MARIT WIJNEN

Introduction of Problem-Based Learning at the Erasmus School of Law

Influences on study processes and outcomes

Introduction of Problem-Based Learning at the Erasmus School of Law: Influences on study processes and outcomes

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Introduction of Problem-Based Learning at the Erasmus School of Law: Influences on study processes and outcomes

Invoering van probleemgestuurd onderwijs bij de Erasmus School of Law: Invloeden op studieprocessen en studieresultaten

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1

General Introduction

Study success and progress in terms of graduation rates in the Netherlands are worrying. The report of the Educational Inspectorate (2009) demonstrated that only 31.3% of the students who started a three-year Bachelor's program at a Dutch university graduated after four years[1]. Moreover, 46.8% of the students dropped out the program within four years (Educational Inspectorate, 2009). Although graduation rates showed an increase since the report of Educational Inspectorate in 2009 (Educational Inspectorate, 2017), there is still room for improvement. Poor study success rates have negative consequences for both students and universities. Policymakers in the Netherlands therefore strive for higher quality of education within higher education institutes. To reach a higher quality of education, several changes in educational methods have been proposed (Ministry of Education, Culture and Science, 2011; 2015). The implementation of educational approaches in higher education that *activate* students in their own learning process and that create more strict criteria for students are two of the proposed changes (Ministry of Education, Culture and Science, 2011).

The report of the Educational Inspectorate showed that of all disciplines, the graduation rate among Dutch law students after four years was the lowest (i.e., 21.4%) and dropout the highest (i.e., 60.3%). The Erasmus School of Law, the Law Department of the Erasmus University Rotterdam (EUR), was no exception in this regard. To improve the study success, a new, student-centered educational approach in the three-year Bachelor's programs (i.e., Dutch law, Tax law, and Criminology) was implemented in September 2012. The Erasmus School of Law adopted the educational approach of problem-based learning (PBL) and, by doing so, aimed to make students more actively involved in their own learning process. Also, more strict criteria for students to continue their study were implemented. In the first year of the Bachelor's program, students were confronted with another examination system in which they were obliged to obtain all 60 course credits in order to continue to the second year. This system became known as "Nominal is Normal," indicating that it should be normal for students to complete a first year in the nominally available time of 12 months. (Vermeulen et al., 2012). Two main characteristics of "Nominal is Normal" were: (1) that the number of resits of examinations has been substantially reduced; (2) that students were allowed to compensate low, insufficient marks with higher sufficient marks.

The educational program at the Erasmus School of Law was very different in the period before the implementation of these changes. Before September 2012, the educational program was more traditional in nature. Large-scale lectures were offered multiple times a week and some courses offered weekly working groups, in which a specific law case was discussed with the teacher. Furthermore, students were obliged to obtain only 40 out of the 60 course credits to continue to the second year.

1 In the Netherlands, graduation rates are measured after four years.

The implementation of PBL and the strict standard of obtaining 60 study credits had two main goals. The first goal was to improve the quality of learning of students within the Erasmus School of Law. The second goal was to improve study success and progress in terms of higher graduation rates. This dissertation investigated the question whether these two goals have been reached five years after the implementation of PBL and the examination system "Nominal is Normal".

PROBLEM-BASED LEARNING

PBL is a student-centered educational method that has been developed in the 1960s at the medical faculty at McMaster University in Canada. Students at that time experienced difficulties with understanding certain topics and did not see the relevance of these study topics for their future profession of medical doctor (Barrows, 1996). As a result, they often were lacking the motivation to study. To overcome these issues, a new instructional method, called PBL, was developed. In PBL, learning takes place in small groups under guidance of a tutor (Barrows, 1996). Students work on realistic problems that challenge and motivate them. Over the years, PBL has been implemented in many medical schools over the world, as well as in other disciplines (e.g., social sciences, business, engineering; Barrows, 1996; Hmelo-Silver, 2004; Loyens, Paas, & Kirschner, 2012). PBL was developed with several goals in mind (Hmelo-Silver, 2004; Loyens et al., 2012; Norman & Schmidt, 1992): (1) the development of a flexible and extensive knowledge base, (2) acquisition of effective collaboration skills, and (3) problem-solving skills, (4) making students intrinsically motivated, (5) and helping students to become self-directed learners.

The PBL process consists of three phases (Hmelo-Silver, 2004; Loyens et al., 2012; Schmidt, Van der Molen, Te Winkel, & Wijnen, 2009b): the initial discussion phase, self-study, and the reporting phase. During the initial discussion, groups of ten to twelve students discuss a realistic, complex problem, which is usually a described situation that could happen in real-life. Students discuss the problem collaboratively, trying to explain the situation. Students base their opinions on their own experiences and common knowledge and they activate their prior knowledge doing so. Since the problem is designed as the starting point of the learning process, questions about certain aspects of the problem remain. Together so-called learning issues are formulated, which help students in the second phase, self-study. Students select and study literature sources in an attempt to answer the learning issues by themselves. After a few days, students return to the same group for the third and final phase, the reporting phase. The studied literature and answers to the learning issues are discussed collaboratively in the group. Ideally, all students study different literature sources in the self-study phase, and hence students can add to each other's contributions when addressing the learning issues. A

tutor is present during the initial and reporting phase. Instead of providing students with direct information, the tutor acts as facilitator. He or she makes sure that students elaborate on course material by themselves. A way to accomplish this is, for example, by asking in-depth questions (Loyens et al., 2012; Schmidt, 1983).

Thursday October 13th 2014 |

Failed drug deal

Last Tuesday, a drug deal went completely wrong in the city center of Rotterdam.

ROTTERDAM – Drug dealer Matthew J. got caught up by surprise last Tuesday. Dan K., one of his buyers, robbed Matthew J. from his drugs and money and he stabbed him in the arm with a knife during the robbery. Afterwards, Matthew J. went to his brother John J. Seeing his little brother bleeding, John J. got furious and he swore revenge. After calling an ambulance for Matthew J., John J. loaded his gun and left the house to find Dan K. In a club downtown, he saw Dan K. talking to a man. John J. walked towards him, pointing at his gun and shouted: 'You see this? I'm coming for you after what you did to my brother!' Suddenly, and with high speed, Dan K. ran up to John J. with a knife in his hand. John J. did not see chance to run away and he grabbed his gun. Within a distance of three meters, he shot Dan K, who died instantly. John J. ran off. Thanks to witnesses, John J. could be arrested the next morning. He is now prosecuted for manslaughter.

On account of the news article, John J.'s attorney states that he is certain John J. will not be pursued in court as he was acting out of self-defense on the attack of Dan K.

Figure 1.1 Example of a PBL-problem in Dutch criminal law.

Over the years, different variations of PBL and ways to shape the PBL process have been developed. The Seven-Jump is the method used to shape the PBL process within the Erasmus School of Law (Schmidt, 1983). This Seven-Jump method consists of seven steps that are divided over the three phases of PBL. An example that could serve as problem regarding self-defense during an introductory course in Dutch criminal law, is a situation about a man who purposely seeks confrontation, gets attacked and therefore shoots the attacker (Figure 1.1). Students will discuss whether the actions that took place in the described situation are justified, following the seven steps of the Seven-Jump. Table 1.1 gives an overview of the PBL process using the seven steps of the Seven-Jump method, including specific examples of the problem described in Figure 1.1.

In **Chapter 2** of this dissertation, an extended description of the PBL method at the Erasmus School of Law is provided. In addition, students' and teachers' experiences about PBL are described (e.g., regarding active involvement, knowledge acquisition, and satisfaction).

Table 1.1. Overview of the PBL process using the Seven Jump

Phases of the PBL process	Steps of the Seven Jump method	Example
Initial discussion	1. Clarification of the problem	Addressing all difficulties with the formulation of the problem (e.g., difficult terms)
	2. Formulation of the problem statement	"Is John's action justified?"
	3. Brainstorm: All students give an answer to the problem statement.	Some students might think that John was right to shoot the attacker, others may not.
	4. Problem analysis: A discussion of mentioned explanations in the brainstorm. The discussion should cover the different views that came up during the brainstorm with more depth.	"Why is it or is it not justified what John did?", "Which rules apply when you defend yourself?"
	5. Formulation of the learning issues	"What is self-defense?", "Under which conditions does the right to self-defense apply?"
Self-study	6. Individual search for and study of relevant literature sources, guided by the learning issues	Book chapters, jurisprudence, and articles of the law on self-defense.
Reporting phase	7. Discussion of the studied literature while addressing the learning issues	All different literature sources on self-defense are discussed.

The student-centered, activating nature of PBL is believed to influence students' learning outcomes. This influence can be manifested both in the study processes (e.g., motivation, study strategies and in study outcomes (e.g., impact on academic achievement). This can be traced back to the specific goals of PBL (e.g., Loyens et al., 2012; Norman & Schmidt, 1992). For example, PBL's goal to stimulate intrinsic motivation has more focus on the study *processes*, while the PBL goal of creating a flexible knowledge base emphasizes an influence on study *outcomes*. Study processes and study outcomes are closely related, as the one influences the other (and the other way around). This makes the two research aims described below connected.

In this dissertation, two research aims are attempted to be answered. One focusing on PBL's influence on study processes and the second on PBL's influence on study outcomes. These research aims are in line with the two goals of the implementation of PBL at the Erasmus School of Law: improving quality of learning and improving study progress.

RESEARCH AIM I: PBL AND THE STUDY PROCESSES

Certain skills and learning behaviors are desirable and needed in the professional life after university. For example, being intrinsically motivated, being able to approach learning at a deep level and being a self-regulated learner. Moreover, these study pro-

cesses in turn are determinative for academic achievement and hence study success. For example, academic intrinsic motivation and deep learning are positively and statistically significantly related to academic achievement (e.g., Richardson, Abraham, & Bond, 2012). These skills and learning outcomes are captured in the first research aim of this dissertation, investigating the influence of PBL on study processes.

Motivation

Motivation, especially intrinsic motivation, is shown to be an important predictor of academic achievement (Richardson et al., 2012). Self-Determination Theory (SDT; Ryan & Deci, 2000) is a contemporary, influential theory of motivation. SDT moves beyond the classic distinction between intrinsic and extrinsic motivation and adheres the idea that not all types of extrinsic motivation are detrimental for learning. Instead, SDT distinguishes autonomous and controlled motivation in which autonomous motivation holds intrinsic motivation (i.e., studying because of fun and interest) and the type of extrinsic motivation that enables personal development (i.e., identified motivation; Deci & Ryan, 2000; Ryan & Deci, 2000). Controlled motivation represents the kind of motivation in which self-determination is low. Students study because they avoid feelings of shame and experience feelings of pride (i.e., introjected regulation), or because they experience external pressure, such as trying to obtain a reward or avoiding punishment (i.e., external regulation).

Motivation and Achievement

Previous studies indicated that autonomous motivation is positively related to school achievement (Taylor et al., 2014), deeper learning and persistence (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), better concentration and time-management in university students (Vansteenkiste, Zhou, Lens, & Soenens, 2005), and lower dropout intentions in high-school students (Hardre & Reeve, 2003). On the other hand, controlled motivation has been negatively related to concentration and time-management and positively related to undesirable study behavior, such as performance anxiety and dropout (Vansteenkiste et al., 2005). Hence, stimulating autonomous motivation is important.

According to SDT, three basic, psychological needs (i.e., autonomy, competence, and relatedness) are to be satisfied in every individual to become more motivated. Applied to the learning context, this means that when the learning environment is able to satisfy the three basic needs, students are more likely to become autonomously motivated to learn (Katz, Kaplan, & Gueta, 2009). The first need, autonomy, refers to having internal control over study activities and the learning process. Competence refers to the feeling of being capable to successfully perform study-related activities. Finally, relatedness refers to the need to feel warmth and support of others, such as teachers and fellow-students (Deci & Ryan, 2000; Ryan & Deci, 2000).

Motivation and PBL

PBL holds elements that can stimulate these three needs. The need for feeling autonomy is stimulated when students are provided with choice and when they take control of their own learning (Ryan & Deci, 2000). Due to the student-centered nature of PBL, students regulate their own learning, whereas tutors only have a facilitating role. This means that the teacher or tutor is more in the background, which is believed to support feelings of autonomy (Black & Deci, 2000). Furthermore, students are offered choice in PBL as well. For instance, they need to formulate their own learning issues instead of receiving learning issues from the tutor. In addition, students select and study their own literature sources, which can foster autonomy as well. In line with this assumption, selecting one's own literature opposed to receiving mandatory literature by an instructor in PBL is proven to result in higher autonomous motivation scores (Wijnia, Loyens, Derous, & Schmidt, 2015). Finally, the amount of autonomy increases when students are progressing in the academic program in PBL. For example, first-year students receive more guidance (e.g., more tips in providing literature and active scaffolding by the tutor) than third-year students.

When students feel successful in their learning tasks, they experience feelings of competence, the second need of SDT. Providing positive, informational feedback and praising students for their achievements, is one way to foster this (Deci, Koestner, & Ryan, 2001). The tutor in PBL provides this kind of feedback on how students function in the tutorial group meetings and on how they prepare themselves for the meetings. Another way to foster feelings of competence is by providing problems based on real-life situations that need to be explained or solved. These "authentic", realistic tasks can help students to feel more competent and confident in handling situations they will encounter in real-life and later in their profession (Dunlap, 2005). If students have the feeling they can tackle real-life situations, it might encourage their feelings of competence.

With regards to the third need of SDT, students want to feel connected and feel warmth of significant others. In the learning context, relatedness comprehends fellow-students and the teacher(s). In PBL, students work in small groups, enabling students to build friendships and to easily approach the tutor. This can contribute to feelings of relatedness. In line with this assumption, PBL students were found to perceive collaboration in the tutorial groups as motivating (Wijnia, Loyens, & Derous, 2011).

In short, PBL is assumed to foster the three needs of SDT (i.e., autonomy, competence, and relatedness), which in turn should lead to more autonomously motivated students. **Chapter 3** of this dissertation addresses the relation between motivation and the PBL approach. A cohort comparison between third-year Dutch law students of the former lecture-based approach is made with the third-year Dutch law PBL students regarding the three SDT needs and students' autonomous and controlled motivation. In addition,

focus groups are conducted to provide a more elaborated explanation of the findings and students' ideas of motivation within PBL.

Learning Strategies

Besides motivation, students' learning strategies constitute an important part of their study process. Different learning strategies are related to academic performance (Richardson et al., 2012). According to Vermunt (1998), learning strategies have two components: The way students process course material (i.e., processing strategies) and the way they regulate or control these processing strategies (i.e., regulatory strategies; Vermunt, 1998). Three types of processing strategies are distinguished (Vermunt, 1998). Students can approach their learning at a deep level, meaning that they are able to connect different concepts together, distinguish relevant from irrelevant information, be critical, and create a deeper understanding of the material (Newble & Entwistle, 1986; Vermunt & Vermetten, 2004). On the other hand, students can also show surface learning or stepwise processing and only memorize information by repetition of the learning material, which results in a more superficial understanding (Newble & Entwistle, 1986). A third processing strategy is concrete processing, meaning that students are able to connect acquired knowledge to real-life situations and prior experiences (Vermunt, 1998).

With respect to the regulation of strategies, students can take responsibility for the learning process by themselves, which is labeled as self-regulation. This holds that students take initiative, are able to set goals, and to plan, monitor, and evaluate their learning process (Boekaerts, 1997; Vermunt, 1998; Vermunt & Vermetten, 2004). On the other hand, students can also depend on external factors for the regulation of learning, such as the teacher or handbook, which is called external regulation (Boekaerts, 1997; Vermunt, 1998). Finally, students can experience difficulties with regulation in general and study with no specific plan in mind, which is referred to as lack of regulation (Vermunt & Vermetten, 2004).

Learning Strategies and Achievement

Many studies have addressed the relationship between learning strategies and academic performance. For example, deep processing is positively related to academic outcomes (i.e., GPA; Boyle, Duffy, & Dunleavy, 2003; Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001), while stepwise processing is often found to be negatively related to academic achievement (i.e., GPA; Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001). Research findings on the relationship between concrete processing and performance are inconsistent and hence less unequivocal (Vermunt, 2005; 2007).

Previous research also gives evidence of positive relations between self-regulation activities and academic outcomes (i.e., GPA; Boyle et al., 2003; Richardson et al., 2012).

Further, negative relations between lack of regulation and academic outcomes are well-established (Lindblom-Ylänne & Lonka, 1999; Vermunt, 2005). For external regulation and its relationship with performance, findings are less clear (Vermunt, 2005). In sum, deep processing and self-regulation can be considered effective learning strategies, while stepwise processing and lack of regulation are detrimental for learning.

Development of Learning Strategies

Deep processing and self-regulation are not only desirable in terms of achievement, but also because these strategies are useful in life after university. Students then need to have acquired a coherent knowledge base and to be able to educate themselves throughout their professional lives. Therefore, deep processing and self-regulation should be stimulated and improved over the course of higher education. Several longitudinal studies shed light on the development of these strategies. However, these studies show inconclusive results. While an increase in deep processing in higher education was found in some longitudinal studies (Busato, Prins, Elshout, & Hamaker, 1998; Donche, Coertjens, & Van Petegem, 2010; Donche & Van Petegem, 2009; Severiens, Ten Dam, & Van Hout-Wolters, 2001; Vermetten et al., 1999), other studies found no differences of deep processing over time (Rodriguez & Cano, 2007; Severiens et al., 2001; Zeegers, 2001). A similar pattern can be perceived for self-regulation: an increase of self-regulation activities over time was found in a number of studies (Busato et al., 1998; Donche & Van Petegem, 2009; Severiens et al., 2001; Vermetten et al., 1999), whereas others found no change over time (Endedijk, Vermunt, Meijer, & Brekelmans, 2014; Severiens et al., 2001). In a similar vein, results on inefficient learning strategies over time are mixed. For example, some studies found a decrease in stepwise processing or surface learning (Rodriguez & Cano, 2007; Severiens et al., 2001), while others indicated that stepwise processing stays constant over time (Donche & Van Petegem, 2009; Vermetten et al., 1999; Zeegers, 2001). Severiens et al. (2001) showed a decline in external regulation, though in the study of Vermetten et al. (1999), a stable pattern of external regulation was found. A decrease in lack of regulation over time was found by Vermetten et al. (1999), Donche et al. (2010), and Donche and Van Petegem (2009).

To summarize, fostering the use of deep processing and self-regulation over the course of higher education is needed, because of their positive relationship with academic achievement and the importance of these strategies in students' future professional life. Previous studies demonstrated that the learning environment plays an important role in the development of students' learning strategies (Donche et al., 2010; Donche & Van Petegem, 2009; Vermetten, Lodewijks, & Vermunt, 1999).

Learning Strategies and PBL

Different aspects of PBL are believed to stimulate deep processing (Mattick & Knight, 2007; Newble & Entwistle, 1986). First, the process of elaboration is encouraged in PBL. Students activate their prior knowledge in the initial discussion, making it easier to connect new learned knowledge to the existing knowledge in memory (Schmidt, 1983). This results in better retention of knowledge (Dochy, Segers, Van den Bossche, & Gijbels, 2003). The tutor also stimulates the use of deep processing by asking in-depth questions, making sure elaboration takes place. Further, students are stimulated to connect different literature sources together, as well as different concepts during both self-study and the reporting phase. Finally, the process in PBL encourages students to formulate questions (i.e., learning issues), provide an answer to these questions, and discuss the questions, which contribute to deep processing as well. Moreover, concrete processing is encouraged in PBL as information is acquired in the context of an authentic situation (i.e., the problem) that fosters application of knowledge in real-life situations.

Besides deep processing, self-regulation[2] is assumed to be fostered by the process of PBL as well. When students are self-regulated, they are able to monitor and control their own learning processes (Boekaerts, 1997). In PBL, students need to formulate learning issues by themselves, select their own set of literature sources, and evaluate whether they have studied sufficiently to answer learning issues during and after the reporting phase (Schmidt, 2000). Further, students need to prepare themselves for each tutorial meeting that aids students to monitor and carefully plan their self-study time.

Chapter 4 focuses on the differences between third-year Dutch law students of the former traditional, lecture-based program and third-year Dutch law students of the PBL program on their reported learning strategies. **Chapter 5** addresses the development of students learning strategies in the three-year PBL Bachelor's law program. In addition, the relation with students' academic performance is investigated in this chapter.

RESEARCH AIM II: PBL AND STUDY OUTCOMES

The second objective in this dissertation is investigating the influence of the implementation of PBL on study outcomes. Study outcomes are investigated in terms of performance on knowledge tests and study progress (i.e., graduation rates).

2 Self-regulated learning should not be confused with self-directed learning (Loyens, Magda, & Rikers, 2008), one of the goals of PBL (Hmelo-Silver, 2004; Loyens et al., 2012; Norman & Schmidt, 1992). Self-directed learning is to a certain degree similar to self-regulated learning (e.g., active engagement of students), however not identical. While self-regulation can be seen as a learner characteristic only, self-directed learning is assumed to be both a learner characteristic as well as a learning environment characteristic (Loyens et al., 2008). PBL can be considered a self-directed educational method that stimulates both self-directed learning and self-regulation in students.

Knowledge Acquisition, Retention, and Application

As mentioned before, to create a flexible knowledge base in students is one of the goals of PBL (Hmelo-Silver, 2004; Loyens et al., 2012). The processes of prior knowledge activation, elaboration, and learning in a realistic context contribute to knowledge acquisition in students (Norman & Schmidt, 1992; Schmidt, 1983). A large body of research has been conducted on the effectiveness of PBL on knowledge acquisition. In these studies, PBL students are often compared to students of traditional, lecture-based curricula on academic performance. Several meta-analyses showed inconclusive results in this respect. Several meta-analyses demonstrated no differences between PBL and non-PBL students, or even negative effects of PBL on their immediate knowledge acquisition (Albanese & Mitchell, 1993; Dochy et al., 2003; Schmidt et al., 2009b; Vernon & Blake, 1993), whereas a more recent meta-analysis of Dağyar and Demirel (2015) demonstrated that PBL students outperformed students of conventional curricula on academic achievement. However, there are two factors that need to be taken into account when addressing the effects of PBL knowledge acquisition: time and type of assessment.

Knowledge Retention

The meta-analysis of Dochy and colleagues (2003) showed that the timing of assessment is crucial when investigating the effects of PBL on knowledge acquisition. While immediate knowledge tests usually do not demonstrate differences between PBL and non-PBL students (or even differences in favor of non-PBL students), PBL appears to have a positive effect on knowledge *retention* over time. In other words, PBL students seem to retain more of the acquired knowledge over time compared to their non-PBL counterparts (Dochy et al., 2003; Strobel & Barneveld, 2009).

Application and Transfer of Knowledge

The meta-analysis of Gijbels, Dochy, Van den Bossche, and Segers (2005) indicated that the type of assessment matters when investigating PBL's effects on performance. If the distinction between simple levels of knowledge structure (e.g., definitions of concepts) and complex levels of knowledge structures (e.g., connecting concepts and applying knowledge) is made in assessment (Sugrue, 1993), a difference in how PBL students and students of the traditional, lecture-based program perform emerges. PBL students, compared to students of traditional curricula, perform better when assessment focuses on higher levels of knowledge structures instead of focusing on definitions of concepts (Gijbels et al., 2005). Studies that focused on PBL's effects on knowledge application (Masek & Yamin, 2012) and knowledge transfer to a novel context (Bergstrom, Pugh, Philips, & Machlev, 2016; Pease & Kuhn, 2011; Wirkala & Kuhn, 2011) found that PBL students outperform students of lecture-based curricula on these types of assessment. Application and transfer of knowledge are useful during higher education, but are

even more needed in students' professional life after university (Pugh & Bergin, 2006). Transfer is, however, a difficult process that does not happen automatically (Norman, 2009). Students need to be able to recognize and understand the underlying principles in different situations or contexts, which makes it difficult, especially for novice students (Norman, 2009).

An explanation why PBL students perform better, when complex levels of knowledge are assessed, is that the PBL approach is more in line with these kinds of knowledge structures (Gijbels et al., 2005). For example, in PBL, learning takes place in a realistic context, which requires students to link course material to real-life situations and therefore to apply the knowledge learned to a certain extent. This is especially useful when during discussion in the reporting phase, students refer to the problem of the initial phase.

Chapter 6 of this dissertation focuses on differences in knowledge acquisition between learning in PBL and learning from a lecture in an experimental study. Both type and time of assessment are taken into account.

Study Progress

Previous studies have shown that several student characteristics predict study success. For example, female students (Bruinsma & Jansen, 2009; Jansen, 2004; Jansen & Bruinsma, 2005; Richardson et al., 2012; Stegers-Jager, Themmen, Cohen-Schotanus, & Steyerberg, 2015; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002), students of ethnic majorities (Van den Berg & Hofman, 2005; Stegers-Jager et al., 2015) and students who have obtained high pre-university grades (Jansen, 2004; Suhre, Jansen, & Torenbeek, 2013; Stegers-Jager et al., 2015), obtain more course credits, higher grades, or seem to get their degree more often and show less study delay.

The way the learning environment is organized influences study success as well. In terms of more strict criteria for students, Vermeulen et al., (2012) demonstrated that raising the number of required course credits at the end of the first academic year (i.e., 60 instead of 40 credits) improved study progress: more students obtained all course credits in the first year. Moreover, it was found that when less courses are offered parallel (i.e., in succession), students obtain more credits and more students pass the first academic year (Jansen, 2004; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002). Further, when less hours are spent on lectures and more hours on self-study, students reach better study progress (Jansen, 2004; Schmidt, et al., 2010). These characteristics of the curriculum design are all in line with the implemented PBL approach at the Erasmus School of Law. Previous studies on the effects of PBL on study success indeed showed that PBL students have a shorter study duration and are less likely to dropout compared to students of more traditional educational methods (Iputo & Kwizera, 2005; Schmidt, Cohen-Schotanus, & Arends, 2009a).

The aspects of PBL and the processes that take place within PBL (e.g., prior knowledge activation and elaboration) are assumed to stimulate study progress. In the study of De Koning, Loyens, Rikers, Smeets, & Van der Molen (2012) study success predictors in a PBL program were investigated. It was found that, in line with previous studies on study success (e.g., Jansen, 2004; Stegers-Jager et al., 2015), female students, and students with a high pre-university GPA, earned more credit points and obtained higher grades over the course of the three-year Bachelor's PBL program. Additionally, a specific factor in PBL, students' observed learning activities, appeared a strong predictor for study success. Observed learning activities is a rating of the tutor on how well the student was prepared for and how well the student participated during the meetings. The study of De Koning et al. (2012), however, did not make a comparison with students of a lecture-based program, which makes it hard to conclude whether study progress is indeed better in PBL and which factors contribute to this.

In **Chapter 7** of this dissertation, the focus lies on study success predictors in both the PBL program and the former, lecture-based program of the Erasmus School of Law. This way, it is investigated whether graduation rates are indeed improved in the new PBL program and which factors predict study success. Figure 1.2 provides an overview of the research aims of this dissertation and the accompanied chapters.

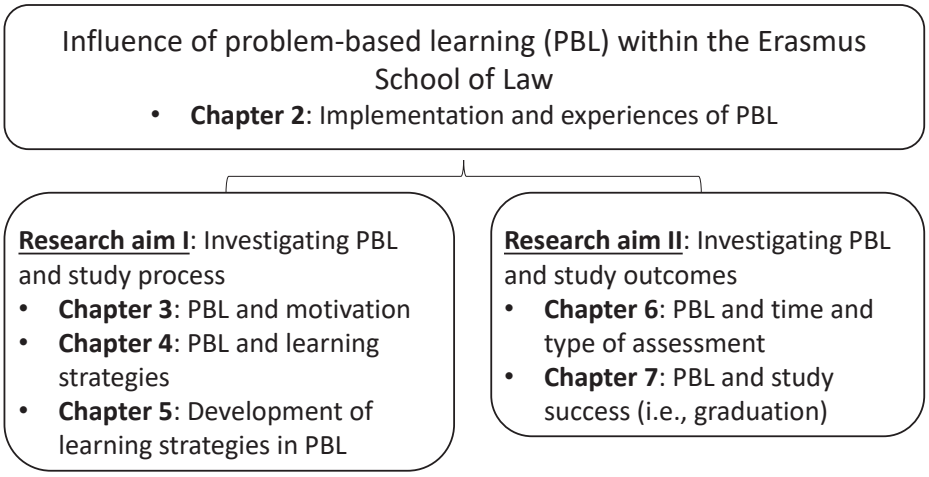

Figure 1.2. Summary of research aims and the content of the chapters

2

Students' and Teachers' Experiences with the Implementation of Problem-Based Learning at a University Law School

This chapter has been published as:

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ABSTRACT

A few years ago, the Erasmus School of Law implemented problem-based learning (PBL) as instructional method in the Bachelor's program. Transition to a PBL program often brings along some difficulties for the teaching staff. In order to find out whether the implementation at the Erasmus School of Law has been successful, students and teachers were questioned about their experiences with and perceptions of the PBL program. Both students and teachers indicated positive study behaviors, such as regular studying and active involvement of students because of PBL. However, also some issues arose after implementing PBL: some dissatisfaction regarding the PBL program of staff members and feelings of insufficient preparation for the legal profession in PBL was reported. Recommendations on how to deal with these issues are discussed.

INTRODUCTION

Study delay and student dropout are two major issues that universities in the Netherlands face. The report of the Educational Inspectorate (2009) demonstrated that only 31.3% of the students who started a three-year Bachelor's program at a Dutch university graduated after four years and the average dropout rate during four years of study was 48% in the years before 2010. Remarkably, dropout rates tend to be higher in legal education compared to other disciplines (e.g., medical education, technical studies, and behavioral sciences). Around 60% of Dutch law students drop out during or after four years of study, of which 39% already quit the academic program during or directly after the first year (Educational Inspectorate, 2009). Clearly, this impacts both the student and university in a negative way.

The Erasmus School of Law is no exception with regards to study delay and student dropout. In an attempt to improve students' learning quality and diminish study delay and dropout, a curriculum-wide implementation of problem-based learning (PBL) in the Bachelor's program took place. PBL is a student-centered instructional method in which students collaboratively work on realistic problems under guidance of a tutor (Barrows, 1996; Hmelo-Silver, 2004; Schmidt, 1983; Loyens, Kirschner, & Paas, 2012). Research has shown that PBL students, compared to students of traditional, lecture-based programs, retain more knowledge on the long-term (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Schmidt, Van der Molen, Te Winkel, & Wijnen, 2009b; Strobel & Barneveld, 2009), are in general more satisfied with the program (Schmidt et al., 2009b), and have less study delay and lower dropout rates (Iputo & Kwizera, 2005; Schmidt, Cohen-Schotanus, & Arends, 2009a; Schmidt et al., 2009b). As the origin of PBL lies in medical education (Barrows, 1996), the majority of studies concerning PBL are conducted within this discipline. However, over the last decades, PBL has been implemented at different fields of education (e.g., psychology, engineering, pre-service teacher education; Savery, 2006). In the present article we will describe the implementation of a PBL program at yet another discipline in higher education: law school.

Problem-Based Learning at the Erasmus School of Law

The Erasmus School of Law started with the PBL program in September 2012. Students enroll in one of three fields of study: Dutch law, tax law, or criminology. All programs contain a three-year Bachelor's and a one-year Master program. Only the Bachelor's program implemented the PBL method. Students who started *before* September 2012 were taught in a traditional, lectured-based way. The professors connected to the program were giving several lectures each week in which they provided students with instructions and information. In addition, some courses offered weekly work groups in which students discussed a specific law case with the teacher. Each academic year was divided

into four ten-week periods. In each period two courses were given parallel (e.g., Dutch administrative law and philosophy of the law). Four examination weeks per year were organized.

Students who entered the Erasmus School of Law from September 2012 on, enroll in the new PBL program. In total, eight courses, lasting for five weeks, are offered sequentially each academic year and all courses end with a written examination. Along with the implementation of PBL, the assessment system changed as well. From September 2012 on, students are required to obtain all course credits in the first academic year in order to continue the second academic year (i.e., 60 ECTS). In the former, traditional program, students needed to obtain only a part of these credits (i.e., 40 out of 60 ECTS) in order to continue their study.

The study activities in the PBL program consist of tutorial meetings, self-study, practical courses, and a limited number of lectures. The tutorial meetings (2.5 hours) take place twice a week in groups of approximately eleven students. In between the meetings, students have two to three days of self-study. During the meetings students collaboratively discuss a realistic problem in the presence of a tutor who acts as a facilitator (Barrows, 1996; Hmelo-Silver, 2004; Schmidt, 1983; Loyens et al., 2012). In general, the PBL process can be divided into the initial discussion, a self-study phase, and the reporting phase. The "Seven Jump" method is applied to shape the PBL process (Schmidt, 1983) as is depicted in Table 2.1.

Table 2.1. Overview of the PBL process, including examples of the seven steps.

Phases of the PBL process	Steps of the "Seven Jump" method	Example
Initial discussion	1. Clarification of the problem	Addressing all difficulties with the formulation of the problem (e.g., difficult terms)
	2. Formulation of the problem statement	"Is John's action justified?"
	3. Brainstorm. All students give an answer to the problem statement.	Some students might think that John was right to shoot the attacker, others may not.
	4. Problem analysis. A discussion of mentioned explanations in the brainstorm. The discussion should cover the different views that came up during the brainstorm with more depth.	"Why is it or is it not justified what John did?", "Which rules apply when you defend yourself?"
	5. Formulation of the learning issues	"What is self-defense?", "Under which conditions does the right to self-defense apply?"
Self-study phase	6. Individual search for and study of relevant literature sources, guided by the learning issues	Book chapters, jurisprudence, and articles of the law on self-defense.
Reporting phase	7. Discussion of the studied literature while addressing the learning issues	All different literature sources on self-defense are discussed.

In the initial discussion phase, students receive a realistic, ill-defined problem (e.g., description of a realistic situation or news article), which is discussed based on own experiences and common sense. A situation about a man who purposely seeks confrontation, gets attacked and therefore shoots the attacker, could serve as a PBL problem regarding self-defense during an introductory course in Dutch criminal law. The problem as used in the law program, under study, which is a fictive news article, is presented in Figure 2.1. As the problem is the starting point of the learning process, prior knowledge is limited and students end up formulating questions about the topic of the problem (i.e., learning issues). The discussion in the first PBL phase follows the first five steps of the "Seven Jump" method (see Table 2.1). In the example problem on self-defense, students are likely to discuss, with help of these steps, whether it was justified what John did. After the initial discussion, the self-study phase starts, which is the sixth step of the "Seven Jump" (Schmidt, 1983). Students individually search for and study relevant literature sources (e.g., book chapters, articles, jurisprudence) to address the learning issues. After two or three days, students return to the group for the reporting phase (i.e., final step of the "Seven Jump"). During this phase, students discuss studied literature sources and collaboratively formulate complete and coherent answers to the learning issues. Table 2.1 illustrates the steps of the "Seven Jump" method including examples of each step of the problem on self-defense.

The tutor is present as facilitator during the initial discussion and the reporting phase. The tutor asks in-depth questions and helps them to get back on track when the discussion becomes focused on irrelevant information (Loyens et al., 2012).

Thursday October 13th 2014 |

Failed drug deal

Last Tuesday, a drug deal went completely wrong in the city center of Rotterdam.

ROTTERDAM – Drug dealer Matthew J. got caught up by surprise last Tuesday. Dan K., one of his buyers, robbed Matthew J. from his drugs and money and he stabbed him in the arm with a knife during the robbery. Afterwards, Matthew J. went to his brother John J. Seeing his little brother bleeding, John J. got furious and he swore revenge. After calling an ambulance for Matthew J., John J. loaded his gun and left the house to find Dan K. In a club downtown, he saw Dan K. talking to a man. John J. walked towards him, pointing at his gun and shouted: 'You see this? I'm coming for you after what you did to my brother!' Suddenly, and with high speed, Dan K. ran up to John J. with a knife in his hand. John J. did not see chance to run away and he grabbed his gun. Within a distance of three meters, he shot Dan K, who died instantly. John J. ran off. Thanks to witnesses, John J. could be arrested the next morning. He is now prosecuted for manslaughter.

On account of the news article, John J.'s attorney states that he is certain John J. will not be pursued in court as he was acting out of self-defense on the attack of Dan K.

Figure 2.1. Example of a PBL-problem in Dutch criminal law.

Teacher Training

Considering the important role the tutor has in PBL (Azer, Mclean, Onishim, Tagawa, & Scherpbier, 2013), serious attention is given to teacher training before the implementation. Two connected training programs were offered to staff members and novice tutors. The first training was a tutor training that focused on the role a tutor should adopt in the PBL process during the meetings. Both senior members of the staff (those responsible for the content of the courses as course coordinators) and novice tutors followed this training. The second training focused on the design of courses and problem and only applied for the course coordinators, which will be referred to as teachers from now on.

In the first three-day tutor training, tutors and teachers were informed about the rationale of the PBL process, the seven steps of the "Seven Jump" method, and the role of the student in PBL. Participants were instructed how to support students when students lead the discussion, make notes, and paraphrase during the discussions. They were informed how to adopt a guiding role in the PBL process, how to stimulate an active role of students, and how and when to intervene the discussions by asking, for example, in-depth questions. Further, instructions were given on how to provide students with feedback on their participation in the tutorial group. The content of this training is much in line with the recommendations given by Azer and colleagues (2013) to assure a successful PBL program.

In the second two-day training, a PBL expert gave instructions to teachers about how to implement PBL. Teachers need to think about the topics they would like to address in their courses and were instructed how to make clear, understandable, and motivating problems. Example problems were discussed and teachers were practicing with creating problems under guidance of the PBL expert. They were also instructed how to make sufficient instructions for tutors (i.e., tutorial manuals) and how the assessment of their courses could be shaped. Guidance and support for teachers remained available after this training. During creating and after finishing definitive versions of the problems for the courses, teachers received feedback from PBL experts. In addition, all problems were tested in a simulated tutorial meeting (i.e., initial discussion) with students. Hence, the problems were tested on their effectiveness, for example, whether they elicited discussion, were understandable for students, and whether the level of prior knowledge of students matched the problem (Loyens et al., 2012).

Additionally, on-going support for tutors remains available throughout the academic year and tutors' functioning is monitored. A few weeks after guiding tutorial sessions, a PBL expert attends the tutorial meetings of all tutors and plans a job evaluation conversation afterwards. From then on, tutors are monitored every three to twelve months. During the job evaluation conversations, students' evaluations of the tutor are discussed as well. Besides these planned meetings, there is always a possibility for tutors to meet the PBL experts when difficulties with students or with the PBL process in general

are encountered. During each course, weekly meetings with all tutors and the course coordinator are held in which experiences are shared and discussed (e.g., difficulties students had with a specific problem of the course).

Student Training

When students enter the Erasmus School of Law an introduction to PBL is provided to them as well. At the start of the academic year, students attend a lecture about the rationale of PBL and their role in the PBL process. It is explained that an active role of students is required during meetings: students need to be prepared every meeting and actively participate in the discussions. They are instructed about the roles of chair and scribe. During each tutorial meeting, one student acts as chair (i.e., guiding the discussion, summarizing the contributions of fellow students) and one as scribe (i.e., taking notes of the discussion for all students in the group). The first tutorial meeting of the first course consists of two initial discussions. The first one is an exercise to practice with the steps of the "Seven Jump" method, the second discussion is the official first initial discussion of the first course.

Experiences with Problem-Based Learning

Implementation of PBL is a complex and time-consuming process and the quality of the implementation is of great importance for student outcomes. Poor implementation often holds that there is a discrepancy between the theory behind PBL and the reality. This can result in dysfunctional groups in PBL, which in turn is detrimental for students' performances (Azer et al., 2013; Dolmans, De Grave, Wolfhagen, & Van der Vleuten, 2005). Examples of this are when tutors act either too directive (i.e., provide too much instructions) or too passive (i.e., barely intervene the discussion when this is actually necessary; Dolmans et al., 2005) or when students short-cut the PBL process (Azer et al., 2013). In order to shed light on the question whether the implementation of PBL at the Erasmus School of Law has been successful, teachers and students were asked about their experiences.

Two short questionnaires, one for students and one for teachers about their experiences with and perceptions of the PBL program were online administered. Questions concerned students' behavior and satisfaction and teachers' satisfaction with the PBL method. Both questionnaires were administered three years after the PBL implementation. Over these three years after implementation, no major changes in the curriculum took place, only minor changes (e.g., adaptations of problems that did not work sufficiently for the year after). The questions were based on the questionnaire used of Kaufman and Holmes (1996). Their article describes teachers' experiences and perceptions after the transition to PBL at a medical school.

Students' Experiences

The questionnaire for students was administered online to all students in the PBL Bachelor's program at the Erasmus School of Law. Students were asked to rate six statements regarding PBL on a five-point scale (1 "Strongly disagree" to 5 "Strongly agree"). Questionnaire items are listed in Table 2.2 accompanied with frequencies and mean scores. Additionally, students had the opportunity to give concluding remarks on the PBL program.

In total, 344 students (37% male) filled out the questionnaire. Response rate was 10 to 15% from the total student population. Participating students were first-year (35%), second-year (29%), and third-year students (36%), of the three different fields of study within the Erasmus School of Law. The majority of them studied Dutch law (65%); the remaining students studied tax law (20%) or criminology (21%)[3]. This distribution is common at the Erasmus School of Law.

Table 2.2. Statements for students, frequencies and mean scores (standard deviations in parentheses)

		1	2	3	4	5	Mean Score
1	Problem-based learning is a pleasant instruction type	15%	19%	16%	33%	17%	3.17 (1.34)
2	I have the feeling that I acquire a lot of knowledge by problem-based learning	13%	13%	15%	43%	16%	3.35 (1.26)
3	I study on a regular basis in problem-based learning	9%	15%	15%	41%	20%	3.46 (1.23)
4	I acquire a lot of skills through problem-based learning	12%	22%	29%	28%	9%	2.99 (1.17)
5	Problem-based learning helps me prepare for work in the professional field	23%	27%	31%	15%	4%	2.51 (1.12)
6	I am satisfied with problem-based learning	20%	19%	19%	29%	13%	2.98 (1.35)

Note. Scores varied from 1 to 5: score of 1 "Strongly disagree", 2 "Disagree", 3 "Do not agree/do not disagree", 4 "Agree", and 5 "Strongly agree"

Results of the questionnaire show that regarding satisfaction of PBL and acquiring skills in PBL, students report a neutral score of 3 (i.e., "do not agree/do not disagree"). They experience PBL in general as a pleasant instruction type, but this score is only slightly above a neutral score. Many of the students agreed on the item regarding acquisition of knowledge in PBL, but the mean score was slightly above a neutral score. An interesting result is that almost half of the students agreed on the item concerning studying on a regular basis because of PBL. When rating the item regarding preparation of PBL for professional work, a mean score of below 3 came out: half of the students indicated to disagree or strongly disagree on this item. This shows that in general, students report to have the feeling PBL does not sufficiently prepare them for work in the professional field.

3 A small percentage of students within the faculty participate in two study programs, (e.g., Dutch law and Tax law). Therefore, the percentages add up to a percentage over hundred.

There was an opportunity to give concluding remarks on PBL and about a third of the students gave comments. Students indicated that PBL makes them more actively involved in the learning process, helps them study on a regular basis, and stimulates them to study. However, some commentaries on the PBL program were that the reporting phase was sometimes not considered to be helpful, because literature findings were simply summed up, and that some tutors lacked in providing proper guidance during meetings. These seem to be issues in other PBL curricula as well (Azer et al., 2013).

Teachers' Experience

The second questionnaire was administered online to teachers who had taught in *both* the former lecture-based curriculum and in the new PBL curriculum. In this questionnaire, teachers were asked to compare students' behavior before and after the implementation of PBL and about their own and their colleagues' satisfaction with both programs (i.e., old and new). All questionnaire items are listed in Table 2.3. For each statement, teachers had to indicate whether the statement fitted the former, traditional educational program (i.e., lecture-based) better, whether no differences were observed between both programs, or whether the statement fitted the PBL program better. Additional, teachers had the opportunity to give concluding remarks on the programs.

A total of 20 teachers (30% male) filled out the questionnaire (response rate was 52%). Teachers taught in different areas of law within the department (e.g., criminal law, company law). Participants' age ranged from 27 to 62. In Table 2.3, the frequencies of responses on each of the three answer options for each item are given.

Table 2.3. Statements for teachers and responses

		Better fits the former method	No difference between both programs	Better fits the PBL method
1	Students get enthusiastic	10%	55%	35%
2	Students are actively involved in the learning process	0%	20%	80%
3	Students acquire a lot of knowledge	40%	50%	10%
4	Students study on a regular basis	0%	20%	80%
5	Students acquire a lot of skills	15%	45%	40%
6	Students get prepared for working in the professional field	25%	70%	5%
7	Students appreciate the educational method	10%	75%	15%
8	In general, the academic staff/faculty is satisfied with the educational method	75%	25%	0%
9	I am satisfied with the educational method	20%	65%	15%

Results show that teachers identify a more active role of PBL students in the learning process, compared to students of the former method and teachers notice that PBL students study on a regular basis more often than 'traditional' students. This result is in line with what students reported. Further, teachers barely observe differences between students in both programs with regards to student enthusiasm and acquisition of skills. Moreover, teachers who filled out the questionnaire are about as equally satisfied with the old as with the new method of teaching. However, teachers do believe that students acquired more knowledge in the former educational method than in PBL. Regarding preparation for the professional field, the majority of teachers reported no differences between both programs. Finally, teachers reported that the majority of the faculty is dissatisfied with PBL, and that the faculty was more satisfied with the educational program before the PBL implementation. None of the teachers reported further remarks on the programs.

Challenges after the Implementation

Experiences and perceptions of students and teachers indicate some positive changes in students' study behavior after the implementation of PBL at the Erasmus School of Law, but also some challenges that need attention.

A positive change in students' study behavior and activities is noticed by both teachers and students. Students seem to study on a more regular basis because of the PBL process. This can be explained by the required study activities in PBL compared to the former educational method. In the former program, lectures were an important source of information. During lectures teachers provided information and students received information and had a rather passive role. As a result, students were not required or stimulated to act on other study activities, such as self-study during the course and they could postpone studying until right before the examination weeks. In contrast, in PBL tutorial meetings take place twice a week for which students need to prepare themselves. Students are stimulated to study on a regular basis this way. Due to the discussions in the tutorial meetings, students are more actively involved in their learning process. In order to discuss on the material, students need to have studied course materials and have thought about arguments and different perspectives. Hence, students need to be actively engaged in study activities.

Despite higher student engagements, some issues have arisen after the implementation of PBL as well. First of all, students in PBL seem to have the feeling that they are not sufficiently prepared for work in the profession. This finding is more or less surprising, as students in PBL work with authentic, complex problems. The problems in PBL aim to demonstrate students resemblances with real-life situations that they are confronted with later in their profession (Schmidt, 1983), in this case legal profession. Remarks students made on the PBL program might offer an explanation for this. Some pointed

out that often in the reporting phase, literature findings are simply summed up, but a connection to the problem of the initial discussion is missing. If there is not an optimal use of the problems, the initial discussion about the realistic situation might feel useless to students and they will not see the relevance of the real-life context. This could contribute to the feeling that PBL does not prepare students for the professional field. Though, some important remarks should be made regarding this finding. First, there is no comparison with the experiences of students in the former, lecture-based curriculum. In fact, in the new PBL program, there is more focus on skill development and practice compared to the former, lecture-based format. Second, students might not completely be aware of what the legal profession entails and that a post-graduate training is often required.

Another concern that was found in the questionnaire results is the dissatisfaction of faculty after the implementation of PBL. Results of the teacher questionnaire showed that teachers noticed that their colleagues were more satisfied with the old educational program than they are with PBL. A possible reason for this is a required change in teacher style. In the old method, teachers passed on their knowledge trough lectures, which made the transition to a more passive role in PBL as tutor quite a change. For example, teachers ought to not directly provide information, but let students take the lead in the discussion. Changing their teacher style is challenging for teachers (Ertmer & Simons, 2006; Kaufman & Holmes, 1996; Morss Clyne & Billiar, 2016) and could result in dissatisfaction. Moreover, these changes in the activities of the given courses require time and effort, which could also cause a dissatisfying feeling.

Dissatisfaction within the Faculty can have a large impact on the effectiveness of the implementation, as it can lead to insufficient application of the PBL process by tutors and teachers. For example, when teachers and tutors provide students with too much information and instructions during the tutorial meetings. On the other hand, teachers and tutors can act too passively and not intervene in the discussion at all, which leave students frustrated. In both cases, there is a poor implementation of PBL, which can have detrimental effects on group functioning and student performance (Dolmans et al., 2005).

Recommendations

In short, the implementation of PBL leaves the Erasmus School of Law with two issues: Students' believe of insufficient preparation for the legal profession and faculty dissatisfaction. Recommendations in order to overcome these difficulties will be discussed below.

Preparation for profession

Regarding students' perceptions of PBL's insufficient preparation for the professional field, there are two ways of dealing with this. First, there should be a closer look at the existing problems and the use of these problems in the reporting phase. Dolmans et al. (2005) explain the importance of problems for group functioning (e.g., when problems are too well-structured or do not relate to students' prior knowledge, this could result in dysfunctional tutorial meetings). The problems within PBL aim to support learning in a realistic context and help students prepare for working with similar cases in the professional field (Schmidt, 1983). Important here is the focus on knowledge *application* during the reporting phase, which can help students see the connection with real-life situations better. Students indicated that the reporting phase now sometimes exists of summing up literature findings. However, the reporting phase should focus on answering the learning issues that are formulated in the initial discussion, integrating different literature sources, and applying the acquired knowledge to the problem at hand. A tutor can refer to the problem during the reporting phase or even come up with different scenarios related to the original problem. He/she can ask students how to handle these scenarios with the information they have studied and discussed. To return to the example of *Self-defense* mentioned in the introduction, tutors could let students discuss about the justification of John's actions if John "only" mildly injured the man. Students then need to be able to understand that subtle differences among scenarios can have a major impact on the rules and laws that need to be applied. The course coordinator could provide these kinds of problem scenarios in the tutorial manuals, so all tutors can address them. Directly applying the learned information will make students more aware of the connection between the problems used in PBL and practice.

A second method to deal with students' perceptions on insufficient preparation has to do with creating awareness among students. As for almost all disciplines and university programs, after graduating law school in the Netherlands, a vocational training is necessary for a job in the legal professional field. Students might not be completely aware of this and despite the fact that there is focus on skill development and practice within PBL, students feel their preparation is insufficient. Making students more aware that they need to acquire basic knowledge in order to apply it in practice might help them to adapt their expectations of the program.

To sum up, more attention could be paid to the application of knowledge in the group discussions and students need to be made aware what the legal profession entails. Still, as mentioned before, only PBL students filled out the questionnaire. At this point, it is hard to ascertain whether in the former program students had the idea they were better prepared for the professional field. Especially since the majority of teachers reported no differences with regards to this item between both programs.

Dissatisfaction of teachers

The second issue, dissatisfaction of teachers, is perhaps a more difficult issue to address. Dissatisfaction could be a result of a change in teaching style or redesign of the course, which requires time and effort. In an attempt to make teachers more satisfied with the PBL program, teachers should be able to share their dissatisfying feeling towards the management of the PBL program. Their ideas, opinions, and remarks should be taken into account when creating and redesigning a course in PBL. It will be challenging, but not impossible, to compromise both teachers' wishes and PBL fundamentals.

Noteworthy from the findings of the teacher questionnaire is that the teachers who filled out the questionnaire reported to be as satisfied with PBL as they were with the lecture-based program. However, they reported that *within the Faculty*, a dissatisfying feeling regarding PBL dominates. Teachers who filled out the questionnaire had taught in both the lecture-based and PBL method, and hence these teachers personally experienced changes in student behavior after implementation. Other Faculty members who are not involved in the PBL program (e.g., teachers of a Masters' program, which is not problem-based) apparently have an (often negative) opinion about PBL. Perhaps, if these teachers would actually teach in the PBL program, their perception of PBL might change as well. In retrospect, teachers who *do* observe students in PBL (those who filled out the questionnaire) perceived PBL students as more actively involved and to study on a regular basis, which probably influenced their satisfaction with PBL in a positive way.

Students' Achievements

There are some important remarks to make regarding the findings reported in this study. First of all, the implementation of PBL took place recently. Therefore, some start-up problems still existed in the program, which can be noticed by both students as teachers. Moreover, the third-year students who filled out the questionnaire were the very first students in the new PBL program. Especially this group could have experienced start-up problems in the PBL program. Furthermore, the response rates of students and teachers were quite low. Perhaps, those who did not participated were satisfied with the PBL program and did not feel the need to fill out the questionnaire.

Despite the PBL challenges mentioned, positive changes in study behavior are reported and this is also reflected in students' achievements, as will be outlined next. The number of students passing the first academic year by obtaining all credits of the year show a positive image of the educational changes made in the program. On average, 43% and 46% of the students within Erasmus School of Law obtained all course credits over the first year before the implementation of PBL in 2010 and 2011 respectively (traditional curriculum). This percentage increased extensively: About 68% of the students obtained all credits of the first year in 2012, after PBL was implemented (Baars, Van Wensveen, & Hermus, 2015). In addition, percentages on student dropout during or after the first

academic year within Erasmus School of Law showed a small decrease from 35% in 2011 (old method) to 30% (PBL method; Baars et al., 2015). In sum, although still preliminary, the positive changes in student behavior after the switch to PBL seem to pay off.

Conclusion

This article describes the implementation of PBL at the Erasmus School of Law. Students' and teachers' experiences gave an indication whether the implementation has been successful. Even though some challenges remain, the implementation of PBL at the Erasmus School of Law brought along positive changes in students' study activities, such as more active involvement of students and regular study behavior, and in academic achievements.

3

Is Problem-Based Learning Associated with Students' Motivation? A Quantitative and Qualitative Study

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ABSTRACT

In this study, a mixed method design was employed to investigate the association between a student-centered, problem-based learning (PBL) method and law students' motivation. Self-Determination Theory (SDT) states that autonomous motivation, which is associated with higher academic performance, can be reached when there is fulfillment of three psychological needs; autonomy, competence, and relatedness. PBL aims to trigger autonomous motivation. In Study 1, 85 third-year PBL law students (37% male; Mean age = 21.99) and 69 third-year law students of a traditional, lecture-based program (39% male; Mean age = 22.72) filled out the Self-Regulation Questionnaire and an adapted version of the Work-related Basic Need Satisfaction Scale, in order to measure autonomous and controlled motivation and perceived autonomy, competence, and relatedness. In order to compare both groups, two MANOVAs were conducted and results showed no differences on autonomous and controlled motivation, nor on feelings of autonomy and competence. However, PBL students experienced more relatedness. Additionally, in Study 2, focus group discussions were conducted and indicated that PBL contains both autonomy-supportive and controlling elements, which might explain why no differences were found on perceptions of autonomy, autonomous, and controlled motivation between PBL students and students of the traditional, lecture-based program. Furthermore, students reported that tutorial groups in PBL contribute to feelings of relatedness.

INTRODUCTION

Low graduation rates and high student dropout are two major issues that universities in higher education face all over the world: On average, 30% of the students enrolled in tertiary education leave without a degree (Organisation for Economic Co-operation and Development, 2013). In the Netherlands, these are serious issues especially in law schools compared to students of other disciplines. Of all discipline's, the graduation rate among Dutch law students after four years was the lowest (i.e., 21.4%) and dropout the highest (i.e., 60.3; Educational Inspectorate, 2009). A construct that is often associated with better academic achievement and graduation rates is students' motivation. For example, students' motivation highly correlates with academic achievements, such as grade point average (GPA; Richardson, Abraham, & Bond, 2012) and less intrinsically motivated students are more likely to dropout (Vallerand, Fortier, & Guay, 1997). Hence, increasing and maintaining students' motivation in higher education is desirable. The design of a learning environment could help in this regard. Problem-based learning (PBL), a student-centered instructional method, aims to stimulate motivation. More specifically, one of the objectives of PBL is to foster intrinsic motivation in students (Barrows, 1986; Hmelo-Silver, 2004; Norman & Schmidt, 1992).

The present research will explore whether PBL can positively affect students' motivation, by conducting a quantitative (i.e., Study 1: a comparison between a PBL cohort and a traditional, lecture-based cohort student cohort) as well as qualitative study (i.e., Study 2: focus group discussions). These studies will be conducted within the Erasmus School of Law, since study progress issues are worrisome especially among Dutch law students. Self-Determination Theory (SDT), a well-known theory of motivation by Deci and Ryan (2000) will be used as the theoretical framework of the studies. SDT has been applied to the learning context, and components of SDT are much in line with the instructional method PBL (cf. Black & Deci, 2000), on which we will elaborate later.

Self-Determination Theory

According to SDT, three basic, psychological needs, namely autonomy, competence, and relatedness, are to be satisfied in every individual in order to stimulate psychological growth and well-being. Autonomy refers to having internal control over study activities and the learning process. Competence refers to the feeling of being capable to successfully perform study-related activities. Finally, relatedness refers to the need to feel warmth and support of others, such as teachers and fellow students (Deci & Ryan, 2000; Ryan & Deci, 2000). As mentioned, SDT has been applied in the learning context, meaning that when the learning environment satisfies the three basic needs, students are more likely to become intrinsically motivated to learn (Katz, Kaplan, & Gueta, 2009).

Satisfaction of basic psychological needs determines the level of self-determination that is experienced. In SDT, a self-determination continuum is proposed consisting of different types of extrinsic motivation that move beyond the classic distinction between intrinsic versus extrinsic motivation. In the classic distinction, extrinsic motivation is often seen as detrimental for learning performances. However, not all types of extrinsic motivation hamper learning performances, depending on the amount of autonomy that is experienced (Ryan & Deci, 2000). Instead, the distinction between different types of motivation can better be expressed by the differentiation between *autonomous* and *controlled* motivation. In autonomous motivation, self-determination is high. Autonomously motivated individuals act upon the activity because it is fun or interesting (i.e., intrinsic motivation) or because it enables personal development (i.e., identified motivation; Deci & Ryan, 2000; Ryan & Deci, 2000). Although the latter reason is extrinsic, that is the activity is not undertaken because it is interesting in itself, it is completely accepted and integrated with the self. In contrast, controlled motivation represents the kind of motivation in which self-determination is low. Students study because they experience pressure, such as trying to obtain a reward or avoiding punishment (i.e., external regulation) or to avoid feelings of shame and experience feelings of pride (i.e., introjected regulation).

Previous studies indicated positive relations between autonomous motivation and learning behavior. A meta-analysis by Taylor et al. (2014) demonstrated a moderately strong, positive relation between autonomous motivation and school achievement. In the meta-analysis studies from elementary school, high school, and college were included. Furthermore, positive effects of autonomous motivation have been demonstrated on deeper learning and persistence in high school and college students of different educational programs, (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), better concentration and time-management in Chinese university students (Vansteenkiste, Zhou, Lens, & Soenens, 2005), and lower dropout intentions in American high school students (Hardre & Reeve, 2003). Controlled motivation, on the contrary, has been negatively related to concentration and time management and positively related to undesirable study behavior, such as performance anxiety and dropout (Vansteenkiste et al., 2005).

Where Problem-Based Learning Meets Self-Determination Theory

Considering the positive effects of autonomous motivation on learning outcomes, this type of motivation is desirable in students. Therefore, PBL specifically aims to stimulate students' intrinsic or autonomous motivation (Barrows, 1986; Hmelo-Silver, 2004; Norman & Schmidt, 1992). PBL consists of three phases: the initial discussion phase, the self-study phase, and the reporting phase. In the initial discussion, a collaborative discussion of a realistic problem (e.g., description of a real-life situation) takes place at the start of the learning process. Based on common sense and prior knowledge, students try to

explain the problem. With the problem as the starting point of the learning process, knowledge on the topic addressed is limited and students collaboratively formulate questions about to-be-learned aspects of the problem, called learning issues. In the second PBL phase, self-study, students individually search for and study relevant literature sources in order to answer the learning issues. After self-study, students return to the tutorial group to discuss the studied literature and address the learning issues together (i.e., the reporting phase). A tutor is present during the initial discussion and reporting phase. A tutor guides the process, for example by intervening when students focus too long on irrelevant issues. He or she asks in-depth questions to make sure students themselves elaborate on course material, instead of providing them with factual knowledge (Barrows, 1996; Loyens, Kirschner, & Paas, 2012; Schmidt, 1983). One could argue that several aspects of PBL encourage feelings of autonomy, competence, and relatedness and subsequently students' autonomous motivation.

Students' needs for autonomy can be stimulated when students are provided with choice and when they can take control of their own learning (Ryan & Deci, 2000). It is assumed that PBL stimulates students' autonomy in different ways. Due to its student-centered nature, students take control of their own learning, whereas the tutors have a facilitating role. The facilitating or guiding role of teachers in student-centered learning is assumed to support students' need for autonomy in SDT (Black & Deci, 2000). Furthermore, PBL offers choice to students due to its emphasis on self-regulated learning. For instance, students formulate learning issues by themselves instead of receiving fixed learning issues from the tutor. Further, students choose and select their own set of literature sources, which stimulates autonomy. An empirical study by Wijnia, Loyens, Derous, and Schmidt (2015) showed that student-selection of literature resources resulted in higher autonomous motivation scores, when compared to receiving mandatory literature sources by an instructor in a PBL setting. The amount of autonomy increases when students are progressing in the academic program in PBL. For example, first-year students receive more guidance (e.g., more tips in providing literature and active scaffolding by the tutor) than third-year students.

Competence is experienced when students feel successful in a study task. Providing positive, informational feedback is one way to contribute to this (Deci, Koestner, & Ryan, 2001). In PBL, the tutor provides formative feedback on how students function in tutorial group meetings (i.e., preparation for and participation in the reporting phase). Another way to anticipate on feelings of competence is by providing problems that are based on real-life situations that need to be explained or solved. These "authentic", realistic tasks can help to students to feel more competent and confident in handling situations they will encounter in real-life and later in their profession (Dunlap, 2005). It is likely that if students feel they can handle those types of situations, this will make them feel more confident and hence contribute to the second need of SDT, competence.

Regarding the third need, feelings of relatedness have a positive impact on students' intrinsic motivation (Ryan, Stiller, & Lynch, 1994; Sheldon & Filak, 2008). Students want to feel connected to and feel warmth of significant others, which, in the learning context, regards relationships with teachers and fellow students. In a small, collaborative group setting (10-12 students), it is easier for students to contact peers and to build friendships and therefore helps to increase their feelings of relatedness. In line with this assumption, PBL students were found to perceive collaboration in the tutorial groups as motivating (Wijnia, Loyens, & Derous, 2011). Additionally, in PBL, a tutor is present during small group meetings. Because the groups are small, the tutor is able to give more individual support when needed and show interest in all students, which can stimulate feelings of relatedness as well.

Problem-based Learning and Motivational Outcomes So Far

Several studies on the PBL effect on student motivation have been conducted. In these studies, a comparison is made between PBL students and students of a more traditional (i.e., lecture-based) setting. Some studies indicate that PBL students report higher on several motivational aspects, such as intrinsic goal orientation and enjoyability (Sangestani & Khatiban, 2013; Sunger & Tekkaya, 2006), which are important aspects of autonomous motivation. Other studies have found positive effects on self-efficacy (Liu, Hsieh, Cho, & Schallert, 2006). As mentioned when students feel more confident and competent they are more likely to experience intrinsic or autonomous motivation. However, other studies show no differences on motivational outcomes between PBL and non-PBL students (Galand, Raucent, & Frenay, 2010; Loyens, Rikers, & Schmidt, 2009; Wijnia et al., 2011). For example, Wijnia et al. (2011), using the SDT framework, found no differences on autonomous and controlled motivation. Similarly, Galand et al. (2010) found no differences on mastey and performance goals, constructs that share close associations with autonomous and controlled motivation, respectively (Deci & Ryan, 2000).

A difference between the studies that found positive effects of PBL on motivational aspects (Liu et al., 2006; Sangestani & Khatiban, 2013; Sungur & Tekkaya, 2006) and studies where no differences between these student groups were found (Galand et al., 2010; Loyens et al., 2009; Wijnia et al., 2011) is the length of implementation. In studies were PBL positively relates to motivation often implemented PBL for a short period of time (e.g., fifteen days, Liu et al., 2006; six weeks, Sungur & Tekkaya, 2006; one semester, Sangestani & Khatiban, 2013), while a curriculum-wide implementation of PBL was investigated in the studies where no differences were found (e.g., Galand et al., 2010; Loyens et al., 2009; Wijnia et al., 2011).

Why no differences on motivation were found in studies conducted in existing PBL curricula is puzzling. The need satisfaction of SDT (i.e., autonomy, competence, and relatedness) is not taken into account in PBL effect studies on motivation outlined above.

Yet, the three needs are connected to several aspects of PBL (e.g., feelings of autonomy in PBL due to student-selection of literature), making the SDT an interesting framework for PBL studies on motivation. In order to learn more about students' motivation in curriculum-wide PBL implementations, more insight into the relation between PBL and the need satisfaction is needed. The present study will investigate students' motivation in a Dutch law school, the Erasmus School of Law, where a curriculum-wide implementation of PBL has taken place, and will specifically focus on the role of PBL characteristics in students' perceptions of the three psychological needs.

The Present Study

This research consisted of two studies: A quantitative and a qualitative study. Two research questions are addressed in Study 1: 'What are the differences between PBL students and students of a traditional, lecture-based program regarding perceived autonomy, competence, and relatedness?' and 'What are the differences between PBL students and students of a traditional, lecture-based program regarding autonomous and controlled motivation?' In order to answer these questions, a quasi-experimental study was conducted, in which third-year PBL law students and law students of a traditional, lecture-based (i.e., non-PBL) method were compared on their self-reported autonomous and controlled motivation, and their perception of need satisfaction in their learning environment. Regarding the first research question, it is hypothesized that PBL students perceive more feelings of autonomy, competence, and relatedness. PBL is assumed to foster these three needs, because of certain characteristics that are present in this environment, such as students' selection of literature (i.e., for autonomy), use of real-life problems (i.e., for competence), and collaborative working in small groups (i.e., for relatedness). In turn, satisfaction of these needs in PBL is assumed to foster autonomous motivation and diminish controlling motivation. Therefore, with regards to the second research question, it is hypothesized that autonomous motivation is higher among PBL students, and controlled motivation lower compared to students of the traditional, lecture-based program.

In order to elaborate on findings regarding the three needs, motivation, and PBL, Study 2, followed up findings of the Study 1 by conducting focus group discussions on the role of motivation and the three needs in PBL. Focus groups are discussion groups concerning specific questions and are helpful in exploring quantitative data (Kitzinger, 1995).

STUDY 1: QUASI-EXPERIMENTAL STUDY

Method

Learning environment

The Dutch law program under study consists of a three-year Bachelor's program. In September 2012, all first-year law students who enrolled at the Erasmus School of Law at the university under study started in the PBL program. Students who had already enrolled in the Erasmus School of Law *before* September 2012 followed the Bachelor's program in a more traditional, lecture-based instructional environment. The differences between both educational programs are indicated in Table 3.1.

The Dutch law study program in the traditional, lecture-based program consisted of four eight-week periods with two to three parallel courses. Lectures were emphasized as the main instructional method and hence, students could attend multiple lectures each week in which a teacher transmitted information. Some courses offered a weekly workgroup, in which a teacher explained and discussed a particular law case regarding the topic of the given course. Both the lectures and the majority of the workgroups were non-mandatory. Examination weeks were held four times each academic year at the end of each eight-week period. During these examination weeks, multiple courses were examined.

Table 3.1. Differences between the Lecture-Based and PBL Method

	Traditional, lecture-based program	PBL program
Courses	Eight courses per academic year	Eight courses (i.e., blocks) per academic year
	Each course is 8 weeks in duration	Each course is 5 weeks in duration
	Courses are offered parallelly (i.e., 2-3 courses per 8-week period)	Courses are offered sequentially (i.e., 1 course per 5-week period)
Assessment	Examination weeks every eight weeks	Examination after each course
	Four examination weeks with multiple exams	Eight examinations, one at the time
Instructions	Lectures are emphasized	Tutorial meetings are emphasized
	Up to ten lectures per week	Two or three lectures per week
	Weakly workgroups	Two tutorial meetings per week

In September 2012, the Dutch law program shifted from traditional, lecture-based learning to PBL. Teachers were trained to adapt their teaching style from a teacher-centered, directive style to a more guiding, facilitating role. Additionally, new tutors were hired and trained as well. Further, training for changing courses and creating problems was provided. The new PBL program is different from the traditional program in several ways. The PBL program consists of eight sequential courses each academic year, meaning courses are not offered parallelly anymore. Each course takes five weeks (i.e., block) and ends with a written examination instead of four examination weeks within the

academic year. The tutorial group meetings, which are held twice a week, are considered an important element in the PBL program. The groups consist of ten tot twelve students and a tutor. The group composition changes each block. Each 5-week course consists of eight problems, all addressing different, but related topics within the course. To give an example, one of the problems in a criminal law course could focus on self-defense. A (fictive) news article could serve as problem, describing a realistic situation in which a man is using self-defense when he is attacked. During a tutorial meeting, the reporting phase of a problem and the initial discussion of a new, subsequent problem take place. In the example of the problem regarding self-defense, students will discuss in the initial phase whether they think the man was in his right to defend himself, ending with questions (i.e., learning issues) when self-defense applies. Between these meetings, students have two to three days of self-study in which they prepare themselves for the upcoming meeting. They search for and select information from different sources, like text books, laws, and jurisprudence and will use this to address the learning issues. In the reporting phase, students collaboratively will discuss the studied materials and learning issues. Law students in general need to learn how to reason about legal cases. The problems used in PBL help students to think about realistic situations in which they need to apply what they have learned. In the Dutch law system, rules and principles are applied more often than comparison with prior cases.

Besides the tutorial meetings and self-study, students participate in practical courses that help students learn how to apply the learned knowledge. For example, students learn to plea a front of a judge and a lawyer with a realistic law case. Students earn study credits when passing the assignments of these courses. Further, non-mandatory lectures are provided by teachers two or three times a week, to expand the knowledge that is acquired during the tutorial meetings.

Participants

In the current study, participants were third-year Dutch law students of two cohorts. A comparison between both student cohorts took place, and hence participants were students from the *first* cohort of the PBL program and students from the *last* cohort of the traditional, lecture-based program (i.e., non-PBL students). Eighty-five PBL students (37% male) and 69 students of the traditional, lecture-based program (39% male) participated. Mean age was respectively 21.99 (SD = 2.02) and 22.72 (SD = 3.15) years. Students in both cohorts did not differ with respect to age, $t(152) = 1.76$, $p = .081$, or gender, $x^2(1)= 115$, $p = .735$. The male/female ratio in both groups is representative for Dutch law schools (Central Bureau for Statistics, 2014).

Materials

Students' perceptions of autonomy, competence, and relatedness and their autonomous and controlled motivation, were measured with two existing questionnaires. It was explicitly stated that students should base their answers on their experiences of the *entire* Bachelor's program (i.e., the first three years of the academic program), and not solely on experiences of the course they participated in at the time they received the questionnaire.

Satisfaction of needs.

The way students perceive autonomy, competence, and relatedness, in their learning environment was measured with the Work-related Basic Need Satisfaction Scale (W-BNS; Van den Broeck, Vansteenkiste, De Witte, Soenens, & Lens, 2010). The W-BNS was originally developed to measure satisfaction of the three needs in the workplace environment (Van den Broeck et al., 2010). Therefore, some adjustments were made in order to fit the items of the questionnaire to a learning environment (e.g., the word 'work' was replaced by 'study'). The adapted version of the W-BNS contained 18 items that were rated on a five-point Likert scale (1 '*totally disagree*' to 5 '*totally agree*'). The questionnaire consists of three subscales with six items each scale. Table 3.2 presents questionnaire characteristics of the adapted WBN-S.

Table 3.2. Adapted version of Work-related Basic Need Satisfaction Scale

Scale	Cronbach's alpha	Example item
Autonomy ($k = 6$)	$\alpha = .72$	'I feel free to study the way I think it could best be done'
Competence ($k = 6$)	$\alpha = .79$	'I am good at the things I do in my study'
Relatedness ($k = 6$)	$\alpha = .82$	'Some people I study with are close friends of mine'

Autonomous/controlled motivation.

The Self-Regulation Questionnaire (SRQ; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009) was used to measure autonomous and controlled motivation. In this questionnaire, students were asked to rate different reasons to study on a five-point Likert scale ranging from 1 (*not important at all*) to 5 (*really important*). The SRQ contains a total of 16 items, divided over four subscales: external regulation, introjected motivation, identified motivation, and intrinsic motivation.

Based on previous research (e.g., Vansteenkiste et al., 2009), the four scales were combined to two types of motivation, controlled motivation (i.e., average scores of the subscales introjected motivation and external regulation; Cronbach $\alpha = .85$) and autono-

mous motivation (i.e., average scores of the subscales identified motivation and intrinsic motivation; Cronbach α = .89). See Table 3.3 regarding questionnaire characteristics.

Table 3.3. Self-Regulation Questionnaire

Composite	Scale	Cronbach's alpha	Example item
Controlled motivation (*k* = 8)	External regulation (*k* = 4)	α = .79	'I am motivated to study, because others (e.g., parents) force me to do this'
	Introjected motivation (*k* = 4)	α = .79	'I am motivated to study, because I would feel guilty if I would not do this'
Autonomous motivation (*k* = 8)	Identified motivation (*k* = 4)	α = .86	'I am motivated to study, because this is an important life goal for me'
	Intrinsic motivation (*k* = 4)	α = .86	'I am motivated to study, because I like to do this'

Procedure

A cohort comparison between PBL students and students of a traditional, lecture-based program was carried out within one university. The PBL students entered the Erasmus School of Law in their first year in September 2012 and the students of the traditional, lecture-based program entered their first year in September 2011. Both student groups participated when they were in their third year. Hence, students of the PBL cohort filled out the questionnaires in April 2015 and students of the traditional, lecture-based cohort a year earlier, in April 2014. This way, PBL students and students of a traditional, lecture-based program could be compared while they were in the same phase of the academic program (i.e., third year).

Due to the shift of the educational program, there were some changes in the course order as well. Students of the traditional, lecture-based cohort received the questionnaires during a non-mandatory lecture of the course 'Business and Corporate Law'. One of the authors handed out the questionnaires to the students and collected them after they were filled out. In the PBL cohort, questionnaires were distributed during a tutorial meeting. Tutors administered the questionnaires during the final (mandatory) tutorial meeting of the course 'Philosophy of Law'. Completing the questionnaires took students about 10 to 15 minutes. Afterwards, tutors collected the questionnaires and handed them over to one of the authors.

Statistical Analysis

To investigate the effects of PBL on students' perception of the satisfaction of the three psychological needs and their motivation, two separate Multivariate Analysis of Variances (MANOVAs) were conducted. The first MANOVA focused on the three needs. Instructional method (i.e., PBL vs. traditional, lecture-based) served as between-subject

factor and scores on satisfaction of the three needs in the learning environment (i.e., autonomy, competence, and relatedness) were dependent variables. The second MANOVA concerned scores on the SRQ. Again, instructional method (i.e., PBL vs. lecture-based) served as between-subjects factor and motivation scores (i.e., autonomous and controlled motivation) as dependent variables. Effect sizes were expressed in partial eta squares (i.e., partial η^2), and were indicated as small, medium, or large effects when values were .01, .06, and .14 respectively (Richardson, 2011b).

Results

Mean scores for both student cohorts on the adapted version of the W-BNS and the SRQ are given in Table 3.4. First inspection of the scores on the three needs showed they were all rather high, especially scores on competence. Scores on autonomous motivation were higher compared to controlled motivation in both student groups. Table 3.5 provides correlations between all variables. The psychological needs were positive and highly correlated with autonomous motivation, with exception of relatedness (i.e., non-significant correlation). Correspondingly, controlled motivation negatively correlated with perceived autonomy and competence. Again, no correlation with relatedness was present.

Table 3.4. Mean scores on subscales of the Self-Regulation Questionnaire and the adapted version of the Work-related Basic Need Satisfaction Scale (SDs in parenthesis)

Questionnaire	Scales	PBL (n = 85)	Lecture-based (n = 69)
Work-related Basic Need Satisfaction Scale (W-BNS)	Autonomy	3.39 (0.72)	3.53 (0.67)
	Competence	3.77 (0.59)	3.75 (0.60)
	Relatedness	3.54 (0.71)	3.21 (0.87)
Self-Regulation Questionnaire (SRQ)	Autonomous motivation	3.82 (0.75)	3.85 (0.64)
	Controlled motivation	2.32 (0.81)	2.22 (0.75)

Note. Scores on both questionnaires could range from 1 to 5.

Table 3.5. Pearson correlations between all variables

		1.	2.	3.	4.
1.	Autonomous motivation	-			
2.	Controlled motivation	.02	-		
3.	Autonomy	.41**	–.23*	-	
4.	Competence	.48**	–.22*	.38**	-
5.	Relatedness	.11	.04	.15	.23*

Note. N = 154.

* p <.01, ** p <.001.

Before conducting the MANOVAs, assumptions were checked and met (e.g., normality of residuals of dependent variables, Box' test for homogeneity of covariance matrices was non-significant for the first and second MANOVA, respectively $p = .175$ and $p = .109$). The first MANOVA on the three basic needs autonomy, competence, and relatedness, showed a medium effect of instructional method, Pillai's Trace (V) = .06, $F(3, 150) = 3.31$, $p = .022$, partial $\eta^2 = .06$. To follow-up this MANOVA, separate Analyses of Variances (ANOVAs) were conducted. In order to reduce the chance of Type I error, a Bonferroni-correction was applied and results were only considered significant when an alpha level of .017 was reached (.05/3). Results showed no differences between both student groups on perceived autonomy, $F(1, 152) = 1.60$, $p = .207$, partial $\eta^2 = .01$, nor on perceived competence, $F(1, 152) = .04$, $p = .844$, partial $\eta^2 < .01$. However, a significant difference emerged for the satisfaction of the need for relatedness, $F(1, 152) = 6.88$, $p = .010$, partial $\eta^2 = .04$ (i.e., small effect), in favor of the PBL students. The second MANOVA on autonomous and controlled motivation showed no effect of instructional method on students' motivation, Pillai's trace (V) = .01, $F(2, 151) = .36$, $p = .696$, partial $\eta^2 = .01$.

Discussion

PBL and students of the traditional, lecture-based program did not differ on their feelings of autonomy and competence in the learning environment. These results were unexpected, because it is believed that PBL stimulates autonomy (e.g., choice in literature sources) and competence (e.g., work on realistic tasks). Further, it was found that feelings of relatedness were higher in PBL students, meaning that PBL students experience more support by others such as teachers and peers. There was, however, no correlation between autonomous motivation and relatedness, nor between controlled motivation and relatedness. Despite higher scores on relatedness, students' motivation was not influenced by this need, which is in contrast to SDT (Ryan & Deci, 2000). Possible explanations are discussed in the general discussion.

Results further demonstrated no differences between PBL students and students of the traditional, lecture-based program on their autonomous and controlled motivation. These findings were not in line with findings of Sangestani and Khatiban (2013), and Sungur and Tekkaya (2006), which demonstrated positive effects of PBL on student motivation, but they were in line with results reported by Galand et al. (2010), Loyens et al. (2009), and Wijnia et al. (2011). While the studies that found positive outcomes implemented only a short-term PBL intervention, the other studies (Galand et al., 2010; Loyens et al., 2009; Wijnia et al., 2011), as well as the current study, were conducted in *existing* PBL curricula. Introducing students to a short PBL intervention might only influence their motivation, as the method is completely new to them then. Conducting the studies in existing curricula is more ecologically valid. Furthermore, correlations indicated that perceived autonomy and competence were positively and moderately

to highly correlated with autonomous motivation and negatively and moderately correlated to controlled motivation (see Table 3.5). Because scores on competence and autonomy feelings were high in both PBL students and students of a traditional, lecture-based program, the absence of significant differences on autonomous and controlled motivation between both groups become clearer.

Considering that most of the findings were not in line with the hypotheses, with the exception of higher relatedness scores in PBL students, a follow-up study with focus group discussions was conducted to add to and explain these findings. The focus group discussions attempted to elaborate more on elements in PBL that can satisfy or thwart the three needs and on motivating and demotivating elements in PBL. Specifically, students discussed which PBL characteristics influence feelings of autonomy, competence, and relatedness in order to acquire more understanding on the lack of differences regarding autonomous and controlled motivation and on perceived autonomy and competence.

STUDY 2: FOCUS GROUP DISCUSSIONS

As we were interested in the relation between different aspects of PBL and the components of SDT, two focus group discussions with PBL students took place. During focus groups, students give their opinions on certain topics and collaboratively discuss them. Findings from focus group discussions add to data of quantitative studies (Kitzinger, 1995) and offer more understanding on why certain results showed up. During the focus groups, students elaborated on PBL characteristics and whether these were experienced as motivating or demotivating and students discussed the degrees of autonomy, competence, and relatedness they experience in PBL and which elements in PBL contributed to this.

Method

Participants

Third-year Dutch PBL law students were recruited. They were explained the process of the focus groups and were told beforehand that the discussion would focus on PBL. They were guaranteed that their contribution would be reported anonymous. In total, thirteen students volunteered to participate and they were assigned to one of two focus groups, depending on the time of their tutorial meeting, as the focus group took place prior to or after their meeting. PBL students who participated in the focus groups were also involved in the quantitative study and filled out the questionnaires on autonomous and controlled motivation. The first group consisted of five students (one male, four females), the second group of eight students (three males, five females). The focus groups were held on one day, directly before or after one of the tutorial meetings in the final

course of the third academic year (June 2015). Students were recruited from different tutorial groups.

Procedure

The first author acted as interviewer in both groups. She asked the questions, took notes and made sure certain topics would be covered in the discussion. The first open-ended question was: 'Which aspects of PBL do you consider motivating and which aspects do you consider demotivating?' Additionally, the interviewer introduced the three psychological basic needs of SDT briefly. Thereafter the following three questions were asked: 'Do you have the feeling there is autonomy in PBL and which characteristics of PBL contribute to this feeling?', 'Do you feel competent in PBL and which characteristics of PBL contribute to this feeling?', and 'Do you experience relatedness in PBL and which characteristics of PBL contribute to this feeling?' Students were instructed to answer freely and discuss each other's opinions. The authors agreed beforehand that certain topics, concerning the most important characteristics of PBL, needed to be addressed, such as the tutor, the problems used in PBL, collaboration, self-regulated learning, connection with practice. Furthermore, topic concerning the implementation of PBL in the curriculum under study, such as the lectures, needed to be addressed. When these topics were not addressed spontaneously, the interviewer asked students' opinion about the role of the particular topic with respect to their motivation/demotivation. Both focus group discussions took about 60 minutes and were recorded.

Analysis

The first focus group discussion was transcribed literally. Due to a technical problem, recording of the second discussion failed. Therefore, the interviewer directly wrote the discussion down after it took place, based on the written notes and memory. This summary of the discussion was analyzed instead. Statements in the transcriptions were classified under one of five categories, which are based on SDT: motivating aspects, demotivating aspects, autonomy, competence, and relatedness. One of the authors and an independent rater both categorized all statements. There was substantial agreement between raters ($\kappa = .80$) and discrepancies were resolved through discussion.

Results

Motivating aspects

Students experienced PBL overall as satisfying. The structure PBL offers, such as a period of self-study prior to a group discussion, and the fact that courses are offered in succession, were pleasant. The tutor and the problems used, which are specific characteristics of PBL, were perceived motivating, as long as they meet certain conditions. Students were enthusiastic about the tutor when he/she showed interests, had expertise, and

was actively involved in the group (i.e., asking in-depth questions and helping when students discus irrelevant information). In general, students were positive about the problems used in PBL. For example, students indicated that when the problem is used to apply the acquired knowledge in the reporting phase, this is enjoyable.

> *I think it is motivating in PBL that the case [the problem] triggers you to find things out.* FG1, S2

> *[…]. That is motivating to me, when at the end of the reporting phase you understand how it [the problem] in a realistic situation works.* FG1, S4

> *It is motivating when I get the feeling the tutor understands the learning material […].* FG1, S4

Demotivating aspects

There were also some perceived demotivating aspects of PBL. For example, in students' opinion, the initial discussion was sometimes redundant and could be shortened (e.g., formulating the learning issues more directly without a discussion). Moreover, if the initial phase of PBL lacks discussion, students were demotivated. When the topic of the problem is too abstract or too far removed from the students, they lack prior knowledge and experience difficulties discussing the topic.

> *For example, in the course Philosophy of the Law, one can take different perspectives, which makes discussion possible. But for example in the course (Dutch) Civil Procedural Law, all we need to know is written down in the Civil Code, so you don't really have an opinion about it. This makes it hard to enter discussion in the initial discussion.* FG1, S1

Some specific elements of PBL that were earlier described as motivating (i.e., tutor and problems), can also be considered demotivating under other conditions. For example, a tutor was considered very demotivating when he/she was passive during the meetings (i.e., hardly asking questions and being inattentive in the discussion). Further, problems that were too long or similar to previous problems were also unsatisfying.

> *It is really demotivating when a tutor is passive and does not intervene in the discussion when necessary and gives us the feeling he/she doesn't understand what is discussed in the group.* FG1. S4.

Another aspect of the educational system that caused a lot of discussion in the focus groups was the mandatory presence requirement for tutorial meetings. In the PBL curriculum under study, students are required to be present during the tutorial meetings. They are allowed to miss only one meeting per course that needs to be compensated with a compensatory assignment. Although understanding the importance of attendance in the tutorial meetings, students felt this rule is too strict. Lectures were also perceived demotivating, especially when they are not interactive. Students argued that there were too much lectures in a row, taking too long for them to stay focused (approximately four to six hours).

> *Lectures are good when the lecturer let's students participate, but only a few lecturers do this […].* FG1, S2.

Autonomy

When students were asked directly whether they experienced autonomy in PBL, the majority reported low feelings of autonomy. Factors that contributed to this were the mandatory presence, lack of choice in courses and not being able to select their own tutorial group, as students are randomly assigned to their tutorial group. However, students did mention some autonomy-supportive elements in PBL as well, such as choice in literature sources and room for own discussions in the tutorial meetings, without interruptions of the tutor. Interestingly, students indicated to be *unsatisfied* with these autonomy-supportive aspects of PBL.

> *I think it is demotivating that teachers want you to read multiple literature sources during one course. They recommend five to six books, but you will never study all of them. […] I think this is confusing.* FG1. S2

> *It would be nice if the tutor guides more often in a way that he or she would make it more clear what we need to know during the discussion*. FG1.S4

Further, the required preparation for every meeting, which is more a controlling element in PBL, served as an incentive to study. Students study on a regular basis that way.

Competence

In general, students felt competent during their study. Both nonspecific PBL elements (e.g., achievements in form of grades) as PBL specific elements (e.g., the phases of PBL) contributed to feelings of competence. During the phases of PBL (i.e., initial discussion, self-study, and reporting phase), students first activate their prior knowledge, then individually study the material and afterwards discuss the material collaboratively. It

seems that being actively involved in the learning process contributes to feelings of competence.

> *I believe that PBL offers the possibility to really understand the material, because you can ask a lot of questions and you can discuss [about the material]. So you'll know whether you get it or not and this gives a feeling of certainty before you enter your examination. Because you know you have discussed all of it.* FG1.S4

As mentioned before, students like to apply the learned knowledge to the problem. In addition to the fact that this is motivating, connecting theory and practice helps create feelings of competence and helps students build coherent understanding of the material.

> *[…]. You can apply the theory you learned on a practical case [when working with the problem]. Otherwise it [learned course material] stays so abstract*. FG1.S4

Relatedness

All students indicated that they felt connected with others. The most important PBL factor that contributes to this is the tutorial group, because students get to know each other in the meetings. Additionally, students feel the tutor is approachable in PBL, and hence they are more likely to ask questions or start a conversation with him/her.

> *You know a large number of law students by now, because there are different students in your tutorial group every course. I really like that, meeting so many new people*. FG1. S5

Discussion

Results of the focus groups analysis showed that PBL students indicated presence of both motivating as well as demotivating elements in the learning environment. In general, students are satisfied with PBL. Especially the process of PBL (i.e., self-study before discussion of the material), sequential courses (i.e., one course for five weeks, ending with an examination), and an active tutor was motivating. Yet, there were some perceived demotivating aspects in PBL as well, such as the initial discussion, a passive tutor, and mandatory presence.

Other statements in the focus group discussions concentrated on the three psychological needs according to SDT (Ryan & Deci, 2000). Students experienced some autonomy, but also felt they were controlled by certain PBL elements such as the mandatory presence and required preparation. Feelings of competence were attained by PBL specific

elements (i.e., realistic problems) and non-specific PBL elements (i.e., grades). Further, the tutorial meetings with fellow students contributed to relatedness.

General Discussion

As motivation is of importance for academic success and study progress (Richardson et al., 2012; Vallerand et al., 1997), motivation needs to be stimulated in students. PBL is an instructional method that aims to foster intrinsic motivation (Barrows, 1986; Hmelo-Silver, 2004; Norman & Schmidt, 1992). Hence, the present study investigated the relation between PBL and Dutch law students' motivation with a mixed-methods design. SDT was used as a theoretical framework to investigate the claim whether PBL can indeed foster students' intrinsic, or in SDT-terms, autonomous motivation. In Study 1, a comparison between students of a PBL cohort with students of a traditional, lecture-based cohort on their perceived feelings of autonomy, competence, and relatedness in the learning environment and their autonomous and controlled motivation was conducted. Perceptions of students' need satisfaction were included because these needs are important for the experience of motivation (see Deci & Ryan, 2000). Results showed no differences on feelings of autonomy and competence, but PBL students experienced more relatedness in their learning environment, Further, no differences were found on both types of motivation. In Study 2, qualitative data on the role of PBL for motivation and need satisfaction (i.e., autonomy, competence, and relatedness) was collected with focus group discussions to follow-up the results of Study 1.

Autonomy, Competence, and Relatedness

SDT states that when the social context of a learning environment satisfies the needs for autonomy, competence, and relatedness, students become autonomously motivated (Ryan & Deci, 2000). Previous studies investigating differences between PBL and non-PBL students' motivation did not include students' perception of this need satisfaction. Examining need satisfaction might be insightful because these needs are important antecedents of motivation (Ryan & Deci, 2000). It was expected that feelings of autonomy, competence, and relatedness would be stimulated more in PBL, than in a traditional, lecture-based curriculum. Yet, results were not completely in line with these expectations.

With regard to autonomy, no differences were found between PBL student and students of the traditional, lecture-based program. In the focus group discussions, it appeared that there were a number of autonomy-supportive elements present in PBL (e.g., some choice in literature), but also controlling elements (e.g., lack of choice in tutorial group composition). One can assume that in the traditional, lecture-based environment also both autonomy-supportive (e.g., choice in fellow students for collaborative assignments) and controlling elements (e.g., prescribed literature) were present. The presence

of controlling elements in PBL and probable autonomy-supportive elements in a traditional, lecture-based environment could help explain why no differences turned up on perceived autonomy.

When asked directly during the focus group discussions, students indicated to experience low degrees of autonomy and high feelings of control. The mainly contributing factor to this feeling was the mandatory presence to tutorial meetings. However, one could argue that mandatory presence does not refer to an autonomy-supportive or controlling element, but more to a *structural* element in PBL. Providing structure holds that students are offered clear instructions of what is expected of them (Jang, Reeve, & Deci, 2010), which for example are instructions about presence. In general, providing structure is beneficial with regards to educational results, opposed to no structure in class (Jang et al., 2010). Yet structure can be offered in an autonomous-supportive way (i.e., discussing rationale, taking students' feelings into account), which is beneficial for students, or in a controlled way (i.e., no discussion of rationale, not taking students' feelings into account), which has a detrimental effect on students (Jang et al., 2010). It is possible that communication about the mandatory presence in the curriculum under study was perceived as controlling rather than autonomy supportive.

Moreover, although elements, such as choice in literature sources and limited interferences of the tutor are intended to be autonomy supportive in nature, students indicated to be unsatisfied with these elements. It is possible that the amount of autonomy expected from students, with respect to literature selection for example, is too high, making students feel lost in the course material (Sierens, Soenens, Vansteenkiste, Goossens, & Dochy, 2006). Kirschner, Sweller, and Clark (2006) described this in terms of minimal guidance, which is, according to them, harmful for learning. In PBL, the amount of instructions should be adapted to the level of the student (i.e., scaffolding; Schmidt, Loyens, Van Gog, & Paas, 2007). For example novice students (e.g., first-year students) are provided more help in literature search (e.g., more tips) compared to experienced students (e.g., third-year students), because novice students lack experience (Schmidt et al., 2007). Possibly, in the curriculum under study, students, even in their third year, experienced difficulties with respect to students' responsibility for literature choices, resulting in feelings of uncertainty.

Considering the need for competence, students indicated that the phases of PBL help them in experiencing feelings of competence. PBL offers opportunities to rehearse course material, which make students feel confident about the learned material. Moreover, the discussion during the reporting phase helps students to create a rich understanding of the course material. Students indicated that the use of realistic problems also contributed to feelings of competence, which is in line with the study by Dunlap (2005). Real-life problems support a connection between theory and practice, leading to a better understanding about the material. Yet, students of the traditional, lecture-

based cohort also reported high feelings of competence in the learning environment. A first explanation is that some courses in the traditional, lecture-based curriculum also offered work groups in which students worked on a realistic law case, contributing to feelings of competence in these students as well. Second, non-specific PBL factors that contribute to feelings of competence, such as obtaining good grades, are common in both instruction types, explaining why no difference on competence showed up. Finally, students of both cohorts were third-year students and probably all experienced feelings of competence, as they all succeeded so far in their academic carrier.

The only difference between PBL students and students of the traditional, lecture-based program was found on feelings of relatedness. Specifically, PBL students reported higher feelings of relatedness when compared to students the traditional, lecture-based program. Analysis of the focus group discussions demonstrated that this feeling can be explained by the opportunity to form peer connections in tutorial meetings. In PBL, students meet twice a week in a small (i.e., ten to twelve students) tutorial group and the groups change each course. In PBL, students therefore get to know a large number of fellow students this way. Alternatively, it is likely that large-scaled, lecture-based curricula (i.e., traditional) create a sense of anonymity among students and are more impersonal. The teacher will be less involved and more distant than in PBL.

Correlations between relatedness and autonomous and controlled motivation were non-significant. This finding was not in line with results of previous studies (e.g., Sheldon & Filak, 2008), in which positive relations between feelings of relatedness and intrinsic motivation were demonstrated. Still, even though there is no relation with motivation, high feelings of relatedness are beneficial for other student outcomes such as student dropout. Tinto's (1975) model stresses the interaction between students and the academic environment and its influence on student dropout. If students are socially integrated in the academic environment, commitment increases, making it less likely that students voluntary drop out of college (Tinto, 1975). Social integration is the result of connections with peers and interaction with staff. Results of our study suggest that social integration is present in PBL, more than in a traditional, lecture-based environment. Students feel related through small-scale tutorial groups in PBL, as they get to know one another in both a formal (i.e., collaborate on study activities) and informal (i.e., friendship) way. In addition, interaction with tutors in the groups contributes to social integration as well. This result is in line with findings of a study by Meeuwisse, Severiens, and Born (2010), which indicate that an active learning environment (i.e., such as PBL) fosters interactions with both teachers and students.

Autonomous and Controlled Motivation

It was expected that PBL students would report higher scores of autonomous motivation. However, Study 1 revealed no differences on autonomous and controlled motiva-

tion between both student cohorts. The PBL students and students of the traditional, lecture-based program reported rather high autonomous motivation scores (M = 3.82 and M = 3.85 respectively, range 1-5). These results indicate that the PBL's claim that it can stimulate students' intrinsic motivation was not supported by our results. A first explanation has to do with the findings on the three psychological needs. No differences between PBL students and their non-PBL counterparts were found on perceived autonomy and competence. Correlations demonstrated a positive relation between perceived autonomy and competence with autonomous motivation, and a negative relation between perceived autonomy and competence with controlled motivation. As scores on perceived feelings of autonomy and competence did not differ, it is not surprising that no differences on autonomous and controlled motivation were found.

Another possible explanation for why there were no differences between the PBL students and students of the traditional, lecture-based program on autonomous motivation is that the participation in our studies of third-year students took place at the end of the academic year. Apparently, all participants were enthusiastic about their study and were motivated to finish the Bachelor's program. In general, students who are autonomously motivated continue the academic program, while controlled motivated (or demotivated) students dropout at an earlier stage (e.g., Vansteenkiste et al., 2005; Vallerand et al., 1997). Nevertheless, third-year law students were chosen, because these students had more experience with the academic program and curriculum (opposed to first-year students), making their opinions rather valuable for the focus group discussions. Nevertheless, we expect that similar effects would have been found if first-year students were questioned. Results are in line with a study that was conducted with predominantly first- and second-year students of a PBL psychology program (Wijnia et al., 2011). In that study, similar to our results, no differences were found between PBL and lecture-based students on autonomous and controlled motivation. Therefore, we assume that the results can more likely be explained by the fact that no differences were found on the perceived needs of autonomy and competence.

Limitations, Recommendations for Future Research and Implications

The present study has some limitations worthwhile mentioning. A first limitation considers the participation of third-year students. It is likely that third-year students are more motivated and confident about their study, because they almost finished the Bachelor's program. However, third-year students are also more experienced with the PBL program and their opinions were therefore valuable for the focus group discussions. Second, the students of the traditional, lecture-based program filled out the questionnaire during a non-mandatory lecture, while the PBL students filled out the questionnaires during a mandatory meeting. It is likely that the students who were present during the lecture, were highly motivated, which could have biased our results. Nevertheless, results were

in line with previous studies conducted in existing PBL curricula (e.g., Galand et al., 2010). Further, administration of the questionnaires took place during different courses in both student groups, due to changes in course order. Even though students were instructed to base their answers on the entire Bachelors' program, it cannot be ruled out that the content of the course has had some sort of influence on the answers. Finally, with regards to the focus group discussions, recording of one of the discussions failed. Even though the interviewer directly wrote down the content of the discussion, exact statements are missing for this group.

Partly based on these limitations, we have some recommendations for further research. Although the main focus of the present study was on the influence of *PBL* on student motivation, it would be interesting to conduct focus groups among students of the traditional, lecture-based cohort as well. At this point, we can only make assumptions on which factors influence student motivation in a traditional instruction method. Further, the present study indicated that there was no correlation between perceived relatedness and autonomous, nor with controlled motivation. Further research is needed why this relation is absent. Moreover, it might be valuable to connect dropout to motivation, especially feelings towards relatedness. Relatedness, which appeared higher among PBL students, might influence student dropout according to Tinto's model.

In this study, we used SDT as the theoretical framework. We realize that other motivational theories might be of interest as well, such as achievement goal theory or expectancy-value theory. However, in the current study, we were mainly interested in investigating whether PBL can indeed stimulate higher levels of intrinsic or autonomous motivation.

Both the quantitative and qualitative studies were conducted with Dutch law students, as they might benefit most from improvements in motivation (with regard to low graduation rates among Dutch law students; Educational Inspectorate, 2009). However, results are also insightful for other higher educational programs: Student-centered instructional methods, based on constructivist learning theories, have received much attention over the past decades (Baeten, Struyven, & Dochy, 2013) and these methods replace conventional lecture-based programs more and more in several disciplines (White et al., 2016). As PBL can be considered an active and constructivist learning approach, findings of the present study on an activating learning approach and motivation are therefore important for other programs and disciplines as well.

Conclusion

The present study showed no differences between PBL students and students of the traditional, lecture-based program regarding autonomous and controlled motivation, and perceptions of autonomy and competence. Students in both educational forms were highly autonomously motivated and experienced feelings of autonomy and com-

petence in their learning environment. This could be due to the presence of both autonomy-supportive and controlling elements in the PBL learning environment, although a difference on feelings of relatedness was found, in favor of PBL. The small tutorial groups in PBL seem to contribute to these high feelings of relatedness, as students get to know their peers and feel that their teachers are more approachable.

4

Comparing Problem-Based Learning Students to Students in a Lecture-Based Curriculum: Learning Strategies and the Relation with Self-Study Time

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ABSTRACT

In educational theory, deep processing (i.e., connecting different study topics together) and self-regulation (i.e., taking control over one's own learning process) are considered effective learning strategies. These learning strategies can be influenced by the learning environment. Problem-based learning (PBL), a student-centered educational method, is believed to stimulate the use of these effective learning strategies. Several aspects of PBL such as discussions of real-life problems, selecting literature by the students themselves, and formulating answers to learning issues encourage students' use of deep processing and self-regulation. In the present study, third-year PBL law students were compared to third-year law students of a lecture-based program with respect to their learning strategies, which were measured with the Inventory Learning Styles (ILS; Vermunt, 1998). In addition, the relation between time invested in self-study and learning strategies, when taking the instructional method into account, was explored. Results showed that PBL students reported to apply deep processing, self-regulation, and external regulation more frequently than their non-PBL counterparts. PBL seems to contribute to the use of effective learning strategies, but PBL students also relied more often on external sources for their regulation, such as teachers, course material, and assessment.

INTRODUCTION

For students in higher education, self-study is always an important part of the study program. Self-study can be approached in two ways, quantitatively and qualitatively (Doumen, Broeckmans, & Masui, 2014). The *quality* of learning focuses on *how* students learn. More specifically, the strategies and activities that students apply during self-study give an indication of the quality of their learning. The *quantity*, on the other hand, can be referred to as time investment. Some students spend more time on studying than others.

Whether the time invested in learning plays an important role in academic success is still a point of debate (e.g., Doumen et al., 2014; Plant, Ericsson, Hill, & Asberg; 2005). However, there is clear evidence that learning strategies and activities are related to academic performance (Mega, Ronconi, & De Beni, 2014; Richardson, Abraham, & Bond, 2012; Vermunt, 2005; Vermunt & Vermetten, 2004). In turn, learning strategies might be influenced by the learning environment, because some learning environments intend to encourage high quality learning (Mattick & Knight, 2007; Vermunt, 2007). Problem-based learning (PBL), a student-centered educational method, can be considered as a learning environment that aims to stimulate effective learning. The present study will investigate whether PBL indeed stimulates effective learning strategies by comparing a PBL and a lecture-based environment with regard to students' study processes.

Learning Strategies

According to Vermunt (1998) learning strategies can be divided into cognitive processing strategies and regulatory strategies. Processing strategies are thinking strategies that are needed in order to process the material to be learned (Vermunt, 1998; Vermunt & Vermetten, 2004). For instance, when students relate different study concepts to each other and link course material to their own experiences and real-life situations, they study in an effective way (Newble & Entwistle, 1986). These ways of learning lead to deep processing and result in a deep understanding of the study content. Less effective processing strategies are for example rehearsing learning material till it is memorized, as this results in only a poor or superficial understanding of the material. Therefore, processing strategies such as rehearsal and memorization are often labeled as surface or stepwise processing strategies (Newble & Entwistle, 1986; Vermunt, 1998).

Regulatory strategies are strategies students use to regulate or control the processing strategies (Vermunt, 1998; Vermunt & Vermetten, 2004). These can be divided into self-regulation in which students take control of their own learning process, and external regulation, which indicates that students rely on external sources for their regulation, such as teachers, course material, and assessment. Moreover, students can have limited abilities to control their own learning in combination with limited external regulation,

resulting in a third form of regulation processes; lack of regulation (Vermunt & Vermetten, 2004). Being self-regulated is considered to be more effective than external regulation and lack of regulation, since students with self-regulated learning (SRL) skills are able to set goals, monitor, and motivate themselves to achieve those goals (English & Kitsantas, 2013).

Learning strategies of students can be influenced by the applied instructional educational method in the study program (Vermetten, Vermunt, & Lodewijks, 2002; Vermunt, 2007). PBL is believed to foster the use of deep processing and self-regulation (Mattick & Knight, 2007) and therefore aims to stimulate high-quality learning.

Problem-based Learning

PBL is a student-centered educational method that emphasizes collaboration on realistic problems under guidance of a tutor. The aim of PBL is both to enhance students' intrinsic motivation and their knowledge construction (Barrows, 1986; Hmelo-Silver, 2004; Loyens, Kirschner, & Paas, 2012; Norman & Schmidt, 1992). PBL stresses the importance of an *active* role of students in their learning process, meaning that students need to construct their own knowledge rather than passively receiving information (Barrows, 1996; Hmelo-Silver, 2004).

The process of PBL can be divided into the initial discussion phase, the self-study phase, and the reporting phase (Schmidt, 1983). In the initial discussion phase, students start the learning process by working in groups of ten to twelve on a realistic, ill-defined problem, which usually describes a situation that can occur in real life and elicits discussion in the group. Students receive the problem at the *beginning* of their learning process, before they have acquired any knowledge about the topic of the problem. They try to come up with explanations and possible solutions, based on their experiences and common sense and hence they activate their prior knowledge. The advantage of this prior knowledge activation is that new information can be connected to already existing knowledge, which is referred to as the process of elaboration (Schmidt, 1983). Elaboration has shown to be beneficial in terms of knowledge retention (e.g., Dochy, Segers, Van den Bossche, & Gijbels, 2003). Because prior knowledge is limited, several aspects of the discussed problem stay unclear and students collaboratively formulate questions (i.e., learning issues) about the aspects of the problem that need further investigation and explanation. These learning issues guide students during their self-study period in which students individually select and study different literature resources in order to answer the learning issues. After a few days of self-study time, students come together for the reporting phase. In this phase the studied literature is discussed and the learning issues are answered in the group. The tutor, who is present during the initial discussion phase and the reporting phase, facilitates the learning process through encouragement of more in-depth thinking about the studied material, for example by asking students

to apply the discussed material to another realistic case (Hmelo-Silver, 2004; Loyens et al., 2012; Schmidt, 1983).

Problem-based learning's Influence on Learning Strategies

Several aspects of PBL intend to stimulate students' use of deep processing (e.g., Lycke, Grøttum, & Strømsø, 2006; Mattick & Knight, 2007; Schmidt, Dauphinee, & Patel, 1987; Van der Veken, Valcke, Muijtjens, de Measeneer, & Derese, 2008). In the initial discussion phase, students try to explain the given problem, based on their prior knowledge and experiences. During self-study and the reporting phase, students gather new knowledge about the topic of the problem. Deep processing is stimulated when students connect their existing knowledge and experiences to the newly learned knowledge (i.e., elaboration). In addition, deep processing and concrete processing are stimulated because information is learned in the context of a realistic situation (i.e., the problem), which facilitates students to connect learned knowledge to practice. Further, in self-study, students should study multiple literature sources, and learn from their fellow students in the reporting phase. Therefore, they need to connect different sources and different learning concepts to each other in order to complete and understand the answers on the learning issues discussed during the reporting phase. Moreover, the role of the tutor is to stimulate this by asking in-depth questions. Hence, deep processing strategies, such as making connections between different learning concepts and linking these to practice, are stimulated in the PBL process.

Despite these encouraging components of PBL, studies investigating the effects of PBL on deep processing showed mixed results (Loyens, Gijbels, Coertjens, & Côté, 2013; Dolmans, Loyens, Marcq, & Gijbels, 2015). Some studies demonstrated more deep processing of PBL students and more surface processing by non-PBL students (e.g., Newble & Clarke, 1986), while other studies found no effects of PBL on deep learning (e.g., McParland, Noble, & Livingston, 2004). A recent review of Dolmans et al. (2015) indicates that in general, PBL seems to positively influence the use of deep processing in students, but that mixed results can partly be explained by the environmental characteristics in which the study takes place: A positive effect on deep learning is only present when it is investigated in a curriculum wide implementation of PBL instead of a one-course implementation (Dolmans et al., 2015).

PBL also intends to stimulate self-regulated learning (English & Katsintas, 2013; Mattick & Knight, 2007). Self-regulated learning is often confused with *self-directed learning* (Loyens, Magda, & Rikers, 2008), one of the goals of PBL (Barrows, 1986; Hmelo-Silver, 2004; Loyens et al., 2012; Norman & Schmidt, 1992). Self-directed learning is to a certain degree similar to self-regulated learning (e.g., active engagement of students), however not identical. While self-regulation can be seen as a learner characteristic only, self-directed learning is assumed to be both a learner characteristic as well as a learning

environment characteristic (Loyens et al., 2008). PBL can be considered a self-directed educational method that stimulates both self-directed learning and self-regulation in students (for an extended description on self-directed learning and self-regulation we refer to Loyens et al., 2008). Several elements of PBL, which are outlined below, contribute to the stimulation of self-regulation.

Students in PBL need to select the literature themselves to address the learning issues. This literature search results in a certain degree of freedom to find answers for the learning issues that have been formulated in the group. Further, PBL fosters self-regulated activities, such as monitoring, planning, and self-evaluation. Students need to prepare themselves for every tutorial meeting, and therefore monitor and carefully plan their self-study time each week. After the reporting phase students should evaluate whether the formulated answers to the learning issues in the group were satisfying. If not, they can decide to study additional literature. Moreover, as the tutor only facilitates the process (e.g., asking in-depth questions instead of providing information), students need to take responsibility for their own learning themselves, which stimulates them to be self-regulated (English & Katsintas, 2013).

Previous studies attempted to investigate the influence of PBL on learning strategies. Lycke et al. (2006) compared medical university students of a PBL program to students of a traditional educational program on their regulation strategies. It was shown that PBL students reported more use of self-regulation and made more use of independent resources, such as textbooks. No differences on external regulation were found. In a study of Van der Veken et al., (2008) medical university students of a PBL cohort were also compared to students of a traditional, lecture-based cohort and it was found that PBL students reported less use of surface processing (i.e., memorizing and rehearsal) and more use of self-regulation compared to their non-PBL counterparts. No difference on external regulation was found, in line with Lycke et al. (2006). Galand, Raucent, and Frenay (2010) compared two cohorts of students in engineering education (i.e., traditional vs. PBL cohort) and also found PBL students to report more use of deep processing, less use of surface processing, and more self-regulated learning (i.e., monitoring, supervision). However, a study by Nijhuis, Segers, and Gijselaers (2005) found that after redesigning an International Business Studies course in line with PBL characteristics, students used less deep learning and more surface learning, which is contrary to previous findings. In similar vein, mixed findings with regard to PBL effects on processing strategies were discussed before (Dolmans et al., 2015; Loyens et al., 2013).

A possible explanation for these mixed results on learning strategies is the difference in academic disciplines in which these studies took place (i.e., medical education in Lycke et al., 2006; engineering education in Galand et al., 2010; International Business education in Nijhuis et al., 2005). This is supported by a study of Dahlgren and Dahlgren (2002) in which it is shown that students in different academic disciplines (i.e., psychol-

ogy, physiotherapy, and computer engineering) experience their study programs in PBL in different ways. In order to get a clearer image of the impact of PBL on students' learning strategies, it is important to study the role of PBL in different disciplines, so results can be generalized and more clarity on its effects can be obtained (Galand et al., 2010). The present study will therefore focus on PBL and learning strategies among Dutch law students, as to our knowledge, learning strategies in PBL are not studied in law education before. The present study aims to shed light on the role of PBL in fostering effective learning strategies, given the mixed findings of previous studies. Our first research question is: What are the main differences between students in a PBL and a lecture-based program on their learning strategies (i.e., processing and regulatory strategies)?

The Relation between Self-study Time and Learning Strategies

Whether time spent on studying alone predicts academic achievement is uncertain, but rather learning strategies matter with regards to understanding and achievement (Doumen et al., 2014; Plant et al., 2005). However, it can be argued that there is a relationship between study time and learning strategies.

Several studies investigated this relationship. It has been demonstrated that university students who apply self-regulation, need less study time, because they know how to spend their time more efficiently (Van den Hurk, 2006). Further, Kember, Jamieson, Pomfret, and Wong (1995) indicated that engineering students' use of surface processing was positively correlated with study time. A possible explanation for this finding is that students who use surface processing face difficulties distinguishing between relevant (e.g., underlying principles) and irrelevant (e.g., side issues) information and therefore try to memorize all information, resulting in longer self-study time (Kember et al., 1995). Kember et al. (1995) and Van den Hurk (2006) demonstrated that students need more time when they study in an ineffective way. On the other hand, Wilkonson, Wells, and Bushnell (2007) showed that medical university students who invested much time in studying also reported more use of deep processing, indicating a positive relationship between time spent on studying and an effective learning strategy (i.e., deep processing). An explanation for this finding is that applying deep processing during study, such as finding connections between different study topics, results in longer study time. In short, studies that investigated the relation between study time and learning strategies show mixed results.

These contradictions show that the relationship between time spent on study and learning strategies is unclear. It can be, however, that this relation is influenced by another factor, specifically the implemented instructional method. PBL attempts to stimulate students' use of effective learning strategies, such as deep learning and self-regulation (Mattick & Knight, 2007), which could influence the relation between time spent on study and applied learning strategies. Moreover, time available for self-study could also

differ between instructional methods (Schmidt et al., 2010). When too much contact hours are available in a program, there will be less time available for self-study. Taking the instructional method into account as a moderator variable when investigating the relationship between study time and learning strategies might provide more information on this relation. The second research question is therefore: How are self-study time and learning strategies related to each other, when taking the learning environment (i.e. PBL vs. lecture-based) into account as moderator?

The Present Study

The present study focused on the difference in learning strategies between students of a PBL and a lecture-based program. It was hypothesized that PBL students would show more deep processing and self-regulation, because PBL is assumed to stimulate the use of deep processing (e.g., encouraging students to connect different study topics) and self-regulation (e.g., students need to monitor their study time carefully). Moreover, the relation between learning strategies and time spent on study is not clearly defined and yet the current study will explore this relation when taking the educational method into account as moderator variable.

The present study also addresses a different academic discipline. Previous studies focusing on PBL and learning strategies were conducted in medical education (Lycke et al., 2006; Van der Veken et al., 2008), engineering education (Galand et al., 2010), and business education (Nijhuis et al., 2005). PBL appears to have different outcomes in different academic areas (Dahlgren & Dahlgren, 2002), which can explain mixed findings concerning PBL effects on learning strategies. Since learning strategies were, to our knowledge, not investigated in law education before, the present study took place in a Dutch law program.

METHOD

Learning environment

The educational program of the Erasmus School of Law, in which the current study took place, consists of a three-year Bachelor's program and a one-year master program. At the start of the academic year in September 2012, a PBL curriculum was implemented. Students who enrolled in the Erasmus School of Law before September 2012 were not taught according the principles of PBL, but in a traditional, lecture-based way. In this lecture-based program, the academic year consisted of four eight-week periods with a total of eight courses. During each period, two courses were offered parallel and each week multiple lectures were provided. Some courses offered a weekly workgroup, where a teacher discussed a particular law case. The number of contact hours were ap-

proximately twelve hours per week. Four exam weeks took place during the academic year, in which the students were assessed on their knowledge and skills.

In the new PBL program, a total of eight courses are offered sequentially within one academic year, each lasting five weeks and all ending with a written examination. In PBL, the focus lies on tutorial meetings that occur twice a week. In these meetings, the initial discussion phase (i.e., collaborative discussion of a realistic problem prior to self-study) and the reporting phase of the previous problem (i.e., discussion of the studied literature) take place and students have sufficient time for self-study in between these meetings. Lectures (i.e., one or two each week) and practical courses are offered next to the tutorial meetings and serve the purpose of extending students' understanding of course material (i.e., lectures) and teaching students how to apply the learned material in real-life law cases (i.e., practical courses). The number of contact hours are approximately eight hours per week. The current study was conducted within one program, to control for particular variables such as course content and teaching faculty.

Design and participants

Third-year Dutch law students of a lecture-based program and a PBL program participated in this study. Students of the lecture-based cohort enrolled in their first year of the study program Dutch law in September 2011, a year *before* the switch to PBL. Students of the PBL cohort registered their first year of Dutch law in September 2012, *after* the switch. At the time of participating in this study, all students had entered their third year of the Bachelor's program.

A total of 338 students participated voluntarily. In the PBL group, 158 third-year Dutch law students (36% males) participated. Mean age was 21.54 years (SD = 1.82). Participants of the lecture-based group were 180 third-year Dutch law students (38% males) with a mean age of 22.49 years (SD = 2.60). The participants were quite representative for the total number of third-year students. Around 80% of the lecture-based students and around 70% of the PBL students in the third year participated.

Students of the lecture-based group were significantly older than students of the PBL group, $t(336) = 3.84$, $p < .001$. This age difference can be explained by a higher number of students in the lecture-based group with a study delay (70% compared to 30% of the PBL students), and therefore a higher age. No differences in gender between both groups were present, $\chi^2(1) = .16$, $p = .689$. The gender distribution (i.e., percentage male and female) in both groups is common for law study programs in higher education in the Netherlands (Central Bureau for Statistics, 2014).

Material

Learning Strategies

The first part of the Inventory Learning Styles (ILS; Vermunt, 1998) was used to measure students' learning strategies (i.e., processing strategies and regulatory strategies). The ILS is a self-report questionnaire in which students rate statements on a scale of 1 ("I never or hardly do this") to 5 ("I (almost) always do this"). Items regarding processing strategies are distinguished in: a) deep processing, which focus on relating topics, structuring, and critical processing, b) stepwise processing, in which the use of memorization, rehearsal, and analyzing is measured, and c) concrete processing, which measures whether learning material is concretized and personalized by the student. Further, items on regulatory processes are divided into d) self-regulation, which measures to what degree students control their own learning process, e) external regulation, which measures to what degree students depend on external resources (e.g., a teacher) for steering and controlling their learning process, and f) lack of regulation, which measures the inability of students to regulate the learning process. In total, the questionnaire contained 55 items. Table 4.1 provides an overview of the subscales with example items of the ILS and Cronbach's alphas for each subscale. The Cronbach's alphas can be considered acceptable, with the exception of the scale "external regulation" ($\alpha = .64$), which has a rather low reliability. Results on the scale external regulation should therefore be interpreted with caution.

Table 4.1. Example items and Cronbach's alphas of each subscale of the learning strategies in the ILS

Learning strategy	Subscale	Example item	Cronbach's alpha
Processing	Deep processing (n = 11)	"I try to combine separately discussed concepts to a whole"	.82
	Stepwise processing (n = 11)	"I rehearse important topics of the learning material till I memorize them"	.79
	Concrete processing (n = 5)	"I use what I learn on a course in my activities outside the study"	.72
Regulation	Self-regulation (n = 11)	"When I'm having difficulties with parts of the course material, I try to analyze why it is hard for me"	.80
	External regulation (n = 11)	"I study according to the instructions provided by course materials or the teacher"	.64
	Lack of regulation (n = 6)	"I confirm that I find it difficult to determine whether or not I sufficiently mastered the course material"	.75

Self-study time

Students were asked to give an estimation of their weekly time investment on self-study (in hours) prior to the ILS, by asking the question: "How many hours, on average, do you spend each week on self-study?" Previous research has showed that there is a strong

connection between self-reported study time and actual time spent on study in PBL (Moust, 1993).

Procedure

In both groups, the teacher (i.e., in the traditional, lecture-based cohort) or tutor (i.e., in the PBL cohort) handed out the questionnaire on paper to students during a regular study week and students took about 15 minutes to fill it out. Students of the lecture-based cohort participated in the current study during the given course of the third academic year in January 2014. The course at the time was called 'moot court', in which students learn to plea in front of a judge. Students of the PBL cohort participated in the current study exactly one year later, in January 2015, when they were in their third academic year. Students of this cohort were enrolled in the course 'criminal law' at the time of the study. All students were instructed to report on their learning strategies and self-study time in general, not in the specific course given at the time.

Statistical Analyses

In order to compare students of both learning environments on their learning strategies, a MANOVA was conducted with educational method as between-subjects factor (i.e., PBL vs. lecture-based) and scores on the three subscales of processing strategies (i.e., deep, surface, and concrete processing) and the three regulatory strategies (i.e., self, external, and lack of regulation) as dependent variables. In order to study the influence of the learning environment on the relation between learning strategies and self-study time, moderation analyses were conducted with PROCESS (Hayes, 2012). Self-study time and educational method (i.e., PBL group vs. lecture-based group) served as predictors, and scores on the ILS subscales as outcome variables. Instructional method was considered a moderator variable and a moderation effect was present when an interaction effect between self-study time and instructional method appeared for the different subscales (Field, 2013). When an interaction effect is present, the relation between self-study time and the scores on learning strategies is different in both learning environments, indicating a moderator effect.

RESULTS

Differences between PBL Students and Students of a Lecture-based Environment on Learning Strategies

Prior to the analyses, two univariate outliers were excluded (i.e., values 2.58 *SD* above the mean), resulting in a total number of 336 participants. Mean item scores on the processing and regulation strategies and self-study time for participants of both groups

are given in Table 4.2. At first sight, scores between the two groups did not seem to differ much. Self-study time did not differ between both groups $t(323) = .90$, $p = .371$. Further, the PBL students seem to report a higher score on deep processing, stepwise processing, self-regulation, and external regulation. In order to say more about these differences and hence answer our first research question, a MANOVA with follow-up ANOVAs were conducted.

The MANOVA showed a significant effect of instructional method, Pillai's trace $V = .06$, $F(6, 329) = 3.27$, $p = .005$, $\eta_p^2 = .06$. Separate univariate ANOVAs on the ILS subscales were conducted. Effect sizes were expressed in eta squared (i.e., η^2). Effect sizes of .01, .06, and .14 indicate small, mediate, and large effect respectively. The ANOVAs showed that students in the PBL group more frequently applied deep processing, $F(1, 334) = 4.15$, $p = .042$, $\eta^2 = .01$, self-regulation, $F(1, 334) = 7.41$, $p = .007$, $\eta^2 = .02$, and external regulation, $F(1, 334) = 7.39$, $p = .007$, $\eta^2 = .02$, compared to students in the lecture-based group. No differences between groups were found on stepwise processing, concrete processing, and lack of regulation, respectively $F(1, 334) = 1.42$, $p = .054$, $\eta^2 = .01$; $F(1, 334) = .27$, $p = .820$, $\eta^2 = .00$; $F(1, 334) = .64$, $p = .285$, $\eta^2 = .00$.

Table 4.2. Mean item scores on all subscales of the ILS and self-study time for both groups (*SD* in parentheses)

		Condition	
		PBL	Lecture-based
Processing strategies	Deep processing	3.03 (.59)	2.89 (.67)
	Stepwise processing	3.03 (.60)	2.90 (.62)
	Concrete processing	2.91 (.71)	2.93 (.74)
Regulation strategies	Self-regulation	2.62 (.60)	2.43 (.66)
	External regulation	3.23 (.49)	3.08 (.50)
	Lack of regulation	2.36 (.73)	2.45 (.77)
Self-study time		11.99 (6.09)	12.68 (7.44)

Note. Scores on all subscales could range from 1 to 5.
Self-study time score is displayed in hours. The range of the reported number of self-study hours per week varied between 0 and 50.

Influence of the Learning Environment on the Relation between Learning Strategies and Self-Study Time

Self-study time appeared positively skewed (skewness = 1.27, *SE* = .14, kurtosis = 2.72, *SE* = .27), and therefore a square root transformation on the self-study time data was performed. This transformation resolved the issues of skewness and kurtosis (skewness = .24, *SE* = .14, kurtosis = .51, *SE* = .27). As a result of missing values on self-study time, the total number of participants in these analyses became 327. Table 4.3 gives a correlation matrix with correlations between all subscales of the ILS and transformed self-

study time. The correlations remarkably show that almost all subscales were positively and significantly related to each other and to study time. Deep processing, concrete processing, and self-regulation were highly correlated to each other, as well as stepwise processing and external regulation.

Table 4.3. Pearson correlations between subscales of the Inventory Learning Styles (ILS) and transformed self-study time.

	1	2	3	4	5	6
1. Deep processing						
2. Stepwise processing	.27*					
3. Concrete processing	.59*	.23*				
4. Self-regulation	.70*	.44*	.56*			
5. External regulation	.30*	.50*	.20*	.35*		
6. Lack of regulation	.07	.27*	.27*	.27*	.16*	
7. Self-study time	.19*	.24*	.19*	.26*	.19*	.62*

Note. * = $p < .001$

In order to answer the second research question, moderation analyses were performed. PROCESS (Hayes, 2012) was used for the moderation analyses, with instructional type (i.e., PBL vs. lecture-based) as moderator, self-study time as predictor, and the mean scores on the subscales of the ILS as dependent variables. Table 4.4 presents the results of the moderation analyses. For all subscales of the ILS, the main effect of instructional type, the main effect of self-study time, and the interaction between instructional type and self-study (i.e., moderation effect) are given. Self-study time appeared to be a significant predictor for scores on all subscales. There was a positive relation between self-study time and all types of processing strategies and regulatory strategies (Table 4.4).

A moderation effect was present when an interaction effect between self-study time and instructional method appeared. With regard to the processing strategies, no interaction effects between the transformed self-study data and instructional methods showed up for any of the processing strategies, deep processing ($t(323) = -1.00$, $p = .319$); surface processing ($t(323) = -.18$, $p = .860$); concrete processing ($t(323) = -.76$, $p = .448$), indicating that instructional method cannot be considered a moderation variable in the relation between self-study time and the processing strategies. For the regulatory strategies, no interaction effects appeared for self-regulation and lack of regulation, respectively $t(323) = -.55$, $p = .583$; $t(323) = .06$, $p = .954$. However, an interaction effect between the transformed self-study time data and instructional method was found for external regulation strategies, $t(323) = 2.19$, $p = .030$, demonstrating that instructional method moderates the relationship between time spent on self-study and external regulation. To follow up this interaction, simple slopes were investigated, showing that the relation between self-study time and external regulation is positive for PBL students,

(b = .17, $SE(b)$ = .04, t = 4.15, p < .001), but this relation is non-existing for students in the lecture-based group (b = .04, $SE(b)$ = .04, t = .89, p = .373).

Table 4.4. Multiple regression analyses with self-study time, instructional type and their interaction (i.e., moderation effect) for all subscales of the Inventory Learning Styles (ILS)

Learning strategy	Effect	*b* (SE)	*t*
Deep processing	Self-study time	.11 (.03)	3.29*
	Instructional type	.13 (.07)	1.88
	Self-study time x Instructional type	-.06 (.07)	-.99
Stepwise processing	Self-study time	.14 (.07)	3.95**
	Instructional type	.14 (.07)	2.10*
	Self-study time x Instructional type	-.01 (.07)	-.18
Concrete processing	Self-study time	.13 (.04)	2.93*
	Instructional type	-.02 (.08)	-.26
	Self-study time x Instructional type	-.07 (.09)	-.76
Self-regulation	Self-study time	.16 (.04)	4.51**
	Instructional type	.20 (.07)	2.88*
	Self-study time x Instructional type	-.04 (.07)	-.55
External regulation	Self-study time	.01 (.03)	3.39**
	Instructional type	.15 (.05)	2.75*
	Self-study time x Instructional type	.13 (.06)	2.19*
Lack of regulation	Self-study time	.12 (.05)	2.58*
	Instructional type	-.07 (.08)	-.88
	Self-study time x Instructional type	-.01 (.09)	-.06

Note. * = p < .05; ** = p < .001
R^2 deep processing = .05; R^2 stepwise processing = .07; R^2 concrete processing = .04; R^2 self-regulation = .09; R^2 external regulation = .07; R^2 lack of regulation = .03

DISCUSSION

The current study investigated the differences between students of PBL, a learning environment that aims to stimulate deep processing and self-regulation, and students of a lecture-based program on their study strategies. Dutch law students of a PBL program were compared to students of a traditional, lecture-based program on their self-reported use of processing (i.e., deep, stepwise, and concrete processing) and regulatory strategies (i.e., self-regulation, external regulation, and lack of regulation). It was hypothesized that PBL students would report more use of deep processing and self-regulation. In line with these expectations, PBL students reported more deep processing and self-regulation. In addition, more external regulation was reported by PBL students.

PBL and Learning Strategies

With regard to the processing strategies, PBL students reported more frequent use of deep processing compared to their non-PBL counterparts. An explanation lies in specific characteristics of PBL, which aim to foster deep learning (e.g., Mattick & Knight, 2007; Schmidt et al., 1987). In a PBL curriculum, students collaboratively discuss a problem, formulate learning issues about the problem, select literature by themselves, and discuss their findings while addressing the learning issues in the reporting phase under guidance of a tutor. PBL students are required to relate different study topics in order to formulate a complete and coherent answer to the learning issues. Moreover, tutors ask students in-depth questions during the initial discussion and the reporting phase, making that students elaborate more on the material. While previous studies indicated mixed results on the influence of PBL on deep learning (e.g., Loyens et al., 2013), this study found a beneficial outcome of PBL on deep processing. This finding is furthermore in line with outcomes of the review of Dolmans et al. (2015), indicating that PBL positively effects the use of deep processing, especially when it is investigated in a curriculum-wide PBL implementation, as is the case in the present study.

No difference between students of the PBL and the traditional, lecture-based cohort was found with respect to reported stepwise processing, which is inconsistent with findings of Galand et al. (2010) and Van der Veken et al. (2008). Yet, considering the mean scores on stepwise processing, PBL students seem to report higher use of stepwise processing compared to the students in the lecture program (respectively, $M = 3.03$ and $M = 2.90$). Although not statistically significant in this study, these results are in line with findings of Nijhuis et al. (2005) and Struyven, Dochy, Janssens, and Gielen, (2006), which showed higher scores of PBL students on surface learning. Several explanations for this finding can be put forward.

First, the exams used in both curricula could offer an explanation (Baeten, Kyndt, Struyven, & Dochy, 2010; Vermunt, 2005). Considering the frequent use of stepwise processing in both cohorts, it might be that exams used in the curricula under study did not always require deep processing in order to receive a sufficient grade, but could be (at least partly) be managed with stepwise processing strategies. This explanation is supported by findings of Vermunt (2005), in which a relation was demonstrated between the reported use of stepwise processing in (non-PBL) law students and succeeding exams. Further, the use of deep and surface learning differs between disciplines of study (Baeten et al., 2010; Vermunt, 2005), which can explain differences with previous studies. In a study by Vermunt (2005) law students reported more use of rehearsal and memorization techniques (i.e. stepwise processing) compared to students of other disciplines (e.g., psychology and art students).

A final explanation is that a comparison was made between a final cohort of students in a lecture-based, traditional cohort and a *first* PBL cohort. Problems regarding imple-

mentation are likely to arise in a first cohort, as everything is new to both students and academic staff. These problems could possibly influence the found results. The transition to PBL is a major change for the faculty and staff, and this comes with difficulty, such as teachers experiencing trouble switching from a leading role to a guiding role (Stinson & Milter, 1996). Moreover, poor implementation can lead to suboptimal tutorial meetings and tutor behavior (Dolmans, De Grave, Wolfhagen, & Van der Vleuten, 2005). Issues in the PBL cohort could be an explanation for the lack of differences in stepwise processing and even a higher reported use for PBL students. If, for example, tutors act insufficiently (i.e., too directive or too passive) this can have an influence on students' learning strategies.

With regard to regulatory strategies, the present study showed that PBL students reported more self-regulation. This finding can be explained by elements of PBL that encourage self-regulation in students, such as selection of literature by themselves, stimulation of students to plan their self-study time carefully because of required preparation for every tutorial meeting, and self-evaluation of formulated answers on the learning issues after the reporting phase (English & Katsintas, 2013; Mattick & Knight, 2007).

Results further indicated that PBL students were more externally regulated compared to students of the lecture-based group, which means for regulation of the processing strategies, PBL students depend more often on external sources such as the tutor, teacher, course material, and assessments. This finding contradicts to findings of earlier studies (i.e., Lycke et al., 2006; Van der Veken et al., 2008) in which no effect of PBL on external regulation was found. However, high amounts of external regulation are not that surprising in a PBL curriculum. There are several external factors that could influence students, such as comments of the tutor, fellow students in the tutorial group, and the required preparation every tutorial meeting. The fact that the present study was conducted in a *first* cohort after implementation (e.g., Dolmans et al., 2005; Stinson & Milter, 1996) could also apply for findings on external regulation. For example, when tutors are new to PBL, they might provide too directive guiding, making students depend too much on them. It should, however, be noted that the reliability of the subscale "external regulation" turned out rather low ($\alpha = .64$) and findings on this subscale should therefore be interpreted with caution.

In sum, results showed positive associations between PBL and deep processing, self-regulation, and external regulation. Results were statistically significant, but all had small effect sizes (respectively, $\eta^2 = .01$, $\eta^2 = .02$, $\eta^2 = .02$). These effect sizes can be explained by previous studies, highlighting that students' applied learning strategies depend on both the environment as on the individual. This means that learning strategies are vulnerable to change, but are also stable to a certain degree (Richardson, 2011a; Vermunt & Vermetten, 2004; Vermetten, Vermunt, & Lodewijks, 1999), which will result in only a small impact, as is the case in the present study. The effect sizes indicate that in practice,

PBL students will be quite similar in their applied learning strategies than students of the traditional, lecture-based program. However, the present study also demonstrated that PBL influences students' learning strategies.

PBL Effects on the Relation between Self-study Time and Learning Strategies

Findings on how the relationship between time investment and learning strategies is defined were inconclusive (e.g. Kember et al., 1995; Wilkonson et al., 2007). Therefore, the current study investigated the relationships between time spent on self-study and the different types of processing and regulatory strategies, with instructional method (i.e., PBL vs. lecture-based) as moderator variable.

Results of the moderation analyses showed a positive relationship between self-study time and all scales of the ILS, meaning that an increase in self-study time is related to an increase in any kind of learning strategy (regardless of the applied instructional method). This finding was surprising, since a distinction between effective and ineffective learners seemed logic and was demonstrated in earlier studies (Kember et al., 1995; Wilkonson et al., 2007). After taking the instructional method into account as a moderator variable, results showed only a moderator effect on the scale external regulation, which indicated that an increase in external regulation goes together with an increase in self-study time for PBL students, but this relation is non-existing for students in the lecture-based cohort. Apparently, when PBL students consider directions from external sources (e.g., teacher, course material), they spend more time on studying. This result is in line with the study of Kember et al., (1995), which indicated a positive relation between self-study time and surface learning. Surface learning and external regulation are both considered undesirable learning outcomes and this study showed a positive relationship between time invested in study and undesirable learning strategies for PBL students. However, as mentioned before, the reliability of this scale turned out rather low and these findings should therefore be interpreted with caution. In general, one could argue that the relationship between study time and learning strategies is stable in different learning settings.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

As with any study, the present study has some limitations. The present study made use of the ILS, a self-reported questionnaire, in order to measure processing and regulatory strategies. This can be considered a limitation on the one hand, because actual learning behavior is not measured. Nevertheless, self-reports for investigating learning activities are probably the most accurate way to measure, because these activities are mostly internal processes. Further, the method of how self-study time was measured yields

some disadvantages and might offer an explanation for the findings of the moderation analyses. Students were asked to give an overall estimation of their time investment in self-study, which applied to the study program in general. This time estimation was very broad. Future research could perhaps obtain time investment on multiple occasions for a more accurate result. Still, it was assumed that third-year students were able to provide an accurate estimation of their time investment, because they had three years of experience with studying and planning self-study at the time the current study took place.

Further, students of the two cohorts under study were not pre-tested on their learning strategies when they entered university. Hence, it is still somewhat uncertain whether the found differences can be ascribed to the difference in learning environment, because it is unsure whether the student groups differed on how they learned beforehand. However we have no reason to believe that both student cohorts were significantly different in this respect. A final limitation is that students' perceptions on the learning environment were not taken into account. Previous studies indicate the importance of perceptions of the learning environment on students' use of learning strategies (Baeten et al., 2010; Galand et al., 2010; Struyven et al., 2006). At this point it is unclear whether students' perceptions of the environment are in line with the principles of PBL (i.e., student-centered). Further research is recommended to take students' perceptions into consideration when investigating the influence of learning environment on students learning strategies.

CONCLUSIONS

The present study compared students of a PBL and a traditional, lecture-based curriculum on their self-reported learning strategies in Dutch law. Results showed that the use of deep processing and self-regulation, which are fostered in PBL, are more frequently reported by PBL students. Students selecting literature themselves, formulating coherent and complete answers to learning issues, and self-evaluating these answers, are beneficial aspects in PBL for applying effective learning strategies. External regulation is also reported more frequently by PBL students compared to students of the traditional, lecture-based program, which indicates that, besides self-regulation, students rely on external factors in PBL (e.g., tutor, fellow students). This study was conducted in Dutch law education, as to our knowledge, learning strategies in PBL were not investigated with law students before. In order to generalize results and get a clearer image on PBL effects, PBL influences on learning strategies should be investigated in different academic areas. The current study contributed to this by focusing on law education.

5

A Longitudinal Study on the Development of Law Students' Learning Strategies in Problem-Based Learning and the Relation with Assessment and Academic Performance

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ABSTRACT

Self-regulated learning and deep processing are desirable learning strategies in higher education. Student-centered educational methods like problem-based learning (PBL) aim to foster these strategies. The present study investigated the development of Dutch law students' learning strategies in a three-year PBL program with a longitudinal design. Second, the relation between learning strategies and academic achievement and study progress was studied, taking the type of assessment into account. Results showed that deep processing stayed stable over time and self-regulation did not increase. Analysis of assessment showed more focus on surface than on deep learning in the exams of the academic program under study. Further, concrete processing (i.e., relating learned knowledge to real-life experiences) increased over the course of the three-year PBL program and lack of regulation decreased. Lack of regulation was negatively associated with academic performance and study progress. The assessments used in the curriculum help explain the use of learning strategies in a PBL curriculum.

INTRODUCTION

How students learn and approach their learning tasks has been a topic of research for decades. The distinction between deep and surface learning (Biggs, 1987; Marton & Säljö, 1976; Newble & Entwistle, 1986) as well as the concept of self-regulation (Boekaerts, 1997; Zimmerman, 1989) received a lot of attention in educational research in the preceding century. There is general consensus that deep processing of information (i.e., relating concepts, structuring, creating deeper understanding of material; Newble & Entwistle, 1986) and self-regulation (i.e., self-initiated information seeking, planning, organizing, and goal-setting; Zimmerman, 1989) are effective learning strategies, as both are positively related to academic outcomes (e.g., GPA; Richardson, Abraham, & Bond, 2012). Hence, self-regulation and deep learning are desirable outcomes in education.

Previous studies demonstrated that the learning environment plays an important role in the development of students' learning strategies (Donche, Coertjens, & Van Petegem, 2010; Donche & Van Petegem, 2009; Vermetten, Lodewijks, & Vermunt, 1999). Vermunt (2007) discussed that self-regulation can be encouraged by learning environments that aim to *activate* students (e.g., working with assignments or problems or cooperation among students). This is in line with the constructivist perspective on education. Constructivism stresses an active role for students, as learners construct and build knowledge structures by themselves (O'Donnell, 2012). Problem-based learning (PBL) is an educational application of a constructivist learning theory (O'Donnell, 2012). The present study investigates whether learning strategies such as deep processing and self-regulation, are indeed fostered in a constructivist, PBL environment.

Learning Strategies

In the Netherlands, Vermunt conducted a lot of research on students' learning approaches in higher education (Vermunt, 1998; Vermunt & Vermetten, 2004). He differentiated several aspects of learning with the Inventory Learning Styles (ILS; Vermunt & Van Rijswijk, 1988): learning strategies (i.e., learning activities), conceptions of learning and teaching, and learning orientations (i.e., motives for studying). These aspects together can be united into four learning patterns (before learning styles; see Vermunt, 1998). However, the current study focused on learning strategies only, because previous studies demonstrated that these are subject to change by the learning environment (e.g., Donche & Van Petegem, 2009; Vermetten et al., 1999).

Learning strategies are divided into cognitive processing strategies and metacognitive regulatory strategies. Cognitive processing strategies refer to thinking strategies that are used to process course material. These strategies affect learning outcomes directly (e.g., these strategies directly lead to knowledge acquisition). Processing strategies are divided into three types. First, deep processing refers to students relating

study concepts together, bringing structure in study material, being critical, and creating a deeper understanding (Newble & Entwistle, 1986; Vermunt & Vermetten, 2004). A second processing strategy is stepwise processing or surface learning, meaning that information is rehearsed till it is memorized (Newble & Entwistle, 1986). Finally, concrete processing holds that students connect acquired knowledge to real-life situations and prior experiences (Vermunt, 1998).

Metacognitive regulatory strategies are used to control or regulate the cognitive processing strategies and hence influence learning outcomes indirectly (Vermunt, 1998). Regulation strategies refer to goal-setting in the learning process, planning study time, monitoring the learning tasks, and evaluating the learning process. Similar to processing strategies, three kinds of regulation strategies are differentiated by Vermunt. Self-regulation is the first, which implies that students steer the learning process by themselves, take initiative, and are self-able to set goals, plan, monitor, and evaluate their learning process (Boekaerts, 1997; Vermunt, 1998; Vermunt & Vermetten, 2004). Second is external regulation, in which students let external factors, such as teachers, control their learning process (Boekaerts, 1997; Vermunt, 1998). Third is lack of regulation, which indicates that students have trouble to regulate the learning process, either by themselves or by an external source (Vermunt & Vermetten, 2004).

Learning Strategies and Academic Performance

Research shows that deep processing positively relates to academic outcomes (i.e., GPA; Boyle, Duffy, & Dunleavy, 2003; Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001), while stepwise processing is often found to be negatively related to academic performances (i.e., GPA; Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001). Positive relations between self-regulation activities and academic outcomes (i.e., GPA; Boyle et al., 2003; Richardson et al., 2012) are often found and negative relations between lack of regulation and academic outcomes (Lindblom-Ylänne & Lonka, 1999; Vermunt, 2005). Regarding concrete processing and external regulation on the one hand and performance on the other hand, the research literature shows inconsistent results. In sum, deep processing and self-regulation are considered good learning strategies with regards to academic achievement, while stepwise processing and lack of regulation are detrimental for learning.

Learning Strategies over Time

Not only are deep processing and self-regulation desirable in terms of achievement, but also because these strategies are useful in life after university. Students then need to have acquired a coherent understanding of the acquired knowledge during study and be able to educate themselves throughout their professional lives. Therefore, deep processing and self-regulation should improve over the course of higher education. The

best way to investigate whether this change actually takes place is to use a longitudinal design. Although longitudinal studies on the progress of learning strategies are scarce, a number of studies have been conducted over the years. Results are, however, inconclusive.

An increase in deep processing in higher education was found in some longitudinal studies (Busato, Prins, Elshout, & Hamaker, 1998; Donche et al., 2010; Donche & Van Petegem, 2009; Severiens, Ten Dam, & Van Hout Wolters, 2001; Vermetten et al., 1999), while other studies found no differences of deep processing over time (Rodriguez & Cano, 2007; Severiens et al., 2001; Zeegers, 2001). The results for self-regulation are similar: an increase of self-regulation activities was found in a number of studies (Busato et al., 1998; Donche & Van Petegem, 2009; Severiens et al., 2001; Vermetten et al., 1999), whereas others found no change over time (Endedijk, Vermunt, Meijer, & Brekelmans, 2014; Severiens et al., 2001). Likewise, results on more inefficient learning strategies over time are mixed. For example, some studies show a decrease in stepwise processing or surface learning (Rodriguez & Cano, 2007; Severiens et al., 2001) while others indicate that stepwise processing stays constant over time (Donche & Van Petegem, 2009; Vermetten et al., 1999; Zeegers, 2001). Severiens et al. (2001) showed a decline in external regulation, though in the study of Vermetten et al. (1999), a stable pattern of external regulation was found. A decrease in lack of regulation over time was found by Vermetten et al. (1999), Donche et al. (2010) and Donche and Van Petegem (2009).

These mixed findings on the development of learning strategies leave us with a challenging question: How can effective learning strategies be fostered in a sustainable way? A learning environment that promotes an *active* role of students and hence promotes deep processing and self-regulation, might offer a solution (Mattick & Knight, 2007; Vermunt, 2007). PBL could be seen as such a learning environment.

Problem-Based Learning

PBL is a student-centered instructional method (Barrows, 1996; Hmelo-Silver, 2004) that consists of three phases. It starts with the initial discussion, in which students work collaboratively on a realistic, ill-defined problem. This is usually a description of a real-life situation, which has no clear-cut explanation or solution and hence elicits discussion in the group. Students discuss the problem and by doing so, they activate prior knowledge, based on experiences and common sense. Since prior knowledge is limited, students end the initial discussion by formulating questions (i.e., learning issues) about the problem. Learning issues guide students during a period of self-study, the second phase, in which they individually select and study literature resources (e.g., book chapters, articles). In the third phase of PBL, the reporting phase, students return to the group after a few days of self-study and formulate a complete answer on the learning issues together. During the group meetings, a tutor is present who stimulates the group discussions by asking

open-ended questions. In between meetings students have ample time for self-study (Hmelo-Silver, 2004; Loyens, Kirschner, & Paas, 2012; Schmidt, 1983).

PBL is believed to foster deep processing in several ways (Mattick & Knight, 2007; Newble & Entwistle, 1986). Students are encouraged to connect their existing knowledge to new to-be-learned knowledge. This happens as prior knowledge is activated in the initial discussion. The process of elaboration (i.e., connecting existing knowledge to new learned knowledge; Schmidt, 1983) is then stimulated, which results in better knowledge retention (Dochy, Segers, Van den Bossche, & Gijbels, 2003). Furthermore, during self-study and discussions in the reporting phase, students need to connect different literature sources and different concepts together in order to create a complete answer to the learning issues. A tutor stimulates the use of deep processing by asking in-depth questions, making sure elaboration takes place. Moreover, concrete processing is also encouraged in PBL as information is learned in the context of an authentic situation (i.e., the problem) that fosters application of knowledge in real-life situations.

Further, stimulation of different aspects of self-regulation takes place in PBL. Self-regulation models assume that learners are able to monitor, control, and regulate their own learning process (Boekaerts, 1997). PBL is expected to stimulate these aspects of self-regulation. In PBL, students themselves formulate the learning issues, collaboratively decide what they need to study after the initial discussion, select different literature sources themselves during self-study, and evaluate whether they have sufficiently studied to answer learning issues during the reporting phase (Schmidt, 2000). Preparation is required for each tutorial meeting and hence students need to monitor and carefully plan their self-study time. In short, PBL is assumed to stimulate effective learning strategies like deep processing and self-regulation.

Assessment

Besides the learning environment, another important factor to take into account when investigating learning strategies is assessment. Assessment affects the learning strategies that are applied by students (Baeten, Kyndt, Struyven, & Dochy, 2010; Gijbels, Van de Watering, Dochy, & Van den Bossche, 2005). One could argue that if deep processing is desired in students, assessment used in higher education should stimulate this type of learning (e.g., more focus on *application* of knowledge in examination than on memorizing information). Moreover, the meta-analysis of Gijbels, Dochy, Van den Bossche, and Segers, (2005) shows that in PBL, students perform better on assessments that focus on complex levels of knowledge structures (e.g., understanding the link between concepts and application of knowledge). The authors explain that PBL's goals are more in line with complex level knowledge structures. Given the crucial role of assessment in students' learning processes, the present study will take assessments used in the PBL curriculum under study into account.

The Present Study

The present study investigates the development of learning strategies in a PBL program and, in addition, the relation between learning strategies and academic performance. Three research questions are addressed. The first research question is: 'How do law students' learning strategies develop over a three-year PBL Bachelor's program?' In order to answer this question, learning strategies (i.e., processing and regulation strategies) are measured six times with the ILS (Vermunt & Van Rijswijk, 1988), over the course of the three-year PBL Bachelor's program at the Erasmus School of Law (i.e., from the start of the first academic year throughout the end of the third and final year of the Bachelor's program). PBL aims to stimulate the use of deep processing and self-regulation (e.g., Mattick & Knight, 2007) and as students get familiar with PBL over the course of the Bachelor's program, it is expected that students' learning activities become more effective in terms of more use of deep processing, concrete processing, and self-regulation over time. Furthermore, it was hypothesized that the use of stepwise processing, external regulation, and lack of regulation would decrease throughout the Bachelor's program, as these strategies are less effective for learning.

The second and third research questions focus on the relation between learning strategies and academic success. With the second research question, 'How do learning strategies relate to academic performance?' we attempt to replicate previous findings. It is hypothesized that deep processing and self-regulation are positively related to academic performance, while stepwise processing and lack of regulation are hypothesized to be negatively related to academic performance (e.g., Richardson et al., 2012; Boyle et al., 2003; Lindblom-Ylänne & Lonka, 1999; Zeegers, 2001). The third research question is: 'What differences in applied learning strategies exist between students who drop out after the first academic year and students who continue the academic program?' It is expected that, in line with the second research question, students who drop out use less deep and concrete processing and more stepwise processing. Further, dropouts are expected to be less self-regulated, more externally regulated and have more lack of regulation, compared to students who continued the program because of the negative relations with academic achievement (e.g., Richardson et al., 2012; Boyle et al., 2003; Lindblom-Ylänne & Lonka, 1999; Zeegers, 2001). However, as mentioned before, assessment used in the curriculum might influence this. Therefore, assessment was taken into account in the present study. We examined the depth of knowledge tested in a selection of exams from the three-year Bachelor's program under study.

The current study will add to findings of previous longitudinal studies on learning strategies in several ways. First, the progress of learning strategies will be studied in a PBL program, which is an interesting addition considering the expected influence on student learning. Second, previous longitudinal research often studied a relative short-time period (e.g., one year; Busato et al., 1998; Vermetten et al., 1999) or contained only

a few measurement moments over time (e.g., two measurements; Busato et al., 1998; Donche & Van Petegem, 2009; Rodriguez & Cano, 2007). This makes it hard to draw conclusions on the development of learning strategies over the course of higher education. The present study attempts to overcome these shortcomings (e.g., few measurement moments) by studying the development over three years with a total of six measurement moments.

METHOD

Learning Environment

Students at the Erasmus School of Law enroll in one of the three study programs: Dutch law, tax law or criminology. All programs consist of a three-year Bachelor's program and a one-year Master program. In the Bachelor's program, a total of 180 study point credits (i.e., European Credit Transfer System (ECTS), 60 ECs per year) can be obtained. A total of 16 courses of five weeks are offered in the first and second academic year (eight each year). The third year starts with a minor course (i.e., ten weeks), followed by five courses and a five week period for writing a Bachelor's thesis. Courses are offered in succession and all end with a written examination (i.e., course test). Each course equals 7.5 ECTS, which are earned when a sufficient grade on the exam is obtained (i.e., a score of 5.5 on a ten point scale or higher). When all courses are completed successfully, students acquire a total of 60 credit points at the end of each academic year. It is required at the university under study to earn all 60 credits in the first year in order to be allowed to the second year (Vermeulen et al., 2012). Insufficient grades can, however, be compensated with higher grades on other courses during the first year (e.g., a 5.0 score for a specific course can be compensated with a 7.0 score for another course), as long as a GPA of 5.5 at the end of the year is reached and the obtained grade is not below a 4.0. The number of retakes is restricted to two each academic year. Courses in the first academic year are mainly introductory courses, in which students get familiar with all areas of the law (e.g., Introduction to criminal law). The majority of the courses in the second and third academic year build upon these introductory courses. However, some courses contain new subjects within Dutch law and do not build upon previous courses (e.g., Philosophy of law).

The Bachelor's program at the Erasmus School of Law is entirely problem-based. Small tutorial meetings (of 2.5 hours each) are a key element in the PBL curriculum. Twice a week, students come together in groups of approximately ten to twelve students and a tutor. At the start of each course, the group composition changes. Eight PBL problems are discussed in each course. Students participate in the initial discussion (i.e., pre-discussion about the problem) and the reporting phase (i.e., discussing literature sources

and answering learning issues). In between meetings, two to three days of self-study are available. Other activities in the curriculum are practical courses that help students learn how to apply the learned knowledge (e.g., practice court) and lectures that address the topics in a broader sense (i.e., two or three a week).

Participants

Students who enrolled in September 2013 in the first year of one of the study programs (i.e., Dutch law, tax law, and criminology) at the Erasmus School of Law participated in this study. Over three years, students' learning strategies were measured twice a year with a six-month interval, resulting in six trials in total. Students, who filled out the questionnaire five or six times out of the six measurements, were included in the analyses. This resulted in a total of 244 students (35.2% male). Mean age at the first trial was 19.33 year (*SD* = 1.58). Of these participants, 167 students were Dutch law students (68.4%), 29 tax law students (11.9%), and 48 studied criminology (19.7%). This distribution, as well as the male-female distribution, are common at the Erasmus School of Law.

In answering the second (i.e., relation learning strategies and academic performances) and third research question (i.e., dropouts comparing to non-dropouts) also students who dropped out of the academic program were included. Dropouts are defined as students who filled out the questionnaire at *both* the first and second trial and quit the program at the end of the first academic year. This resulted in a total of 52 dropouts (48.1% male). Mean age at trial one of these students was 19.85 (*SD* = 1.66). Thirty-nine dropouts were Dutch law students (75.0%), six were tax law students (11.5%), and seven students studied criminology (13.5%).

Materials

Learning Strategies

Learning strategies were measured with the ILS. The ILS, a self-report questionnaire developed for students in higher education, was used to measure learning strategies (Vermunt, 1998; Vermunt & Van Rijswijk, 1998). Only the first part of the ILS was used and students' conceptions and motives were not included as our focus was on learning strategies. Processing and regulatory strategies are divided into three subscales each. Processing strategies are categorized in: A) Deep processing (11 items), which contain relating, structuring, and critical processing, B) Stepwise processing (11 items), in which the use of memorization, rehearsal, and analyzing is measured, and C) Concrete processing (5 items), which measures whether the learning material is concretized and personalized by the student.

Regulatory processes are divided into D) Self-regulation (11 items), which measures to what degree students control their own learning process, E) External regulation (11 items), which measures to what degree students depend on external resources (e.g., a

teacher) for steering and controlling their learning process, and F) Lack of regulation (6 items), which measures whether students experience difficulty in regulating their learning process. In total, the questionnaire contains 55 items. Each item represents a statement of which students need to indicate to what extent each statement fits them. This is measured on a scale of 1 ("I never or hardly do this") to 5 ("I (almost) always do this"). An overview of the subscales including an example item is shown in Table 5.1.

Table 5.1. Example Items of ILS

Learning strategy	Subscale	Example item
Processing Strategies	Deep processing	'I try to combine separately discussed concepts to a whole'
	Stepwise processing	'I rehearse important topics of the learning material till I memorize them'
	Concrete processing	'I use what I learn on a course in my activities outside the study'
Regulation Strategies	Self-regulation	'When I'm having difficulties with parts of the course material, I try to analyze why it is hard for me'
	External regulation	'I study according to the instructions provided by course materials or teacher'
	Lack of regulation	'I admit that I find it difficult to determine whether or not I sufficiently mastered the course material'

Academic performance

Students' grades (i.e., a score between 1.0 and 10.0) for all course tests of the Bachelor's program were retrieved from the university administration. For each student, six mean grades were calculated and included in the analysis: a mean grade was calculated for the courses that were finished by the time the questionnaire was administered. Mean grade 1 is the mean grade of the first and second course of the first year; mean grade 2 is the mean grade of the third till seventh course of the first year; mean grade 3 is the mean grade of the eight course of the first year and the first and second course of the second year; mean grade 4 is the mean grade of the third till seventh course of the second year; mean grade 5 is the mean grade of the eight course of the second year and the minor course (i.e., a course of choice which has the duration of two courses) of the third year; mean grade six is the mean grade of the third till seventh course of the third year. An overview of when the mean grades were calculated is given in Table 5.2.

Procedure

Students filled out the ILS twice each year of the three-year Bachelor's program. In total, they hence received the questionnaire six times. The first measurement moment each academic year was at the first day of the third course (i.e., November). At the start of the eighth and final course of the academic year (i.e., June), the questionnaire was distrib-

uted again. Table 5.2 provides an overview of these measurement moments throughout the Bachelor's program. Questionnaires were administered by the tutors during the first tutorial meeting of the course that was given at the time. It took students about 15 minutes to fill out the ILS. Participation was voluntary.

Table 5.2. Overview measurement moments learning strategies and mean grades

	Measurements			
	Learning strategies		Mean grade	
Academic year 1 (Sep 2013 – Jul 2014)	T1	November (2013)	G1	Courses 1.1 - 1.2
	T2	June (2015)	G2	Courses 1.3 – 1.7
Academic year 2 (Sep 2014 – Jul 2015)	T3	November (2014)	G3	Courses 1.8 – 2.2
	T4	June (2015)	G4	Courses 2.3 – 2.7
Academic year 3 (Sep 2015 – Jul 2016)	T5	November (2015)	G5	Courses 2.8, minor
	T6	June (2016)	G6	Courses 3.3 – 3.8

Assessment

Half of the exams that were administered in the three-year Dutch law Bachelor's program were analyzed in the current study. This concerned exams of the first, second, and third year. Exam questions were either multiple-choice (MC) or open-ended. Exams in the first year mostly contained MC questions, while in the third year, exam questions were exclusively open-ended. Exam questions were coded on the level of knowledge that was tested, based on Sugrue's (1993) coding scheme for problem-solving. Sugrue distinguished three levels of problem solving assessment that are linked to different cognitive levels used in problem solving: the understanding of concepts (i.e., knowledge of what a certain concept is), the understanding of principles (i.e., knowledge of the relationship between concepts), and the linking of concepts and principles to conditions and procedures for application. The latter is in line with the highest cognitive level of knowledge structures (Sugrue, 1993). Sugrue's coding scheme was chosen for categorizing the exam questions, because this model is based on problem solving skills. Working with problems and problem solving/understanding play a central role in PBL.

Exam questions of eleven course exams (i.e., four exams of the first year, four exams of the second year, and three exams of the third year) were investigated. In total, 283 exam questions were assessed on the level of knowledge that was tested. One of the authors and a second, independent rater, who graduated in Dutch law, coded three exams based on Sugrue's scheme. Interrater reliability turned out to be rather low, Cohen's kappa = .55. Differences were solved through discussion. Due to the insufficient interrater reliability, both raters assessed again three exams, which resulted in a Cohen's kappa of .70. The remaining exam questions (151 items) were then coded by the first rater only.

Table 5.3. Classification of Knowledge Structure Level of Exam Questions

	Exams		
	First year	Second year	Third year
Number of exam questions	N_{total} = 161 n_{MC} = 120 (74.5%) n_{open} = 41 (25.5%)	N_{total} = 82 n_{MC} = 46 (56.1%) n_{open} = 36 (44.9%)	N_{total} = 40 n_{MC} = 0 (0.0%) n_{open} = 40 (100.0%)
Level of knowledge assessed			
Concepts	n = 108 (67.1%)	n = 40 (48.8%)	n = 13 (32.5%)
Principles	n = 47 (29.2%)	n = 33 (40.2%)	n = 19 (47.5%)
Linking concepts and principles	n = 6 (3.7%)	n = 9 (11.0%)	n = 8 (20.0%)

Table 5.3 shows an overview of the levels of knowledge tested in exam questions each year. In the first year, the focus lies on concepts in the exam questions (i.e., 67.1 %), referring to the lowest level of knowledge. In the second academic year, still about half of the exam questions focus on understanding concepts. In the final year of the Bachelor's program, understanding concepts is the main focus in a third of the exam questions. Questions regarding principles and application of concepts and principles increase over the Bachelor's program. These types of questions require a higher level of knowledge structure. Understanding of principles (i.e., second level) receives most attention in the third year exams. The number of questions regarding application of concepts and principles increases over the years. Still, only about 20.0% of these question types are included in the final year, which is not an excessive increase over the years.

Statistical analyses

Three analyses are conducted in order to answer the three research questions. Regarding the first research question, the development of learning strategies, six Repeated Measures Analysis of Variances (RM-ANOVA's) were applied. Moment of testing (i.e., six levels) served as the within-subject factor and the six subscales of the ILS (i.e., three processing and three regulation strategies) served as dependent variables. To reduce the chance of Type I error, Bonferroni-corrections were applied and results were only considered statistically significant when an alpha level of .008 was reached (.05/6).

To answer the second research question, namely the relationship between learning strategies and academic performance, correlations were calculated between the ILS scores and mean grades at every moment of measuring.

To compare dropouts after the first academic year with students who continued the program (i.e., the third research question) six separate Analysis of Variances (ANOVA's) were conducted with type of student (dropout vs. non-dropout) as between-subject factor and ILS scores as dependent variables. These students were compared at the end of

the first academic year and therefore, scores on the second measurement moment were used in the analysis. In order to reduce the chance of Type I error, Bonferroni-corrections were applied and results were only considered statistically significant when an alpha level of .008 was reached (.05/6).

RESULTS

Development of Learning Strategies in PBL

Table 5.4 provides mean item scores of the subscales of the ILS at all trials. In order to visualize the development of PBL students' learning strategies, Figure 5.1 depicts this in a graph. Processing strategies scores will be discussed first, followed by results on regulatory strategies.

Table 5.4. Mean item scores of learning strategies each measurement moments (Standard Deviation in Parentheses)

		T1	T2	T3	T4	T5	T6
Processing strategies	Deep	3.21 (.59)	3.14 (.61)	3.15 (.59)	3.14 (.61)	3.17 (.58)	3.16 (.63)
	Stepwise	3.09 (.60)	3.02 (.59)	3.07 (.54)	3.07 (.58)	3.15 (.61)	3.05 (.62)
	Concrete	2.98 (.66)	3.07 (.68)	3.07 (.66)	3.18 (.65)	3.20 (.65)	3.20 (.61)
Regulatory strategies	Self	2.83 (.62)	2.74 (.64)	2.70 (.61)	2.73 (.62)	2.91 (.57)	2.77 (.65)
	External	3.22 (.51)	3.23 (.50)	3.12 (.50)	3.14 (.48)	3.24 (.43)	3.12 (.46)
	Lack	2.60 (.71)	2.45 (.72)	2.42 (.67)	2.54 (.67)	2.50 (.63)	2.52 (.69)

Note. $N = 241$
Range: 1 – 5

No effect of time on deep processing was present, $F(5,1200) = 1.04$, $p = .391$. A small statistically significant effect of time was found for stepwise processing, $F(5,1200) = 3.23$, $p = .007$, partial $\eta^2 = .01$. Bonferroni's post-hoc tests showed that stepwise processing at T5 was significant higher than scores at T2 ($t(240) = 3.82$, $p = .002$, $r = .24$), and scores at T6 ($t(240) = 2.97$, $p = .049$, $r = .19$). A small effect of time was also present for concrete processing, $F(5,1200) = 9.53$, $p < .001$, partial $\eta^2 = .04$. Post-hoc tests indicated that scores on concrete processing at T1 were significantly lower than at T4 ($t(240) = -4.56$, $p < .001$, $r = .28$), T5 ($t(240) = -4.68$, $p < .001$, $r = .29$), and T6 ($t(240) = -4.80$, $p < .001$, $r = .30$). Concrete processing scores at T2 were also significant lower compared to T5, $t(240) = -3.05$, $p = .035$, $r = .19$. Further, concrete processing scores at T3 were lower than scores on T5 ($t(240) = -3.21$, $p < .001$, $r = .20$), and T6 ($t(240) = -3.22$, $p < .001$, $r = .20$). In short, these results show no change in deep processing over time, a small increase in stepwise processing, followed by a small decrease at the end of the program, and an increase in concrete processing over the course of higher education.

With regards to regulatory strategies, a small effect of time on self-regulation was found, $F(5,1200) = 8.79$, $p < .001$, partial $\eta^2 = .04$. Post-hoc tests showed a decrease of self-regulation from T1 to T3, ($t(240) = 3.42$, $p = .011$, $r = .22$). Further, scores of self-regulation were higher on T5 compared to T2 ($t(240) = 4.70$, $p < .001$, $r = .29$), T3 ($t(240) = 5.68$, $p < .001$, $r = .34$), T4 ($t(240) = 5.51$, $p < .001$, $r = .34$), and T6 ($t(240) = 4.15$, $p = .003$, $r = .26$). Also for external regulation a small effect of time was found, $F(5,1200) = 6.61$, $p < .001$, partial $\eta^2 = .03$. Bonferroni's post-hoc tests showed that external regulation scores at T1 were higher than T3 ($t(240) = 3.29$, $p = .015$, r = .21) and T6 ($t(240) = 3.00$, $p = .044$, $r = .19$). Scores at T2 were higher than scores of external regulation at T3 ($t(240) = 3.58$, $p = .006$, r = .23), T4 ($t(240) = 3.00$, $p = .046$, $r = .19$), and T6 ($t(240) = 3.26$, $p = .020$, $r = .21$). Also, external regulation appeared higher at T5 compared to T4 ($t(240) = 3.28$, $p = .018$, $r = .21$) and T6 ($t(240) = 3.87$, $p = .002$, $r = .24$). A statistically significant effect of time was also found for lack of regulation, $F(5,1200) = 4.28$, $p = .001$, partial $\eta^2 = .02$. Post-hoc tests pointed out that lack of regulation scores were higher at T1 compared to T2 ($t(240) = 3.20$, $p = .025$, $r = .20$) and T3 ($t(240) = 3.85$, $p = .002$, $r = .24$).

In sum, the development of regulatory strategies demonstrate the following pattern: a decrease in self-regulation, followed by a small increase later in the Bachelor's program and again a small drop at the end of the third year. External regulation shows a similar pattern: a decrease in external regulation, followed by an increase, and a decrease again at the end of the Bachelor's program. Lack of regulation demonstrated a drop at the beginning of the Bachelor's program and this remains till the end of the program.

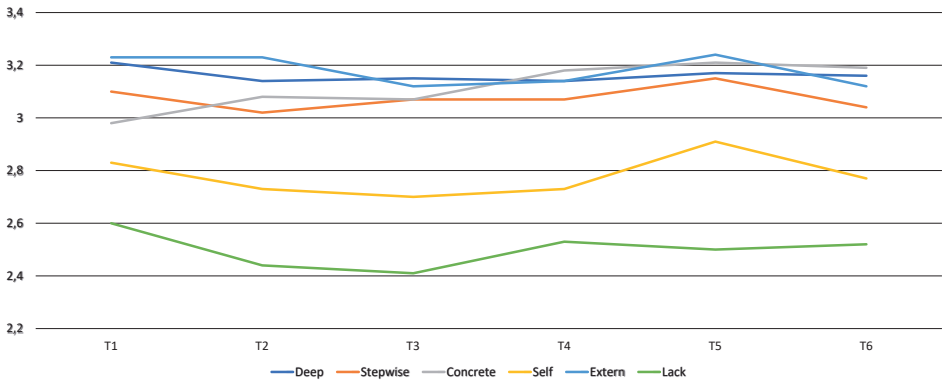

Figure 5.1. Development of Learning Strategies in PBL

Relationship Learning Strategies and Academic Performance

Table 5.5 provides the correlations between learning strategies and mean grades at each measurement moment. The majority of the learning strategies appeared unrelated to academic performances. The only statistically significant correlations for processing

strategies were found between stepwise processing and mean grade at T2 and T3 (respectively, r = -.12, p = .046; r = -.14, p = .032). Both correlations are negative, meaning that a higher score on stepwise processing is related to a lower mean grade. However, these correlations should be considered as small.

Regarding regulation strategies, significant correlations with mean grades and lack of regulation showed up at almost all measurement moments (T1: r = -.18, p = .002; T2: r = -.21, p < .001; T3: r = -.17, p = .007; T4: r = -.18, p = .006; T6: r = -.20, p = .002). These correlations can be considered small and negative, meaning that high scores on lack of regulation are linked to low academic performance. The other regulatory strategies did not have statistically significant correlations with academic performance.

Table 5.5. Pearson Correlations between Learning Strategies and Mean Grade at each Measurement Moment

		T1 (*N*=296)	T2 (*N*=296)	T3 (*N*=244)	T4 (*N*=244)	T5 (*N*=244)	T6 (*N*=244)
		Mean grade					
Processing strategies	Deep processing	.01	.10	.09	.03	-.02	.06
	Stepwise processing	-.09	-.12*	-.14*	-.06	-.05	-.02
	Concrete processing	-.04	.00	-.11	-.11	-.01	.06
Regulation strategies	Self-regulation	-.05	.04	.02	.01	-.01	.07
	External regulation	-.04	-.00	-.01	.00	-.03	.01
	Lack of regulation	-.18*	-.21**	-.17*	-.18*	-.04	-.20*

Note. ** p < .001; * p < .05

Drop-out Analysis

Mean scores on the subscales of the ILS for students who continued the academic program and students who dropped out after the first academic year are displayed in Table 5.6. These are the scores of the second trial (T2), measured at the end of the first year. Separate ANOVA's only showed a statistically significant effect of dropout on the scale lack of regulation, $F(1,294) = 12.77$, p < .001, partial η^2 = .04. There was no effect present on any of the processing strategies (deep processing: $F(1,294)$ = .06, p = .806; stepwise processing: $F(1,294)$ = .48, p = .490; concrete processing: $F(1,294)$ = .06, p = .808), nor on self-regulation and external regulation (respectively $F(1,294)$ = 1.01, p = .315, $F(1,294)$ = 1.02, p = .313).

Table 5.6. Mean item scores on the subscales of learning strategies for drop-outs and students who continue on the second measurement (T2) (Standard Deviation in parentheses)

Learning strategy	Subscale	Non-Dropouts (*N*=244)	Dropouts (*N*=52)
Processing strategies	Deep processing	3.14 (.61)	3.16 (.60)
	Stepwise processing	3.02 (.59)	3.08 (.54)
	Concrete processing	3.08 (.68)	3.10 (.60)
Regulation strategies	Self-regulation	2.73 (.64)	2.83 (.67)
	External regulation	3.23 (.49)	3.16 (.47)
	Lack of regulation	2.44 (.71)	2.84 (.77)

DISCUSSION

Deep processing and self-regulation are desirable learning strategies in higher education. PBL is a student-centered instructional method that is assumed to stimulate these strategies. The present study investigated the development of law students' learning strategies over the course of a three-year PBL program at the Erasmus School of Law. In addition, the association between learning strategies and academic performance was studied, as well as the differences in learning strategies between students who dropped out after the first academic year and those who continued the academic program. Results are discussed below.

Development of Learning Strategies

Processing Strategies.

Regarding the development of processing strategies, deep processing showed no change over time and stepwise processing increased slightly at first and decreased slightly at the end of the Bachelor's program. No change of deep processing is in line with some previously conducted longitudinal studies (Rodriguez & Cano, 2007; Severiens et al., 2001; Zeegers, 2001). Moreover, the review of Asikainen and Gijbels (2017) shows that the pattern of development of deep learning in higher education is still inconclusive. However, it was expected that deep processing would increase and stepwise processing would decrease in a PBL program. A possible explanation might lie in the exams used in the curriculum under study, which could influence the use of students' learning strategies (Baeten et al., 2010; Gijbels, Van de Watering, et al., 2005).

After analyzing a selection of exams from the Bachelor's program, the number of questions focusing on simple level knowledge structures (e.g., concepts) appeared rather high. In the first year, the majority of exam questions focused on understanding of concepts. In the third year this was still the case for about a third of the exam questions. One could argue that considering the high number of these types of exam questions, stepwise processing is still a useful learning strategy in a later phase of

the Bachelor's program. This might explain why there is no large decline in the use of stepwise processing. Moreover, questions regarding the application of concepts and principles (i.e., highest level of Sugrue's model) showed a small increase over the course of the Bachelor program's, but these types of questions remain underrepresented in the curriculum under study. Hence, deep learning is not always required, which could provide an explanation why deep processing is not improving over the three academic years. It should be noted that a lack of change in deep processing could also be ascribed to the already high scores on deep processing from the start of the program. Still, there is room for improvement of deep processing.

The area of study or academic discipline could also offer an explanation here (Baeten et al., 2010). Vermunt (2005) found that Dutch law students reported more use of stepwise processing and external regulation than students in other disciplines (e.g., Psychology, Arts, and Economics). This could indicate that the course materials in Dutch law do not always require deep processing, but can also be managed with stepwise processing. Moreover, this would further explain why the exams in all three academic years contain many questions with a focus on concepts (i.e., low level of knowledge in Sugrue's model).

Finally, a small increase over time in the use of concrete processing was shown, meaning that students apply learned knowledge more often to practice as they progress in their academic program. An increase of concrete processing is in line with the goals of PBL. In PBL, students work with authentic, ill-defined problems. These problems relate to real-life situations that students can encounter later in their professional life. PBL claims that when students learn in a realistic context during their academic program, they will be better able to apply the knowledge in a similar situation (Schmidt, 1983).

Regulatory Strategies.

Self-regulation was expected to increase in the three years of the PBL program under study, because in PBL, students need to plan their own study time, select their own literature, and evaluate what they have learned (Schmidt, 2000). However, results of the present study showed a different pattern: self-regulation decreased over the first two years, then increased at the beginning of the third year, and decreased again at the end of the program. Although this specific pattern is hard to explain, it shows that there is no steady increase of self-regulation, as was expected. One explanation is that the PBL aspects, which are assumed to stimulate self-regulation in theory, are not always present in practice or that external factors to rely on are more often present than they should (e.g., a tutor who provides too many instructions during meetings). An encountered issue in PBL practice is that some students appear to be actively involved, while in reality students do not always learn optimal from it (e.g., when students read the literature, but do not understand it and are not able to connect concepts; Dolmans, Wolfhagen, Van der Vleuten, & Wijnen, 2001; Dolmans, De Grave, Wolfhagen, & Van der Vleuten, 2005).

As a consequence, the tutors in PBL might be frustrated and instead of asking more in-depth questions, they provide students with more guidance than is actually intended to in PBL (e.g., give learning issues or lectures in tutorial groups; Dolmans et al., 2001; Dolmans et al., 2005). Self-regulation activities are not stimulated this way while external regulation is. In short, how PBL is implemented and executed could play a major role in how students act in their learning process.

The high scores on external regulation among Dutch law students found in this study are in line with previous research findings (Vermunt, 2005; Wijnen, Loyens, Smeets, Kroeze, & Van der Molen, 2017). Furthermore, Liddle (1999) showed that after following a course in PBL, law students still preferred clear directions, guidance, and teachers explaining information in the learning environment. Despite the high rates of external regulation, external regulation seems to decline a bit over the years (with exception of the beginning of the third year).

Lack of regulation reduced over the program. This indicates that over the course of a three-year PBL program, students experience less difficulty in steering and controlling the learning process, either by themselves or by depending on external factors. Other longitudinal studies found a similar decrease of lack of regulation over time in higher education (Donche et al., 2010; Donche & Van Petegem, 2009; Vermetten et al., 1999). This indicates that when students gain experience with studying, they get clearer ideas about how to manage the learning process. A decrease in lack of regulation is positive in terms of learning outcomes, as was shown in this study and on which we will elaborate below.

Striking are the scores of both processing and regulatory strategies on the fifth trial (i.e., start of the third year). Stepwise processing, self-regulation, and external regulation are relatively high compared to scores on the other trials. A possible explanation for this is the course students followed right before filling out the questionnaire. Students participated in a so called minor, which is an elective course that can either be more in-depth of an area within legal education, or broader in nature, such as a course in another discipline. Only a limited number of minors are offered in a PBL format. The majority of minors contained different educational formats (e.g., lectures and large work groups). The sudden change in instruction style right before the fifth trial might explain the changes in learning strategies.

Relationship between Learning Strategies and Academic Performance

The current study only showed a few statistically significant correlations between learning strategies and academic achievement. Concerning processing strategies, only stepwise processing was small and negatively related to mean grades on the second and third trial. This means that a higher score on stepwise processing is related to a lower grade at the end of first and the beginning of the second academic year. This

result is in line with previous studies (Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001). However, it was expected that deep processing would be related to academic performance, based on prior studies (Boyle et al., 2003; Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001). Again, assessments used in the curriculum could provide an explanation here. As was demonstrated, deep processing is not so much required in exams as is the case for concrete processing. Mainly questions at the conceptual level were present in exams.

Self-regulation and external regulation were not related to academic performance, which contradicts earlier studies demonstrating positive associations between self-regulation and performance (Boyle et al., 2003; Richardson et al., 2012). It is, however, demonstrated that when students have difficulties with regulation at all (i.e., lack of regulation), this is related to achievement. Students with a high lack of regulation are clueless in what they need to do during studying, which is connected to lower achievement. In short, it shows that if students are able to regulate their learning, either by themselves or by external factors, it is not related to how they perform. However, when students have difficulty in regulating their study activities, a relationship with academic performance can be expected.

Drop-out

In line with the correlations found between academic performance and learning strategies, lack of regulation was the only strategy associated with dropping out. Students who dropped out of the academic program after the first year showed higher scores on lack of regulation. Again, whether regulation depends on oneself or on external factors does not seem to matter for performing and academic success, but the presence of regulation itself is crucial. If one has difficulties with regulation of processing strategies, it is detrimental for one's study progress.

LIMITATIONS

A limitation of the present study is that measurements of learning strategies were based on self-report. A disadvantage here is that not actual learning strategies were measured, but how students *think* they learn. In addition, students can answer in a socially desirable way, however instructions indicated that there are no correct or incorrect answers. Still, since learning is an internal process, self-reports seem to be the best way of investigating this. Despite this limitation, we believe that the longitudinal character of this study (i.e., over the course of a complete three-year Bachelor's program with six measurement moments) is a strength.

Even though the findings showed that deep processing and self-regulation were not associated with academic performance and study progress, these strategies are still desirable in higher education and these strategies should be stimulated. Whether or not the use of these strategies are reflected in grades, educational institutions aim to create deep instead of surface understanding in students. This because, after university, students need to be able to apply their knowledge in practice and regulate their own learning processes, as learning continues in the professional life.

CONCLUSIONS

The present study showed that deep processing and self-regulation did not increase over the course of a three-year PBL program. Assessments, as well as the presence of other external factors (e.g., tutor who provides too much instructions) could provide an explanation for the present findings. Further, it was shown that students relate more knowledge they have learned to practical cases (i.e., concrete processing) in the course of their program. Working with authentic problems seems to help in relating material to real-life situations. Additionally, lack of regulation decreases over the years, meaning that students tend to experience less difficulties with regulating their learning process. This appeared to be beneficial for academic performance and study progress.

6

Effects of Problem-Based Learning when Taking into Account Time and Type of Assessment

This chapter is in preparation as:

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ABSTRACT

The present study aims to shed light on the question whether PBL is effective in terms of knowledge acquisition, when taking into account both time and type of assessment. In a randomized, controlled experiment, participants were assigned to either a PBL or a lecture condition. They learned a topic about Dutch criminal law and were tested on factual knowledge, application of knowledge, and transfer of knowledge, in both an immediate and delayed (i.e., one week later) test. Results showed no effects on knowledge retention over time, possibly due to the short time between immediate and delayed tests. Further, participants in the lecture condition outperformed PBL participants on factual knowledge questions, although performance in both conditions were sufficient. Participants in the PBL condition, however, performed better on application of knowledge assignment. Directly transmitting information to students appears helpful when students need to acquire basic knowledge, but when they need to relate their knowledge to a certain situation, the processes in PBL, e.g., activation of prior knowledge and elaboration, seem to be crucial. No differences regarding transfer of knowledge were found. The findings are both of theoretical and practical value.

INTRODUCTION

In academic programs lectures are often a core instructional method. Providing such lectures is considered a very efficient way of teaching since a lot of information can be transmitted from the teacher to a large group of students at once. However, there are several limitations bound to lectures as well. For example, students often fail to reach higher order thinking skills (e.g., application of knowledge) due to the passive nature of lectures (Bligh, 2000; White et al., 2016). These skills are, however, very important in higher education and in life after university. Educational methods in which students are required to be *actively* involved in learning, like student-centered methods, aim to foster these skills. Problem-based learning (PBL) is an example of such an approach. The present study focuses on the differences between instruction by PBL and by lectures on student performance. First, we will go into depth about the origin and process of PBL.

Problem-Based Learning

At the McMaster University Medical School in Canada in the 1960s, students experienced difficulties with understanding complex topics, were less motivated, and did not see the relevance for their profession (Barrows, 1996). To motivate and help students, working with and discussing realistic problems in small groups was introduced as instructional method. This was referred to as PBL. Since its origin (Norman & Schmidt, 1992; Schmidt, 1983), PBL has been implemented all over the world and over the past decades, different variations of PBL have evolved (Barrows, 1996; Loyens, Paas, & Kirschner, 2012). Despite various types, the following characteristics of PBL are defined. (1) Learning is student-centered, which holds that the students themselves should take responsibility for their learning process. (2) Learning takes place in small groups. (3) The teacher acts as facilitator, meaning that he/she asks those questions that make students elaborate on information instead of providing factual information. (4) Problems that challenge and motivate students are used in the instruction, and (5) these problems should foster the development of problem-solving skills. (6) Self-directed learning should be present (Barrows, 1996).

Schmidt, Van der Molen, Te Winkel, and Wijnen (2009b) describe three perspectives of PBL. One of these perspectives considers PBL as a cognitive constructivist approach with the primary goal to build flexible mental models in learners. One of the goals of PBL, construction of an extensive knowledge structure, is in line with this perspective. The process of PBL contributes to the attempt to achieve this goal. In general, three phases are distinguished. In the initial discussion phase, students receive a problem, which is usually a description of a specific situation. Collaboratively, the problem is discussed and students try to explain it. This way, prior knowledge about the topic of the problem at hand is activated. As the problem is the starting point, students end up with questions about unclarified aspects and they formulate so called learning issues. In the second

phase, the self-study phase, students individually select and study relevant literature sources, attempting to answer the learning issues for themselves. This is the preparation for the final phase, the reporting phase. During this phase students discuss their findings together and collaboratively address the learning issues. The tutor, who is present during the initial and reporting phase, can ask in-depth questions to make students elaborate more on the material (Loyens et al., 2012; Schmidt, 1983).

In order to realize knowledge acquisition in students, the processes of activation of prior knowledge, elaboration of knowledge, and learning in a realistic context (Norman & Schmidt, 1992; Schmidt, 1983) play an important role. Students activate their prior knowledge in the initial phase when discussing the problem as starting point. When students acquire new knowledge during the self-study and reporting phase, it is easier for them to connect new knowledge to existing knowledge in memory. This is also called the process of elaboration and takes place trough discussion, fostering knowledge retrieval (Norman & Schmidt, 1992; Schmidt, 1983). Hence, this assumes that students in PBL acquire more knowledge of the PBL instruction than students in more traditional, lecture-based environments.

Knowledge Acquisition and Retention

Several studies have focused on the effectiveness of PBL with regards to knowledge acquisition. In the majority of these studies, PBL students were compared with students from more conventional, lecture-based educational methods on their academic performance, e.g. course exams. Several meta-analyses that contain these effect studies exist, however with inconclusive results. Most meta-analyses demonstrated in general no differences between PBL and non-PBL students, or even negative effects of PBL on their immediate knowledge acquisition (Albanese & Mitchell, 1993; Dochy, Segers, Van de Bossche, & Gijbels, 2003; Schmidt, Van der Molen, Te Winkel, & Wijnen, 2009b; Vernon & Blake, 1993). However, a recent meta-analysis of Dağyar and Demirel (2015) demonstrated that PBL students obtain better academic achievements than students of conventional curricula.

The meta-analysis of Dochy et al., (2003) indicated the importance to also explore effects of PBL over time. PBL does seem to have a positive effect with regards to knowledge *retention* on the long-term: PBL students perform better on delayed tests and hence retain more knowledge over time compared to their non-PBL counterparts (Dochy et al., 2003; Strobel & Barneveld, 2009). In short, studies demonstrate that PBL is not necessarily beneficial in terms of immediate knowledge acquisition, but retention on the long-term appears to be better among PBL students.

Application and Transfer of Knowledge in Problem-Based Learning

Besides the importance of retention period in assessment, the type of assessment should be taken into account as well. The meta-analysis of Gijbels, Dochy, Van den Bossche, and

Segers (2005) showed that PBL students, compared to students of traditional curricula, perform better when assessments focus on higher levels of knowledge structures. These levels contain the understanding of principles that link concepts and the application of knowledge (i.e., procedure; Sugrue, 1993). The lower level of knowledge structure on the other hand means understanding of concepts (e.g., factual knowledge). Similar results were found in an experiment by Masek and Yamin (2012): students taught by lectures performed better on the understanding of concepts, while PBL students acquired more knowledge regarding principles and procedures (Masek & Yamin, 2012). An explanation for this is that the instructions of PBL are more in line with the higher level of knowledge structures. For example, in PBL, learning takes place in a realistic context (i.e., the problem presented to the students) that requires students to link the course material to real-life situations and therefore apply their knowledge to a certain extent. Further, elaborating and discussing the material might contribute to application of knowledge as well, because students refer back to the problem they started with. These aspects might even help students to *transfer* the knowledge to new situations.

Transfer is the process in which students apply the knowledge they have learned in a different and novel context (Perkins & Salamon, 1992). Transfer is a very important aspect of education (Perkins & Salamon, 1992), as students need to be able to apply the knowledge they have learned in real-life situations, as well as in their future profession (Pugh & Bergin, 2006). Despite its importance, transfer is a difficult process that does not happen automatically (Norman, 2009). In order for transfer to take place, students need to be able to recognize and understand the underlying principles in different situations or contexts. However, not all contexts and situations look similar and it is difficult for students, especially for novices, to recognize the deeper, underlying principles (Norman, 2009).

It could be argued that PBL fosters transfer, because students start their learning process in a realistic context. The learning material is integrated with a realistic and complex problem, making it easier to relate acquired knowledge to new situations. Previous studies that have focused on PBL's effect on transfer (Bergstrom, Pugh, Philips, & Machlev, 2016; Pease & Kuhn, 2011; Wirkala & Kuhn, 2011) found that indeed students in PBL are better in applying their knowledge in new and different situations and hence, that PBL seems to stimulate transfer.

The Present Study

As reported above, a lot of research has been done on the effectiveness of PBL on knowledge acquisition. However, one general shortcoming of the existing studies that the present study tries to overcome is the lack of controlled experiments (Kirschner, Sweller, & Clark, 2006). The majority of the PBL effect studies are conducted in existing curricula and courses. Although this is highly ecologically valid, there are many external factors that might influence the results such as the group composition of the tutorial groups

and the tutor. Wijnen, Schaap, and Loyens (2016) aimed to overcome this by conducting a randomized controlled lab-experiment on the effectiveness of PBL. Participants were taught on a psychology topic either by PBL, a lecture, or through self-study. They were tested on their acquired knowledge on a multiple-choice (MC), factual knowledge test, both immediate as delayed. Results showed that participants in the PBL condition outperformed those in the lecture condition on knowledge acquisition. However, besides the issue of controlled experiments, two remarks about PBL effect studies remain.

First, the majority of the PBL effect studies are conducted in the area of medical education or social sciences (e.g., psychology). However, in order to generalize findings, studies should focus on different disciplines as well. The present study tries to overcome this by focusing on a different area, legal education. To our knowledge, effects of PBL have not often been investigated within this discipline. The second remark relates to the type of assessments used in PBL effect studies. A limitation of past studies is that the different levels of knowledge structures have seldom been measured at the same time. The present study will therefore focus on factual knowledge, application of knowledge, and transfer of knowledge and hence take several levels (i.e., lower and higher levels) into account.

In the present study a controlled experiment was conducted. Participants were randomly assigned to either a PBL or lecture condition and were compared on the performances on different types of assessment mentioned above that were tested on both an immediate as delayed test. Figure 6.1 depicts the procedure of the experiment. In the Method section the procedure is discussed in more depth. The first research question was "What is the influence of PBL on a) knowledge acquisition and b) knowledge retention?" The influence of PBL has been studied on both an immediate and delayed test to measure respectively knowledge acquisition and retention. Previous studies showed mixed findings regarding PBL's effect on knowledge acquisition (Albanese & Mitchell, 1993; Dağyar & Demirel, 2015; Dochy et al., 2003; Schmidt et al., 2009b; Vernon & Blake, 1993). Therefore, for the first part of the first research question, no specific hypothesis is formulated, but we kept the question more explorative. Moreover, acquisition of knowledge is expected to differ between types of assessment, which will be outlined in the next paragraph. Regarding the second part of the first research question (hypothesis 1b), it is hypothesized that PBL students outperform those in the lecture condition on the delayed test despite the type of assessment (Dochy et al., 2003; Strobel & Barneveld, 2009).

The second research question focused on the type of assessment: "What is the influence of PBL on a) factual knowledge, b) application of knowledge, and c) transfer of knowledge?" It was hypothesized that regarding the factual knowledge questions (hypothesis 2a), participants in the lecture condition performed better (Masek & Yamin, 2012). However, we expected that PBL students performed better on the application

assignment (hypothesis 2b; Gijbels et al., 2005; Masek & Yamin, 2012) and the transfer assignments (hypothesis 2c; Bergstrom et al., 2016; Pease & Kuhn, 2010; Wirkala & Kuhn, 2011).

METHOD

Participants

Participants were undergraduate psychology students from a Dutch university and so they were novices in the area of Dutch criminal law and were expected to have a similar level of prior knowledge. In total, 67 students participated (17.9% male). Age ranged from 18 to 25 and the mean age was 20.0 years (SD = 1.56). Participants were randomly assigned to either the lecture condition (n = 33; 21.2% male) or PBL condition (n = 34; 14.7% male), mean age = 19.9 (SD = 1.51) and mean age = 20.0 year (SD = 1.62) respectively. There were no significant differences between both conditions regarding age ($t(65)$= -.70, p = .488) and gender ($\chi^2(1)$ = .48, p = .487). In return for participation, students earned credit points.

Material

Participants learned about Dutch criminal law topics "self-defense" and "unreasonable use of self-defense". This topic is part of the academic Dutch law program at the university under study. It is briefly brought up in the first academic year during the introductory course of criminal law, and more in-depth during the second academic year, in the follow-up course of Dutch criminal law. Since participants were psychology students, there were no conflicts between the content of the topic to-be-learned in the experiment and the content of the curriculum of the participants. Several materials were deployed in the learning phases of both conditions (i.e., the problem for the PBL condition, the text, and the test). Two independent experts on Dutch criminal law were involved in the development of some of the materials and conducting the experiment. The first expert helped with the construction of the lecture for the lecture condition and the test to measure the effects of the intervention. Additionally, this expert assisted with rating the answers to the open questions. The second expert acted as lecturer in the lecture condition and as tutor in the PBL condition. By doing so, we controlled for possible differences in instructors. The expert was briefed in advance and the first author was present during the experiment in both conditions. Both experts involved were young jurists, graduated in Dutch criminal law and were employed at the university under study for several years.

Lecture

Participants in the lecture condition received a lecture of 45 minutes. The lecture contained 26 Powerpoint slides. The three main topics that were addressed were self-defense, unreasonable use of self-defense, and *culpa in causa* (i.e., guilt by cause). The lecture started with defining self-defense according to Dutch law. Next, all required conditions to appeal to self-defense were mentioned along with examples (e.g., the attack needs to be *immediate* in order to appeal to self-defense). After self-defense, unreasonable use of self-defense was addressed: how it is defined in Dutch law, the conditions that are required, and again some examples. Next, an explanation was given of *culpa in causa* (i.e., appeal to self-defense and unreasonable use of self-defense will not succeed when someone is seeking the confrontation). The final part of the lecture focused on a (fictive) news article (*"Failed drug deal"*) relating to a situation in which someone defended himself and appealed for self-defense. This news article was exactly the same as the problem in the PBL condition. This news article is described in more detail below (i.e., problem). The conditions for self-defense in this particular case were explained to the participants.

The lecturer received the instruction to give the lecture in a realistic way, to resemble the existing educational practice as closely as possible. The instructor asked several questions during the lecture to the participants (e.g., "Can you try to explain in your own words what is said here on the slide?", "Can you give an example of an attack that is out of proportion?"). When discussing the news article, the lecturer asked participants the question whether they thought that the person in the article could appeal to (unreasonable use of) self-defense. Some of the participants were asked to explain themselves and some discussion arose in the audience.

Problem

The problem in the PBL condition was a fictive news article titled *"Failed drug deal"*. This news article described a situation in which a drug dealer was robbed of his drugs and drugs money by another man. The brother of the drug dealer wanted revenge for his brother and – with a gun – he left his house to search for the man who robbed his brother. When they met each other, the man who stole the drugs and money was running up to the brother with a knife in his hand. The brother was not able to run away and he shot the other man in the chest, with immediate death as a consequence. The lawyer of the drug dealer's brother claimed that shooting the man was self-defense. In the initial phase, participants needed to discuss whether they agree with the lawyer, and whether they thought an appeal to self-defense will succeed. The Seven-Jump method (Schmidt, 1983) was used to shape the PBL process.

This problem is part of the curriculum of Dutch law at the Erasmus School of Law. In the criminal law course in the second academic year, self-defense and unreasonable

use of self-defense is part of the course. All designed problems of all courses at the law program under study are checked and provided with feedback by PBL experts. In addition, before these problems are used in the law program, they are tested out with a small sample of students to check whether they work sufficiently. If that is not the case, adjustments are made. Therefore we assume that the quality of the problem at hand was good.

Text for Self-Study

In both conditions, there was a period of 45 minutes of self-study in which participants had the opportunity to study. A text was provided in which self-defense, unreasonable use of self-defense, and *culpa in causa* were explained, along with all of its conditions and requirements. This text was copied from a study book that is used in the Dutch law curriculum of the university under study. The text contained 13 pages and was written in Dutch. The same topics that were addressed in the lecture condition were cited in the text. To be more specific, the lecture was based on the text. Besides the study text, participants received a copy of the relevant Dutch law articles (i.e., in Dutch: Art. 41 lid 1 Sr, and Art. 42 lid 2 Sr).

Test

The test used in the experiment contained three parts. First, 10 MC questions that measured factual knowledge. Second, an assignment to measure application of knowledge, and third an assignment that measured transfer of knowledge. The test was the same in both conditions and both test phases. The first author in collaboration with one of the experts developed the test. The test was based on the text and the questions had 3 answer options each. An example of a MC question was: "Immediate attack is a requirement of: A) Self-defense, B) Unreasonable use of self-defense, C) Both self-defense as unreasonable use of self-defense. (C is the correct alternative)" Participants could obtain one point for each correctly answered MC question. This resulted in a minimum obtainable score of 0 and a maximum obtainable score of 10 for this part of the test.

The two assignments that were administered, one for application of knowledge and transfer of knowledge, both contained a news article in which a situation was described. The application assignment represented the news article that all participants saw and discussed before (i.e., as problem in the PBL condition and final slide in lecture condition). The question belonging to the article was "Motivate whether you think an appeal to self-defense / unreasonable use of self-defense will succeed in this case? Explain, step by step, how you came to your conclusion." A total score of 10 points could be obtained for this assignment.

The second assignment intended to measure the transfer of knowledge. A new fictive news article was presented here with the following situation: A woman and her three-

year old daughter were attacked by the husband of the woman (and father of the child). The woman and husband started a discussion, but this resulted in physical assault by the husband (i.e., grabbing the woman and shaking her). Moreover, when the daughter started to cry, the husband roughly grabbed the child's arm. The woman tried to pull him away from their daughter and he furiously ran up towards her. The woman grabbed a rolling pin lying on the kitchen counter next to her and she hit her husband on the head. He fell to the ground and did not move anymore. After this, she hits him again with the rolling pin. The question belonging to this news article was "Motivate whether you think an appeal to self-defense / unreasonable use of self-defense will succeed in this case? Explain, step by step, how you came to your conclusion." A total score of 10 points could be obtained for this assignment as well.

A model answer for both assignments was developed by the first author and expert. In this answer, the correct steps for coming to the right conclusion were mentioned with the number of points earned for each part. Answers to the assignments were rated based on these model answers, by the first expert and partly by the first author. Both raters were blind for participants and the condition of the participants. Interrater reliability turned out to be very high, as an intraclass correlation coefficient (ICC) of .95 was reached.

Design of the Experiment and Procedure

The experiment consisted of a learning phase, in which instructions differed between conditions (i.e., lecture vs. PBL), and two test phases (i.e., immediate test and delayed test) that were the same in both conditions. No pre-test was administered, in order to prevent priming of knowledge.

In the lecture condition participants started the experiment with a lecture of 45 minutes. During the lecture, participants were allowed to ask questions and to take notes. After that, a 45 minute period of self-study started, in which participants had the opportunity to study the text. Again, they were allowed to take notes. The first, immediate test phase started right after self-study. The experimenter collected the texts and notes of all participants before administrating the test. Participants had a total of 30 minutes to fill out the test. After a week, participants returned for the second, delayed test phase in which they filled out the same test for which they had 30 minutes. In order to test the retention of acquired knowledge after one week participants were not informed in advance that the test would be administered again the second time they returned for the experiment.

In the PBL condition, participants were assigned to one of a total of four PBL groups. Each group consisted of about nine participants and one tutor. The tutor could ask in-depth questions about the problem, making students elaborate more on the material. Moreover, the tutor monitored whether everyone participated actively in the discus-

sions. Each PBL group started the experiment with the initial phase, which took about 15 minutes. During the initial phase, participants discussed the problem *"Failed drug deal"*. The PBL process in the experiment followed the Seven-Jump method (Schmidt, 1983) and hence the first five steps were applied in the initial phase (i.e., clarifying terms and concepts, defining the problem, brainstorming, problem analyzing, and formulating learning issues). The formulated learning issues were comparable in all groups and they came down to: "What is self-defense?", "What if self-defense is out of proportion?" and "What happens when one appeals to self-defense, but he/she actually seeks confrontation?" These learning issues referred to the three main topics in the text. After the initial phase, a 45 minute period of self-study started, which is the sixth step in the Seven-Jump method. Participants were allowed to take notes. The reporting phase started afterwards (i.e., seventh step) and took 30 minutes. One of the participants volunteered or was chosen to guide the discussion in the reporting phase. Participants answered the learning issues during the reporting phase and the instructor was told to make sure that in all PBL groups, a connection should be made to the problem. After the reporting phase, the experimenter collected all texts and written notes before administering the test. Similar as in the lecture condition, participants had 30 minutes to fill out the test. One week later, participants returned to fill out the same test again (30 minutes) in the second test phase. Participants were not informed in advance that they would be asked to do the test again.

In both conditions, the first author was present during the whole experiment. In the lecture condition, the lecturer left after giving the lecture, and in the PBL condition, the tutor was only present during the initial and reporting phase. In addition, the instructor was unaware of the exact content of the given test. Time on task was equal in both conditions: the total time of the experiment was two and a half hours. The procedure is depicted in Figure 6.1.

Data analysis

Three Mixed Analysis of Variance (ANOVA's) were conducted, one for each type of assessment. The first regarding scores on the factual, MC questions, the second for the application assignment, and the third for the transfer assignment. In all Mixed ANOVA's, the between-subjects factor was condition (lecture vs. PBL) and the within-subjects factor was time (immediate vs. delayed). Knowledge *acquisition* for each type of assessment was operationalized as main effect of instruction type. Knowledge *retention* was operationalized by the interaction of time and instruction type. This interaction gave evidence of the knowledge that participants retained from the immediate to the delayed test and whether that differed between conditions. Effects were reported as significant when $p < .05$. Partial eta-squared effect sizes indicated the size of the effect. A value of partial $\eta^2 > .01$ is considered small, a partial $\eta^2 > .06$ is considered medium and a partial $\eta^2 > .14$ is considered large.

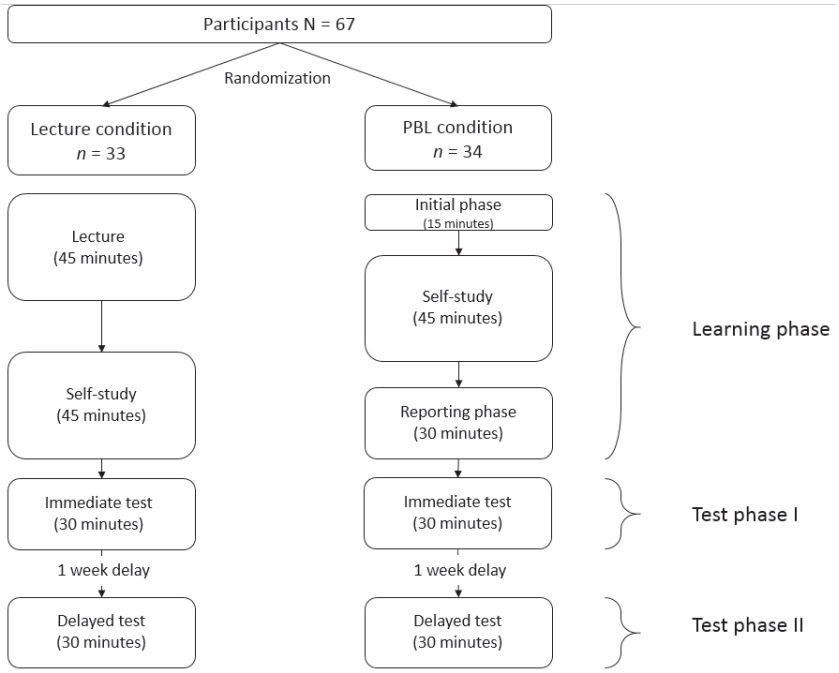

Figure 6.1. Experimental procedure

RESULTS

Before conducting the analyses, assumptions for mixed ANOVA's were checked and met (i.e., normality, Leven's tests). However, the reliability of the MC test appeared very low (Cronbach's alpha of .13). Therefore, results on the first mixed ANOVA should be interpreted with caution. Two participants did not show up on the delayed test phase and they were left out of further analyses, resulting in a total number of 65 participants. Table 6.1 provides the mean scores in both conditions on all three assessment types. Mean scores demonstrated that performance on the MC questions was sufficient in both conditions (a mean score of 6-7 out of 10), however, scores on the application and transfer assignments were rather low (a mean score of 2-3 out of 10).

Results are discussed for each assessment type separate. First, the effect of time is mentioned, followed by the effect of instruction type, and ending with the interaction effect.

Table 6.1. Mean scores on the immediate and delayed tests for both conditions

		Immediate test	Delayed test
MC questions	PBL	6.53 (*SD* = 1.30)	6.19 (*SD* = 1.62)
	Lecture	7.18 (*SD* = 1.19)	6.85 (*SD* = 1.37)
Application assignment	PBL	3.08 (*SD* =1.61)	2.88 (*SD* = 1.08)
	Lecture	2.33 (*SD* = .97)	2.27 (*SD* = .83)
Transfer assignment	PBL	2.81 (*SD* = 1.63)	2.48 (*SD* = 1.44)
	Lecture	3.30 (*SD* = 1.57)	3.17 (*SD* = 1.41)

Note. Scores could range from 0 to 10 on all types of assessment.

Factual knowledge MC questions

Although both for the PBL and the lecture condition the mean scores were lower at the delayed test than at the immediate test, there was no main effect of time, $F(1, 63) = 2.54$, $p = .116$, partial $\eta^2 = .04$. A significant main effect of instruction type showed up, in favor of the participants in the lecture condition, $F(1, 63) = 6.04$, $p = .017$, partial $\eta^2 = .09$ (medium effect), which supports hypothesis 2a. Furthermore, there was no interaction effect, $F(1, 63) = .00$, $p = .981$, partial $\eta^2 = .00$, so performance over time was similar in both conditions. Hence, regarding factual knowledge questions, hypothesis 1b on knowledge retention was not confirmed. Still, as mentioned before, results on the MC questions should be interpreted with caution due to the low reliability.

Application of knowledge assignment

No main effect of time was found for the open-ended question $F(1, 63) = .62$, $p = .431$, partial $\eta^2 = .01$. There was a significant main effect of instruction type, $F(1, 63) = 8.35$, $p = .005$, partial $\eta^2 = .18$ (large effect). Giving support to hypothesis 2b, participants in the PBL condition outperformed participants in the lecture condition. Further, no interaction effect was present, $F(1, 63) = .18$, $p = .670$, partial $\eta^2 = .00$. Hypothesis 1b was not confirmed with regards to the application of knowledge, as PBL students did not retain more knowledge over time.

Transfer of knowledge assignment

There was no main effect of time for the transfer question, $F(1, 63) = 1.36$, $p = .249$, partial $\eta^2 = .02$. Also, no effect of instruction type appeared, $F(1, 63) = 3.39$, $p = .071$, partial $\eta^2 = .05$, which was contrary to hypothesis 2c that stated that participants in the PBL condition would outperform those in the lecture condition. Finally, no interaction effect was found, $F(1, 63) = .23$, $p = .632$, partial $\eta^2 = .00$. Again, hypothesis 1b was not confirmed with regards to the transfer of knowledge.

DISCUSSION

The present study focused on the effectiveness of PBL on time and type of assessment. Knowledge acquisition and knowledge retention were studied on three assessment types: factual knowledge MC questions, one assignment intending to measure the application of knowledge, and a second assignment intending to measure transfer of knowledge. A controlled experiment was conducted, in which participants were randomly assigned to either a PBL or a lecture condition and learned about a Dutch law topic. Measurements took place immediately after the instruction and one week after that.

Time of Assessment: Knowledge Acquisition and Retention

Knowledge acquisition

The first research question focused on the influence of PBL on immediate knowledge acquisition and knowledge retention. No specific hypothesis with regards to knowledge acquisition was formulated because of inconclusive findings in existing literature (Albanese & Mitchell, 1993; Dağyar & Demirel, 2015; Dochy et al., 2003; Schmidt et al., 2009b; Vernon & Blake, 1993). Moreover, it was expected that knowledge acquisition would differ between the PBL and lecture condition for the types of assessment (Gijbels et al., 2005). The latter was indeed shown in the results. Participants in the lecture condition outperformed those in the PBL condition on the factual knowledge questions, while it was the other way around for the application of knowledge assignment. These results are discussed below.

Knowledge retention

Further, it was hypothesized that retention of knowledge over time would be higher when participants received instructions through PBL, on all types of assessment. In PBL there is emphasis on elaboration that is assumed to help students remember more of the learned knowledge (Dochy et al., 2003; Schmidt, 1983; Strobel & Barneveld, 2009). In addition, it was expected that participants in the lecture condition would forget more of the acquired knowledge. Results were however contrary to the hypothesis, as no interaction effects were shown for any of the assessment types. Knowledge loss over time was similar for all participants, irrespective of the instructional method used.

A possible explanation for these findings is that the time between the immediate and delayed test was only one week. We can relate this to the finding that for none of the assessment types there was a main effect of time, meaning that performance stayed equal over time. It could be argued that a week is too short to detect the effect of PBL on the long-term. The study of Capon and Kuhn (2004), for example, did show an effect

of PBL over time, but their test was administered six weeks after the learning phase. However, since the time on task in this experiment was shorter than a regular lecture or PBL tutorial meeting, the time between tests was adapted to this and kept on a week.

Type of Assessment: Factual Knowledge, Application of Knowledge and Transfer of Knowledge

The second research question focused on the level of knowledge that was assessed. We discriminated between factual knowledge, application of knowledge, and transfer of knowledge. It was expected that differences showed up for type of assessment. Our specific hypotheses stated that participants in the lecture condition outperformed participants in the PBL condition on factual knowledge (hypothesis 2a), however, that it was expected that this was the other way around for application of knowledge (hypothesis 2b), and transfer of knowledge (hypothesis 2c). Results met some of our expectations.

Factual knowledge

It was found that participants in the lecture condition outperformed participants in the PBL condition on factual knowledge, measured by 10 MC questions, confirming hypothesis 2a. This result is in line with findings of for example Capon and Kuhn (2004) in which students in a lecture-based environment performed better when assessment focused on the understanding of concepts (i.e., basic knowledge). Apparently, transmitting information directly from a teacher during a lecture is beneficial for the understanding and reproduction of basic knowledge. Although the mean scores are higher in the lecture condition than in the PBL condition, if the caesura between an insufficient and a sufficient score is put at 6.0, performances on the MC questions in general were sufficient in both conditions. Again, the reliability of the MC test turned out very low. Results on this part of the test should therefore be interpreted with caution.

Application of knowledge

Regarding the assignment that required application of the learned knowledge, participants in the PBL condition scored higher than participants in the lecture condition, supporting our hypothesis. This result is in line with findings of Masek and Yamin (2012), in which PBL students were better in applying their knowledge than students taught by lectures. In the present study, the context of the application assignment was made familiar for all participants during the learning phase. There was equal exposure to the context of the assignment in both conditions (as problem in the PBL condition and as news article on the final slide of the lecture in the lecture condition). Despite the fact that in the lecture condition participants received an explanation of the situation described, it did not help them to reach the same level of performance as participants in the PBL condition. This indicates that the specific processes that occur in PBL, such as

activation of prior knowledge, elaboration, and collaborative discussion, contribute to the application of knowledge (Capon & Kuhn, 2004; Schmidt, 1983). During PBL discussions, students explain and elaborate on the literature collaboratively and they refer to the problem in the reporting phase. Hence, students integrate the described situation of the problem at hand with the knowledge they have acquired. This will help application of knowledge at a later point in time.

It should be noted that in general performance on the application assignment was quite low (a score of about 3 out of 10). Applying knowledge appeared a difficult process for participants. This might be due to the limited amount of time of the experiment. The total time of the experiment took 2.5 hours, which is perhaps too short for novice students to learn sufficiently about a topic in a new area.

Transfer of knowledge

With regards to performance on transfer of knowledge, operationalized by the last assignment, there were no differences between participants in the PBL and lecture condition. This was not in line with our hypothesis, as it was expected that instructions by PBL would result in better transfer of knowledge. It was expected that the processes mentioned before – activation of prior knowledge and elaboration – would be beneficial for transfer as well. Prior studies on PBL's effects on transfer tasks demonstrated higher performances of PBL students compared to students in traditional learning environments (Bergstrom et al., 2016; Pease & Kuhn, 2010; Wirkala & Kuhn, 2011).

There is a possibility that the transfer assignment was too challenging for participants. To transfer knowledge to new situations, although very important, is in general a difficult process for students to master (Norman, 2009; Perkins & Salamon, 1992). For example, in his article, Norman (2009) described that only about 10-30% of the medical students is able to do this. This can be observed in the low mean scores on the transfer assignment (score around 3 out of 10). The short time span of the experiment might also provide an explanation here. Two and a half hours is probably too short for novice students to master the knowledge and be able to transfer this to new situations.

LIMITATIONS

Several limitations of this study have to be mentioned. First, the total time of the experiment was relatively short compared to regular educational practices. For example, the time on the PBL process in this study is shorter than the normal PBL process at the university under study (i.e., 45 minutes for initial and reporting phase vs. two and a half hours for initial and reporting phase for one PBL session in real education). The same applies to the lecture time (i.e., 45 minutes vs. approximately two hours). A shorter time

for a lecture might be more beneficial for participants, because it is easier to keep their attention, while for the PBL session, the shorter time can be more of a disadvantage. A second limitation was that in the PBL condition, participants were not able to select their own literature sources. In the experiment, one text was provided for self-study. Despite the fact that this is in contrast with a realistic PBL setting, providing one text for all participants made sure there was controlled for similar knowledge intake among participants. A third important limitation is the very low reliability of the factual knowledge MC test. The low reliability has to do with the limited number of questions that could be developed about the single subject that was taught to the participants. This makes it difficult to interpret any of the findings regarding the factual knowledge assessment.

CONCLUSION

The present study contributes to existing literature on PBL effect studies in, because of the controlled experimental nature of this study (opposed to effect studies in existing curricula) and the discipline in which it took place (legal education opposed to medical education). The findings of this study show the importance of type of assessment used when investigating the effectiveness of PBL compared to lectures. When testing factual knowledge, lectures seem to be more effective, although the mean performance on this assessment type is sufficient for both instruction types and the reliability of this part of the test was low. However, when students need to apply their knowledge to a realistic situation, PBL instructions seem to be somewhat more beneficial. In this study we have opposed PBL to lectures. Though, as is shown by the results of this study, both methods can be used to support each other and in practice this is often the case. A combination of lecturing for acquiring basic, factual knowledge and PBL for getting deeper understanding and application of knowledge, might be an advantageous way of instructing students.

7

Predicting Law Students' Study Progress in a Problem-based Learning and Traditional, Lecture-Based Environment

This chapter is in preparation as:

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ABSTRACT

Study delay and student dropout are serious concerns in higher education institutes. Both student characteristics and characteristics of the learning environment appear determinative in study success and progress. Problem-based learning (PBL), a student-centered educational approach is believed to stimulate study progress. In the present study, two different learning environments were compared regarding study progress and its predictors. Students enrolled in a traditional, lecture-based university law program were compared to students enrolled in a PBL university law program (i.e., cohort comparison at one faculty) regarding their completion of the three-year Bachelor's program within four years. Results showed no statistically significant differences on study progress between both programs. However, some differences emerged regarding the type of predictors that played a role. In the traditional program, age turned up as a predictor, while in the PBL program gender appeared predictive. Pre-university GPA predicted degree completion regardless of the instructional method used. Additionally, observed learning activities (i.e., a rating of students preparation for and participation in meetings) proved to be the strongest predictor of completing the Bachelor's program within four years in the PBL program. Working in small groups with a tutor who is able to observe study behavior, can help in detecting students who are at risk of failing.

INTRODUCTION

Predicting study success and study progress has received a lot of attention in higher education research, given the high student dropout and study delay in higher educational institutes (Educational Inspectorate, 2009). Knowing which factors relate to study progress could help improving the graduation rates and lowering dropout. In the Netherlands, graduation rates are worrying especially among law students (Educational Inspectorate, 2009). Policymakers in the Netherlands aim to increase the quality of student learning within universities by (1) raising the bar for students (i.e., more strict criteria for continuing the academic program) and by (2) stimulating the implementation of small-scaled, activating educational programs (Ministry of Education, Culture and Science, 2011). The rationale for these changes is that they lead to a higher quality of learning and consequently to better study progress. The Erasmus School of Law endeavored to meet these propositions. To achieve better study success, problem-based learning (PBL), a student-centered instructional method has been implemented within the three-year Bachelor's program at the Erasmus School of Law. Secondly, the number of course credits that first-year students need to obtain in order to continue to the second academic year has been raised.

Student Characteristics as Predictors of Study Success and Progress

In the existing literature on predictors of study success and progress, both demographic and non-demographic student characteristics emerged, which will be outlined below. The majority of these studies are conducted in traditional, lecture-based curricula.

Demographic Student Factors

In general, gender is shown to be an important predictor, as female students obtain more course credits, higher grades, and pass academic years more often during the academic program (Bruinsma & Jansen, 2009; Jansen, 2004; Jansen & Bruinsma, 2005; Richardson, Abraham, & Bond, 2012; Stegers-Jager, Themmen, Cohen-Schotanus, & Steyerberg, 2015; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002). Second, age has an influence on study success. Some studies found that younger students obtain more course credits and pass the academic program more often than older students (Bruinsma & Jansen, 2009; Jansen, 2004; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002), while other studies found the opposite, that older students have better study success (Richardson et al., 2012; Stegers-Jager et al., 2015). Another demographical factor related to study success and progress is ethnicity. In general, it is shown that students of ethnic minorities opposed to students of an ethnic majority obtain less credit points at the end of the academic program (Van den Berg & Hofman, 2005), are

less likely to complete the first year or the entire academic program (Stegers-Jager et al., 2015), and are more likely to dropout (Chen, 2012).

Non-Demographic Student Factors

Academic achievement before entering university, also referred to as pre-university general point average (i.e., GPA) relates positively to study success and progress in terms of obtaining a higher GPA at the end of the first academic year (Jansen & Bruinsma, 2005), earning more course credits (Van der Hulst & Jansen, 2002), and passing the first academic year (Jansen, 2004; Stegers-Jager et al., 2015; Suhre, Jansen, & Torenbeek, 2013). In addition, grades obtained at the beginning of the academic program have shown to be predictors of academic success later in the program, as it relates to obtaining more course credits (Busato, Prins, Elshout, & Hamaker, 2000), and completion of the first year and the entire program (Stegers-Jager et al., 2015). Moreover, a negative relation between obtained grades during the academic program and dropout is shown (Chen, 2012).

Predictors of Study Progress in Different Learning Environments

Besides student characteristics, elements in the learning environment and curriculum seem to play a role in study success as well. In terms of more strict criteria for students, Vermeulen et al. (2012) demonstrated that raising the number of required course credits at the end of the first academic year to the maximum obtainable credits (i.e., 60 credit points instead of 40 credit points), in combination with a reduction of resits and a compensatory model for the examinations, improved study progress (referred to as "Nominal is Normal"; Vermeulen et al., 2012). More students obtained all course credits in the first academic year compared to the prior situation in which the minimum number of required credits was lower (i.e., 40 out of 60 course credits), but which offered for every exam one or more resits, and in which no compensation of insufficient marks was allowed.

Regarding curriculum organizations, several studies found that when less courses are given in parallel, students obtained more course credits and more students passed the first academic year (Jansen, 2004; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002). Further, it is found that more hours spent on lectures in the academic program was associated with less students passing their first year (Jansen, 2004; Schmidt et al., 2010). Moreover, Van den Berg and Hofman (2005) demonstrated that more activating educational formats were related to better study progress in the first academic year. In addition to the implemented changes in assessment system (i.e., requirement of 60 course credits in the first-year, reduction of resits, and compensation possibilities), the Bachelor's program at the Erasmus School of Law underwent changes in line with the above described curriculum organizations as well: Courses were offered serial, the

number of lectures became limited, and the PBL approach was implemented. The PBL approach is described in more detail up next.

Problem-Based Learning

In PBL, students start their learning process by discussing a realistic, complex problem in small groups under the guidance of a tutor (Barrows, 1996; Hmelo-Silver, 2004; Loyens, Kirschner, & Paas, 2012; Schmidt, 1983; Schmidt, Van der Molen, Te Winkel, & Wijnen, 2009b). Students together try to explain the problem, which is often a realistic description of a situation. By doing so, prior knowledge about the topic of the problem is activated. As the problem is the starting point, students end up with questions about the problem's topic. They formulate so called learning issues; i.e., questions about the problem that need further study. These activities happen in the first phase of the PBL process, the initial discussion phase. Afterwards, students individually search for and study relevant literature (e.g., study books, research articles) to answer the formulated learning issues in the second PBL phase, i.e. self-study phase. After self-study, students return to the group and collaboratively address the learning issues, in the final phase, which is called the reporting phase. The tutor is present during the initial discussion and reporting phase and adopts a role as facilitator. This holds that the tutor will not directly provide information with respect to the to-be-learned material, but that he or she stimulates students to elaborate on the material themselves by asking for example in-depth questions (Barrows, 1996; Hmelo-Silver, 2004; Loyens et al., 2012; Schmidt, 1983; Schmidt et al., 2009b).

Several aspects of PBL contribute to the development of knowledge (Hmelo-Silver, 2004; Loyens et al., 2012; Norman & Schmidt, 1992). These aspects are prior knowledge activation in the initial phase, stimulation of elaboration (i.e., connecting existing knowledge to new, to-be-learned knowledge), and learning in a realistic context (i.e., learning with realistic problems that relate to practice; Schmidt, 1983). It could be argued that the activating components of PBL (e.g., stimulation of elaboration) improve academic performance and hence study progress. Previous studies that compared students in a PBL approach to students in traditional, lecture-based curricula regarding study progress showed that PBL students have a shorter study duration and are less likely to dropout (Iputo & Kwizera, 2005; Schmidt, Cohen-Schotanus, & Arends, 2009a). Studying which predictors affect study success and progress is not often conducted in PBL curricula. In the study of De Koning, Loyens, Rikers, Smeets, and Van der Molen (2012) however, this was investigated.

Predictors of Study Success in Problem-Based Learning

In the study of De Koning et al. (2012) it was demonstrated, in line with previous findings (e.g., Bruinsma & Jansen, 2009; Jansen, 2004; Van den Berg & Hofman, 2005; Van

der Hulst & Jansen, 2002), that younger, female students with higher pre-university GPA obtain higher academic achievements later in the program (i.e., higher GPA's and more course credits). Further, obtained GPA in the first year was a strong predictor of study success in the second year. In addition, a specific PBL characteristic, namely observed learning activities, was included as predictor. Observed learning activities is a grade tutors give with regards to students' preparation for and participation during the tutorial meetings. Observed learning activities turned out a strong predictor of study success (De Koning et al., 2012).

To summarize, study success and progress in a PBL curriculum have not been studied often before. The majority of studies on predicting study success and progress are conducted in traditional, lecture-based curricula. However, the organization of the learning environment influences study progress as well. Characteristics of the PBL environment (e.g., activating elements) could positively influence students' study progress. The study of De Koning et al. (2012) on predictors of study success was performed in a PBL curriculum, and a specific characteristic of PBL (i.e., observed learning activities) appeared a strong predictor of study success. However, a direct comparison between study success factors in both a traditional and PBL environment has not been conducted yet. Therefore, in the present study, predictors of study progress are compared between a traditional, lecture-based program and a PBL program. The main aim is to explore possible differences in the factors that contribute to completion of the Bachelor's program. The activating components of PBL could influence several predictors for study success.

The Present Study

In the present study the following research questions were investigated. First, "What is the difference in study progress between students of the traditional and the PBL curriculum?" It was expected that students in the PBL curriculum would have better study progress compared to students of the traditional program, based on findings of previous studies (Iputo & Kwizera, 2005; Schmidt et al., 2009a). Due to prior knowledge activation and the stimulation of elaboration in PBL, construction of knowledge structures is promoted (Schmidt, 1983), which in turn affects study success and progress. The second research question was "Are there differences in predictors of study progress between the traditional and the PBL curriculum?" Several determinants that have shown to predict study progress, such as gender, age, and pre-university GPA (e.g., Bruinsma & Jansen, 2009; De Koning et al., 2012; Richardson et al., 2012; Stegers-Jager et al., 2015) will be included in answering this question. Two student cohorts within the same faculty were compared: Students of the *last* cohort of the traditional program (from now on referred to as traditional cohort) and students of the *first* cohort of the PBL program (from now on referred to as PBL cohort). No specific hypotheses were formulated here, as this comparison was explorative in nature.

In addition to the second research question, the added value of the PBL characteristic, observed learning activities, was investigated as predictor of study progress within PBL. Therefore, besides the first comparison between the traditional and PBL cohort, a second comparison was made. Study progress in PBL was predicted based on the predictors mentioned before (excluding observed learning activities as a predictor). This was compared to a model predicting study progress in PBL with the same predictors and, in addition, the variable observed learning activities was included as a predictor. Based on findings of De Koning et al. (2012), it was expected that observed learning activities would be an important predictor of study success and progress in the PBL program.

METHOD

Learning Environment

The Erasmus School of Law offers three study programs: Dutch law, tax law, and criminology. All three study programs contain a three-year Bachelor's and a one-year Master curriculum. A total of 180 study point credits (i.e., European Credit Transfer System [ECTS], 60 ECs a year) needs to be achieved in the Bachelor's program to enroll in one of the Master programs. The instructional method of the Bachelor's program changed in September 2012. The instructional method before September 2012 was traditional, lecture-based.

In the traditional learning environment, four ten-week periods were offered each academic year. Two or three courses during these periods were given parallel, containing multiple lectures per week. During these lectures professors provided information to a large group of students. This was the core method of instruction in the academic program at that time. Some courses offered a weekly workgroup in which a specific law case was discussed by a teacher. The lectures and the majority of the workgroups were non-mandatory. There were four examination weeks during each academic year in which two or three courses were examined (i.e., parallel assessment). In order to continue from the first to the second academic year, students needed to obtain a minimum of 40 out of 60 course credits during the first year. Course credits could be earned by obtaining a sufficient grade (i.e., 5.5 points out of 10) for a course exam. It was not possible for students to compensate insufficient grades (e.g., compensating a 5.0 with a 7.0 to maintain a mean of 6.0), but students had several opportunities to resit the exams on which they failed.

From September 2012 on, all students who started their first year of the Bachelor's program enrolled in the PBL environment, which contained several differences compared to the former lecture-based program. First of all, the main focus in PBL lies on (mandatory) tutorial meetings that occur twice a week. In these meetings, the initial

phase and reporting phase (of the previous problem) take place under guidance of a tutor. Tutorial meetings last about 2.5 hours. In between meetings, students have two or three days available for self-study, in which they (individually) study relevant literature sources. Second, opposed to the traditional program, the number of lectures is limited in PBL (i.e., approximately two per week). Third, a total of eight courses each academic year are given sequential, lasting five weeks each. During each course, eight problems are discussed and all courses end with a course exam directly after the course, resulting in eight exams each academic year (i.e., sequential assessment). Fourth, next to each course, a practical course is given as well. During these practicals, students develop new academic and professional skills (e.g., practice court in which students plea in front of a lawyer). Fifth, changes were made in the assessment system as well when PBL was implemented. In order to continue from the first to the second academic year, all 60 course credits need to be obtained (Vermeulen et al., 2012). Furthermore, opposed to the former program, students are able to compensate their grades, as long as their mean grade at the end of the year is a 6.0 (on a scale from 0 to 10) or higher (e.g., a 5.0 can be compensated with a 7.0). In contrast, while students could retake the exams multiple times in the old program, the number of retakes is limited (i.e., maximum of 2 out of 8) in the new program. This examination system became known as "Nominal is Normal," indicating that it should be normal for students to complete a first year in the nominally available time of 12 months.

Participants

As mentioned above, students of two cohorts that were taught with different instructional methods (traditional vs. PBL) within one law school were compared. The traditional cohort started the first academic year at one of the three Bachelor's programs (i.e., Dutch law, tax law, criminology) in September 2011 and students were taught in a lecture-based curriculum. The PBL cohort started the first year in September 2012 and hence, these students were taught in the PBL curriculum. Certain conditions were set for students to be included in the analyses. First, only students who enrolled in *one* academic program at the university were included. This left out students who were enrolled in two or more Bachelor's programs at the same time (e.g., Dutch law and criminology, or Dutch law and economics). Second, students who switched to a different academic program, either within the faculty (e.g., from Dutch law to Tax law) or outside the faculty (e.g., from Dutch Law to Psychology), but completed their new Bachelor's program within four years, were excluded from further analyses. Third, only students who had complete data on all predicting variables were included. Fourth, students who enrolled in the traditional cohort (2011) but took the same courses later in the PBL program were excluded from further analyses. After exclusion of all students based on these conditions, the dataset contained data of 772 students for further analyses.

In the traditional cohort, 382 students (38.7% male) were included. Of them, 245 students enrolled in the Dutch law program, 66 in the Tax law program, and 71 in the Criminology program (respectively, 64.1%, 17.3%, and 18.6%). Mean age at the start of the first academic year of these students was 19.36 years (*SD* = 1.59). The majority of these students, 234, belonged to the ethnic majority group (61.3%), whereas 119 (31.2%) belonged to the non-Western ethnic minority group, and 29 students (7.6%) to the non-Dutch, Western ethnic minority group. Regarding pre-university education, 288 students (75.4%) completed university preparatory education (i.e., highest level in secondary education in the Netherlands), 74 students (19.4%) completed the first year of higher vocational education, and 20 students (5.2%) completed another pre-university degree.

In the PBL cohort, 390 students (41.3% male) enrolled in their first year at the Erasmus School of Law in September 2012. The majority of them started the Dutch law program, (244 students), 58 students the tax law and 88 the criminology program (respectively, 62.6%, 14.9%, and 22.6%). Mean age at the start of the first academic year was 19.16 (*SD* = 1.60). Of these students, 251 belonged to the ethnic majority group (64.4%), whereas 110 (28.2%) belonged to the non-Western minority, and 29 students (7.4%) to the non-Dutch, Western minority. With respect to their pre-university education, 294 students (75.4%) completed university preparatory education, 82 students (21.0%) completed the first year of higher vocational education, and 14 students (3.6%) completed another pre-university degree.

There were no significant differences between the PBL and non-PBL cohort regarding gender ($\chi^2(1)= .52$, $p = .472$), ethnicity ($\chi^2(2) = .87$, $p = .648$), pre-university education ($\chi^2(2)= 1.45$, $p = .485$), and age ($t(770) = 1.74$, $p = .083$).

Predicting variables

Information of students was retrieved from the university database. However, in order to secure for students' privacy and anonymity, variables were linked to each other by a data manager. The authors received an anonymous dataset and were not able to trace the identity of students.

Demographic characteristics

Gender, age (at the start of the academic program), and ethnicity were included in the analyses as demographical factors. Ethnicity was distinguished into (1) ethnic majority, (2) Western ethnic minority, or (3) non-Western ethnic minority. Ethnicity was treated as a dummy variable, with ethnic majority as the baseline group. Dummy variable D1 (Western minority = 1, ethnic majority + non-Western minority = 0) holds that students belonged to a Western ethnic minority. Dummy variable D2 (non-Western ethnic minor-

ity = 1, ethnic majority + Western ethnic minority = 0) indicates that students belonged to the non-Western ethnic minority.

The registration of ethnicity was traced from the national registration of students in the Netherlands. An individual is part of an ethnic minority group if at least one parent or the students himself/herself was born outside the Netherlands.

Pre-university education

This represents the latest, completed pre-university education before accessing university. The distinction was made between (1) university preparatory education, (2) completion of first year of higher vocational education, and (3) other pre-university education. Again, dummy variables were created for report of pre-university education, with university preparatory education as baseline group. Dummy variable D1 (higher vocational education = 1, university preparatory education + other pre-university education = 0) holds that students reported completion of higher vocational education as pre-university education. Dummy variable D2 (other = 1, university preparatory education + higher vocational education = 0) holds that students reported other pre-university education.

Pre-university GPA

Students' pre-university GPA is the average grade obtained at the end of pre-university education and is the final mean grade mentioned on the pre-university degree. It is presented as a number between 0 and 100.

Pre-university Dutch GPA

This is the mean grade of the Dutch course tests and the accompanying Dutch exam grade of secondary education. Pre-university Dutch GPA is a grade between 0 and 10.

Course test GPA B1

The mean grade of all obtained grades of course exams in the first academic year was calculated. It should be noticed here that all students who at least earned one grade during the academic year were included and a mean grade of the participated courses was calculated.

Observed learning activities B1

This variable only counts for the students in the PBL cohort. In PBL, the tutor grades students on their learning and professional behavior. This rating is based on (1) students' preparation for the tutorial meetings, (2) students' active involvement and participation during the meetings, and (3) how well they perform in their role of chair (i.e., leading the discussion by structuring it, summarizing the contributions, and making sure all

students participate) and scribe (i.e., taking notes during the meeting; De Koning et al., 2012). The tutor rates several statements belonging to one of these three components. A grade (0 – 10) is calculated for each student during each course. For this study, a mean grade was calculated for students' observed learning activities in all courses of the first academic year.

Dependent variables

Study progress

Study progress was the outcome measure in the analyses. Study progress was a dichotomous variable that was defined by completing the Bachelor's program within four years (yes or no). As the Bachelor's program consists of three years, a small study delay of one year was already taken into account. This definition of study progress is in line with the national definition of study progress in higher educational institutes and was also the definition of study progress used in the report of the Educational Inspectorate (2009).

Statistical Analyses

In order to answer the first research question "What is the difference in study progress between students of the traditional and the PBL curriculum?", a chi-square test was conducted with the variables cohort (traditional vs. PBL) and study progress (completion of Bachelor's program in four years vs. no completion of Bachelor's program in four years).

To answer the second research question, three multivariable logistic regression analyses were conducted. First, the traditional cohort and PBL cohort were compared on the predictors. Therefore, the first regression analysis (model I) was conducted with students of the traditional cohort. Age, gender, ethnicity, pre-university education, pre-university GPA, pre-university Dutch GPA, and GPA of the course tests of the first academic year of the Bachelor's program, were evaluated as predictors. The second analysis (model II) was similar to the first, however this time with students of the PBL cohort.

To further investigate study progress predictors in the PBL cohort, a third regression analysis (model III) was conducted in which the variable observed learning activities was included as predictor. This analysis was compared to the second, in order to identify whether the variable observed learning activities adds in predicting study progress.

RESULTS

Table 7.1 provides the characteristics of all predictors and outcome measure in both student cohorts. No major discrepancies in mean scores were shown between both student cohorts, indicating that both groups were similar. Only the course test GPA of the first

year is striking: It indicates that students in PBL in general obtained about half a grade higher on the course tests compared to the students of the traditional, lecture-based program. This difference is significant ($t(770) = -5.66$, $p < .001$).

Table 7.1. Student characteristics

	Traditional program (cohort 2011) n = 382	PBL program (cohort 2012) n = 390
	n (%) / Mean (*SD*)	n (%) / Mean (*SD*)
Independent variables		
Gender		
Male	148 (38.7%)	161 (41.3%)
Female	234 (61.3%)	229 (58.7%)
Mean age at start program	19.36 (*SD* = 1.59)	19.16 (*SD* = 1.60)
Ethnicity		
Ethnic majority	234 (61.3%)	251 (64.4%)
non-Western ethnic minority	119 (31.2%)	110 (28.2%)
Western ethnic minority	29 (7.6%)	29 (7.4%)
Prior education		
University preparatory education	288 (75.4%)	294 (75.4%)
Higher vocational education	74 (19.4%)	82 (21.0%)
Other	20 (5.2%)	14 (3.6%)
Pre-university GPA (0 - 100)	65.87 (*SD* = 4.22)	65.54 (*SD* = 3.98)
Pre-university Dutch GPA (0 - 10)	6.50 (*SD* = .66)	6.52 (*SD* = .62)
Course test GPA Ba1 (0 - 10)	6.06 (*SD* = 1.20)	6.54 (*SD* = 1.12)
Observed learning activities Ba1 (0 - 10)	-	7.28 (*SD* = .58)
Dependent variable		
Passed Bachelor's study program in four years		
Not passed	151 (39.5%)	132 (33.8%)
Passed	231 (60.5%)	258 (66.2%)

Study Progress in Traditional vs. PBL cohort

In order to answer the first research question, "What is the difference in study progress between students of the traditional and the PBL curriculum?" a chi-square test was conducted. As shown in Table 1, the percentage of students passing their Bachelor's degree in four years was higher among PBL students than the students of the traditional progam, respectively 66.2% and 60.5%. Although this difference is in the expected direction, it was not statistically significant, $\chi^2(1) = 2.68$, $p = .101$, and our first hypothesis was not supported.

Predictors of Study Progress in Traditional vs. PBL cohort

To answer the second research question, "Are there differences in predictors of study progress between the traditional and the PBL curriculum?" multivariate logistic regressions were conducted. Before conducting the analyses, assumptions were checked in both cohorts. The assumption of linearity of the logit for two predictors, "course test GPA Ba1" and "pre-university Dutch GPA", was violated in the PBL cohort. Therefore, these predictors were excluded from the analyses in model II and III. As a consequence, we decided to leave these two predictors out in the first analysis with the traditional cohort as well, in order to make a good comparison between both educational programs. Results of the multivariable logistic regression analyses with predictors of study progress are shown in Table 7.2.

Traditional program

Younger age (odds ratio (OR) .84, 95% confidence interval [CI] .711 - .995; $p = 0.044$) and having a higher pre-university GPA (OR 1.17, 95%CI 1.09 – 1.25, $p < .001$) were identified as significant predictors for study progress in the traditional cohort, after controlling for gender, ethnicity, and pre-university education. These two predictors explain between 12-17% of the variance of study progress.

PBL program

In the PBL cohort, female gender (OR 1.60, 95%CI 1.01 – 2.53; $p = 0.046$) and having a higher pre-university GPA (OR 1.16, 95%CI 1.08 – 1.23, $p < .001$) were identified as significant predictors for study progress after adjustment for age, ethnicity, and pre-university education. These two predictors explain between 10-13 % of the variance of study progress in the Bachelor's program.

The influence of observed learning activities in PBL was assessed by conducting a third multivariable logistic regression analysis that included this variable. Hence it could be compared to the former analysis with the PBL cohort that left this variable out. In the new regression model, female gender (OR 1.72, 95%CI 1.04 – 2.85; $p = 0.031$) and high pre-university GPA (OR 1.08, 95%CI 1.01 – 1.16, $p = .031$) were still predictors of study progress, and observed learning activities had a statistically significant influence as well (OR 7.98, 95%CI 4.42 – 14.42, $p < .001$). This indicates that the variable observed learning activities has additional predictive value to the other variables. This confirms our hypothesis regarding the additional value of this variable in a PBL program. These three predictors together explain 24 to 33% of the variance of study progress, which show a large increase in explained variance compared to both previous models.

Table 7.2. Predictors of study progress in a traditional, lecture-based program and PBL program.

	Model I[c]			**Model II[d]**			**Model III[e]**		
	Traditional program (cohort 2011)			PBL program (cohort 2012)			PBL program (cohort 2012)		
	Completion Bachelor's degree in four years			Completion Bachelor's degree in four years			Completion Bachelor's degree in four years		
Characteristic	**β (SE)**	**Odds ratio (95% CI)**	***p*-value**	**β (SE)**	**Odds ratio (95% CI)**	***p*-value**	**β (SE)**	**Odds ratio (95% CI)**	***p*-value**
Female gender	-.343 (.238)	1.409 (.884 – 2.246)	.149	.469 (.235)	1.598 (1.008 – 2.533)	**.046**	.544 (.036)	1.723 (1.040 – 2.854)	**.031**
Age (in years)	-.173 (.086)	.842 (.711 – .995)	**.044**	.145 (.033)	.919 (.784 – .1078)	.301	-.175 (.090)	.839 (.703 – 1.002)	.052
Ethnicity[a]									
Western ethnic minority	-.230 (.424)	.795 (.346 – 1.826)	.589	-.559 (.434)	.572 (.244 – 1.340)	.198	-.382 (.480)	.682 (.266 – 1.748)	.426
Non-Western ethnic minority	-.475 (2.52)	.622 (.380 – 1.019)	.060	-.334 (.258)	.716 (.432 – 1.188)	.196	-.184 (.282)	.832 (.478 – 1.447)	.514
Pre-university education[b]									
Higher vocational education	-.303 (306)	.738 (.406 – 1.344)	.321	-.465 (.292)	.628 (.354 – 1.114)	.112	-.257 (.328)	.773 (.406 – 1.471)	.433
Other	.867 (.580)	2.381 (.764 – 7.417)	.135	.858 (.769)	2.358 (.522 – 10.642)	.265	.846 (.800)	2.330 (.486 – 1.471)	.290
Pre-university GPA	.154 (.033)	1.166 (1.093 – 1.245)	**< .001**	.145 (.033)	1.156 (1.083 – 1.234)	**< .001**	.078 (.036)	1.081 (1.007 – 1.160)	**.031**
Observed learning activities B1	-	-	-	-	-	-	2.077 (.302)	7.981 (4.419 – 14.415)	**< .001**

[a]Compared to ethnic majority

[b]Compared to university preparatory education

[c]R^2 = .126 (Cox & Snell), .171 (Nagelkerke); model $\chi^2(7) = 51.599$; $p < .001$

[d]R^2 = .097 (Cox & Snell), .134 (Nagelkerke); model $\chi^2(7) = 39.708$; $p < .001$

[e]R^2 = .237 (Cox & Snell), .329 (Nagelkerke); model $\chi^2(8) = 105.618$; $p < .001$

GPA = General point average

DISCUSSION

In the present study differences in and predictors of study progress were investigated within a traditional learning environment and a PBL environment at the Erasmus School of Law. A cohort comparison was made between students who entered the Erasmus School of Law in 2011 in a traditional, lecture-based program, and students who enrolled at the Erasmus School of Law in 2012 in a PBL program. Several student characteristics (i.e., demographic and non-demographic) were included in order to predict completion of the Bachelor's program within four years. The first research aim focused on whether there was a *difference* between both student cohorts in study progress. The second research aim focused on *which* specific factors contributed to study progress in both educational methods.

Study Progress in Traditional vs. PBL Cohort

The first research question was directed at a difference in study progress (i.e., graduation rate of the three-year Bachelor's program in four years) between students in the traditional and PBL program. The percentage of students who completed the Bachelor's program within four years is higher among PBL students compared to their non-PBL counterparts, respectively 66.2% and 60.5%. However, although it is in the expected direction, this difference is not statistically significant and therefore, our first hypothesis, that PBL students have higher graduation rates, based on previous finding in literature (Iputo & Kwizera, 2005; Schmidt et al., 2009a) is not supported. Still, even though the difference is non-significant, the gain in graduation of about 5% should not be underestimated. The absolute number of students who graduated the three-year Bachelor's program within four years increased after the implementation of multiple changes at the Erasmus School of Law. Although not statistically significant, we consider this increase as "educationally" relevant.

A possible explanation for the non-significance of our finding lies in the first implementation and the novelty of the PBL program. When applied for the first time in an educational environment that was used to the traditional lecture based approach, some issues might arise regarding PBL processes. Examples of these issues are tutors who provide students with too much information and lack of active involvement of students (Dolmans, Wolfhagen, Van der Vleuten, & Wijnen, 2001; Dolmans, De Grave, Wolfhagen, & Van der Vleuten, 2005). Previous research at the faculty under study indicated that despite positive changes (e.g., more active participation of students), there is still room for improvement of the PBL program (Wijnen, Loyens, Smeets, Kroeze, & Van der Molen, 2017). The complications that showed up could have influenced the processes in PBL (e.g., insufficient group discussions) and hence the effectivity of PBL.

A striking finding was that the course test GPA of the first academic year was significantly higher among the PBL students. This indicates that, although it is not reflected in significantly improved graduation rates, academic achievement is better in the new implemented program. A possible explanation here is that students in the former educational program *need* four years to graduate, but that the students in the PBL program *take* four years to graduate. The PBL students might either use the extra time to put more effort in their study, which results in higher grades. Or they use the extra time to take part in extracurricular activities like internships or the board of a society. Because these activities take time as well, this could lead to the same graduation rates of students in the former, more traditional program. In sum, factors on the account of both organization as students might explain why there is no significant increase in graduation rates after the implementations. However, improvements are shown in terms of an increase of about 5% of graduated students and a higher GPA of the first year course tests among the PBL students.

Predictors of Study Progress in Traditional vs. PBL Cohort

The second research question focused on *which* factors predicted study progress in the traditional and PBL method, and what the similarities and differences were between both methods when predictors are concerned. Results indicated that GPA of one's pre-university education is a strong influence in both instructional methods. Previous studies on study success in traditional programs (Jansen, 2004; Jansen & Bruinsma, 2005; Suhre et al., 2013; Stegers-Jager et al., 2015, Van der Hulst & Jansen, 2002) and in PBL (De Koning et al., 2012) have found similar results. When students obtain high grades during their pre-university education, they are able to complete the Bachelor's program more timely. Interestingly, the type of pre-university education is not of influence on study progress, but *how* students performed during pre-university education does matter.

Predictors in Traditional Cohort

Some differences between predictors showed up between both cohorts. In the traditional program, age turned out to be a predictor for study progress. Younger students pass the Bachelor's program more often within four years than older students. Previous studies have found similar results (Bruinsma & Jansen, 2009; Jansen, 2004; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002). A possible explanation here is that older students have had a study delay in their previous education, like doing a class two times in pre-university education. This could indicate that these students have more difficulties with studying or are less motivated.

Another interesting predictor in the traditional cohort was ethnicity, in which a trend was visible in the first regression model. Even though not statistically significant, students with an ethnic majority seem to pass the Bachelor's program more often in time

than students of the non-Western ethnic minority group in the traditional, lecture-based program. This is in line with findings of previous literature that investigated ethnicity in relation to study success and progress (Chen, 2012; Stegers-Jager et al., 2015; Van den Berg & Hofman, 2005). An explanation is that students of ethnic minorities feel in general less at home at the institution, which can cause dropping out of the program (Meeuwisse, Severiens, & Born, 2010). This explanation can be traced back to the model of Tinto (1975), which stresses integration (i.e., formal and informal contact with peers and staff) for persistence in the academic program. Absence of these feelings of connection might especially be stronger in a traditional, lecture-based program. A large-scale environment like this creates a sense of anonymity among students. Still, it should be mentioned that only a trend, and not a statistical difference, was identified with regards to ethnicity, so these assumptions should be interpreted with caution.

Predictors in PBL Cohort

In the PBL program gender turned up as a predictor of study progress, next to the strong influence of pre-university GPA. Female students more often pass the Bachelor's program in time than male students in the PBL program. Better study success and progress by female students is found in the majority of existing studies (Bruinsma & Jansen, 2009; Jansen, 2004; Jansen & Bruinsma, 2005; Stegers et al., 2015; Van den Berg & Hofman, 2005; Van der Hulst & Jansen, 2002). A general explanation for the finding of better study progress by female students is that they have more work discipline and better time-management skills (Jansen, 2004; Van der Hulst & Jansen, 2004). If this is the case, it is possible that female students benefit more from the PBL system and the additional changes of "Nominal is Normal" than male students do. Time-management is a useful and necessary skill of students in PBL. Students need to be prepared for each tutorial meeting, which requires that they are able to plan their study time efficiently. If students experience difficulties with time-management, they might experience difficulties in the PBL system, making that they drop out of the program or have a study delay. Moreover, time-management is desirable when students are required to obtain all course credits in the first academic year. Again, if students have difficulties with time-management, it is likely that they are not able to obtain all course credits during the first year, making them drop-out of the program. Still, only assumptions can be made here, so further research is necessary to explain the gender differences.

As discussed before, in the traditional program, a trend was shown regarding ethnicity in such a way that students of an ethnic majority have better study progress than students of a non-Western minority. This trend, however, disappeared in the PBL program, as the second and third regression analyses show. If feeling connected to and feeling at home at the university institute is indeed the reason that students of a non-Western ethnic minority have worse study progress in the traditional program, it is likely that this is

changed in the PBL program. In a PBL environment, students could feel more integrated due to the small-scaled group meetings twice a week. Evidence for this assumption can be found in the study of Severiens, Meeuwisse, and Born (2015). In that study a student-centered environment was compared to a lecture-based environment and it was found that students in the student-centered environment reported to feel more at home at the institute. Again, this could be of greater influence for students of ethnic minorities, as these students feel less at home at institutes (Meeuwisse et al., 2010) and more isolated in a large-scale learning environment (Van den Berg & Hofman, 2005).

An important finding in the PBL cohort regarding predictors of study progress was the added value of observed learning activities as predictor. After adding this predictor, it turned out that it was the strongest predictor of passing the Bachelor's program in time. Observed learning activities appeared also a strong predictor for academic achievement in the first and second academic year of psychology in the study of De Koning et al. (2012). Further, the study of Loyens, Rikers, and Schmidt (2007) found that observed learning activities had a large effect on academic achievements in a first-year PBL curriculum, and was negatively related to drop-out. The present study shows that observed learning activities is even predictive for passing or failing the whole Bachelor's program, not just academic achievements during the program. Ratings of observed learning activities are based on several student activities that tutors detect. Examples are active involvement during discussion, application of deep processing (e.g., connecting concepts), and being able to see the bigger picture of the learning material. Findings here indicate that the more students show these types of study activities, the better they proceed in the academic program.

Practical Implications

As stated in the Introduction, study progress should be improved within higher educational institutes, due to disappointing graduation rates (Educational Inspectorate, 2009). Some improvements after the implementation of PBL are shown in the present study in terms of a small (non-significant) increase in graduation rates and higher academic achievement in the first year. However, the findings of the present study also provide some practical implications to achieve even better study progress. First of all, study progress seems to be strongly predicted by pre-university GPA. Students who enter university with a low pre-university GPA should therefore be closely monitored from the beginning and could be offered extra guidance throughout the academic program. This could help them to sufficiently study and could lead to better study results.

The same implication accounts for observed learning activities in PBL. Students with low scores on observed learning activities could be monitored in the first academic year and provided with additional guidance on how to study more effectively and efficiently. Moreover, the predictive value of observed learning activities shows the benefits of a

small-scaled learning environment like PBL. The small group meetings, in which a tutor is close to students, offers the opportunity to observe how students learn. This is more difficult to accomplish in a large-scale, traditional educational environment.

LIMITATIONS

The present study yields some limitations worthwhile mentioning. First of all, only two cohorts of the Erasmus School of Law were included in the analyses, the last cohort of the traditional program and the first cohort of the new, PBL program. As mentioned earlier, a first year of an educational reform might go hand in hand with some "children's diseases". To get a clearer image of study progress in the PBL program, more cohorts of students who started after September 2012 at the Erasmus School of Law should be included. A second limitation is that only a select pair of predictors was taken into account. Other student characteristics, like motivation, personality, and ability could be predictors for study success and progress as well. However, the focus of the present study lied on exploring differences in predictors of study progress in a traditional and PBL program. Future research should replicate the present study and add other variables as well.

CONCLUSIONS

The present study shows some improvements after the implementation of PBL at the Erasmus School of Law. Although not significant, graduation rates of the three-year Bachelor's program in four years improved with about 5%, and higher academic achievements in the first year were obtained by PBL students. Still, room for improvement is left to increase study progress more. Pre-university GPA appeared an important factor for predicting study progress, despite the educational method used. However, in the PBL program, an important additional predictor was observed learning activities by the tutor. These observations could and should be used more, in order to monitor students and offer them additional guidance which eventually would lead to improved study progress.

8

Summary and Discussion

Within this dissertation, several studies with regards to the influence of problem-based learning (PBL) within law studies are described. PBL is a student-centered educational approach in which students work in small groups under guidance of a tutor on realistic, ill-defined problems. The PBL process starts with the initial discussion phase. Students discuss a problem (i.e., description of a situation that could happen in real-life) and hence activate their prior knowledge on the topic of the problem. They try to explain the described situation, but end up with questions regarding the problem at hand, since their prior knowledge is insufficient to fully grasp all aspects of the problem. This leads to the formulation of so called learning issues that ends the initial discussion phase. Then students have a few days of self-study (i.e., the second phase of PBL), in which they select and study different literature sources to answer the learning issues. Afterwards, students return to the group for the final reporting phase. Together, the studied literature is discussed and a coherent and complete answer to the learning issues is constructed. The tutor is present during the initial discussion and reporting phase. He/she adopts a role as facilitator. For example, in-depth questions are asked to students, rather than providing direct information (Barrows, 1996; Hmelo-Silver, 2004; Loyens, Paas, & Kirschner, 2012). PBL was developed with several goals in mind (Hmelo-Silver, 2004; Loyens et al., 2012; Norman & Schmidt, 1992): (1) the development of a flexible and extensive knowledge base, (2) acquisition of effective collaboration skills, and (3) problem-solving skills, (4) making students intrinsically motivated, and (5) helping students to become self-directed learners.

The PBL approach has been implemented in several (higher) educational institutes all over the world. PBL's origin lies in medical education and even though it has been applied to other disciplines as well (e.g., social sciences, engineering; Barrows, 1996; Hmelo-Silver, 2004; Loyens et al., 2012), the majority of the PBL research is conducted in medical education. In this dissertation, the influence of PBL is addressed in the area of legal education, a discipline that has not yet received a lot of attention in PBL studies.

The Erasmus School of Law of the Erasmus University Rotterdam implemented PBL as educational approach in the three-year Bachelor's curriculum. The implementation started in September 2012 for the three academic programs within the Erasmus School of Law: Dutch law, tax law, and criminology. Before the educational reform, the Bachelor's curriculum was more traditional in nature with lectures as core instruction. Besides the implementation of PBL, other changes in the organization of the curriculum and assessment system were made as well. Regarding the curriculum organization, courses were offered sequential instead of parallel after the implementation of PBL. With regards to the assessment system, the approach known as "Nominal is Normal" was applied (Vermeulen et al., 2012). Students need to obtain all 60 course credits in the first year, in order to continue to the second year. Two other important characteristics of "Nominal is Normal" are a reduction of the number of resits of examinations and that compensa-

tion of low, insufficient marks with higher sufficient marks is allowed. The aim of the implementation of PBL and the changes in curriculum organization and assessment system was twofold: (1) Improving the quality of student learning and (2) improving study progress in terms of better graduation rates (i.e., higher number of students that graduate from the Bachelor's program within four years). Graduation rates were rather low in the years before.

The research aims of this dissertation are in line with the aims of the implementation of PBL within the Erasmus School of Law and with the theoretical fundamentals of PBL. The first research aim focused on investigating PBL's influence on study *processes* and the second research aim on investigating the influence of PBL on study *outcomes*. In total, six studies are conducted. One study describes the experiences of the implementation. The other five studies answer the questions what the influence of PBL is on study processes (three studies) and study outcomes (two studies) within the Erasmus School of Law.

MAIN FINDINGS

An extended description of the implementation of PBL at the Erasmus School of Law was given in **Chapter 2**. An overview of all changes that took place at the department (e.g., tutor training of the Seven-Jump method which is characteristic for PBL, training for teachers on how to develop their courses) was given. In addition, students' and teachers' experiences with PBL were questioned. These results gave an indication of whether the implementation of PBL had been successful in terms of the perceptions of the stakeholders. The quality of implementation is important, as it can affect the processes in PBL, and in turn student performance (Dolmans, De Grave, Wolfhagen, & Van der Vleuten, 2005; Dolmans, Wolfhagen, Van der Vleuten, & Wijnen, 2001).

Questionnaire results showed that students felt PBL helped them to study on a regular basis, and that PBL stimulated them to be actively involved in the learning process. The required preparations for the tutorial meetings might contribute to this. However, students also made some critical remarks regarding PBL. The reporting phase (i.e., discussion about studied literature) was sometimes experienced as not useful because the studied literature was simply summed up. Teachers reported that PBL students were more actively involved and studied on a more regular basis compared to students in the former, lecture-based program. Furthermore, teachers indicated that within the faculty, employees are dissatisfied with the PBL program. Dissatisfaction of teachers could be due to changing their teaching style (i.e., from a more directive role to a facilitating role), which is challenging for them (Ertmer & Simons, 2006; Kaufman & Holmes, 1996) and may have led to dissatisfaction.

PBL and Motivation

Motivation was the topic of **Chapter 3**. The well-known Self-Determination Theory (SDT; Ryan & Deci, 2000) on motivation, was used as the theoretical background in two studies (Study 1 and 2) conducted in Chapter 3. SDT states that satisfaction of three needs (i.e., need for feelings of autonomy, need for feelings of competence, and need for feelings of relatedness) leads to more intrinsically motivated students. This motivation type is positively related to academic achievement (e.g., Taylor et al., 2014). Opposite of autonomous motivation is controlled motivation (i.e., avoiding feelings of shame or motivation due to external factors; Ryan & Deci, 2000), which is negatively related to academic achievement.

In Study 1, it was investigated whether the learning environment (traditional vs. PBL) satisfied the three needs of SDT, and the two types of motivation, autonomous and controlled motivation. A cohort comparison was made between third-year Dutch law students in the former, lecture-based Bachelor's program at the Erasmus School of Law and third-year Dutch law students in the PBL Bachelor's program. It was expected that students in PBL would experience more feelings of autonomy, competence, and relatedness. In addition, it was expected that PBL students would be more autonomously motivated and would experience less controlled motivation. Contrary to the expectations, no differences were found between the PBL students and students of the traditional, lecture-based program on autonomous motivation and controlled motivation, nor on feelings of autonomy and competence. PBL students did score higher on feelings of relatedness than students from the traditional learning environment.

To find an explanation for these mainly unexpected results, focus groups with PBL students were conducted in Study 2. In the focus group discussions, PBL students indicated the presence of some autonomy-supportive elements in PBL, such as choice in literature sources and room for own discussions in the tutorial meetings. However, they also identified some controlling elements, such as mandatory presence, and lack of choice in courses. The presence of both controlling and autonomy-supportive elements can provide an explanation for the lack of differences in autonomy feelings between both student cohorts. It is likely that in the lecture-based program, also both autonomy-supportive and controlling elements were present. Further, students in the focus groups reported feeling competent because of some PBL specific elements, like realistic problems, but also because of non-specific PBL elements, like obtained grades during the academic program. Feeling competent because of sufficient grades can also play a role in a lecture-based curriculum, and this could therefore explain why no differences emerged between both student cohorts. Finally, PBL students indicated that working in small groups contributed to feelings of relatedness. Students got to know their peers well in the tutorial meetings. Moreover, students felt the tutor was approachable in PBL. In sum, the results of the focus groups indicated that not all three needs were fulfilled

in PBL and that could explain why PBL students are not more autonomously motivated than students from the traditional learning environment.

PBL and Learning Strategies

Students' learning strategies constitute an other important part of their study processes. Therefore, learning strategies were the second topic of study. Some learning strategies, like deep processing and self-regulation, are found to be positively related to academic performance (Boyle, Duffy, & Dunleavy, 2003; Richardson, Abraham, & Bond, 2012). Similar to Chapter 3, a cohort comparison between third-year Dutch law students of the lecture-based Bachelor's program and third-year Dutch law students in the PBL program at the Erasmus School of Law was made. This study was reported in **Chapter 4**. Research on how students learn in the three-year PBL program was investigated in **Chapter 5**, in which the focus was on the development of learning strategies, the relationship with academic achievement, and the relation with assessment.

A distinction among learning strategies was made based on Vermunt's (1998) distinction. Processing strategies are thinking strategies that students use to process learning material, consisting of three types i.e., deep processing, stepwise processing, and concrete processing. Within regulatory strategies, also three types are distinguished, i.e., self-regulation, external regulation, and lack of regulation. Based on previous studies (Lycke, Grøttum, & Strømsø, 2006; Mattick & Knight, 2007; Schmidt, Dauphinee, & Patel, 1987; Van der Veken, Valcke, Muijtjens, De Measeneer, & Derese, 2008) it was expected that the PBL environment would stimulate the use of deep processing better than the traditional learning environment. In PBL, prior knowledge is activated, which stimulates the process of elaboration. During self-study and the discussion in the reporting phase, students need to connect the existing knowledge to the newly learned knowledge. Furthermore, it was expected that self-regulation would be stimulated more in PBL than in the traditional cohort (English & Katsintas, 2013), because of the selection of one's own literature, careful planning of self-study time for tutorial group preparation, and the evaluation after the reporting phase in which students can indicate whether they feel they have studied enough.

Results of Chapter 4 revealed that PBL students reported more use of deep processing, more self-regulation, and more external regulation than the students in the traditional cohort. Effect sizes were, however, small. No differences between PBL students and students of the traditional, lecture-based program were found on stepwise processing, concrete processing, and lack of regulation. Results were partly in line with the expectations. It is assumed that the PBL environment stimulates the way students learn to a certain extent, and that students are better able to process material at a deeper level because they need to make connections between concepts and with the problem used in the initial discussion. In addition, higher scores on self-regulation are explained by the PBL processes that make sure students take their own responsibility in PBL. Results

further showed that external regulation turned out high among PBL students. Considering the external factors in PBL, this outcome is not really surprising. The tutor, fellow students in the tutorial group, and the required preparation for every tutorial meeting are elements in PBL on which students could depend their learning behavior.

In Chapter 5, another study on students' learning strategies within PBL was conducted with a focus on (1) the development of learning strategies, (2) the relationship between learning strategies and academic achievement, and (3) the level of knowledge tested in exams at the curriculum under study. Type of assessment was evaluated to shed light on the findings regarding the development of learning strategies. With respect to development, it was hypothesized that over the course of three years in PBL, deep processing, concrete processing, and self-regulation would increase. Moreover, it was expected that stepwise processing, external regulation, and lack of regulation would decrease over time. Regarding the relationship with academic achievement, deep processing and self-regulation were expected to positively relate to performance (e.g., Boyle, Duffy, & Dunleavy, 2003; Richardson et al., 2012), while stepwise processing was expected to be negatively related to academic performance (i.e., Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001) as well as lack of regulation (Lindblom-Ylänne & Lonka, 1999; Vermunt, 2005).

Results of Chapter 5 on the development of learning strategies over the three-year PBL Bachelor's program showed that deep processing stayed stable over time. Stepwise processing increased and then decreased towards the end of the program. Explanations for these findings will be discussed below in combination with type of assessment. Concrete processing increased over the years. This was expected, because PBL students work in a realistic context, making application of knowledge easier to accomplish (Schmidt, 1983). The results for both self-regulation and external regulation showed a puzzling pattern: a decrease in the first year, then an increase in the second year, and finally a small drop towards the end of the Bachelor's program. Although this specific pattern is hard to explain, it shows that there is no steady increase of self-regulation or decrease of external regulation over time, as was expected. Presence of external factors in PBL could serve as an explanation here (e.g., a tutor who provides too much information during meetings). Furthermore, lack of regulation declined over time. This is in line with results of previous studies (Donche et al., 2010; Donche & Van Petegem, 2009; Vermetten et al., 1999), which indicates that gaining experience with studying helps to manage the learning process better.

For the relationship between learning strategies and academic performance, only lack of regulation (i.e., difficulty with regulation of learning in general) was statistically significantly related to academic achievement. This relationship was, as expected, negative. Experiencing difficulties in regulation of learning was associated with lower academic achievement. Correlations between achievement and other strategies like deep processing

and self-regulation did not emerge. This suggests that for earning sufficient grades, other student qualities are needed as well. Still, development of these strategies is important for life after university, as students continuously need to be able to develop themselves.

The exams in the PBL program were evaluated on their required level of knowledge processing. Questions that focus on factual knowledge reproduction require a different kind of knowledge processing compared to questions that emphasize the application of knowledge. The analysis of exams demonstrated that the number of exam questions that focused on factual knowledge (i.e., simple knowledge processing) was high. Especially in the first academic year, but also in the third year, still about one third of the exam questions focused on basic, factual knowledge. Exam questions regarding application are highly underrepresented in all three years (although more present in the third year). This exam analysis might offer an explanation for some of the findings on the development of learning strategies. Students apply strategies necessary for obtaining a sufficient grade (Newble & Entwistle, 1986). With a strong focus on factual knowledge questions in exams, it is not surprising that students apply stepwise processing often, even in the final year of the Bachelors' program.

Knowledge Acquisition, Retention, and Application

Ideally in education, students acquire new knowledge, create a deep understanding and are able to apply knowledge in different situations (i.e., transfer). Moreover, students should be able to retain knowledge over time, both during the academic program as well as afterwards. In **Chapter 6**, the focus was on both of these issues: influences of PBL on knowledge acquisition and retention, and the type of assessment. An experimental study was conducted in which students were randomly assigned to a PBL condition or a lecture condition. They learned about Dutch criminal law (the topic was self-defense and unreasonable use of self-defense) and were tested immediately after the learning phase (i.e., knowledge acquisition) and one week later (i.e., knowledge retention). The test contained three types of assessment: factual knowledge, application of knowledge, and transfer of knowledge. It was expected that in PBL, knowledge retention would be better because of the process of elaboration in PBL (i.e., prior knowledge is activated that helps connecting existing knowledge to newly learned knowledge and helps in knowledge retention; Dochy, Segers, Van de Bossche, & Gijbels, 2003; Schmidt, 1983). Regarding type of assessment, it was expected that in the lecture condition, performance on factual knowledge questions would be better (e.g., Albanese & Mitchell, 1993).On the other hand, application and transfer of knowledge were expected to be better among PBL students, due to working with realistic problems and the stimulation of deep processing (Gijbels, Dochy, Van den Bossche, & Segers, 2005).

Results in Chapter 6 showed no effects of time on any of the assessment types. A possible explanation could be the short time between immediate and delayed test (i.e.,

one week). Performance on factual knowledge was sufficient in both conditions (i.e., 6 or 7 out of 10), but significantly higher for participants in the lecture-based condition, in line with our expectations. Performance on the application assignment was insufficient in both groups, but was significantly better in the PBL condition, also in line with our expectations. Apparently, providing direct information in a lecture aids in acquiring factual basic knowledge, but the processes in PBL are more helpful when students need to apply knowledge. No differences were found regarding transfer of knowledge. An explanation here lies in the difficulty of transfer in general (Norman, 2009). Especially in a short-time experiment as the one presented in Chapter 6, it might be too difficult for students to master the material sufficiently to transfer it at a later point in time.

PBL and Study Progress

In higher education institutes in the Netherlands, the number of students graduating a Bachelor's program without a delay used to be quite low (Educational Inspectorate, 2009). Although graduation rates showed an increase since the report of Educational Inspectorate in 2009 (Educational Inspectorate, 2017), there is still room for improvement. Both students and universities would benefit from better study progress. **Chapter 7** contains a study that focusses on study progress. The curriculum organization (e.g., contact hours, room for self-study) and the assessment system play a role in improvement of study progress (e.g., Jansen, 2004; Schmidt et al., 2010; Vermeulen et al., 2012). The Erasmus School of Law aimed to improve study success and progress of the students. Several studies showed that in PBL less study delay is present and more students earn their degree compared to students of more traditional programs (Iputo & Kwizera, 2005; Schmidt, Cohen-Schotanus, & Arends, 2009a).

A lot of research has been conducted regarding factors that contribute to study success and progress and the factors that determine study success and progress. However, the majority of these studies were conducted in traditional curricula (e.g., Bruinsma & Jansen, 2009). The study of De Koning, Loyens, Rikers, Smeets, and Van der Molen (2012) is an exception and the authors investigated study success in an existing PBL curriculum. A specific PBL characteristic appeared to a strong predictor, namely observed learning activities. The tutor in PBL observes students' behavior and rate the behavior on certain criteria. For example, whether the students keep to the agreements (e.g., arrive on time), whether students are well prepared and actively involved in the discussion. At the end of the course, the tutors gives a grade on a ten-points scale for each students in the group.

This chapter makes a direct comparison between a PBL and lecture-based curriculum on study progress and its predictors. It was expected that study progress in terms of completing the Bachelor's program within four years, would be higher after the implementation of PBL at the Erasmus School of Law. Moreover, differences in which predictors play an important role in study progress in both learning environments were explored.

Results showed that the PBL program did not significantly differ in the percentage of students that completed the Bachelor's program within four years. In other words, study progress did not change after the implementation of PBL. It was further shown some factors were predictive in both learning environments, but also that some factors were specific predictors in either the traditional or the PBL environment. Pre-university GPA strongly predicts study progress in general, regardless of the instructional method used. In both environments, a positive relation between pre-university GPA and graduation in four years was shown. In the traditional cohort, age was an additional predictor: the younger students were, the better their study progress. In the PBL cohort, gender was the strongest predictor: female students had better study progress than male students. When the variable observed learning activities was added as a predictor in the PBL cohort, it turned out to be the strongest predictor of completing the Bachelor's program. The higher tutors graded the students on the quality of preparation for and active participation during the meetings, the more likely it was that students graduated within four years.

The main findings of the studies presented in this dissertation are presented in Figure 8.1. This figure contains the influence of PBL on both study processes and study outcomes.

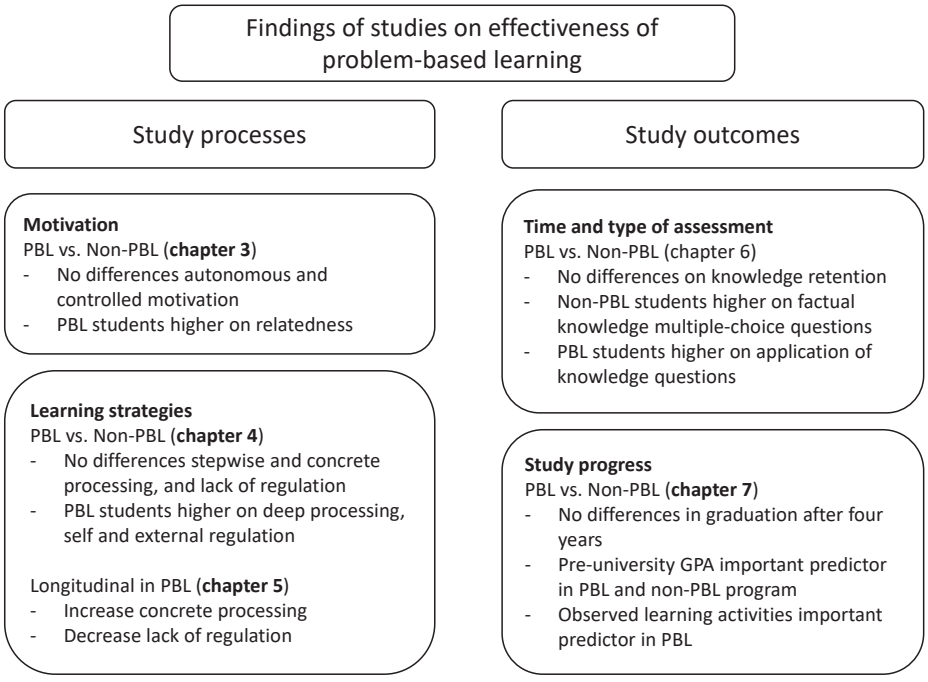


Figure 8.1. Overview of the main findings of the influence of problem-based learning on study process and outcomes.

MAIN DISCUSSION

Study processes and study outcomes in PBL were at the heart of the two research aims in the present dissertation. These two are closely related, as the factors regarding study processes – motivation and learning strategies – impact study outcomes (e.g., Richardson et al., 2012). Both positive effects as unexpected findings of PBL appeared in the current studies. First, the positive findings are discussed, followed by the unexpected findings.

With regards to study processes, an increase of concrete processing over time in the three-year PBL Bachelor program (Chapter 5). Concrete processing means that students are able to relate the learned material to practice and real-life situations (Vermunt, 1998). Somewhat in line with this finding were the results of Chapter 6, in which PBL participants outperformed the lecture condition on the application of knowledge. It could be argued that PBL stimulates knowledge application, because students work with authentic, ill-defined problems (Schmidt, 1983). These problems relate to real-life situations that students can encounter later in their professional life. PBL claims that when students learn in a realistic context during their academic program, they will be better able to relate and apply the knowledge in a similar situation (Schmidt, 1983). In the experiment of Chapter 6, the tutor referred in the reporting phase to the problem at hand, assuring students would relate the learned knowledge to the situation. Moreover, in the focus group discussions (Chapter 3) students indicated they enjoyed working with the problems in PBL, because the problem makes the learned knowledge more concrete.

A second positive result was that PBL students seem to be more self-regulated than students in the traditional cohort. So, they were better able to control the learning process. Chapter 4 demonstrated a small influence of PBL on students' reported use of self-regulation compared to students in the traditional program. Additionally, in Chapter 2 students were described as more actively involved in the learning process. In PBL, self-regulation is fostered because students need to select their own literature sources, plan and monitor self-study time, and evaluate their learning process (Loyens, Magda, & Rikers, 2008; Schmidt, 2000). Students indicated that PBL helps them to study on a regular basis. Moreover, teachers who had taught in both the lecture-based and the new PBL program observed PBL students as more actively participating than students in the former program. These experiences and observations indicate that students take responsibility for their own learning process, one of the aspects of self-regulation. Besides, being more actively involved in the learning process contributed to study progress. Results of Chapter 7 demonstrated that the grade on observed learning activities, was the strongest predictor of completion of the Bachelor's program in time in PBL. These findings indicate that being engaged in one's own learning, like being able to plan,

monitor, and evaluate study activities, is more present in PBL according to teachers, tutors, and students themselves and relates positively to study progress.

A third positive finding regarding PBL has been found in the reported feelings of relatedness, which were significantly higher than those of students in the former, lecture-based program. In the focus group discussions of Chapter 3, students mentioned that working in small groups with a tutor contributed to these feelings. In PBL, students get to know each other in the small group meetings that change each course (i.e., every five weeks). The change in tutorial groups enable connections to peers and building friendships. Moreover, students described that the tutor was approachable during the meetings that also contributed to their feelings of relatedness. Alternatively, students in the former program reported lower sense of relatedness. It could be argued that in the traditional program, a sense of anonymity among students was created due to the large-scale lectures. Teachers were perhaps less involved in students' learning activities and more distant than in PBL. Moreover, it is likely that in the former educational setting, less interaction between students took place.

Study 1 of Chapter 3 showed that the feelings of relatedness had no correlation with autonomous motivation, as was expected based on SDT (Deci & Ryan, 2000; Ryan & Deci, 2000). Still, feeling connected to fellow students and staff can be beneficial for other outcomes. For example, the model of Tinto (1975) states that the interaction between students and the academic environment influences student persistence. If students feel socially integrated in the academic environment, their commitment increases, preventing them from voluntarily dropout. In PBL, integration is stimulated by the small group size and the role of the tutor. The tutor provides more personal attention to the students compared to a teacher in front of lecture with a large number of students. The personal attention of the tutor to students could affect both course content as personal matters.

Despite these positive findings, some unexpected findings after the implementation of PBL showed up as well. The comparison studies demonstrated little differences regarding motivation and need satisfaction, and little differences with regards to several learning strategies. As mentioned, these components of study processes are related to academic performance (e.g., Richardson et al., 2012). Therefore, the fact that only small differences appeared in study processes might explain the non-significant difference in study progress after the implementation of PBL (Chapter 7). Moreover, the development of learning strategies demonstrated no major changes over time regarding deep processing and stepwise processing in the three-year PBL program. Several explanations could be offered here.

The first explanation lies in the assessment used in the curriculum. It is likely to assume that students adapt their learning strategies to the assessments applied in the academic program (Baeten, Kyndt, Struyven, & Dochy, 2010; Vermunt, 2005). For example, when exams focus more on factual knowledge questions, students will apply

stepwise processing more often. An evaluation of the course exams of the three years of the Bachelor's program (Chapter 5) showed that this was indeed the case in the curriculum under study. Factual knowledge questions (e.g., definitions of concepts) were highly representative in the first year exams, and even still in the third academic year. On the contrary, the number of questions that required complex knowledge processing like the application of knowledge were quite low in all three years. Stepwise processing was rather high among Dutch law students, in both the traditional lecture-based program (Chapter 4) and the PBL program (Chapter 4 and 5). The high number of factual knowledge questions in exams could explain why students apply stepwise processing and are not encouraged to develop the more demanding strategy of deep processing. Moreover, this could also explain why deep processing is not increasing over time. The study of Vermunt (2005) showed, in line with these results, higher reports of stepwise processing (i.e., more use of rehearsal and memorization techniques) among Dutch law students, compared to students of other disciplines (e.g., psychology students, arts students). This could indicate that the nature of the material to be learned in Dutch law does not always demand deep processing, but can also be managed with stepwise processing. However, when the focus of assessment is on the application of knowledge, instructions through PBL appeared more useful than providing a lecture as is shown in results of Chapter 6.

A second, more general explanation for the lack of differences found between students of the lecture-based and the PBL program is that the majority of the studies in this dissertation were conducted within the third and final year of the Bachelor's program. It is likely that third-year students, despite the learning environment they are in, feel more capable about their performance, are more motivated to study, and already gained experience over the years on which learning techniques help them.

A third explanation for the lack of differences might be an insufficient implementation of the PBL process. Implementing a new educational method requires and implies many changes for Faculty and staff. This is a complex and time-consuming process. Teachers needed to change their course materials and their teaching style. In the former educational program, teachers had a directive role and transmitted information to students in lectures. However, in PBL, teachers should adopt a facilitating role, and be more in the background. Changing their teacher style is challenging for teachers (Ertmer & Simons, 2006; Kaufman & Holmes, 1996) and could (especially in the beginning of the transition) result in dissatisfaction (Chapter 2). In the comparison studies of Chapters 3 and 4, the PBL students were third-year students from the *first* PBL cohort at the Erasmus School of Law. Complications regarding implementation are more likely to arise in a first cohort, as everything is new to both students and academic staff.

Practical Relevance and Recommendations

Results showed that external factors play a role in the learning process and that students identify some controlling elements within PBL. Further, some of the processes within the PBL program are not optimally applied (e.g., literature summed up in reporting phase). Hence, PBL in practice is not always completely in line with the ideas and principles of PBL in theory, as also is described in Moust et al. (2005). We offer some specific recommendations to further optimize the implementation of PBL and study progress.

A first recommendation is that the application of knowledge should be emphasized in the reporting phase by the tutors. During the reporting phase, the focus should lie on the learning issues and the questions that arise from there and in addition, on combining different literature sources. Furthermore, students should relate the learned knowledge to the problem that was the starting point in the initial phase. If this is not happening automatically, the tutor can help to accomplish this. A tutor can refer to the problem during the reporting phase and even come up with different scenarios related to the original problem and ask how students would explain that with the studied literature.

A second recommendation is to put more focus on the application of knowledge in the exams and to increase the number of applications tasks during the years of the Bachelor's program. Being able to apply knowledge is an important skill that students need to acquire and control when they work in the professional field. PBL stimulates working in a realistic context and hence application of knowledge in real-life situations. The meta-analysis of Gijbels et al. (2005) showed that PBL students are better in application tasks than students of more traditional programs. Putting more emphasis on this in assessment will help students use relevant learning strategies like deep processing.

A third and final recommendation is based on the findings of Chapter 7. Students who are likely to fail the Bachelor's program could and should be identified at an early stage. Predictors of study progress in the PBL program indicated that pre-university GPA and observed learning activities of the first year are important factors in predicting study progress. Students who have a low pre-university GPA and low scores on observed learning activities could be offered with guidance on how to learn efficient and effectively. Hopefully, this contributes to the study success and progress.

Strengths and Weaknesses of the Studies and Suggestions for Future Research

The studies in this dissertation address PBL in legal education. The findings of this dissertation therefore contribute to the existing literature. The majority of existing research took place in medical education. In order to generalize findings of PBL studies, research should be conducted in other areas of education as well.

Second, the studies in this dissertation have a broad variation of studies, in design and used analyses. Additionally, the studies are innovating compared to existing studies. Comparison studies, as well as a longitudinal, and an experimental study are included.

In Chapter 3, a mixed-method design was applied. Results of the quantitative study were supplemented with a qualitative study. The longitudinal design of the study in Chapter 5 is unique because longitudinal studies in PBL curricula are rather scarce. In Chapter 6, an experimental study was conducted, making sure all factors were kept under control. In general, there is a lack of experimental studies in existing PBL literature (Kirschner, Sweller, & Clark, 2006). Further, in Chapter 7, a comparison was made on the study progress predictors between PBL and non-PBL students within one university, which was not done before.

The studies in this dissertation are a first attempt to generalize findings of previous PBL effect studies in medical education to legal education. However, more research is necessary to further generalize the results. There are some limitations with the current studies. A first limitation in the studies on the implementation of PBL is that the implementation of PBL took place at the same time of the implementation of the new assessment system "Nominal is Normal". At this point, it is difficult to answer the question to what factors the improved learning strategies and outcomes can be attributed. The didactical principles of PBL and "Nominal is Normal" are closely related. Both aim that students study on a more regular basis and reduce procrastination of students.

Second, all studies are conducted within the PBL curriculum of one faculty at one university. Results of these studies could be further generalized when other law schools in the Netherland, Europe, or the world apply PBL and are willing to do research to the effects. Third, future research could focus more on student development within PBL during a longer time period than focus on comparison studies between cohorts. For example, research that investigate comparisons within Bachelor's programs in three years, and not just between cohorts, as most studies in this dissertation did. Other factors could play a role when performing research between the students of different cohorts, like pre-existing differences in the student groups.

A forth limitation is that the studies on study processes, motivation and learning strategies, in Chapters 3, 4, and 5, mostly made use of self-reports. The most important reason to use self-reports is that study processes are difficult to observe. However, the risk of self-reports is that students could provide social desirable answers. We recommend in future research to either make use of more objective measurements, or to add self-reported data with qualitative information to provide a broader sight on the results (as was done in Chapter 3 as well).

Finally, in the majority of the studies of this dissertation a comparison between the former educational program and the PBL program within the Erasmus School of Law was made. Even in the experimental studies, lectures were compared to instructions by PBL. However, in practice, these two instructional methods are often used to support each other. Results of Chapter 6 suggest that this is useful for performance on different types of assessment. Lectures appeared effective mostly for acquisition of factual

knowledge, while PBL instructions were effective for application of knowledge. Future research should therefore not focus much on the *comparison* between PBL and traditional learning environments, but more on the factors that could be improved within an educational method that combines PBL and lectures.

S

Samenvatting (Summary in Dutch)

In dit proefschrift worden verschillende onderzoeken naar de invloed van probleemgestuurd onderwijs (PGO) binnen rechtenstudies beschreven. PGO is een studentgerichte onderwijsmethode, waarin studenten samenwerken in kleine groepen aan realistische, complexe problemen onder begeleiding van een tutor. Het proces van PGO start met de voorbespreking. Studenten discussiëren over een probleem (een omschrijving van een situatie die in de praktijk zou kunnen voorkomen) en zij activeren op deze manier voorkennis over het onderwerp van de beschreven situatie. Ze proberen het probleem te verklaren, maar eindigen met vragen omdat zij nog over te weinig kennis beschikken. Dit leidt tot de formulering van leerdoelen (geformuleerd als vragen) waarmee de voorbespreking eindigt. Studenten hebben vervolgens een paar dagen tijd voor zelfstudie, de tweede fase van PGO, waarin zij individueel verschillende leerbronnen selecteren en bestuderen met als doel de leerdoelen te realiseren door antwoorden op de vragen die daaruit voortvloeien te vinden. Na de zelfstudiefase komen studenten weer bijeen in hun onderwijsgroep voor de laatste fase van PGO, de nabespreking. Samen discussiëren zij over de bestudeerde literatuur en creëren zij een zo compleet mogelijk antwoord op de leerdoelen die geformuleerd werden in de voorbespreking. Een tutor is aanwezig tijdens de voor- en nabespreking. Tutoren hebben een begeleidende rol in het proces. Zo kunnen zij bijvoorbeeld verdiepende vragen stellen of instructies bieden, maar zij mogen geen directe informatie geven (Barrows, 1996; Hmelo-Silver, 2004; Loyens, Paas, & Kirschner, 2012). In het algemeen beoogt PGO de volgende doelen (Hmelo-Silver, 2004; Loyens et al., 2012; Norman & Schmidt, 1992): (1) het ontwikkelen van een flexibele kennisbasis, (2) verkrijgen van samenwerkingsvaardigheden en (3) vergroten van probleemoplossend vermogen, (4) het intrinsiek motiveren van studenten, en (5) het stimuleren van zelfgestuurd leren.

De PGO methode is ingevoerd op verschillende universiteiten wereldwijd. Het ontstaan van PGO ligt in het medisch onderwijs, maar door de jaren heen hanteren steeds meer opleidingen uit verschillende vakgebieden PGO als onderwijsmethode (bijvoorbeeld sociale wetenschappen en bouwkunde; Barrows, 1996; Hmelo-Silver, 2004; Loyens et al., 2012). Het merendeel van het wetenschappelijk onderzoek naar PGO is echter uitgevoerd binnen geneeskundeopleidingen. In de studies van dit proefschrift onderzochten we of eerdere bevindingen inzake PGO-effecten in het medisch onderwijs ook aantoonbaar zijn in rechtenstudies, een vakgebied dat nog weinig aandacht heeft gekregen binnen het onderzoek naar de invloed van PGO.

De Erasmus School of Law, de rechtenfaculteit van de Erasmus Universiteit Rotterdam, implementeerde PGO als onderwijsmethode binnen het driejarig bachelorprogramma in september 2012. De invoering gold voor de drie opleidingen binnen het bachelorprogramma van de Erasmus School of Law: rechtsgeleerdheid, fiscaal recht en criminologie. Voor de invoering van PGO hanteerde de Erasmus School of Law een meer traditionele onderwijsmethode, waarin hoorcolleges de belangrijkste vorm van onderwijs waren.

Naast de invoering van kleinschalig, probleemgestuurd onderwijs hebben er meer veranderingen plaatsgevonden in de organisatie van het onderwijs en in het toetsingssysteem. Wat betreft de organisatie van het onderwijs hield de verandering in dat vakken voortaan sequentieel in plaats van parallel werden aangeboden. Wat betreft het toetsingssysteem is de zogenaamde "Nominaal is Normaal" aanpak ingevoerd (Vermeulen et al., 2012). Studenten moeten daarbij alle 60 studiepunten in plaats van 40 studiepunten behalen in het eerste jaar om door te stromen naar het tweede studiejaar. Twee andere hoofdkenmerken van dit toetsingssysteem zijn de mogelijkheid tot compenseren van onvoldoendes en beperking van de herkansingsmogelijkheden. Met de invoering van PGO en de bijkomende veranderingen in de organisatie van het onderwijs en het toetsingssysteem beoogde men (1) onderwijskwaliteit te verbeteren en (2) de studievoortgang onder de studenten die deelnamen aan het bachelorprogramma te bevorderen. Die studievoortgang was namelijk in de achterliggende jaren erg laag.

De onderzoeksdoelen van dit proefschrift sluiten aan bij de beoogde doelen achter de invoering van PGO binnen de Erasmus School of Law en bij de theoretische onderbouwing van PGO (e.g., Loyens et al., 2012; Norman & Schmidt, 1992). Het eerste onderzoeksdoel van dit proefschrift is de invloed van PGO op de *studieprocessen* binnen rechtenstudies te bestuderen. Het tweede onderzoeksdoel van dit proefschrift is de invloed van PGO op de *studieresultaten* binnen rechtenstudies te onderzoeken. In totaal zijn er zes studies uitgevoerd. In één studie worden de ervaringen met de invoering van PGO beschreven. De overige vijf studies geven antwoord op de vraag wat de invloed is van PGO op de studieprocessen (drie studies) en de studieresultaten (twee studies) binnen de Erasmus School of Law.

HOOFDBEVINDINGEN

De invoering van PGO binnen de Erasmus School of Law is in detail omschreven in **hoofdstuk 2**. Dit hoofdstuk biedt onder andere een overzicht van alle veranderingen die hebben plaatsgevonden binnen de Faculteit (bijvoorbeeld de tutortraining ten aanzien van de PGO kenmerkende Zevensprong methode en de training van docenten inzake vakontwikkeling binnen PGO). Daarbij werd studenten en docenten aan de hand van vragenlijsten gevraagd naar hun ervaringen met de invoering van PGO. De resultaten gaven een indicatie van de door docenten en studenten gepercipieerde kwaliteit van het onderwijs in het PGO systeem. Deze kwaliteit is van belang, omdat *hoe* de PGO methode wordt gehandhaafd (bijvoorbeeld het verloop van de voor- en nabespreking, houding tutor, gebruik van problemen) invloed kan hebben op hoe studenten functioneren binnen de groep en uiteindelijk op hoe zij presteren (Dolmans, De Grave, Wolfhagen, & Van der Vleuten, 2005; Dolmans, Wolfhagen, Van der Vleuten, & Wijnen, 2001).

Uit de reacties op de vragenlijsten bleek dat studenten het gevoel hebben dat PGO hen helpt regelmatig te studeren en dat PGO hen stimuleert actief betrokken te zijn in het leerproces. De vereiste voorbereiding op en bediscussiëring in de nabespreking van verschillende antwoorden op de vragen die voortkomen uit de leerdoelen heeft waarschijnlijk een gunstige invloed op de actieve deelname van studenten aan het onderwijs. Aan de andere kant hadden studenten ook enkele aanmerkingen op de uitvoering van PGO. De nabespreking werd soms als zinloos bestempeld wanneer er enkel een opsomming van literatuur had plaatsgevonden. Docenten gaven ook aan dat studenten in PGO actiever betrokken zijn en regelmatiger studeren dan studenten in de voorgaande onderwijsmethode. Verder rapporteerden docenten dat er binnen de Faculteit nog wel enige onvrede heerst over het PGO systeem. De ontevredenheid van docenten kan zijn ontstaan door het veranderen van onderwijsstijl (d.i. van een directe rol naar begeleidende rol), wat voor hen lastig en uitdagend is gebleken (zie ook Ertmer & Simons, 2006; Kaufman & Holmes, 1996).

PGO en motivatie

De relatie tussen PGO en studiemotivatie van studenten werd onderzocht in **hoofdstuk 3**. De zelfdeterminatietheorie (Ryan & Deci, 2000) diende hierbij als theoretisch kader. De zelfdeterminatietheorie stelt dat studenten streven naar bevrediging van drie basisbehoeften, namelijk het gevoel van autonomie, het gevoel competent te zijn en het gevoel van verbondenheid met medestudenten en docenten. Bevrediging van deze behoeften leidt tot hogere motivatie. Er wordt in deze theorie een onderscheid gemaakt tussen autonome en gecontroleerde motivatie. Autonome motivatie representeert voornamelijk intrinsieke motivatie en is positief gerelateerd aan studieprestaties (e.g., Taylor et al., 2014). Gecontroleerde motivatie representeert voornamelijk extrinsieke motivatie; die is gebaseerd op factoren op basis van externe factoren, zoals druk van ouders of gevoel van schaamte (Ryan & Deci, 2000). Onderzoek toont aan dat deze vorm van motivatie negatief gerelateerd is aan studieprestaties (Vansteenkiste et al., 2005).

In studie 1 werd aan de hand van een vragenlijst onderzocht in hoeverre de leeromgeving (traditioneel vs. PGO) van invloed was op de drie behoeften en de twee typen motivatie. Binnen de Erasmus School of Law werd een cohortvergelijking gemaakt tussen de derdejaars rechtsgeleerdheid studenten in het oude onderwijssysteem en studenten in het nieuwe PGO systeem. De verwachting was dat PGO studenten meer gevoel van autonomie, competentie en verbondenheid zouden ervaren, dat de autonome motivatie hoger zou zijn onder PGO studenten en de gecontroleerde motivatie juist lager. De resultaten lagen voor een groot deel niet in lijn met de verwachtingen. Er werden geen verschillen gevonden tussen beide studentcohorten op gevoel van autonomie en competentie, noch op autonome en gecontroleerde motivatie. Studenten in het PGO onderwijs scoorden echter wel hoger op gevoel van verbondenheid.

Om een verklaring te vinden voor deze onverwachte resultaten werden focusgroepdiscussies uitgevoerd met PGO studenten in studie 2. In deze focusgroepdiscussies gaven studenten aan bepaalde elementen in PGO te herkennen die bijdragen aan het gevoel van autonomie, zoals zelf kiezen van literatuur die je bestudeert en ruimte voor discussies die je zelf belangrijk vindt tijdens de nabespreking. Zij identificeerden echter ook elementen in PGO die als controlerend werden ervaren en daardoor niet bijdragend aan het gevoel van autonomie, zoals de aanwezigheidsplicht en een gebrek aan keuze tussen vakken. De aanwezigheid van zowel elementen die bijdragen aan het gevoel van autonomie als elementen die als controlerend worden beleefd geeft een mogelijke verklaring voor het uitblijven van verschillen tussen beide studentcohorten met betrekking tot dit gevoel. Hoewel we geen studenten uit de oude leeromgeving hebben kunnen bevragen, achten we het waarschijnlijk dat daarin ook beide typen elementen aanwezig waren. Verder gaven studenten in de focusgroepen aan zich competent te voelen door specifieke componenten van PGO, zoals het gebruik van realistische problemen, maar ook door niet-specifieke PGO elementen zoals behaalde cijfers. Zich competent voelen door goede cijfers is uiteraard ook aanwezig in het traditionele onderwijsprogramma en verklaart wellicht waarom er geen verschillen gevonden werden op verschil in gevoel van competentie in studie 1. Verder benoemden studenten dat het werken in kleine groepen in PGO bijdraagt aan gevoel van verbondenheid, omdat zij hun medestudenten goed leren kennen tijdens de onderwijsgroepen en omdat de tutor goed benaderbaar is. Al met al blijkt uit de resultaten van de focusgroepdiscussies dat PGO niet alle drie de behoeften vervult. Dit kan een verklaring bieden voor het uitblijven van een hogere score op autonome motivatie van PGO studenten.

PGO en leerstrategieën

Het studieproces werd tevens onderzocht door te kijken naar de wijze waarop studenten leren, of met andere woorden, naar hun leerstrategieën. Bepaalde leerstrategieën, zoals diepe verwerking en zelfregulatie, blijken positief gerelateerd aan studieprestaties (Boyle, Duffy, & Dunleavy, 2003; Richardson, Abraham, & Bond, 2012). Net als in hoofdstuk 3 werd een cohortvergelijking binnen de Erasmus School of Law uitgevoerd tussen de derdejaars rechtsgeleerdheid studenten in het traditionele onderwijsprogramma en de derdejaars rechtsgeleerdheid studenten in het PGO programma. Deze vragenlijststudie wordt gerapporteerd in **hoofdstuk 4**. Verder onderzoek naar hoe studenten leren is beschreven in **hoofdstuk 5**, waarbij de focus ligt op de ontwikkeling van leerstrategieën in het driejarig PGO bachelorprogramma, de relatie tussen leerstrategieën en studieprestaties, en de relatie tussen leerstrategieën en toetsing binnen het curriculum.

Leerstrategieën kunnen worden onderverdeeld in verwerkingsstrategieën en regulatiestrategieën (Vermunt, 1998). Verwerkingsstrategieën zijn denkstrategieën die studenten gebruiken om lesmateriaal te verwerken. Er zijn drie typen verwerkingsstrategieën:

diepe verwerking, stapsgewijze verwerking en concrete verwerking. Regulatiestrategieën zijn strategieën die gebruikt worden om het leerproces te reguleren. Er worden in de literatuur drie regulatiestrategieën onderscheiden: zelfregulatie, externe regulatie en regulatieloosheid. De verwachting was dat PGO het gebruik van de diepe verwerking stimuleert (Lycke, Grøttum, & Strømsø, 2006; Mattick & Knight, 2007; Schmidt, Dauphinee, & Patel, 1987; Van der Veken, Valcke, Muijtjens, De Measeneer, & Derese, 2008). De activatie van voorkennis en de stimulatie van het elaboratieproces dragen hieraan bij (Schmidt, 1983). Een tweede verwachting was dat zelfregulatie zou worden bevorderd in PGO (English & Katsintas, 2013) door verschillende PGO karakteristieken, zoals het zelf selecteren van literatuur, eigen planning van de zelfstudie en eigen evaluatie of voldoende literatuur is bestudeerd.

Uit de resultaten in hoofdstuk 4 bleek dat studenten in het PGO cohort significant meer gebruik van diepe verwerking, zelfregulatie en externe regulatie rapporteerden dan studenten in het traditionele cohort. Het ging hier wel om relatief kleine verschillen. Er werden geen verschillen tussen de twee cohorten betreffende stapsgewijze verwerking, concrete verwerking en regulatieloosheid gevonden. Deze resultaten waren gedeeltelijk in lijn met de verwachtingen. De processen in PGO kunnen bijdragen aan een diepe verwerking, doordat studenten in de PGO methode gestimuleerd worden verbanden te leggen tussen verschillende concepten en het probleem uit de voorbespreking. Verder dienen studenten in PGO verantwoordelijkheid te nemen voor hun eigen leerproces, wat zelfregulatie bevordert. PGO studenten bleken hoog te scoren op de strategie externe regulatie. Dit kan verklaard worden door de invloed van externe factoren in PGO, zoals verplichte aanwezigheid, de tutor, medestudenten in de onderwijsgroep en de vereiste voorbereiding. De leeromgeving lijkt dus tot op bepaalde hoogte invloed uit te oefenen op de manier waarop studenten leren.

Het onderzoek naar leerstrategieën werd vervolgd in hoofdstuk 5. In deze studie lag de nadruk op (1) ontwikkeling van leerstrategieën binnen PGO, (2) de relatie tussen leerstrategieën en prestaties, en (3) het niveau van kennisverwerking dat getoetst werd in de examens van het curriculum. De hypothese met betrekking tot de ontwikkeling van leerstrategieën was dat gedurende de drie jaren van het PGO bachelorprogramma het gebruik van diepe verwerking, concrete verwerking, en zelfregulatie zouden toenemen. Daarnaast verwachtten we dat het gebruik van stapsgewijze verwerking, externe regulatie en regulatieloosheid zou afnemen in de loop van het PGO programma. Met betrekking tot de relatie tussen leerstrategieën en studieprestaties was de hypothese dat diepe verwerking en studieprestaties positief gerelateerd zouden zijn, net als zelfregulatie en studieprestaties (Boyle, Duffy, & Dunleavy, 2003; Richardson et al., 2012). Aan de andere kant verwachtten we dat stapsgewijze verwerking (Lindblom-Ylänne & Lonka, 1999; Richardson et al., 2012; Zeegers, 2001) en regulatieloosheid (Lindblom-Ylänne & Lonka, 1999; Vermunt, 2005) negatief zouden correleren met studieprestaties.

Met betrekking tot de ontwikkeling van leerstrategieën, blijkt uit de resultaten in hoofdstuk 5 dat het gebruik van diepe verwerking stabiel blijft over tijd. Het gebruik van stapsgewijze verwerking nam toe en vervolgens weer af aan het eind van het bachelorprogramma. Verklaringen voor deze onverwachte bevindingen lichten we verderop toe. Uit de onderzoeksresultaten volgt dat de concrete verwerking toeneemt tijdens het bachelorprogramma. In PGO werken studenten in een realistische context wat het toepassen van kennis stimuleert (Schmidt, 1983). Zelfregulatie en externe regulatie vertoonden beide een ingewikkeld patroon. Beide namen af in het eerste academisch jaar, vervolgens namen ze toe in het tweede jaar en vertoonden opnieuw een afname aan het einde van het programma. Deze ontwikkelingen waren tegengesteld aan de verwachting. De aanwezigheid van externe factoren binnen PGO, zoals de tutor en medestudenten bieden een mogelijke verklaring voor de aanwezigheid van hoge externe regulatie. Tot slot daalde regulatieloosheid in het driejarige PGO programma. Deze bevinding is eerder aangetoond in bestaande studies (Donche et al., 2010; Donche & Van Petegem, 2009; Vermetten et al., 1999) en lijkt erop te duiden dat toenemende ervaring met studeren ertoe leidt dat studenten minder moeite hebben met het reguleren van hun studieactiviteiten.

Met betrekking tot de relatie tussen leerstrategieën en studieprestaties werd in hoofdstuk 5 aangetoond dat alleen regulatieloosheid een significante, negatieve relatie had met behaalde cijfers gedurende het bachelorprogramma. Een slechte regulatie van leeractiviteiten was geassocieerd met het behalen van lagere cijfers. De correlaties tussen de overige leerstrategieën en studieprestaties waren laag. Dit suggereert dat voor het verkrijgen van een goed cijfer andere kwaliteiten nodig zijn. Hoewel deze relaties niet aangetoond werden in deze studie, blijft de ontwikkeling van bepaalde leerstrategieën zoals diepe verwerking en zelfregulatie van belang voor een succesvolle carrière na de universiteit. Studenten zullen zich na hun studie ook moeten blijven ontwikkelen.

Het kennisverwerkingsniveau van de studenten werd onderzocht door middel van de examens van het PGO programma. Het kennisverwerkingsniveau kan onderverdeeld worden in simpele verwerking van kennis, zoals het reproduceren van feitelijke kennis, en complexe kennisverwerking, zoals het toepassen van kennis. De evaluatie van de gebruikte examens in het PGO programma demonstreerde een focus op vragen naar feitelijke kennis (d.i. simpele kennisverwerking). In het bijzonder gold dit voor examens in het eerste academiejaar, maar in het derde jaar werd dit kennisniveau nog steeds relatief veel getoetst. Toepassing van kennis, ofwel complexe kennisverwerking, bleek relatief weinig getoetst in de drie academische jaren, al komen deze wel vaker voor in het laatste, derde jaar. De uitkomsten van de examenanalyse bieden mogelijk ook een verklaring voor de beperkte ontwikkeling van diepe en stapsgewijze verwerking binnen de Erasmus School of Law. Studenten passen namelijk strategieën toe die nodig zijn voor het behalen van hun examen. De nadruk op kennisvragen in de tentamens kan

verklaren waarom studenten veel stapsgewijze verwerking bleken te gebruiken, zelfs in de laatste fase van het bachelorprogramma.

PGO en verwerven, onthouden en toepassen van kennis

Een hoofddoel van onderwijs is dat studenten kennis verwerven. Idealiter vergaren studenten niet enkel kennis, maar creëren zij een diep begrip van de materie en zijn ze in staat de kennis toe te passen in nieuwe situaties, een proces dat in de onderwijspsychologie *transfer* wordt genoemd. Daarnaast zouden studenten de verkregen kennis moeten kunnen onthouden op lange termijn. **Hoofdstuk 6** bevat een studie waarin het verwerven en onthouden van kennis is onderzocht bij verschillende typen toetsing. Een experimentele studie werd uitgevoerd, waarbij studenten willekeurig werden ingedeeld in een PGO- of collegeconditie. Zij vergaarden kennis over een Nederlands strafrechtelijk onderwerp (d.i. noodweer en noodweerexces) en die kennis werd getest direct na de leerfase (verwerven van kennis) en een week later (onthouden van kennis). De test bevatte drie onderdelen: feitelijke kennisvragen, een toepassingstaak en een *transfertaak*. De hypothese was dat deelnemers in de PGO conditie meer kennis zouden onthouden, vanwege het proces van elaboratie (d.i. bestaande kennis koppelen aan nieuwe kennis) dat kennisretentie stimuleert (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Schmidt, 1983). Met betrekking tot het type toetsing werd verwacht dat deelnemers in de collegeconditie beter zouden presteren op de feitelijke kennisvragen (bijv. Albanese & Mitchell, 1993), maar dat deelnemers in de PGO conditie beter zouden presteren op de toepassings- en transfertaak, doordat zij werken met realistische problemen (Gijbels et al., 2005).

Uit de resultaten bleek dat de kennisretentie tussen beide groepen niet verschilde. Dit gold voor alle toetsingsvormen. Een mogelijke verklaring hiervoor is de korte tijd (een week) tussen de directe en verlate test. De score op de feitelijk kennisvragen was ruim voldoende (d.i. score van 6 à 7 op 10) in beide condities, maar de deelnemers in de collegeconditie scoorden significant hoger dan de deelnemers in de PGO conditie. Deze bevinding lag in lijn met de geformuleerde hypothese. Op de toepassingstaak scoorden beide groepen onvoldoende, maar deelnemers in de PGO conditie scoorden wel significant hoger dan deelnemers in de college conditie. Deze resultaten lijken aan te geven dat het direct verstrekken van informatie helpt voor het verkrijgen van feitenkennis, terwijl de processen in PGO helpen om kennis beter te kunnen toepassen. Er werd geen verschil tussen beide condities gevonden op de transfertaak. Met betrekking tot het toepassen van kennis in nieuwe situaties verschilden beide groepen dus niet. Een mogelijke verklaring hiervoor is de moeilijkheid van transfer in zijn algemeenheid (Norman, 2009). Bovendien was er sprake van een kort leerproces in het experiment. Aangezien transfer op zich al een moeilijk proces is, wordt dit nog lastiger wanneer er sprake is van een kort leerproces.

PGO en studievoortgang

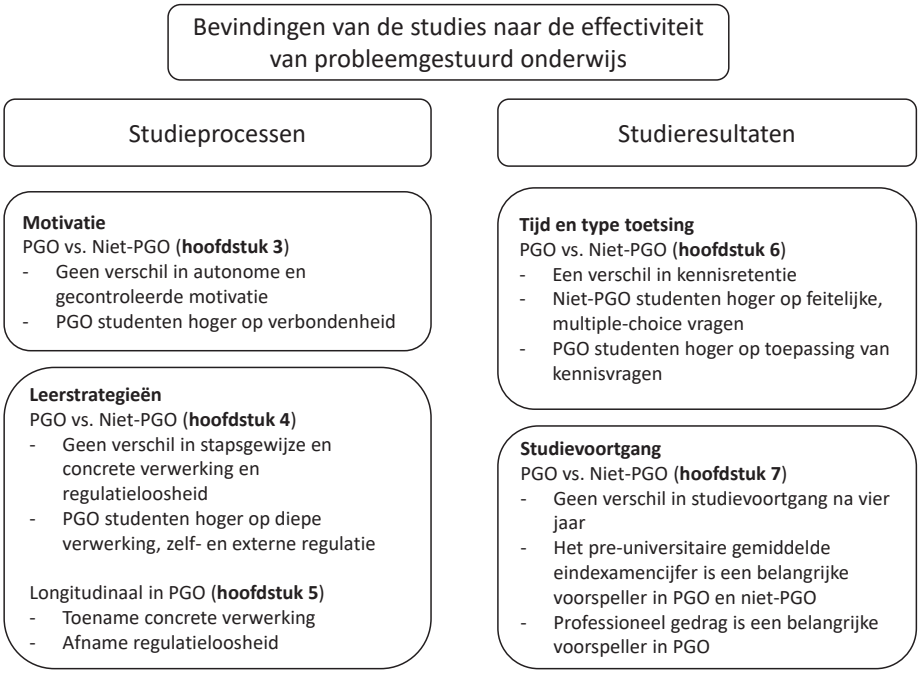
Op Nederlandse universiteiten is het aantal studenten dat een bachelordiploma behaalt binnen drie (nominaal), of vier jaar (d.i. met één jaar studievertraging) vrij laag (Educational Inspectorate, 2009). Studievoortgang is enigszins verbeterd na 2009, zo blijkt uit de rapportage van de onderwijsinspectie (Educational Inspectorate, 2017). Ondanks dat is er nog steeds ruimte voor verbetering. Voor zowel de studenten als voor de universiteit is het verbeteren van de studievoortgang van belang. Over die studievoortgang gaat het laatste **Hoofdstuk 7**. De inrichting en organisatie van de opleiding (zoals het aantal contacturen, de beschikbare ruimte voor zelfstudie en de inrichting van het toetssysteem) blijkt een grote rol te spelen bij verbetering van de studievoortgang (e.g., Jansen, 2004; Schmidt et al., 2010; Vermeulen et al., 2012). Het doel van de invoering van PGO bij de Erasmus School of Law was het studiesucces en de studievoortgang van studenten te bevorderen. Bestaande onderzoeken tonen aan dat studenten in een PGO programma minder studievertraging oplopen en vaker hun diploma behalen ten opzichte van studenten in een traditioneel programma (Iputo & Kwizera, 2005; Schmidt, Cohen-Schotanus, & Arends, 2009a).

Een groot aantal eerdere onderzoeken is gericht op de vraag *welke* factoren, zowel demografisch als niet-demografisch, studiesucces en -voortgang voorspellen. Het merendeel van deze studies is echter uitgevoerd binnen traditionele onderwijscurricula (bijvoorbeeld Bruinsma & Jansen, 2009). De studie van De Koning, Loyens, Rikers, Smeets, en Van der Molen (2012) is hierop een uitzondering. In deze studie zijn studiesuccesvoorspellers onderzocht binnen een bestaand PGO curriculum. De resultaten lieten zien dat een specifiek element binnen PGO, namelijk professioneel gedrag van studenten, een sterke voorspeller is voor studiesucces. Het begrip professioneel gedrag heeft betrekking op de professionele houding en gedragingen van studenten binnen de onderwijsgroep. De tutor observeert dit gedrag tijdens de bijeenkomsten en beoordeelt het door scores te geven op een aantal gedragscriteria. Zo wordt gekeken of de student zich aan de afspraken houdt (bijvoorbeeld op tijd komen), of deze kwalitatief goed is voorbereid en actief deelneemt aan de groepsdiscussies. Aan het einde van het vak kent de tutor een cijfer op een tienpuntsschaal toe aan iedere student uit de onderwijsgroep.

De studie beschreven in dit hoofdstuk maakt een directe vergelijking tussen de effectiviteit van de traditionele onderwijsvorm aan universiteiten (namelijk hoorcolleges) en die van PGO. De verwachting was dat studievoortgang (d.i. het behalen van de bachelordiploma binnen vier jaar) zou verbeteren na de invoering van PGO. Of er verschil was in *welke* factoren voorspellend zijn voor studievoortgang tussen beide leeromgevingen, was een exploratieve onderzoeksvraag.

De resultaten in hoofdstuk 7 tonen aan dat de studievoortgang niet significant verschilde tussen studenten uit het traditionele cohort en het PGO cohort. De studievoortgang was dus niet significant verbeterd na de invoering van PGO. Uit de verkenning

van voorspellende factoren van studievoortgang bleek dat er algemene voorspellers waren die in beide leeromgevingen een rol speelden, maar dat er ook specifieke voorspellers waren die ófwel in de traditionele-, ófwel in de PGO onderwijsvorm van belang zijn. Het behaalde pre-universitaire gemiddelde eindexamencijfer bleek een sterke algemene voorspeller voor studiesucces. In beide onderwijsvormen was er een positief verband tussen gemiddeld eindcijfer vanuit de vooropleiding en het behalen van het bachelordiploma in vier jaar tijd. In het traditionele cohort kwam leeftijd als een tweede voorspeller naar voren: d.i. jongere leeftijd was geassocieerd met een grotere kans op het behalen van de bachelordiploma binnen vier jaar. In het PGO cohort daarentegen speelde niet leeftijd, maar geslacht een rol: vrouwelijke studenten hadden een betere studievoortgang dan mannelijke. Wanneer professioneel gedrag werd toegevoegd als voorspeller in het PGO cohort, bleek dit verreweg de sterkste voorspeller voor studievoortgang: hoe hoger het cijfer op professioneel gedrag, hoe hoger de kans op het behalen van het bachelordiploma binnen vier jaar. Dit laatste resultaat laat zien hoe belangrijk een goede voorbereiding van- en actieve deelname aan het onderwijs is voor de studievoortgang van studenten. De kleinschaligheid van PGO biedt de kans om dit studeergedrag te observeren en indien nodig bij te sturen.



Figuur 1. Overzicht van de bevindingen uit de studies van dit proefschrift.

Een overzicht van de bevindingen die aangetoond zijn in de studies van dit proefschrift is weergegeven in figuur 1. Deze bevindingen hebben betrekking op de studies naar de invloed van PGO op studieprocessen en studieresultaten.

ALGEMENE DISCUSSIE

De doelstelling van het onderzoek in dit proefschrift was tweeledig. Het onderzoek poogde enerzijds meer inzicht te verschaffen in de relatie tussen PGO en *studieprocessen* en anderzijds in de relatie tussen PGO en *studieresultaten*. De twee zijn nauw verbonden aangezien de studieprocessen – motivatie en leerstrategieën – invloed hebben op studieresultaten (Richardson et al., 2012). De in dit proefschrift uitgevoerde studies hebben zowel bevindingen opgeleverd die het belang van PGO ondersteunen als bevindingen die dat niet doen. Hieronder bespreken we eerst de bevindingen die duiden op een positieve invloed van PGO.

Met betrekking tot studieprocessen werd een toename van het gebruik van de concrete verwerkingsstrategie gevonden in het driejarig PGO bachelorprogramma (hoofdstuk 5). Concrete verwerking houdt in dat studenten in staat zijn de geleerde kennis te koppelen aan de praktijk (Vermunt, 1998). In de experimentele studie bleek bovendien dat deelnemers die PGO onderwijs volgden kennis beter konden toepassen dan deelnemers die traditioneel hoorcollege onderwijs volgden (hoofdstuk 6). Het werken met authentieke, complexe problemen in PGO bevordert het relateren van kennis aan de praktijk (Schmidt, 1983). Deze problemen dienen als realistische context en representeren situaties die studenten na afronding van de studie mogelijk kunnen tegenkomen in de praktijk. Kortom, PGO bereidt studenten voor op toekomstige werksituaties. Tijdens het experiment dat is beschreven in hoofdstuk 6 refereerde de tutor tijdens de nabespreking aan het probleem, om er zo zeker van te zijn dat de deelnemers de geleerde kennis zouden relateren aan de beschreven situatie. Bovendien bleek uit de focusgroepdiscussies uit hoofdstuk 3 dat studenten werken met problemen in PGO waarderen, omdat deze problemen de materie concretiseren. Kortom, werken met authentieke, complexe problemen binnen PGO lijkt een positieve uitwerking te hebben op het kunnen relateren van kennis aan de praktijk en op het kunnen toepassen van kennis in situaties die kenmerkend zijn voor het vakgebied.

Met betrekking tot de leerstrategieën blijkt verder dat studenten in het PGO systeem meer zelfregulatie vertonen dan studenten in het traditionele systeem. De studie in hoofdstuk 4 demonstreerde dat gerapporteerde zelfregulatie iets hoger was onder PGO studenten dan onder studenten in het traditionele programma. Verder vermeldden PGO studenten aan de hand van de vragenlijst in hoofdstuk 2 dat zij actief betrokken waren bij het leerproces en dat zij regelmatig studeerden. Docenten, die les hebben gegeven

in zowel het traditionele als het nieuwe (PGO) onderwijssysteem, bevestigden dat studenten in PGO meer betrokken zijn bij het leerproces dan studenten in het traditionele systeem. Zelfregulatie wordt gestimuleerd in PGO, doordat studenten zelf literatuurbronnen moeten selecteren, zelfstudietijd moeten inplannen en het leerproces moeten evalueren (Loyens, Magda, & Rikers, 2008; Schmidt, 2000). De in hoofdstuk 2 beschreven ervaringen van studenten en de observaties van docenten duiden erop dat studenten bij PGO verantwoordelijkheid nemen voor hun eigen leerproces, een van de aspecten van zelfregulatie. Verder bleek dat actieve deelname in het leerproces bijdraagt aan studievoortgang. Uit de in hoofdstuk 7 gepresenteerde resultaten bleek dat professioneel gedrag de sterkste voorspeller was voor studievoortgang in het PGO curriculum. Al met al blijkt betrokkenheid bij het eigen leerproces, zoals kunnen plannen, monitoren en evalueren van studie activiteiten, meer aanwezig is onder PGO studenten volgens studenten en docenten en dit heeft een positieve invloed op studievoortgang.

Een derde positieve bevinding ten aanzien van de PGO methode is dat studenten meer gevoel van verbondenheid ervaren vergeleken met studenten uit het traditionele onderwijsprogramma. Uit de focusgroepdiscussies kwam naar voren dat het werken in kleine groepen bestaande uit medestudenten en een tutor hieraan bijdraagt. Studenten leren hun medestudenten goed kennen tijdens de onderwijsbijeenkomsten. De samenstelling van de onderwijsgroepen verandert ieder blok (d.i. elke vijf weken). Dit maakt het leren kennen van medestudenten en het bouwen van onderlinge vriendschappen gemakkelijker. Bovendien beschrijven studenten de tutor als goed benaderbaar in de kleine groepen. Studenten in de oude onderwijsmethode binnen de Erasmus School of Law, die meer grootschalig en traditioneel van aard is, rapporteerden een lagere score op verbondenheid. Een verklaring hier is dat de docent minder betrokken is bij hoe studenten leren en meer op afstand is. Bovendien kan er een gevoel van anonimiteit heersen en is er waarschijnlijk minder interactie tussen studenten.

Uit studie 1 van hoofdstuk 3 bleek dat het gevoel van verbondenheid niet samenhangt met autonome motivatie. Dit was echter wel verwacht op basis van de zelfdeterminatietheorie (Deci & Ryan, 2000; Ryan & Deci, 2000). Een gevoel van verbondenheid kan bevorderlijk zijn voor studenten en hun studieprestaties. Het model van Tinto (1995) stelt bijvoorbeeld dat een goede interactie tussen de student en de academische leeromgeving het risico op uitval tijdens studie vermindert. Als studenten zich sociaal geïntegreerd voelen in de leeromgeving, neemt hun betrokkenheid toe, wat vervolgens voorkomt dat studenten vrijwillig stoppen met hun studie. In PGO wordt sociale integratie gestimuleerd doordat studenten werken in kleine groepen en door het feit dat de tutor meer persoonlijke aandacht kan geven aan de studenten dan de docent die een college aan een grote groep studenten geeft. Die aandacht kan zowel betrekking hebben op de inhoud van het vak als op persoonlijke kwesties van de student.

Ondanks de positieve bevindingen die hierboven benoemd zijn, waren er ook een aantal bevindingen die het belang van PGO niet ondersteunden in ons onderzoek. De vergelijkingsstudies toonden slechts kleine verschillen aan met betrekking tot de aspecten van motivatie en bepaalde leerstrategieën. Motivatie en leerstrategieën zijn gerelateerd aan studieprestaties, zo blijkt uit eerder onderzoek (Richardson et al., 2012). Het vinden van enkel kleine verschillen kan een verklaring bieden voor een niet-significante verbetering in studievoortgang na de invoering van PGO (hoofdstuk 7). Verder bleek dat ook in de ontwikkeling van leerstrategieën geen grote veranderingen plaatsvonden tijdens het driejarig PGO programma.

Een eerste verklaring voor deze bevindingen ligt mogelijk in de toetsing binnen de opleiding. Het is aannemelijk dat studenten hun leerstrategieën aanpassen aan de aard en inhoud van de toetsen, die gehanteerd worden binnen het onderwijsprogramma (Baeten, Kyndt, Struyven, & Dochy, 2010; Vermunt, 2005). Naarmate er bij de toetsing meer nadruk ligt op reproductie van feitelijke kennis, zullen studenten vooral stapsgewijze verwerkingsstrategieën toepassen. Een evaluatie van de gebruikte examens binnen het driejarige bachelorprogramma (hoofdstuk 5) toonde aan dat dit inderdaad het geval is. Feitelijke kennisvragen (bijv. definities van concepten) op examens kwamen niet alleen in groten getale voor in het eerste jaar, maar ook nog steeds in het derde jaar. Examenvragen waarin complexere kennisverwerking centraal stond – zoals het toepassen van kennis – kwamen relatief weinig voor. Het gebruik van stapsgewijze verwerking bleek relatief veel voor te komen bij studenten van de Erasmus School of Law, zowel binnen het traditionele onderwijscurriculum (hoofdstuk 4) als binnen het PGO curriculum (hoofdstuk 4 en 5). Bovendien nam diepe verwerking niet toe binnen het PGO programma. De focus op feitelijke kennisvragen in examens van de bachelor biedt hiervoor een verklaring. In de studie van Vermunt (2005) werd, net als in de huidige studies, een hoge rapportage van stapsgewijze verwerking gevonden onder studenten Nederlands recht vergeleken met studenten uit andere vakgebieden (bijv. psychologie). Wellicht vereist de materie binnen de rechtenopleiding niet altijd diepe verwerking. Echter, als de nadruk binnen toetsing meer op toepassing zou liggen, blijkt PGO onderwijs effectiever dan het geven van hoorcolleges (hoofdstuk 6).

Een tweede algemene verklaring voor het uitblijven van verschillen tussen studenten uit het traditionele en het PGO programma is dat de meeste studies zijn uitgevoerd binnen het derde en laatste jaar van het academische programma. Het is aannemelijk dat derdejaarsstudenten, ongeacht de leeromgeving, zich meer competent voelen, meer gemotiveerd zijn te studeren, en al meer ervaring hebben met welke leerstrategieën effectief voor hen zijn en welke niet. Derdejaarsstudenten zijn immers al vrij ver gekomen in de opleiding. De minder gemotiveerde studenten zijn waarschijnlijk al eerder uitgevallen.

De derde mogelijke verklaring voor het uitblijven van verschillen in studieprocessen en studieresultaten zou kunnen liggen aan de uitvoering van de PGO methode. Het invoeren van een nieuwe onderwijsmethode vereist grote veranderingen binnen een Faculteit. Dit is een tijdrovend en complex proces. Docenten moeten veranderingen doorvoeren in hun onderwijsstijl en materialen voor het vak. Het veranderen van een onderwijsmethode is uitdagend voor docenten (Ertmer & Simons, 2006; Kaufman & Holmes, 1996) en kan (zeker in het begin) leiden tot frustratie en ontevredenheid (hoofdstuk 2). De vergelijkingsstudies in hoofdstuk 3 en 4 includeerden PGO studenten uit de *eerste* PGO lichting binnen de Erasmus School of Law. Complicaties met betrekking tot de uitvoering van PGO kunnen vooral in het beginstadium van de invoering van een nieuwe onderwijsmethode voorkomen, aangezien alles nieuw is voor zowel docenten als studenten.

PRAKTISCHE RELEVANTIE EN AANBEVELINGEN

Uit de resultaten is gebleken dat externe factoren een rol spelen tijdens het leerproces en dat studenten bepaalde elementen binnen PGO als 'controlerend' ervaren. Ook blijkt dat bepaalde uitgangspunten van PGO soms niet optimaal doorgevoerd zijn (bijvoorbeeld zich beperken tot het opsommen van literatuur in de nabespreking). PGO in de praktijk lijkt dus niet altijd in lijn te zijn met de ideeën en principes van PGO in theorie, zoals ook omschreven in het artikel van Moust et al. (2005). We geven een aantal specifieke aanbevelingen om de verdere invoering van PGO en de studievoortgang te optimaliseren.

Een eerste aanbeveling is dat tutoren in de onderwijsgroep de toepassing van kennis meer zouden moeten benadrukken in de nabesprekingen van PGO. Tijdens de nabespreking moet de focus in eerste instantie liggen op de leerdoelen en de vragen die daaruit voortvloeien en op het combineren van verschillende literatuurbronnen. Daarbij zouden studenten de geleerde kennis altijd moeten relateren aan het probleem dat als startpunt diende in de voorbespreking. Als dit niet automatisch gebeurt, kan de tutor helpen om dit te bewerkstelligen. De tutor kan dan refereren aan het beschreven probleem en verschillende scenario's op de situatie beschreven in het probleem aandragen met de vraag hoe studenten die kunnen verklaren met de bestudeerde literatuur.

Een tweede aanbeveling is in tentamens meer toepassingstaken te verwerken en het aantal toepassingstaken te laten toenemen over de jaren van het programma. Het toepassen van kennis is een belangrijke vaardigheid die afgestudeerde juristen nodig hebben wanneer zij gaan werken in de praktijk. De PGO methode stimuleert het werken in realistische context en dus het toepassen van kennis in praktijksituaties. Uit de meta-analyse van Gijbels et al. (2005) kwam naar voren dat PGO studenten hier beter in zijn ten opzichte van studenten in meer traditionele onderwijsmethodes. Door bij de toetsing

meer nadruk te leggen op toepassing van kennis zullen studenten waarschijnlijk meer diepe verwerkingsstrategieën gebruiken.

Een derde en laatste aanbeveling is gebaseerd op de bevindingen uit hoofdstuk 7. Studenten die een grotere kans hebben om hun bachelordiploma niet te behalen binnen vier jaar kunnen vroegtijdig geïdentificeerd worden. Het behaalde gemiddelde pre-universitaire cijfer en professioneel gedrag in het eerste jaar blijken belangrijke voorspellers van studievoortgang binnen het PGO curriculum te zijn. Studenten die hier laag op scoren zouden al vanaf het begin van de opleiding begeleiding kunnen krijgen in hoe zij efficiënt en effectief kunnen studeren. Hopelijk zal dat bijdragen aan de studieprestaties en de studievoortgang.

Sterktes en zwaktes van de studies en suggesties voor vervolgonderzoek

De studies in dit proefschrift zijn de eerste die betrekking hebben op PGO binnen rechtenopleidingen. De uitkomsten van deze studies leveren daarom een belangrijke bijdrage aan reeds bestaande onderzoeksliteratuur. Het merendeel daarvan is uitgevoerd binnen het medisch onderwijs. Om resultaten van die eerdere onderzoeken te generaliseren, is het nodig studies te repliceren in verschillende vakgebieden.

In de tweede plaats hebben de studies in dit proefschrift een brede variatie, zowel met betrekking tot de gebuikte designs als de gebruikte analysemethoden. Tevens zijn de studies vernieuwend ten opzichte van bestaande onderzoeken. Het onderzoek bevat vergelijkingsstudies, een longitudinaal onderzoek en een experimentele studie. In hoofdstuk 3 is een mixed-method design toegepast. Resultaten van de kwantitatieve studie in dit hoofdstuk werden aangevuld met een kwalitatieve studie. Het longitudinale design dat hoofdstuk 5 presenteert is uniek omdat longitudinaal onderzoek zelden toegepast is in PGO onderzoek. Binnen PGO onderzoek is er in het algemeen een gebrek aan experimentele studies (Kirschner, Sweller, & Clark, 2006). Hoofdstuk 6 bevat wel zo'n experimentele studie, waarin verschillende factoren onder controle gehouden worden, zoals de bestudeerde materie en de instructeur. De studie beschreven in hoofdstuk 7 bevat een cohortvergelijking tussen studenten in het traditionele programma en het PGO programma binnen de Erasmus School of Law op studievoortgang en de voorspellers daarvan. Een soortgelijke studie was nog niet eerder uitgevoerd.

De studies in dit proefschrift zijn een eerste poging om te toetsen of positieve invloeden van PGO die eerder zijn aangetoond in vooral het medisch onderwijs ook gevonden worden bij rechtenstudies. Er is echter meer onderzoek nodig om de bevindingen uit onze studies verder te generaliseren. Er kleefden daaraan namelijk ook verschillende beperkingen. Een eerste belangrijke beperking van de studies naar de invloed van PGO is dat de invoering daarvan gelijktijdig plaatsvond met de invoering van het nieuwe examensysteem "Nominaal is Normaal". Daardoor is het lastig definitieve conclusies te trekken ten aanzien van de vraag waaraan verbeteringen in leerstrategieën en in

studieprestaties zijn toe te schrijven. Qua didactische principes sluiten PGO en "Nominaal is Normaal" overigens goed op elkaar aan. Beide hebben tot doel dat de student regelmatig en hard studeert, en beide streven ernaar uitstelgedrag (procrastinatie) van studenten terug te dringen.

In de tweede plaats zijn alle studies uitgevoerd in een PGO curriculum van één Faculteit binnen één universiteit. De uitkomsten van onze studies zouden verder gegeneraliseerd kunnen worden als ook andere rechtenopleidingen in Nederland, Europa of de wereld gebruik zouden gaan maken van PGO en bereid zouden zijn mee te werken aan onderzoek naar de effecten daarvan.

In de derde plaats zou er in vervolgonderzoek meer nadruk kunnen komen op ontwikkeling binnen PGO over langere tijd in plaats van vergelijkingen tussen cohorten. Te denken valt aan onderzoek waarbij vergelijkingen binnen bachelorcohorten van in totaal drie jaar gemaakt worden, en niet alleen tussen cohorten, zoals de meeste studies in dit proefschrift. Er valt dan meer te zeggen over de voortgang van een specifiek cohort. Tussen studenten van verschillende cohorten kunnen namelijk ook anderen factoren meespelen, zoals op voorhand bestaande verschillen tussen de studentgroepen.

Een vierde beperking is dat de studies over studieprocessen, motivatie en leerstrategieën, in hoofdstuk 3, 4 en 5, met name gebruik is gemaakt van zelfrapportages. De belangrijkste reden voor deze keuze is dat studieprocessen moeilijk te observeren zijn. Het gebruik van zelfrapportages brengt het risico met zich mee dat studenten sociaal wenselijk antwoorden. We bevelen aan om in toekomstig onderzoek naar studieprocessen ofwel meer van objectieve methoden gebruik te maken, ofwel om de resultaten aan te vullen met kwalitatieve data om zo een beter beeld te creëren van de resultaten (zoals ook gedaan is in hoofdstuk 3).

De laatste beperking heeft betrekking op het volgende. In het merendeel van de studies in dit proefschrift zijn vergelijkingen gemaakt tussen het traditionele onderwijsprogramma waarbij vooral hoorcolleges werden gegeven, en het nieuwe PGO programma binnen de Erasmus School of Law. Ook in de experimentele studie zijn de instructies in de vorm van college en PGO tegenover elkaar gezet. In de praktijk van het academisch onderwijs worden beide didactische methoden echter dikwijls in aanvulling op elkaar gebruikt. De resultaten uit hoofdstuk 6 toonden aan dat het gemengd gebruik van beide onderwijsvormen nuttig kan zijn voor prestaties op verschillende typen toetsen. Hoorcolleges bleken vooral effectief voor de verwerving van feitenkennis, PGO bleek effectief voor de toepassing van kennisvragen. In toekomstig onderzoek zou daarom niet enkel aandacht moeten zijn voor de *vergelijking* tussen PGO en traditioneel onderwijs, maar de nadruk zou moeten liggen op factoren die verbeterd kunnen worden binnen een onderwijsmethode waarin PGO en hoorcolleges gecombineerd worden.

D

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CURRICULUM VITAE

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PUBLICATIONS

Wijnen, M., Loyens, S. M. M., & Schaap, L. (2015). Experimental evidence of the relative effectiveness of problem-based learning for knowledge acquisition and retention. *Interactive Learning Environments*. doi: 10.1080/10494820.2015.1060504.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2016). Comparing problem-based learning students to students in a lecture-based curriculum: learning strategies and the relation with self-study time. *European Journal of Psychology of Education*. doi: 10.1007/s10212-016-0296-7.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M. J., & Van der Molen, H. G. (2017). Special Issue: Competency Orientation in Problem-Based Learning: Students' and Teachers' Experiences with the Implementation of Problem-Based Learning at a University Law School. *Interdisciplinary Journal of Problem-based Learning*. doi: 10.7771/1541-5015.1681

Wijnen, M., Loyens, S. M. M., Wijnia, L., Smeets, G., Kroeze, M. J., & Van der Molen, H. G. (2018). Is Problem-Based Learning Associated with Students' Motivation? A Quantitative and Qualitative Study. *Learning Environments Research*. doi: 10.1007/s10984-017-9246-9

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (submitted). A Longitudinal Study on the Development of Law Students' Learning Strategies in Problem-Based Learning and the Relation with Assessment and Academic Performance.

PRESENTATIONS

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2015, July). *The Influence of Problem-Based Learning on Law Students' Learning Strategies*. Paper presented at International Research Symposium in PBL, San Sebastian, Spain.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2016, April). *Does Problem-Based Learning influences students' motivation? A quantitative and qualitative study*. Paper presented at American Education Research Association, Washington D.C.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2016, May). *De invloed van probleemgestuurd onderwijs op motivatie. Een kwantitatieve en kwalitatieve studie*. In G. Smeets (chair), Curriculumwijzigingen in het hoger onderwijs: naar een

evidence-based benadering. Symposium conducted at the Onderwijs Research Dagen, Rotterdam.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2016, May). *Toetsing in Hoger Onderwijs: een probleemgestuurde workshop*. Workshop conducted at the Onderwijs Research Dagen, Rotterdam.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2016, June). *What do you think of problem-based learning? Teachers' and students' experiences with the implementation of problem-based learning in a university law program*. Paper presented at the Conference of Problem-based Learning, Zurich, Switzerland.

Wijnen, M., Loyens, S. M. M., Smeets, G., Kroeze, M., & Van der Molen, H. (2017, April). *A Longitudinal Study on the Development of Law Students' Learning Strategies in Problem-Based Learning and the Relation with Assessment and Academic Performance*. Paper presented at American Education Research Association, San Antonio, Texas.

ICO DISSERTATION SERIES

348. Jansen in de Wal, J. (18-11-2016). Secondary school teachers' motivation for professional learning. Heerlen: Open University of the Netherlands.

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