulating certain theoretical insights. *Four cases* were studied, i.e., four groups of students, who learn according to the newly applied mixed interdisciplinary problem-based learning, when tutor's support is minimal, were investigated.

Conducting the present research on interdisciplinary problem-based learning, a "two-stage" strategy for the selection is applied: firstly, the cases are selected, and then, a sample of every studied case is formed (Merriam, Tisdell, 2016).

In this multiple case study, a case refers to a small group of problem-based learning. In total, four cases are studied, i.e., four microgroups of students, the formation of which was not influenced by the researcher or the teaching professor because the students formed groups of four by themselves. The choice of the number of cases was influenced by the goal to investigate the learning of all the microgroups studying in accordance with the method of interdisciplinary problem-based learning in one master study programme of education management. The empirical research was conducted within one semester module, where the teaching professor applied the so-called *single module* approach (Savin-Baden, Major, 2004), i.e., problem-based learning was introduced as an innovation in one studied sub-discipline but not in the whole study programme. The process of implementing problem-based learning was projected by the professor and tutor and embraced three stages:

i. During *the stage of theoretical empowerment,* the students learnt the theory of educational and learning environments in lectures delivered by a professor, i.e., the methodology of the structure and creation of environments. In the introductory lecture delivered by the tutor, the students were familiarised with the model of interdisciplinary learning, features of disciplinary, multidisciplinary and interdisciplinary knowledge and strategies of interdisciplinary learning, aspects of writing a learning diary and reports on problem-based learning.
ii. During *the stage of practical empowerment*, the students practiced solving a problem as a training assignment; the tutor actively provided support at this stage: consulted regarding the process of problem-based learning, the theories chosen for solving the problem, group interaction, solution design, various instantaneous learning disturbances, etc.
iii. In *the cycle of interdisciplinary problem-based learning,* with minimal support from the tutor, the students solved the main problem of the module in a self-directed way, i.e., they established different circus-based educational environments in the museum.

Striving for the reliability of the research, the data are collected from several sources of social information (Stake, 1995) (see Fig. 3).

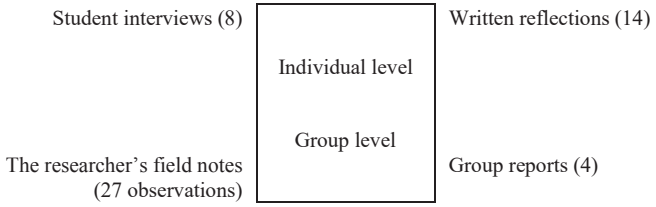

Fig. 3. The triangulation of research sources

The analysis of qualitative data was conducted in several directions and could have been hardly arranged into a linear trajectory of the process (Pierre, Jackson, 2014). On the basis of ideas of qualitative (Flick, 2014; Hsieh, Shannon, 2005) and post-qualitative research (Pierre, Jackson, 2014; Pierre, 2018), the present research observes the attitude that for a researcher, it is important to concentrate not only on the defined processes (i.e., problem-based learning and construction of interdisciplinary knowledge), but on different experiences of these processes, multi-dimensional reality, complexity of attitudes and actions as well. Following the conception of instrumental case study, the research results are structured according to the main categories (see Fig. 4).

Fig. 4. The logic of data analysis

Analysing and interpreting the acquired research data, the fact that problem-based learning is innovation for students and that it is implemented by applying a narrow single module approach is considered.

The ethical aspects of this case study are linked to the informed consent agreement of research participants, respect for personal privacy, confidentiality and anonymity. The main ethical challenges encountered in the process of qualitative data analysis are mainly related to the theoretical "filters" of research and inclusion/exclusion of data from the analysis (Merriam, Tisdell, 2016). Ethical dilemmas are solved by revealing the researchers conceptual positions and following the principle that authentic research data cannot be radically reduced to achieve homogeneity of interpretation.

Publishing the results of the multiple case study, the anonymity of the study participants is ensured.

3. RESULTS OF EMPIRICAL RESEARCH ON STUDENTS' INTERDISCIPLINARY PROBLEM-BASED LEARNING

This part presents the context of the research: the study programme, the module structure, a training module assignment and the main module assignment, the tutor's role (Subchapter 3.1). The other two parts focus on the analysis of the group (Subchapter 3.2) and individual (Subchapter 3.3) interdisciplinary problem-based learning, emphasising the structure (stages) of problem-based learning that occurred in groups and the aspects of interdisciplinary problem understanding. The results of all the researched cases are summarised and discussed below.

3.4. Summary of the research results

Emphasising that theoretical conceptions of problem-based learning are grounded on ideal, logical prerequisites and conditions, Hung (2011) asks how problem-based learning is implemented in real-life situations and how it reflects its theoretical conception. The multiple case study reveals the multiplicity of configurations of the implemented interdisciplinary problem-based learning, which manifests a different deviation from the ideal conception. The research highlighted two main configurations of interdisciplinary problem-based learning: *disciplined* (groups A, B and C) and *flexible* (group D) problem-based learning (see Fig. 5). Disciplined interdisciplinary learning in this inquiry is interdisciplinary problem-based learning that is slightly modified in the study practice, which, on the basis of constructivist approach, is treated as a result of socially constructed different realities of learning. In the process of disciplined interdisciplinary problem-based learning, students penetrate into learning "steps", perceiving "stepping" as a technique of empowerment and a prerequisite for learning success. In the case of flexible interdisciplinary learning, students adrift in the flow of learning and see the theoretical structure as non-binding.

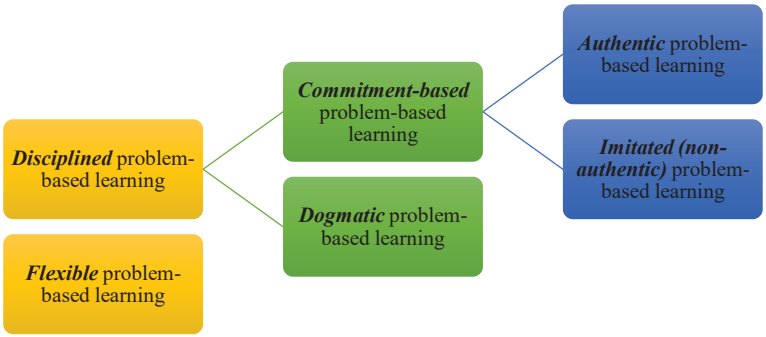

Fig. 5. Configurations of interdisciplinary problem-based learning

In the case of *disciplined* interdisciplinary problem-based learning, the changes in the learning process are not radical, but the intensity of different interdisciplinary learning stages varies because student groups encounter *thresholds* of knowledge construction that are hard to overcome or are simply ignored. The thresholds are caused by the epistemological beliefs, failure to find an integrating theory, superficial understanding of disciplinary theories and concepts, change from a verbal group discourse to a written one, a dysfunctional group and prevalence of sub-group. Disciplined interdisciplinary problem-based learning is not homogeneous. Following the empirical data, two modalities are distinguished in disciplined interdisciplinary problem-based learning, which are related to the epistemic position of students: *commitment-based* (groups A and C) and *dogmatic* (group B) interdisciplinary problem-based learning. Dogmatic understanding of interdisciplinary learning as *a strict method* encourages penetration into the linearity of the process and consistent control of the method, i.e., continuous and excessive monitoring how precisely the consistency and boundaries of phases in the learning process are observed. However, such monitoring results in methodological conflicts in the group, which hinder the co-construction of multidisciplinary and interdisciplinary knowledge. Moreover, methodological arguments lead to the formation of a sub-group within the group, which mutes the voices of members of the group with different attitudes and critical opinions about occurring processes. In the case of problem-based learning that is grounded on the commitment, when interdisciplinary problem-based learning is perceived as *an intentional process*, which leads to more a comprehensive understanding of the problem, less stress and anxiety regarding possible methodological failure are experienced, and the main focus is laid on the "critical stops", where certain obligatory actions have to be performed (e.g., to identify a problem, to apply a theory that explains the aspect of the problem etc.). Personal learning reflections and in-depth interviews highlight the intentionality of committed students to engage in the assignment and learning process, manage group discourse and overcome the challenge of multiplicity of interdisciplinary learning. The problem was identified when a group of students (group A) who started interdisciplinary learning in the research field (i.e., in the museum) and identified some limitations of museum spaces, but later, they turned to non-authentic learning after choosing not fully understood integrating theory. All this led to withdrawal of some group members from the process of integration of essential theories.

Table 2. Configurations of interdisciplinary problem-based learning: theoretical vision and real modifications

Ideal ltheoreticala interdisciplinary problem-based learningoits stages					
Primary analysis of the problem: facts, concepts, theories and methods	Identification and decom-position of interdisci-plinary problem	Critical analysis of multidisci-plinary insights	Integration of multidisci-plinary insights while co-creating alternative problem-solving scenarios	Co-construction of integrated, interdisciplinary problem solution	Reflection on (group) new interdisci-plinary understand-ing of the problem
i. Disciplined interdisciplinary problem-based learningoits stages					
i.i. Imitated commitment-based interdisciplinary problem-based learning, its stages					
Primary analysis of the problem space: empirical experiences, investigation, concepts and theories	Identification and decom-position of the problem	Analysis of multidisci-plinary insights and their integration attempts	Creation of problem-solving scenario: two theories, different design elements	Co-construction of interdisciplinary problem-solution scenario	Individual reflection on new understand-ing of the problem
i.ii. Authentic commitment-based interdisciplinary problem-based learning, its stages					
Primary analysis of the problem space: empirical experiences, investigation, concepts and theories	Identification and decom-position of the problem	Analysis and integration of multidisci-plinary insights	Co-creation of alternative problem-solving scenarios and its different design elements	Co-construction of interdisciplinary problem-solution scenario	Individual reflection on new understand-ing of the problem
i.iii. Dogmatic interdisciplinary problem-based learning, its stages					
Primary analysis of the problem: text reading, concepts and theories	Methodo-logical arguments of identification and decom-position of the problem	Analysis of secondary multidisci-plinary concepts and their integration	Creation of alternatives of problem-solving while finding theory and sharing an understanding of its elements	Co-construction of interdisciplinary problem-solution scenario	Individual reflection on new understand-ing of the problem
ii. Flexible interdisciplinary problem-based learningoits stages					
Analysis of the problem space, identification of the problem, analysis of concepts and theories	Decomposition of the problem and analysis of multidisciplinary concepts and theories			Co-construction of interdisciplinary problem-solution scenario	

The problem-solving scenarios that are constructed in the process of *disciplined* interdisciplinary learning (see Table 2) manifest students' multidisciplinary and interdisciplinary knowledge of different level. In one case, the students mechanically link two disciplinary theories without creating a coherent narrative of the educational environment. In the context of the present research, this failure is connected to the paradigm of *non-authentic, imitated*

problem-based learning, prevalence of subgroup, transformation of live discourse into a written one and organisational disruptions in group learning. In another case, due to the *dogmatic attitude* towards problem-based learning and methodological conflicts that occurred in the group, the students did not manage to elaborate on the interdisciplinary problem-solving scenario, although they demonstrated a deeper penetration into the integrated theories. Moreover, student groups interpreted the phase of creating alternative problem solving scenarios in different ways: one group tended to *reduce* it by declaring paradoxical coincidence of opinions of all the group members; another group generated it in accordance with suggestions, regarding the design of the constructed educational environment that is constructed following a general vision, i.e., on multidisciplinary micro solutions. The interdisciplinary understanding that is constructed in the process of non-authentic and dogmatic *disciplined* interdisciplinary learning can be partially interpreted as possessing features of *primary (qualitative)* interdisciplinary understanding. In the case of *authentic disciplined* interdisciplinary learning, students created an integral problem solution, which was synthesised by following multiple problem-solving scenarios, organically integrating theoretical insights of several disciplines. Led by interpersonal solidarity, the students overcame the thresholds of interdisciplinary learning; understanding intentionality of interdisciplinary learning, they actively searched for integrational links of multidisciplinary perspectives. Moreover, they even created the evaluation criteria for the ideas that were generated in the group discourse. Such interdisciplinary understanding of students can be evaluated as *main (qualitative)* interdisciplinary understanding related to one analysed problem.

The findings evoke the question how (non-)maturity of interdisciplinary problem-solution scenarios is influenced by differences in applied integrative strategies and (or) different quality of applying these strategies. The students, who created an integrated, interdisciplinary solution, mainly referred to the problem-centring strategy, which enables identifying the interconnectivity of problem elements and creating a theoretically substantiated interdisciplinary solution. An epistemological goal of this strategy is related to problem solving. Therefore, according to Nikitina (2006), the result is not supposed to be conceptually purified, generalised, and the contexts are not supposed to be comprehensively described. The students perceive the problem as the axe of interdisciplinary links. For this reason, they learn to solve a problem by following their own desire, without engaging in any deep reflections or analyses and applying only theories and tools that were chosen for this, as it is stated by Nikitina (2006). Two groups of students (A and B) interpret the theory of educational environment as *common ground* and seek to enrich it by integrating the psychological theory of multiple intelligences. The superficial understanding of the theory or its unsystematic application has influence on the limitations of

their co-created problem-solving scenarios. The group of students (group A), who started with contextualising strategy and linked knowledge of areas that are not externally related (Nikitina, 2006), i.e., the old town and developmental aspects of circus phenomenon, later did not integrate these insights into the co-created problem solution, although their intentions to apply several integrative strategies forecasted a deeper interdisciplinary understanding of the problem. Therefore, in the context of this research, it cannot be stated that a certain strategy of integration predetermines the quality of integration. It is even more appropriate to assume that the *quality* of applying integrative strategies is linked to the level of interdisciplinary understanding of the problem.

Boix Mansilla et al. (2016) see intellectual openness as one of the essential cognitive factors of successful collaboration. In the process of interdisciplinary knowledge construction, students encounter difficult to overcome *thresholds* of knowledge construction. Despite the start of *authentic* problem-based learning in the research field (e.g., application of different research methods) and instead of theoretical analysis and interpretation of identified empiric set of facts, the group of students turns to *non-authentic* learning, which *imitates* learning steps (group A). The learning of another group was continuously interrupted by *excessive method control,* when the method rather than integration of interdisciplinary knowledge was perceived as the core of interdisciplinary problem-based learning (group B). Thus, the disciplined interdisciplinary learning may reveal itself in different modalities, which are linked to the heterogeneity of the groups, epistemological group beliefs and openness to authentic learning experience. In the context of this research, the *disciplined* interdisciplinary learning is the most appropriate configuration for the construction of interdisciplinary problem understanding, which is inseparable from the group identity, i.e., non-radical epistemological beliefs, commitment to the group and assignment, equal (symmetric) engagement of the group members in learning. O'Brien (2019) also notes that increased social identity (sense of involvement and belongingness) of the student, as well as his/her sense of value to the group, are related to the success of problem-based learning.

The empirical research as well discloses another configuration of interdisciplinary problem-based learning, i.e., *flexible* problem-based learning (see Table 2). As it has been mentioned, in the case of flexible interdisciplinary learning, students adrift in the flow of learning and consider the theoretical learning structure as non-binding. When failing to acquire a more stable form, the chaotic learning impedes the process of interdisciplinary knowledge construction, the empowerment of which requires epistemological awareness, a certain logic of the process. In such case, the interdisciplinary dimension of problem-solving scenario is put at risk. The distinguishing feature of flexible interdisciplinary problem-based learning is firstly related to the fact that this kind of learning occurs according to the principle of natural flow, when the previous

experience of working in interdisciplinary teams is taken into account and observing certain spontaneously remembered ideas of problem-based learning but not *imitating* this process (differently from the group A). At the end of learning, while reflecting on group learning and writing a joint group report, this group attempted to "rewrite" and reconstruct the process that occurred to fit the phrases of interdisciplinary problem-based learning. When analysing the learning report of students and their personal diaries, the efforts to structure text according to the theoretical stages of problem-based learning are observed, but the interviews and the field notes that recorded the modifications in the interdisciplinary problem-based learning process reveal that this group allocated only four group sessions to the interdisciplinary problem-based learning (one for a visit to the museum, where they had to turn the space of museum into an educational environment), and three individual learning sessions. Partially, such shortening of problem-based learning process means radical deviation from the *ideal* model of interdisciplinary knowledge construction, but in the shortened configuration of learning, certain features of the process "compaction" can be observed, i.e., merging of certain stages (e.g., primary problem analysis and identification, problem identification and analysis of multidisciplinary attitudes). The problem-solving scenario that is constructed in the process of *flexible* interdisciplinary learning manifests a multidisciplinary understanding of different levels and superficial interdisciplinary understanding of the problem. Students understand a general idea of the theory of educational environment but lack deep insights into it just as into the concept of values, value typologies that are broadly articulated in the contemporary scientific discourse. However, students provided thorough explanations of certain theories (e.g., problems of adolescence, learning needs of adolescents and their learning styles). While constructing an interdisciplinary scenario for problem solution, students relied on multidisciplinary theories. Although they were able to select theories related to the analysed problem, they did not analyse them critically. This led to conceptual mistakes, inaccurately used conceptual vocabulary and failure to comply with the stylistics of scientific language. Procedural and epistemological mistakes are mainly conditioned by certain *epistemological unawareness* of the group, the superficial analysis of the process of interdisciplinary learning process, meaning of integration and its strategies. It is difficult to identify the level of interdisciplinary understanding that is achieved by students, because it possesses features of *primary (quantitative)* and *main (qualitative)* interdisciplinary understanding.

The data of empirical research allowed concluding that the identified configurations of interdisciplinary problem-based learning have strengths and limitations. Excessive discipline can lead to the same extent of disempowerment as chaotic learning, which fails to acquire a more stable form. The construction of interdisciplinary knowledge requires *sustainable* learning structure.

Methodological dogmatism may harden creativity, whereas apparent creative chaos may not crystallise into a theoretically substantiated problem-solving scenario. Finally, non-authentic interdisciplinary problem-based learning may turn into a simulacrum, when a group starts imitating learning processes that does not occur in the reality. The multiple case study confirms that interdisciplinary understanding of the qualitative level is a result of consistent cognitive (Spelt, 2015), social and emotional efforts. Such an insight does not seek to object the possibilities of generating interdisciplinary ideas by using creative problem-solving methods. However, considering the interdisciplinary problem-based learning that is implemented in the process of university studies and the context of social sciences, the configuration of disciplined commitment-based interdisciplinary problem-based learning creates the most favourable medium for the construction of interdisciplinary understanding of students. Such results of empirical research coincide with the theoretical articulations of interdisciplinary problem-based learning as a gradual and cumulative process that prevails in the scientific discourse (e.g., Yew, Chng, Schmidt, 2011; Manathunga, Lant, Mellick, 2006; Spelt et al., 2009).

CONCLUSIONS

1. The problematic aspects that were highlighted while conceptualising interdisciplinary problem-based learning in the scientific context allow formulating the following theoretical propositions:

1.1. The analysis of problem-based conceptions and the compiled taxonomy show that the concepts of problem-based learning method, strategy, model, methodology, phenomenon, philosophy that were used in the scientific context have not been crystallised; their structural and procedural differences have not been highlighted. However, problem-based learning transcends the boundaries of the method in its narrow sense and becomes a method in its broadest sense, i.e., the one, which embraces multiple philosophical ideas, multiple visions of learning structure and process. Multiple models of problem-based learning differ depending on the established learning goals, the character of student interaction, scaffolding forms, roles of tutor and objects of evaluation.

1.2. The analysis of paradigmatic dimensions of problem-based learning disclose that in its general sense, problem-based learning is defined as self-directed tutor-supported learning of students, when following the chosen philosophical (theoretical) problem-solving paradigm; integral individual and group learning occurs when solving problems of different types, complexity and structure. Since the problem is articulated as one of the predeterminers of successful problem-based learning in scientific discourse,

the typology and designs of problems receives considerable scholarly attention. The identified criteria for problem evaluation (e.g., 3C3R model, internal and external features, dimensions of complexity and structure) are linked to the immanent difficulty of the problem and student's powers.

1.3. The conducted research on the problem-based learning process reveals its structural multiplicity. The typology of problem-based learning phases allows conceptualising problem-based learning through its five essential phases, which are perceived not as elements of the linear learning process but as certain stages of cyclic process. For this reason, there are no clear boundaries between phases, and it is possible to return to them by revising and reformulating the understanding of the solved problem that is achieved in each phase. The cycle of problem-based learning is determined as the process that integrates microprocesses of group and individual learning. Group problem-based learning embraces five phases of problem solution: (i) primary analysis of the problem (facts, concepts, processes), (ii) problem identification and deconstruction, (iii) problem contextualisation, (iv) construction of alternative scenarios for problem solution and (v) co-construction of problem-solution. The four phases of individual learning that intervene among the phases of group problem-based learning are necessary for the implementation of epistemic goals of the group.

1.4. The epistemic content of interdisciplinarity varies depending on the plurality of philosophical positions and interests. Various typologies of interdisciplinarity are grounded on different criteria of classification (goal, type and function of interaction of disciplines). The integral concept of interdisciplinarity embraces several forms of interdisciplinarity (e.g., instrumental, critical and synthetical interdisciplinarity), which manifest themselves in the process of studies through students' efforts to critically evaluate disciplinary concepts, theories and methods, link them when seeking for complex problem solutions, explanations of multifaceted phenomena, raising new interdisciplinary questions, etc.

1.5. The analysis of interdisciplinary thinking, knowledge and understanding reveals the complexity of these cognitive phenomena. Interdisciplinary thinking embraces complex cognitive and communicative skills that enable to change disciplinary perspectives and articulate an interdisciplinary attitude. Interdisciplinary knowledge is determined as multidisciplinary knowledge that is integrated around the main theme of studies and possesses a complex internalised inner structure (i.e., schemes, mental, conceptual models, structures of knowledge). The interdisciplinary knowledge structure is constructed by gradually improving cognitive skills of higher level, i.e., metacognitive skills, critical thinking and personal epistemology. Interdisciplinary understanding is the consequence of the cognitive ability to

integrate, apply and articulate knowledge (concepts, theories) and modes of thinking (methods) for explaining a complex phenomenon, solving a problem, creating a product or raising new problem questions. Interdisciplinary understanding (knowledge) is firstly individual, based on the integration of personal meanings into the structures of pre-existing knowledge (cognitive aspect), but it has been acknowledged as well that when sharing a discourse, i.e., collaborating in a heterogenous group (socio-cognitive aspect), more comprehensive interdisciplinary understanding is co-constructed.

1.6. In the absence of a universal theory of knowledge integration, interdisciplinary integration is regarded as a process, when ideas, data and information, methods, tools, concepts and (or) theories of different scientific fields are synthesised, integrated and blended. The fundamental role in self-construction of interdisciplinary understanding is played by interdisciplinary approaches and social group interaction. The integrative strategies (i.e., contextualising, conceptualising, problem-centring, common ground) that are used in the process of interdisciplinary learning are based on the specifics of the structures of knowledge from different disciplines, intensity of their integral links, different epistemological goals and different approach towards interdisciplinary integration.

1.7. Relying on the conceptual features of problem-based learning (complexity and structuredness of the problem, synergy of individual and group learning, integration of theoretical approaches) and conceptual features of interdisciplinary learning (interdisciplinary problem, critical analysis of multidisciplinary approaches and their integration, reflection on new interdisciplinary understanding), interdisciplinary problem-based learning in this research is defined as a process, which consists of six iterative phases of interdisciplinary problem solving, i.e., it embraces: (i) primary analysis of the problem (i.e., articulation of facts, concepts, theories and methods), (ii) identification, deconstruction of interdisciplinary problem and generation of multidisciplinary ideas related to a problem, (iii) critical analysis of multidimensional insights, (iv) integration of multidisciplinary approaches while creating alternative scenarios for problem-solving, (v) co-construction of integrated group solution based on new interdisciplinary understanding of a problem, and (vi) reflection of new interdisciplinary understanding of a problem. Interdisciplinary problem-based learning is a nonlinear, iterative, spiral and cumulative process, where applying certain step-by-step tactics of solution, students acquire a more comprehensive interdisciplinary understanding of a complex problem.

1.8. The construction of interdisciplinary knowledge in the process of problem-based learning is a multidimensional cognitive, meta-cognitive, social and

emotional process, which occurs when students construct problem-solving scenarios, which integrate knowledge of several disciplines individually and collaborating in groups. Theoretically, it is complicated to define how disciplinary and multidisciplinary understanding of different levels is transformed into interdisciplinary understanding of different levels, because the structure of interdisciplinary problem-based learning expresses the general idea of constructing interdisciplinary knowledge. Interdisciplinary problem-based learning and construction of interdisciplinary knowledge are experienced simultaneously as a twofold synesthetic process. The typology of disciplinary, multidisciplinary and interdisciplinary knowledge that are elaborated in the present research eliminates limitations of the previous typologies and defines every type of knowledge in quantitative and qualitative categories without providing any privileged status to any type of knowledge.

2. Seeking to provide an answer to the question *what process of problem-based learning allows achieving interdisciplinary understanding,* it is meaningful to apply an instrumental multiple case study, which allows to formulate theoretical insights. Applying an instrumental multiple case study, the researched phenomenon, i.e., interdisciplinary problem-based learning of students, is disclosed. It makes sense to investigate more than one (four in this study) multidisciplinary groups of university students, studying according to the newly implemented interdisciplinary problem-based learning. The set of qualitative research data includes the artefacts created by the students in the process of learning (reports on problem-based learning, written reflections), in-depth interviews and the researcher's field notes. The triangulation of sources of research data allows revealing contradictions between the real interdisciplinary problem-based learning and personal articulations of learning. The qualitative content analysis that was applied for the analysis of research data highlights different configurations of students' interdisciplinary problem-based learning.

3. The structure of the process of interdisciplinary problem-based learning, which enables construction of interdisciplinary knowledge that was highlighted during the multiple case study as well as critical moments of constructing interdisciplinary knowledge, allows formulating the following conclusion of empirical research:

3.1. The multiplicity of configurations of the implemented interdisciplinary problem-based learning indicates a different deviation from the theoretical conception of interdisciplinary problem-based learning. The theoretical model of interdisciplinary problem-based learning is modified in the study practice. The research highlighted two main configurations of interdisciplinary problem-based learning: *disciplined* and *flexible* problem-

based learning. In the process of disciplined interdisciplinary problem-based learning, students penetrate into the "steps" of learning, considering this "stepping" as an empowerment technique and a prerequisite for learning success. In the case of flexible interdisciplinary learning, students as if adrift in the flow of learning and consider the theoretical learning structure as non-binding. Both configurations of interdisciplinary problem-based learning have immanent similarities and limitations. Following the data of empirical research, two modalities of disciplined interdisciplinary problem-based learning can be distinguished: *commitment-based* and *dogmatic* interdisciplinary problem-based learning. The dogmatic interdisciplinary problem-based learning that supports the understanding of *strict method*, encourages penetration into the linear character of the process and is manifested through excessive control of the method, i.e., persistent observation how accurately the sequences and boundaries of phases in the process of learning are observed. In the other case, perceiving interdisciplinary problem-based learning as *an intentional process*, which leads to more comprehensive understanding of a problem, students experience less tension and anxiety regarding the possible methodological failures; the main focus is laid on critical knowledge moments, when certain obligatory actions are necessary (to analyse, compare, weigh, synthesise, etc.). The essential violations of the process of interdisciplinary problem-based learning within the framework of present empirical research are (i) insufficient critical analysis of multidisciplinary approaches and (ii) the elimination of phase of creating individual problem solutions or its minimisation to separate suggestions of problem elements. Such distortions violate the logic of interdisciplinary integration and create the preconditions for unjustified solutions of interdisciplinary problems.

3.2. The interdisciplinary problem-solution scenarios are created through the consciously managed cycle of interdisciplinary problem-based learning (disciplined configuration) or through the partial ignoring of the structure of interdisciplinary problem-based learning, selectively observing only some of its structural principles and thus creating a liquid learning structure (flexible configuration). The construction of multidisciplinary and interdisciplinary understanding of a problem in the process of problem-based learning is of multidimensional nature. Students apply different strategies of integration (i.e., problem-centring, based on common ground, contextualising), and in this way, new knowledge is synthesised by gradually increasing the volume of knowledge of different disciplines and deepening the understanding that is linking it with the context of the researched problem and seeking to enrich the main theory with multidisciplinary insights. From the interdisciplinary perspective, problem-solving scenarios that are created by students imply interdisciplinary knowledge of different levels: when (i) isolated

unsustainable interdisciplinary links, which are hardly explained by students, are mechanically made and when (ii) integrated understanding of a problem is created, which links multidisciplinary approaches. Therefore, it can be concluded that disciplined, commitment-based interdisciplinary problem-based learning is the most favourable learning configuration for the construction of interdisciplinary knowledge, whereas interdisciplinary understanding of qualitative level is a result of consistent cognitive (as well social and emotional) efforts. The epistemological and existential position of students, i.e., the awareness and authenticity (not imitation), is related to the success of interdisciplinary learning, i.e., it creates a favourable environment for constructing up interdisciplinary understanding of a problem and developing an integrated problem-solving scenario.

3.3. Contextual insights that are related to some aspects of interaction between individual and group learning at every phase of the problem-based learning evoke questions to what extent individual learning preferences and practices (e.g., different strategies of searching for information, individual determination to deeply understand multidisciplinary theories and concepts) influence group learning and to what extent group solutions (e.g., to analyse multidisciplinary theories in a critical or biased way, (not) to create individual problem-solving scenarios, to develop verbal discourse or limit to written process) result in complications in individual problem-based learning. The construction processes of individual and group interdisciplinary knowledge are integral ones, and their interaction can be revealed through future in-depth qualitative research.

3.4. Critical moments of constructing interdisciplinary knowledge (understanding) in this research are manifested by disturbances in the construction of interdisciplinary knowledge and conceptual changes that promote the construction of interdisciplinary knowledge. Inflexible epistemological beliefs of group members (method hyper-control vs method ignoring), methodological conflicts, naive interdisciplinary thinking, prevalence of sub-groups, imitation of the process of interdisciplinary problem-based learning are seen as the thresholds that are most difficult to cross in interdisciplinary learning. On the contrary, conceptual changes (e.g., empirical experience of a problem, understanding of a concept, identification of integrating theory) activate the construction of interdisciplinary knowledge and even modify the configuration of group interdisciplinary problem-based learning (e.g., from dogmatic to commitment-based learning). The strategies for coping with disturbances of constructing interdisciplinary knowledge (understanding) have been under-researched, but in the context of this multiple case study, it was observed

that cognitive group efforts to understand an interdisciplinary problem can afresh the "stuck" thinking of problem-based learning groups.

At the end of the dissertation, there are presented recommendations that encourage the implementation of student interdisciplinary problem-based learning, which was conceptualised in the present research.

REFERENCES

Barnett, R. (2004). The Purpose of Higher Education and Changing Face of Academia. *London Review of Education, 2*(1), 61−73.

Barrows, H. S. (1986). A taxonomy of problem-based learning methods. *Medical education, 20*(6), 481−486.

Barry, A., s Born, G., Weszkalnys, G. (2008). *Logics of interdisciplinarity. Economy and Society, 37*(1), p. 20−49.

Berger, P. L., s Luckmann, T. (2011). *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. London: Open Road Media.

Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., s Schramm, E. (2013). *Methods for transdisciplinary research*. Frankfurt/New York: Campus Verlag.

Biggs, J., s Collis, K. (1982). *Evaluation the quality of learning: The SOLO taxonomy – Structure of the Observed Learning Outcome*. New York, San Diego: Academic Press.

Boix Mansilla, V. B. (2016). *Interdisciplinary Learning: A cognitive-epistemological foundation*. Project Zero, Harvard Graduate School of Education. http://www.pz.harvard.edu/sites/default/files/Xl 20Boixl 20Mansillal 20Interdisciplinaryl 20Learning.pdf

Boix Mansilla, V., s Duraising, E. D. (2007). Targeted Assessment of Students' Interdisciplinary Work: An Empirically Grounded Framework Proposed. *The Journal of Higher Education, 78*(2), 215−237.

Boix Mansilla, V., Duraisingh, E. D., Wolfe, Ch. R., Haynes, C. (2009). Targeted Assessment Rubric: An Empirically Grounded Rubric for Interdisciplinary Writing. *The Journal of Higher Education*, *80*(3), 334–353.

Boix Mansilla, V., Lamont, M., s Sato, K. (2016). Shared Cognitive–Emotional–Interactional Platforms: Markers and Conditions for Successful Interdisciplinary Collaborations. *Science, Technology, & Human Values, 41*(4), 571−612.

Braßler, M. (2016). Interdisciplinary Problem-Based Learning - A Student-Centered Pedagogy to Teach Social Sustainable Development in Higher Education. In W. L. Filho, s P. Pace (Eds.), *Teaching Education for Sustainable Development at University Level* (pp. 245−257). Switzerland: Springer International Publishing. https://doi.org/10.1007/978-3-319-32928-4_17

Dolmans, D. H. J. M., s Schmidt, H. G. (2006). What Do We Know About Cognitive and Motivational Effects of Small Group Tutorials in Problem-Based Learningv *Advances in Health Sciences Education, 11,* 321−336. https://doi.org/10.1007/s10459-006-9012-8

Flick, U. (2014). Mapping the Field. In U. Flick (Ed.), *An Introduction to Qualitative Research* (5th Ed.). London: SAGE Publications.

Hallinger, Ph., Bridges, E. (2007). A problem-based approach for management education: Preparing managers for action. https://doi.org/10.1007/978-1-4020-5756-4_1

Hmelo-Silver, C. E., Duncan, R. G., s Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, *42*(2), 99−107.

Holstein, J. A., s Gubrium, J. F. (2008). *Handbook of Constructionist Research.* New York, London: Guilford Press.

Hsieh, H. F., s Shannon, S. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative health research, 15*. 1277−88.

Hung, W. (2011). Theory to reality: a few issues in implementing problem-based learning. *Education Technology Research Development*, *59*, 529−552.

Ivanitskaya, L., Clark, D., Montgomery, G., s Primeau, R. (2002). Interdisciplinary Learning: Process and Outcomes. *Innovative Higher Education, 27*(2), 95−111.

Kirschner, P. A., Sweller, J., s Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*(2), 75−86.

Lattuca, L. R., Voight, L. J., s Fath, K. Q. (2004). Does Interdisciplinarity Promote Learningv Theoretical Support and Researchable Questions. *Review of Higher Education, 28*(1), 23−48.

Manathunga, C., Lant, P., s Mellick, G. (2006). Imagining an interdisciplinary doctoral pedagogy. *Teaching in Higher Education, 11*(3), 365−379.

Merriam, S. B. (1998). Qualitative Research and Case Study Applications in Education. San Francisco: Jossey-Bass.

Merriam, S. B., s Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). San Francisco: Jossey-Bass.

Moore, R. (2011). Making the break: Disciplines, interdisciplinarity and paradigms. In F. Christie, s K. Maton (Eds.), *Disciplinarity: Functional linguistic and sociological perspectives* (pp. 87−105). London: Continuum.

Newell, W. H. (2010). Educating for a Complex World: Integrative Learning and Interdisciplinary Studies. *Liberal Education, 96*(4), 6−11.

Nikitina, S. (2006). Three strategies for interdisciplinary teaching: contextualizing, conceptualizing, and problem-centring. *Curriculum Studies*, *38*(3), 251−271.

Norum, K. E. (2008). *Reality and Multiple Realities*. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods*. http://dx.doi.org/10.4135/9781412963909.n371

O'Brien, R. F (2019). Graduate Students' Perceptions of a Problem-based Learning (PBL) Programme in a Higher Education Institution in Ireland; Exploring the Function of Power Relations and Group Identity Formation (Doctoral dissertation, University of Limerick, ID 213161865).

Patton, M. Q. (2014). *Qualitative research and evaluation methods* (4th ed.). London: SAGE Publications.

Repko, A. F., Szostak, R., s Buchberger, M. P. (2014). *Introduction to Interdisciplinary Studies*. Los Angeles: SAGE Publications.

Savery, J. R. (2006). Overview of Problem-based Learning: Definitions and Distinctions. *Interdisciplinary Journal of Problem-based Learning, 1*(1). http://dx.doi.org/10.7771/1541-5015.1002

Savin-Baden, M. (2014). Using problem-based learning: New constellations for the 21st century. *Journal on Excellence in College Teaching, 25*(3−4), 197−219.

Savin-Baden, M. (2016). The Impact of Transdisciplinary Threshold Concepts on Student Engagement in Problem-Based Learning: A Conceptual Synthesis. *Interdisciplinary Journal of Problem-Based Learning, 10*(2). https://doi.org/10.7771/1541-5015.1588

Savin-Baden, M. (2017). The fault in our stars: Constellations of Problem-based Learning: Living with the Liminal Keynote presented at University of Aalborg, Denmark 3−4th May.

Savin-Baden, M., s Major, C. H. (2004). *Foundations of Problem-Based learning*. Berkshire: Open University Press.

Schmidt, H. G., Van der Molen, H.T., Te Winkel, W. W. R., Wijnen, W. H. F. W. (2009). Constructivist, Problem-Based Learning Does Work: A Meta-Analysis of Curricular Comparisons Involving a Single Medical School. *Educational Psychologist, 44*(4), 227–249.

Spelt, E. J. H. (2015). Teaching and learning of interdisciplinary thinking in higher education in engineering (Doctoral Dissertation, Wageningen university) (No. 492349).

Spelt, E. J. H., Biemans, H. J. A., Tobi, H., Luning, P. A., s Mulder, M. (2009). Teaching and Learning in Interdisciplinary Higher Education: A Systematic Review. *Educational Psychology Review*, *21*, 365−378.

Stake, R. E. (1995). *The Art of Case Study Research*. London: SAGE Publications.

Stentoft, D. (2017). From saying to doing interdisciplinary learning: Is problem-based learning the answerv *Active Learning in Higher Education, 18*(1), 51−61.

Wu, B., s Wang, M. (2012). Integrating problem solving and knowledge construction through dual mapping. *Knowledge Management & E-Learning, 4*(3), 248−257.

Yew, E. H. J, Chng, E, s Schmidt, H. G. (2011). Is learning in problem-based learning cumulativev *Advances in Health Science Education*: *Theory and Practice.* https://doi.org/10.1007/s10459-010-9267-y

Dissemination of the Research Results

Articles in Peer-Reviewed Foreign International Conference Proceedings

Misiūnaitė-Bačiauskienė, E. (2018). Problem-Based Learning in Shared Interdisciplinary Space. *EDULEARN18 Proceedings,* pp. 3845−3851.

Misiūnaitė-Bačiauskienė, E. (2017). Problem-Based Learning: Diversity and Flexibility of Students' Experience. *EDULEARN17 Proceedings,* pp. 1113−1122.

Dissemination of Scientific Results in International Scientific Conferences

Problem-Based Learning: Diversity of Students' Experience in Constructing an Interdisciplinary Knowing. ECER 2018: "Inclusion and Exclusion, Resources for Educational Research?", Free University Bolzano, Bolzano, Italy, 3−7 September 2018.

Problem-Based Learning in Shared Interdisciplinary Space. EDULEARN18: 10th International Conference on Education and New Learning Technologies, Palma, Spain, 2−4 July 2018.

Problem-Based Learning: Diversity and Flexibility of Students' Experience. EDULEARN17: 9th International Conference on Education and New Learning Technologies, Barcelona, Spain, 3−5 July 2017.

Dissemination of Scientific Results in National Scientific Conferences

The Experience of not Writing a Dissertation. 2nd Conference of the Lithuanian Association of Educational Research "Development and Education for the Wellbeing of an Individual", 11−12 October 2018.

What Problem-Based Learning Enables the Construction of Students' Interdisciplinary Knowledgev 3rd Conference of the Lithuanian Association of Educational Research "Ideas for the Future of Education", 11−12 October 2019.

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ANOTACIJA

Aktualumas. Probleminis mokymasis yra vienas iš tarpdalykinio *curriculum* tipų, kuris kelia mokslinių diskusijų dėl jo pagrįstumo, daugybinių formų, tikslų, mokymosi proceso variantiškumo ir komplikacijų, studentų bei dėstytojų kontroversiškų vaidmenų ir patirčių, mokymosi aplinkų struktūros, veiksmingumo etc. Newell'io (2010) požiūriu, edukacinės patirtys turėtų būti projektuojamos taip, kad baigęs studijas studentų gebėtų spręsti naujas sudėtingas problemas. Probleminis mokymasis kaip *curriculum* inovacija (Schmidt, van der Molen, te Winkel, Wijnen, 2009), besiremianti kognityvine, socialinio konstruktyvizmo, pragmatizmo bei postmodernizmo filosofinėmis idėjomis, diegiamas universitetuose ir kito tipo aukštojo mokslo institucijose siekiant atliepti visuomenės poreikius – įgalinti asmenį veikti konceptualiosios netvarkos, etinių dilemų, dauginių galimybių pertekliaus sąlygomis ir spręsti kompleksines tarpdalykines problemas. Tarpdalykinis probleminis mokymasis, peržengiantis disciplinų „teritorijas" ir ugdantis tarpdalykinį sudėtingų problemų supratimą, įmanomas tik iš esmės permąsčius aukštojo mokslo *curriculum* ideologijas, implikuojančias kokybiškai skirtingas *curriculum* tikslų, turinio, proceso, studento ir dėstytojo vaidmenų konfigūracijas. Probleminio mokymosi aktualumas stiprėja atsirandant vis daugiau tyrimų, pagrindžiančių, kad mokymasis sprendžiant sudėtingas, neaiškios struktūros realaus gyvenimo problemas formuoja savivaldaus besimokančiojo tapatumą ir mokymosi visą gyvenimą gebėjimus, o tai atliepia Europos mokslo ir studijų erdvės tikslus. Be to, tarpdalykiškumas tapo inovatyvumo sinonimu, o tarpdalykinis mokymasis – neatsiejamu nuo aukštojo mokslo (Newell, 2010; Repko, Szostak, Buchberger, 2014; Spelt, 2015). Tokių iššūkių kontekste universitetinės švietimo vadybos studijos neišvengiamai patiria didelių transformacijų: nuo teorinių pasakojimų apie švietimo vadybą radikaliai gręžiamasi prie nestruktūruotų realaus gyvenimo problemų sprendimo daugiadalykėse studentų grupėse. Todėl aukštojo mokslo politikos ir praktikos diskursuose probleminis mokymasis vis dažniau traktuojamas ne kaip radikali *curriculum* dizaino inovacija, o kaip viena iš studijų proceso rutinų.

Mokslinė problema. Moksliniame diskurse probleminis mokymasis analizuojamas įvairiais teoriniais pjūviais. Nemažai dėmesio mokslininkai skiria probleminio mokymosi aukštajame moksle *filosofiniams pagrindams, sampratoms*, *problemų*, *sprendžiamų probleminio mokymosi procese*, *tipologijai, formulavimui* ir *kokybei, problemų sprendimui*, *probleminio mokymosi procesui* ir *jame besiformuojamiems gebėjimams*, *tutoriaus vaidmenims* ir *kompetencijai*, *grupės mokymuisi* ir *grupės heterogeniškumo aspektams*, *mokymosi rezultatams, efektyvumui*, *vertinimo, įsivertinimo metodams* ir *strategijoms*, *curriculum dizainui, teoriniams modeliams* ir *įvairiems jų diegimo aspektams*.

Moksliniame diskurse probleminis mokymasis artikuliuojamas kaip daugines formas turintis mokymosi modelis (Savin-Baden, 2014). Probleminio

mokymosi tyrimai atskleidžia probleminio mokymosi sudėtingumą ir kontekstualumą, kylančius iš pasirinktos filosofinės paradigmos, konceptualiųjų probleminio mokymosi nuostatų, analizuojamų problemų tipo, mokymosi tikslų, taikymo konteksto (studijų krypties, tarpdalykinių jungčių etc.). Tokia *išsklidusi* teorinė probleminio mokymosi samprata savaime yra prielaida tyrinėti probleminį mokymąsi, (ne)paisant vis gausėjančių šio edukacinio reiškinio tyrimų. Be to, tyrimuose daugiausia dėmesio skiriama teorinei probleminio mokymosi koncepcijai ir studentų mokymosi rezultatams (Hung, 2011), o probleminio mokymosi proceso tyrinėjimai, ypač susitelkiantys į mikrolygmenį, yra riboti. Iš pirmo žvilgsnio „prisotintame“ probleminio mokymosi diskurse pasigendama tyrimų, kuriuose probleminis mokymasis būtų atskleidžiamas *tarpdalykiškumo* požiūriu, t. y. kaip tarpdalykinį mąstymą aktyvinantis, daugiadalykių požiūrių integravimą paskatinantis ir link išsamaus tarpdalykinio sudėtingų problemų supratimo vedantis mokymosi procesas. Probleminis mokymasis dažnai traktuojamas kaip pedagoginis požiūris, siūlantis galimybes studentams įsitraukti į tarpdalykinį mokymąsi arba kaip tarpdalykinio mokymosi tipas (pvz., Savery, 2006; Savin-Baden, Major, 2004), tačiau nesigilinama į tarpdalykinę probleminio mokymosi dimensiją. Mokslininkų (pvz., Spelt, Biemans, Tobi, Luning, Mulder, 2009) požiūriu, tarpdalykinio mokymosi aukštajame moksle tyrimai taip pat riboti ir nepakankami. Kontroversijų kelia Stentoft (2017) įsitikinimas, kad probleminis mokymasis *per se* „nepalaiko tarpdalykiškumo“ (p. 58), todėl būtina ieškoti tarpdalykiškumą palaikančios probleminio mokymosi formos. Nors problemos sprendimas ir žinių konstravimas yra integruotas dvipusis procesas, moksliniuose tyrimuose šie procesai dažniausiai analizuojami atskirai (Wu, Wang, 2012). Dar viena teorinio mąstymo kryptis susijusi su tutoriaus vaidmens probleminio mokymosi procese kontroversijomis. Prieštaraudama Kirschner'io, Sweller'io ir Clark'o (2006) bei Hmelo-Silver, Duncan'o ir Chinn'o, (2007) teorinėms pozicijoms, susijusioms su aktyviu tutoriaus vaidmeniu probleminio mokymosi procese, Savin-Baden (2016) siūlo paradoksalią „įstrigimo vertės“ idėją (angl. *value of stuckness*) teigdama, kad eliminavę ar iki minimumo sumažinę paramą tutoriai gali padėti studentams įsitraukti į probleminį mokymąsi, perlipti mokymosi „slenksčius“, nes per didelė parama slopina studentų mokymąsi, pastūmėja juos į „pereinamąsias būsenas“, ribodama transformacijos galimybes, nuskurdina probleminio mokymosi patirtis, nepalieka vietos performatyvumui (p. 12). Mokslininkės požiūriu, aukštasis mokslas turi priimti iššūkį parengti studentus barnetiškam kintančiam, superkompleksiškam pasauliui, nenuspėjamumo ir netikrumo situacijoms (ibid.). Toks radikalus siūlymas skatina grįžti prie Kirschner'io et al. (2006) bei Hmelo-Silver (2007) mokslinės diskusijos apie tutoriaus vaidmenį ir empiriškai tirti tarpdalykinį probleminį mokymąsi, kuriame eliminuojama arba taikoma minimali tutoriaus parama.

Atsiliepiant į minėtus imperatyvus užpildyti moksliniame diskurse atsivėrusią empirinių tarpdalykinio probleminio mokymosi tyrimų properšą, prasminga kelti klausimą, ***koks studentų probleminio mokymosi procesas leidžia pasiekti tarpdalykinį supratimą?***

Tyrimo tikslas – atskleisti studentų tarpdalykinio probleminio mokymosi procesą.

Tyrimo objektas – studentų tarpdalykinis probleminis mokymasis.

Siekiant tyrimo tikslo, formuluojami šie **uždaviniai**:

1. Konceptualizuoti studentų tarpdalykinį probleminį mokymąsi.
2. Pagrįsti studentų tarpdalykinio probleminio mokymosi tyrimo metodologiją.
3. Ištirti studentų tarpdalykinio probleminio mokymosi procesą atskleidžiant tarpdalykinio supratimo konstravimą.

Disertacijoje remiamasi šiomis **konceptualiosiomis nuostatomis**:

- *Konstruktyvizmo* epistemologiniai svarstymai remiasi idėja, kad reikšmės (t. y. konceptai, mentalinės reprezentacijos) kuriamos individų, turinčių unikalias patirtis (Berger, Luckmann, 2011), o realybės interpretacijos remiasi ir yra ribojamos individualaus žinojimo.
- *Socialinis konstrukcionizmas* žinojimą traktuoja kaip interaktyviai konstruojamą socialinėse praktikose, vienoms interpretacijoms suteikiant pranašumą, kitas – nuslopinant (Holstein, Gubrium, 2008). Remdamasis tokia perspektyva, tyrėjas siekia atpažinti skirtingą tiriamojo reiškinio supratimą, įvairialypes realybės patirtis (Patton, 2014).
- *Kognityvinės raidos teorija* teigia, kad bet kokia nauja informacija gali būti interpretuojama tik ankstesnio žinojimo ir pasidalytų perspektyvų kontekstuose (Piaget, 1929, cit. Savin-Baden, Major, 2004). Ankstesnės kognityvinės struktūros yra esminė prasmingo mokymosi prielaida. Patirdami ir priimdami netikrumą studentai turi įveikti keletą kognityvinės raidos stadijų, kad autoritarinį, poliarizuotą pasaulio matymą pakeistų intelektinė ir emocinė branda (Perry, 1970, 1988, cit. ibid.). Tarpdalykinį probleminį mokymąsi studentai pradeda turėdami individualias kognityvines struktūras ir ankstesnių žinių (angl. *pre-existing knowledge*). Bendradarbiaudami probleminio mokymosi grupėje jie skaido problemą, lygina naują informaciją, identifikuoja turimą žinojimą, jo ribotumus, integruoja naujas žinias transformuodami ankstesnį žinojimą ir mąstymo būdus ir taip įgydami naują prasmingą problemos supratimą (Savin-Baden, Major, 2004, p. 28).
- *Hibridinio (mišriojo) probleminio mokymosi teorija* (Barrows, 1986) probleminį mokymąsi apibrėžia išskirdama du konceptualiuosius

požymius – studentų *savivaldumą* ir *neaiškios struktūros* problemų sprendimą probleminio mokymosi procese. Konceptualizuojant tarpdalykinį probleminį mokymąsi studentų savivaldumas (grupių ir individualus) bei kompleksinių neaiškios struktūros realaus gyvenimo problemų sprendimas laikomi pamatiniais. Tutoriaus eliminavimo arba minimalios paramos idėja siejama su „įstrigimo" verte, kuri probleminio mokymosi procese paskatina pirminio supratimo transformacijas, praturtina probleminio mokymosi patirtis, atveria galimybes performatyvumui ir sudaro prielaidas pasirengti kintančiam, superkompleksiškam pasauliui, nenuspėjamumo ir netikrumo situacijoms (Savin-Baden, 2016).

- *Integruoto,* arba *sintetinio, tarpdalykiškumo teorija* (Barry, Born, Weszkalnys, 2008) dalykinę integraciją laiko būdu visuminiam kompleksinių realaus pasaulio problemų supratimui konstruoti. Tarpdalykinių žinių sintetinimas yra aukštesnio lygmens gebėjimas, reikalaujantis sąmoningo mokymosi, žinių ir mąstymo būdų jungimo įgūdžių, siekiant giliau suprasti įvairialypius fenomenus (Boix Mansilla, 2016, p. 1).

Tyrimo metodologija. Tarpdalykiniam probleminiam mokymuisi konceptualizuoti šiame tyrime taikoma *naratyvinės (tradicinės) literatūros analizė,* t. y. išanalizuojamas didelis masyvas mokslinių tyrimų, skelbiamų aukštą citavimo indeksą turinčiuose mokslo žurnaluose, monografijose ar straipsnių rinkiniuose. Siekiant atsakyti į klausimą, koks studentų probleminio mokymosi procesas leidžia pasiekti tarpdalykinį supratimą, pasirenkama *dauginių atvejų studijos strategija* (Merriam, 1998; Stake, 1995). Instrumentinė atvejų studijos strategija sutelkiama į kokybinių duomenų ir jais paremtų teorinių įžvalgų generavimą. Toks metodologinis pasirinkimas remiasi konstrukcionistine epistemologija ir dauginių realybių idėja (Norum, 2008, p. 739). Kokybiniai tyrimo duomenys renkami iš keleto informacijos šaltinių: interviu, probleminio mokymosi procese studentų sukurtų artefaktų (refleksijų, ataskaitų) ir stebėjimo. *Individualus giluminis interviu* taikomas studentų požiūriams į tarpdalykinį probleminį mokymąsi, tarpdalykinių žinių konstravimo procesą, taip pat probleminio mokymosi patirtims kaupti. Interviu medžiaga atskleidžia asmenines studentų probleminio mokymosi interpretacijas ir patirtis, esminius tarpdalykinio žinojimo konstravimo momentus. Iš dalies struktūruotose *rašytinėse refleksijose* studentai aprašo kiekvienos dienos probleminį mokymąsi ir žinojimo pokyčius. Struktūruotos probleminio mokymosi ataskaitos fiksuoja studentų grupių daugiadalykio ir tarpdalykinio žinojimo formavimąsi sprendžiant tarpdalykinę problemą ir integruotą grupės sprendimo scenarijų. Tyrėjo *lauko užrašai* rašomi stebint kritinius incidentus, įvykstančius kiekvienos tiriamosios grupės probleminio mokymosi situacijose. Kokybiniams duomenims analizuoti taikoma *kokybinė turinio analizė*.

Mokslinis tyrimo naujumas ir teorinė reikšmė. Šiame tyrime sudaryta probleminio mokymosi sampratų taksonomija, susistemintos probleminio mokymosi dimensijos ir proceso fazės, apibrėžtas probleminis mokymasis. Analizuojant tarpdalykinio mokymosi diskursą išryškinti tarpdalykiškumo, tarpdalykinio mąstymo, žinių ir supratimo (žinojimo) konceptai. Integravus probleminio mokymosi ir tarpdalykinio mokymosi procesus ir konceptualiuosius jų požymius, naujai konceptualizuojamas tarpdalykinio probleminio mokymosi procesas, įgalinantis tarpdalykinio žinojimo konstravimą, be to, plėtojama ir reartikuliuojama probleminio mokymosi procese konstruojamo dalykinio, daugiadalykio ir tarpdalykinio žinojimo tipologija. Ieškant dermės su švietimo diskurse artikuliuojama mokymosi paradigma, taikoma nauja prieiga – teorinis žvilgsnis sutelkiamas į savivaldų tarpdalykinį studentų mokymąsi, o ne į tarpdalykinės probleminio mokymosi aplinkos kūrimą, įprastą edukologijos tyrimams. Instrumentinės dauginių atvejų studijos duomenimis paremtos teorinės įžvalgos reikšmingai prisideda prie tarpdalykinio probleminio mokymosi diskurso plėtojimo bei teorinio (idealiojo) ir praktinio (realiojo) mokymosi problematikos aktualizavimo. Tyrime identifikuojamos keturios tarpdalykinio probleminio mokymosi modifikacijos žymi skirtingo studentų santykio su diegiama mokymosi inovacija manifestacijas.

Praktinė tyrimo reikšmė grindžiama teorinio tarpdalykinio probleminio mokymosi proceso modelio funkcionalumu, t. y. jis gali būti diegiamas įvairiose aukštojo mokslo institucijose, o dalykinio, daugiadalykio ir tarpdalykinio žinojimo tipologija taikoma studentų probleminio mokymosi rezultatams vertinti. Probleminio mokymosi naujumas tyrimo dalyviams atskleidžia „neornamentuotą“ tarpdalykinio probleminio mokymosi realybę ir jos komplikacijas inovacijos diegimo pradžioje. Mokslinės literatūros analizė ir empirinio tyrimo rezultatai leido suformuluoti rekomendacijas už studijų procesus ir kokybę atsakingiems aukštųjų mokyklų vadovams, probleminį mokymąsi taikančioms dėstytojų grupėms ir pavieniams dėstytojams.

Tyrimo išvados

1. Konceptualizuojant tarpdalykinį probleminį mokymąsi moksliniame diskurse išryškėję probleminiai aspektai leidžia formuluoti šiuos teorinius teiginius:

1.1. Probleminio mokymosi sampratų analizė ir sudaryta taksonomija atskleidžia, kad moksliniame diskurse vartojami probleminio mokymosi metodo, strategijos, modelio, metodologijos, fenomeno, filosofijos konceptai nėra išsikristalizavę, struktūriniai ir procesiniai jų skirtumai ir panašumai neišryškinti. Probleminis mokymasis peržengia metodo siaurąja prasme ribas ir tampa *metodu plačiąja prasme,* t. y. apimančiu daugialypes filosofines idėjas, daugines mokymosi struktūros ir proceso vizijas.

Dauginiai probleminio mokymosi modeliai skiriasi – priklauso nuo keliamų mokymosi tikslų, studentų interakcijos pobūdžio, tutoriaus paramos formos ir vaidmens, vertinimo objektų.

1.2. Paradigminių probleminio mokymosi dimensijų analizė atskleidžia, kad bendriausia prasme probleminis mokymasis gali būti apibrėžiamas kaip tutoriaus palaikomas savivaldus studentų mokymasis, kai remiantis pasirinkta filosofine (teorine) problemų sprendimo paradigma vyksta integralus individualus ir grupės mokymasis sprendžiant įvairių tipų, sudėtingumo ir struktūros problemas. Moksliniame diskurse problema artikuliuojama kaip vienas iš pagrindinių probleminio mokymosi sėkmės lėmėjų, todėl problemų tipologijai ir dizainui skiriama daug dėmesio. Identifikuojami problemos vertinimo kriterijai (pvz., 3C3R modelis, vidiniai ir išoriniai požymiai, kompleksiškumo ir struktūriškumo dimensijos) siejami su imanentiniu problemos sunkumu ir studento galiomis.

1.3. Probleminio mokymosi proceso tyrimai atskleidžia struktūrinį daugiavariantiškumą. Probleminio mokymosi fazių tipologija sudaro prielaidą konceptualizuoti probleminį mokymąsi išskiriant penkias esmines jo fazes, kurios traktuojamos ne kaip linijinio mokymosi proceso elementai, o kaip ciklinio grupės ir individualaus mokymosi tarpsniai, todėl kiekviena fazė neturi aiškių ribų, prie jos gali būti grįžtama tikslinant, performuluojant kiekvienoje fazėje pasiektą sprendžiamos problemos supratimą. Probleminio mokymosi ciklas apibrėžiamas kaip grupės ir individualaus mokymosi mikroprocesus integruojantis procesas. Grupės probleminis mokymasis apima penkias problemos sprendimo fazes: 1) pirminę problemos analizę (faktai, konceptai, procesai), 2) problemos identifikavimą ir dekonstravimą, 3) problemos kontekstualizavimą, 4) alternatyvių problemos sprendimo scenarijų kūrimą ir 5) bendrojo problemos sprendimo scenarijaus sukonstravimą. Tarp grupės probleminio mokymosi fazių įsiterpiančios keturios individualaus mokymosi fazės būtinos grupės episteminiams tikslams realizuoti.

1.4. Episteminis tarpdalykiškumo turinys įvairuoja – priklauso nuo filosofinių pozicijų ir interesų pliuralizmo. Įvairios tarpdalykiškumo tipologijos grindžiamos skirtingais klasifikavimo kriterijais (tikslo, disciplinų sąveikos tipo, funkcijos). Integralus tarpdalykiškumo konceptas apima keletą tarpdalykiškumo formų (pvz., instrumentinį, kritinį ir sintetinį tarpdalykiškumą), kurios studijų procese pasireiškia studentų pastangomis kritiškai vertinti dalykinius konceptus, teorijas ir metodus, jungti juos siekiant rasti kompleksinių problemų sprendimus, paaiškinti daugialypius fenomenus, kelti naujų tarpdalykinių klausimų etc.

1.5. Tarpdalykinio mąstymo, žinių ir supratimo (žinojimo) analizė atskleidžia šių kognityvinių fenomenų kompleksiškumą. Tarpdalykinis mąstymas apima sudėtingus kognityvinius ir komunikacinius gebėjimus, įgalinančius keisti, integruoti dalykines perspektyvas, artikuliuoti tarpdalykinį požiūrį. Tarpdalykinės žinios apibrėžiamos kaip aplink pagrindinę studijų temą integruotos daugiadalykės žinios, turinčios sudėtingą internalizuotą vidinę struktūrą (t. y. schemas, mentalinius, konceptualiuosius modelius, žinių struktūras). Tarpdalykinė žinių struktūra konstruojama palaipsniui tobulinant aukštesnio lygmens kognityvinius gebėjimus, t. y. metakognityvinius įgūdžius, kritinį mąstymą ir asmeninę epistemologiją. Tarpdalykinis supratimas yra kognityvinio gebėjimo integruoti, taikyti ir artikuliuoti skirtingų dalykų žinias (konceptus, teorijas) ir mąstymo būdus (metodus) sudėtingam fenomenui paaiškinti, problemai išspręsti, produktui sukurti ar naujiems probleminiams klausimams iškelti padarinys. Tarpdalykinis supratimas (žinojimas) pirmiausia yra individualus, grindžiamas asmeniniu reikšmių integravimu į ankstesnes žinių struktūras (kognityvinis aspektas), tačiau pripažįstama, kad dalijantis diskursu, t. y. bendradarbiaujant daugiadalykėje grupėje (sociokognityvinis aspektas), konstruojamas išsamesnis tarpdalykinis supratimas.

1.6. Nesant universalios žinių integravimo teorijos, tarpdalykinė integracija laikoma procesu, kai sintetinamos, jungiamos ir sumaišomos skirtingų mokslinių laukų idėjos, duomenys ir informacija, metodai, įrankiai, konceptai ir (ar) teorijos. Tarpdalykiniam supratimui su(si)konstruoti fundamentalią reikšmę turi daugiadalykiai požiūriai ir socialinė grupės interakcija. Tarpdalykinio mokymosi procese taikomos integravimo strategijos (t. y. kontekstualizavimo, konceptualizavimo, į problemą sutelktoji, bendrojo pagrindo) remiasi skirtingų dalykų žinių struktūrų specifika, jų tarpusavio sąryšio intensyvumu, skirtingais epistemologiniais tikslais ir skirtingu požiūriu į tarpdalykinę integraciją.

1.7. Remiantis probleminio mokymosi konceptualiaisiais požymiais (problemos kompleksiškumas ir struktūriškumas, individualaus ir grupės mokymosi sinergija, skirtingų teorinių požiūrių integravimas) ir tarpdalykinio mokymosi konceptualiaisiais požymiais (tarpdalykinė problema, kritinė daugiadalykių požiūrių analizė ir integravimas, naujo tarpdalykinio supratimo refleksija), šiame disertaciniame tyrime tarpdalykinis probleminis mokymasis apibrėžiamas kaip procesas, susidedantis iš šešių tarpdalykinės problemos sprendimo fazių: 1) pirminės problemos analizės (t. y. faktų, konceptų, teorijų ir metodų); 2) tarpdalykinės problemos identifikavimo, dekonstravimo ir daugiadalykių idėjų, susijusių su problema, generavimo; 3) kritinės daugiadalykių įžvalgų analizės; 4) daugiadalykių požiūrių integravimo kuriant alternatyvius problemos sprendimo scenarijus; 5) nauju

tarpdalykiniu problemos supratimu pagrįsto integruoto grupės sprendimo konstravimo ir 6) naujo tarpdalykinio problemos supratimo refleksijos. Tarpdalykinis probleminis mokymasis yra nelinijinis, iteracinis, spiralinis ir kumuliatyvus procesas, kuriame taikydami tam tikrą pakopinę sprendimo taktiką studentai įgyja išsamesnį tarpdalykinį kompleksinės problemos supratimą.

1.8. Tarpdalykinio žinojimo konstravimas probleminio mokymosi procese yra daugialypis kognityvinis, metakognityvinis, socialinis ir emocinis procesas, vykstantis studentams individualiai ir bendradarbiaujančioje grupėje konstruojant keleto dalykų žinias integruojančius problemos sprendimo scenarijus. Teoriškai sunku apibrėžti, kaip įvairaus lygio dalykinis ir daugiadalykis supratimas transformuojamas į skirtingo lygio tarpdalykinį supratimą, nes tarpdalykinio probleminio mokymosi struktūra išreiškia bendrąją tarpdalykinio žinojimo konstravimo idėją. Tarpdalykinis probleminis mokymasis ir tarpdalykinių žinių konstravimas patiriami vienu metu kaip dvilypis sinestetiškas procesas. Šiame tyrime išplėtota dalykinio, daugiadalykio ir tarpdalykinio žinojimo tipologija pašalina ankstesnių tipologijų ribotumus ir kiekvieną žinojimo tipą apibrėžia kiekybinėmis ir kokybinėmis kategorijomis nė vienam žinojimo tipui nesuteikdama privilegijuoto statuso.

2. Siekiant atsakyti į klausimą, *koks studentų probleminio mokymosi procesas leidžia pasiekti tarpdalykinį supratimą,* prasminga taikyti instrumentinę dauginių atvejų studiją, leidžiančią formuluoti teorines įžvalgas. Taikant instrumentinę dauginių atvejų studiją atskleidžiamas tiriamasis fenomenas, t. y. studentų tarpdalykinis probleminis mokymasis. Tiriamos dvi ir daugiau (šiame disertaciniame tyrime – keturios) daugiadalykės universiteto studentų grupės, besimokančios naujai diegiamu tarpdalykinio probleminio mokymosi metodu. Kokybinių tyrimo duomenų rinkinį sudaro studentų mokymosi procese sukurti artefaktai (probleminio mokymosi ataskaitos, rašytinės refleksijos), giluminiai interviu ir stebėjimas rašant lauko užrašus. Tyrimo duomenų šaltinių trianguliavimas padeda atskleisti prieštaravimus tarp realiai vykstančio tarpdalykinio probleminio mokymosi bei asmeninių mokymosi artikuliacijų. Tyrimo duomenims analizuoti taikoma kokybinė turinio analizė išryškina skirtingas studentų tarpdalykinio probleminio mokymosi konfigūracijas.

3. Remiantis dauginių atvejų studija išryškėjusi tarpdalykinio probleminio mokymosi proceso struktūra ir kritiniai tarpdalykinio žinojimo konstravimo momentai leidžia formuluoti šias empirinio tyrimo išvadas:

3.1 Realizuojamo tarpdalykinio probleminio mokymosi konfigūracijos rodo skirtingą nutolimą nuo teorinės tarpdalykinio probleminio mokymosi

koncepcijos. Teorinis tarpdalykinio probleminio mokymosi modelis studijų praktikoje modifikuojamas. Tyrime išryškėjo dvi pagrindinės tarpdalykinio probleminio mokymosi konfigūracijos: *disciplinuotas* ir *lankstusis* probleminis mokymasis. Disciplinuoto tarpdalykinio probleminio mokymosi procese studentai gilinasi į mokymosi „žingsnius“ laikydami „žingsniavimą“ įsigalinimo technika ir mokymosi sėkmės prielaida. Lanksčiojo tarpdalykinio mokymosi atveju studentai pasiduoda mokymosi tėkmei, teorinę mokymosi struktūrą laikydami neįpareigojančia. Abi šios tarpdalykinio probleminio mokymosi konfigūracijos turi imanentinių pranašumų ir ribotumų. Remiantis empiriniais tyrimo duomenimis, išskiriami du disciplinuoto tarpdalykinio probleminio mokymosi modalumai: *įsipareigojimu grindžiamas* ir *dogmatinis* tarpdalykinis probleminis mokymasis. Dogmatiškas tarpdalykinio probleminio mokymosi *kaip griežto metodo* supratimas skatina gilintis į proceso linijiškumą ir pasireiškia perdėta metodo kontrole, t. y. nepaliaujamu stebėjimu, kaip tiksliai laikomasi mokymosi proceso fazių sekos ir ribų. Kitu atveju, tarpdalykinį probleminį mokymąsi suprantant *kaip intencionalų procesą*, vedantį prie išsamesnio problemos supratimo, studentai patiria mažiau įtampos ir nerimo dėl galimų metodologinių nesėkmių, jų dėmesys sutelkiamas į esminius žinių konstravimo momentus, kai būtina atlikti tam tikrus privalomus veiksmus (analizuoti, palyginti, pasverti, sintetinti etc.). Šiame empiriniame tyrime esminiais tarpdalykinio probleminio mokymosi idealiojo (teorinio) proceso pažeidimais laikytini (i) nepakankama kritinė daugiadalykių požiūrių analizė ir (ii) individualių problemos sprendimų kūrimo fazės eliminavimas arba redukavimas iki pavienių problemos elementų pasiūlymų. Tokie iškraipymai pažeidžia tarpdalykinio integravimo proceso logiką ir sukuria terpę nepakankamai pagrįstiems tarpdalykinių problemų sprendimams.

3.2 Problemų sprendimo scenarijai kuriami sąmoningai valdant tarpdalykinio probleminio mokymosi ciklą (disciplinuotoji konfigūracija) arba iš dalies nepaisant tarpdalykinio probleminio mokymosi struktūros ir selektyviai laikantis tik kai kurių jo struktūrinių principų, taip susikuriant takią mokymosi struktūrą (lanksčioji konfigūracija). Daugiadalykio ir tarpdalykinio problemos supratimo konstravimas probleminio mokymosi procese yra įvairialypis. Studentai taiko skirtingas integravimo strategijas (t. y. į problemą sutelktąją, bendruoju teoriniu pagrindu grįstąją, kontekstualizavimo), taigi naujos žinios sintetinamos laipsniškai didinant įvairių dalykinių žinių kiekį, gilinant supratimą, siejant su tiriamosios problemos kontekstu arba siekiant daugiadalykėmis įžvalgomis praturtinti pagrindinę teoriją. Tarpdalykiniu požiūriu, studentų sukurti problemos sprendimo scenarijai implikuoja skirtingo lygmens tarpdalykinį žinojimą: kai (i) mechaniškai suformuojamos pavienės, netvarios tarpdalykinės

jungtys, kurias studentai sunkiai paaiškina, arba kai (ii) sukuriamas integruotas, tarpdalykinis problemos sprendimas, susiejantis daugiadalykius požiūrius. Todėl galima teigti, kad disciplinuotas, įsipareigojimu grįstas tarpdalykinis probleminis mokymasis yra palankiausia mokymosi konfigūracija tarpdalykinėms žinioms konstruoti, o kokybinio lygmens tarpdalykinis problemos supratimas yra nuoseklių kognityvinių (taip pat socialinių ir emocinių) pastangų padarinys. Epistemologinė ir egzistencinė studentų laikysena, t. y. sąmoningumas ir autentiškumas (o ne imitavimas) lemia tarpdalykinio mokymosi sėkmę, t. y. sudaro palankią terpę tarpdalykiniam problemos supratimui formuotis ir integraliam problemos sprendimo scenarijui sukurti.

3.3 Kontekstualios įžvalgos, susijusios su kai kuriais individualaus ir grupės probleminio mokymosi sąveikos kiekvienoje probleminio mokymosi fazėje aspektais, kelia klausimus, kiek individualaus mokymosi preferencijos ir praktikos (pvz., skirtingos informacijos paieškos strategijos, individualus apsisprendimas gilintis į daugiadalykes teorijas ir konceptus) veikia grupės mokymąsi ir kiek grupės sprendimai (pvz., kritiškai ar šališkai analizuoti daugiadalykes teorijas, (ne)kurti individualius problemos sprendimo scenarijus, plėtoti žodinį diskursą ar apsiriboti rašytiniu procesu) lemia individualaus probleminio mokymosi komplikacijas. Individualaus ir grupės tarpdalykinio žinojimo konstravimas yra integralūs procesai, kurių sąveikai atskleisti būtini giluminiai kokybiniai tyrimai.

3.4 Kritiniai tarpdalykinio žinojimo (supratimo) konstravimo momentai šiame tyrime pasireiškia tarpdalykinio žinojimo konstravimo trikdžiais ir tarpdalykinio žinojimo konstravimą paskatinančiais konceptualiaisiais pokyčiais. Nelankstūs grupės narių epistemologiniai įsitikinimai (metodo hiperkontrolė v. metodo ignoravimas), metodologiniai konfliktai, naivusis tarpdalykinis mąstymas, subgrupių įsigalėjimas, tarpdalykinio probleminio mokymosi proceso imitavimas traktuojami kaip sunkiausiai peržengiami tarpdalykinio mokymosi slenksčiai. Priešingai, konceptualieji pokyčiai (pvz., empirinis problemos patyrimas, koncepto supratimas, integruojamosios teorijos radimas) suaktyvina tarpdalykinio žinojimo konstravimą ir net modifikuoja grupės tarpdalykinio probleminio mokymosi konfigūraciją (pvz., iš dogmatiškosios į įsipareigojimu grindžiamą mokymąsi). Tarpdalykinio žinojimo (supratimo) konstravimo trikdžių įveikimo strategijos mažai tyrinėtos, tačiau šios dauginių atvejų studijos kontekste pastebėta, kad kognityvinės grupės pastangos, dedamos siekiant suprasti tarpdalykinę problemą, gali išjudinti „įstrigusį“ probleminio mokymosi grupių mąstymą.

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