

Performance of the Seven-step Procedure in Problem-based Hospitality Management Education

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ABSTRACT

The study focuses on the seven-step procedure (SSP) in problem-based learning (PBL). The way students apply the seven-step procedure will help us understand how students work in a problem-based learning curriculum. So far, little is known about how students rate the performance and importance of the different steps, the amount of time they spend on each step and the perceived quality of execution of the procedure. A survey was administered to a sample of 101 students enrolled in a problem-based hospitality management program. Results show that students consider step 6 (Collect additional information outside the group) to be most important. The highest performance-rating is for step two (Define the problem) and the lowest for step four (Draw a systemic inventory of explanations from step three). Step seven is classified as low in performance and high in importance implicating urgent attention. The average amount of time spent on the seven steps is 133 minutes with the largest part of the time spent on self-study outside the group (42 minutes). The assessment of the execution of a set of specific guidelines (the Blue Card) did not completely match with the overall performance ratings for the seven steps. The SSP could be improved by reducing the number of steps and incorporating more attention to group dynamics.

Keywords: Seven-step procedure, problem-based learning, hospitality management education.

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INTRODUCTION

In the past decades, higher education has introduced educational approaches in which students are involved in active, self-regulated, collaborative and constructive learning. The adoption of a social constructivist conception of education has brought about a shift of focus from teaching to learning. Problem-based learning is an approach to education that is generally seen as emblematical of social constructivist conceptions of education. Characteristic for problem-based learning is that students learn in small groups by collaboratively solving problems and working on unstructured tasks. Experiences with the facilitation of the learning processes in problem-based learning by tutors have shown differences and difficulties in structuring and coaching the process. Therefore, Schmidt (1982; 1983) introduced the seven-step procedure as a scaffold for PBL in order to help structure the explanation of underlying phenomena and processes, and the elaboration on knowledge to gain deeper understanding of the problem. In the PBL-process knowledge acquisition and knowledge application are integrated. Several authors have described the rationale and the different steps of the seven-step procedure (De Boer & Den Dulk, 2009; Dochy, Segers, Van den Bossche, & Struyven, 2005; Moust, Bouhuys, & Schmidt, 2007; Schmidt, 1982; 1983; Williams, 1992; Authors, 2010; 2012; 2014). The seven-step procedure structures the cumulative process of knowledge building in PBL-sessions and positively influences student achievement (Hmelo-Silver, 2004; Taylor & Miflin, 2008; Yew, Chng, & Schmidt, 2011; Yew & Schmidt, 2012). In this study of a problem-based hospitality management program we are interested in how students rate the performance and execution of the seven-step procedure in problem-based learning in general, and each of the seven steps of the procedure separately. The execution of the seven-step procedure can be problematic because many students have little prior experience in a systematic approach to problem-solving. Therefore, the ‘blue card’ with short explanations of every step of the seven-step procedure was introduced as a learning aid, and we study how students apply the blue card.

INTRODUCING THE SEVEN-STEP MODEL

Step 1: Clarify terms and concepts not readily comprehensible

The first step of the seven-step procedure confronts students with a real-life problem. Students have to carefully read the problem, must be able to paraphrase the problem, and summarize the problem in their own words. It is essential that students identify relevant concepts and facts. The students have to understand and agree on the core issues and concepts. When students have little prior knowledge relevant to solving the problem or if concepts and terms are subject to different interpretations, students have to make a working list in which they explicitly state what is known and what is unknown about the problem.

It is essential that the tasks that are used in problem-based learning are of a high quality to stimulate students' interest in the subject matter, increase time spent on self-study, and impact achievement (Norman & Schmidt, 2000; Van Berkel & Schmidt, 2000). An example of a PBL-task is shown below.

PBL task: The lures and limits of leverage.

Corine is the 37-year old CFO of a Dutch hotel chain called "The Windmill Hotels Group" (WHG) which is operating 58 hotels in the EMEA region. She is preparing for next week's shareholders meeting and checking the latest update on the financial performance of the company. The company is considering expansion to Asia and will need a substantial amount of capital to do so. Figures show that the leverage of the WHG is considerably higher than for their major Asian competitor "The Asian Hotel Consortium" (AHC).

She wonders how the leverage might affect the price-earnings ratio of the shareholders and the perceived attractiveness to invest in WHG. How much dividend should she pay the shareholders? Or should she rather retain the earnings for the expansion plans?

Step 2: Define the problem

By sharing their ideas, understandings, and knowledge about the problem and its interrelated phenomena, students construct a common understanding of the problem. The students define the exact nature of the problem and agree upon the phenomena that have to be explained.

Step 3: Analyze the problem

Based on the often incomplete information in the problem description students activate their prior knowledge, and use their thinking and problem solving skills to elaborate on the contents of the task. In a round of free association they can express ideas, thoughts, questions, opinions, concepts, and hypotheses about the problem and its underlying mechanisms. Brainstorming techniques are often used for the generation of ideas. Students are encouraged to freely express themselves and to avoid criticism and discussion about the quality of ideas while brainstorming. The main objective of the analyzing phase is twofold. First, students engage in a creative process that enables them to generate a list with a wide variety of facts, ideas and concepts. Second, after ideas have been generated, students explain and discuss the ideas, and ask critical questions to assess the quality of ideas. Inadequate execution of step three results in poor and superficial problem analysis with little elaboration on prior knowledge (De Grave, Boshuizen, & Schmidt, 1996; Moust, Van Berkel, & Schmidt, 2005).

Step 4: Draw a systemic inventory of the explanations inferred from step 3

Collaboration in PBL-groups is important because students have to develop a common understanding of the problem not only at the individual level but also on the group level. Different viewpoints and interpretations must be discussed, interrelated, and negotiated to attain shared conceptions and a shared mental model, which functions as a context for future communication, collaboration, and joint activities (Akkerman, Van den Bossche, Admiraal,

Gijselaers, Segers, Simons, & Kirschner, 2007). Unlike the unstructured process of ideas generation, the systematic inventory in step four provides a structure for the problem analysis that took place in the previous step of the seven-step procedure. The various explanations of the problem are placed in a systematic inventory.

Concept mapping, a graphical tool that promotes conceptual thinking and understanding, has been introduced to improve student learning in problem-based learning (Addae, Wilson, & Carrington, 2012; Hsu, 2004; Johnstone & Otis, 2006; Kassab & Hussain, 2010; Rendas, Fonseca, & Rosado Pinto, 2006; Authors, 2012). Notwithstanding promising experiences with concept mapping, research on the implementation of concept mapping in problem-based learning has not yet shown convincing empirical evidence.

Step 5: Formulate learning issues

In the previous steps, the students have formulated what they already know about the problem, have generated ideas, and made a systematic inventory of possible explanations. In step five, students formulate learning issues that will guide learning outside the PBL-tutorial. These learning issues emerge in the PBL-tutorial through discussion and negotiation. Three conditions for learning issues must be met: ‘there must be a recognizable knowledge deficiency, the students must see the missing knowledge as relevant to or necessary for the eventual practice, and, finally, there must be consensus about the timelines of undertaking the study’ (Koschmann, Glenn, & Conlee, 1997, p. 2). Van den Hurk, Dolmans, Wolfhagen, and Van der Vleuten (1998) formulated three criteria for student generated learning issues in step five of the seven-step procedure. A proper learning issue: 1. should contain keywords; 2. include a concise description of the main aspects of the learning topics; 3. should be understood regarding purpose and content by all members of the PBL-group.

Several studies show that a considerable percentage of task-constructor’s preset learning objectives were not identified by the students in the PBL-sessions. Dolmans, Gijselaers, Schmidt, & Van der Meer (1993) listed three characteristics of these mismatches:

1. the objectives were related to the curriculum but not specifically to the problem in question;
2. the objectives were covered by more than one problem;
3. psychological and social objectives (in a medical curriculum) were often not detected.

Moreover, Dolmans, Schmidt & Gijselaers (1995) could not confirm that the student-generated learning issues were used as the major factor influencing students’ self-study activities. Self-study activities can also be influenced by the availability and selection of resources, course objectives, tutor interventions, additional lectures, and assessment procedures.

Step 6: Collect additional information outside the group

Students are supposed to search for relevant literature from a diversity of sources. The library is an important source of information and the e-library provides access to databases, e-journals, e-dictionaries, and e-books which facilitates the search for relevant literature. The quality and reliability of other Internet sources is not always evident. Moreover, experts inside and outside the university can be consulted to get additional information. The students select and study literature that they consider worthwhile for attaining their learning goals. The time available for individual study is a decisive factor for graduation rates and study duration (Schmidt, Cohen-Schotanus, Van der Molen, Splinter, Bulte, Holdrinet, & Van Rossum, 2010). It is essential that tutors, who facilitate PBL-tutorials, emphasize the importance of self-study to the students, set norms for the amount of time and effort students should devote to self-study, and give feedback to the students about the level of learning and knowledge (Nuutila, Törmä, & Malmi, 2005). Musal, Gursel, Taskiran, Ozan, and Tuna (2004) found that first-year medical students spent more time on self-study than third-year students. First-year students generally restrict themselves to the learning issues that were agreed upon in step five, while senior students use the guidelines in a more flexible manner and tend to follow their own learning interests. Students who study beyond the learning objectives spend more time on self-study and gain better results on knowledge tests (Van den Hurk, Wolfhagen, Dolmans, & Van der Vleuten, 1999; 2001).

In a problem-based curriculum, effective and efficient allocation of time for instruction is necessary to allow for sufficient self-study time. The total time that students want to invest in (medical) education generally does not exceed 37 hours per week (Gijselaers & Schmidt, 1995). Whereas time for instruction and time for self-study is limited, the question arises how much time must be allocated for instruction in relation to self-study time to maximize the total time students spend on studying. The restricted total time students are expected and willing to spend on education implies that there is a trade-off between the time for instruction and self-study time whereby an increase in time for instruction over 10 to 12 hours per week is associated with a decrease in time spent on self-study (Gijselaers & Schmidt, 1993, 1995; Torenbeek, Jansen, & Suhre, 2013). Curriculum activities that reduce the time for self-study negatively influence graduation rates and extend study duration (Schmidt et al, 2010).

Step 7: Synthesize and test the newly acquired information

After the individual research and self-study, the newly acquired knowledge is shared and discussed with the other group members. The students relate the acquired knowledge to the problem and evaluate what they have learnt from the problem, which helps them to apply their knowledge to other problems. The individual study of relevant information in preparation to the reporting phase influences the breadth and depth of discussion in the reporting phase (Van den Hurk, Dolmans, Wolfhagen, Muijtjens, & Van der Vleuten, 1999). When students don't spend enough time on literature search, study the same literature, restrict themselves to

the learning issues, and don't study beyond the issue in question, it does not come as a surprise that they have little to discuss and that elaboration and synthesizing of knowledge is insufficient. The necessary synthesis and integration of knowledge in step seven is often reduced by the students to reporting findings without any discussion or reflection on the newly required information (Moust, Van Berkel, & Schmidt, 2005).

Research by Visschers-Pleijers, Dolmans, De Grave, Wolfhagen, Jacobs, and Van der Vleuten (2006) using focus group interviews of 48 undergraduate students about their perception of factors that contribute to the effectiveness of the reporting phase yielded four main characteristics:

1. Giving and receiving explanations.

Students explain the findings in their own words, discuss these findings, check information and interpretations, and receive feedback from one another. The tutor plays a significant role in giving just-in-time and just-enough guidance to further students' in-depth discussion of learning content.

2. Integrating and applying knowledge.

Structured discussions, summary of information, and explanations of the relations with the prior phases contribute to further understanding and integration of knowledge. Relating theory to practice by giving examples and exploring problems of the same kind fosters broader understanding of learning contents.

3. Discussing unclear information and expressing opinions.

As students find and study from diverse literature sources discussions about diverging views and different interpretations may lead to improved integration of information and deeper understanding of learning contents.

4. Guiding and monitoring the discussions in the PBL-tutorial.

The tutor and the chairperson of the PBL-tutorial guide the discussions and the group process to allow for active participation of all group members. Giving and receiving feedback both on the contribution to the group process and the contents of the discussions are essential for sharing information and reaching consensus on the main learning contents. The creation of a safe learning environment is important to deal with conflicts about knowledge issues. Most of the study time in the reporting and discussion phase is spent on cumulative reasoning, a learning-oriented interaction leading to consensus on knowledge, without much challenging of mutual contributions. On average 7% of the time in the PBL-tutorial was spent on conflicts and evaluations of knowledge that were beneficial for gaining understanding (Visschers-Pleijers, Dolmans, De Leng, Wolfhagen, & Van der Vleuten, 2006).

PROBLEM STATEMENT AND RESEARCH QUESTIONS

The main goal of this study is to generate an overview of student perceptions about the way each of the seven steps is executed in the sessions they have experienced so far. The problem statement is: How do students appreciate the performance and execution of the seven-step procedure in problem-based learning?

The following research questions will be addressed:

1. How do students rate the performance of the seven-step procedure?
2. How do students rate the importance of the seven-step procedure?
3. How much time do students spend on each of the separate steps?
4. How do students assess the application of the blue card?

METHOD

Context of the study

Students of the Hotel Management School of a University of Applied Sciences in the Netherlands participated in this study. The hotel school was the first school of the university to implement problem-based learning in 1987. The curriculum can be characterized as a hybrid PBL-curriculum indicating that problem-based learning is supported by other, often more teacher-oriented, educational methods like lectures and workshops to support students' learning.

Problem-based learning is integrated in all four thematic-interdisciplinary modules in the first three years of the Bachelor program. The PBL-groups consist of twelve students and meet twice a week for 90 minutes in PBL-tutorials. A real-life PBL-task is used as a stimulus for the learning process in the PBL-tutorial.

Sampling and data collection

Five tutors allowed us to administer a survey to six first-year tutorials in the module "Guest Experience", three second-year workshops in the module "Operations Design", and three third-year tutorials in the module "Strategic Hospitality Management". All data were collected in the final week of a module at the beginning of the PBL-tutorials and workshops. On average the students spent about 15 minutes to fill out the questionnaire. The students participated voluntarily and received no incentives or compensation for their participation.

In total 101 students participated in the study. Students were from different years of study: 47 first-year students, 35 second-year students, and 19 third-year students. Most of the students were female (71.3%). The age of the respondents ranged from 17 to 29 with a Mean of 20.31

(SD = 2.13). In the sample 79.2% of the students are from the Netherlands and the international students come from Germany, China, Ukraine, Thailand and Bulgaria.

Instrumentation

The survey consists of three sections. Section one includes three blocks: (a) rating the importance by dividing 100 points over the seven steps; (b) rating of the performance (= perceived quality of execution) of each of the steps using a report mark (1 = poor; 10 = excellent); (c) estimating how much time is spent on each of the seven steps. In section two, subjects are asked to provide an overall mark on each of the following three issues: problem-based learning, the seven-step procedure and the Blue Card. Section three contains 27 statements derived from the Blue card and related to the execution of each of the seven steps.

Data analyses

For the three blocks in section one, descriptive statistics will be provided and the performance and importance scores will be combined into an Importance-Performance Matrix. Section two will be analyzed using the mean and standard deviation for each of the ratings. Finally, we will compare the performance scores from section one (report marks) with the performance scores from section three (Blue Card).

RESULTS

Importance, performance and time

Students divided 100 points over the seven steps (with a minimum of one point per step) to measure the relative importance of each of the seven steps. As shown in table 1, students consider step six (collect additional information outside the group) to be the most important step, while step one (clarify terms and concepts) is lowest in the ranking.

	Mean	SD
<i>Step 6: Collect additional information outside the group</i>	17.42	7.80
<i>Step 5: Formulate learning issues</i>	15.86	6.99
<i>Step 2: Define the problem</i>	15.34	7.17
<i>Step 3: Analyze the problem</i>	15.30	5.75
<i>Step 7: Synthesize and test the newly acquired information</i>	14.38	6.78
<i>Step 4: Draw a systemic inventory of explanations from step 3</i>	11.31	5.06
<i>Step 1: Clarify terms and concepts not readily comprehensible</i>	10.46	6.21

Table 1: Importance of the seven steps (n = 101).

As shown in table 2 the quality of performance for each of the steps using a report mark from 1 to 10 ranges from 6.43 (step four) to 7.08 (step two).

	Mean	SD
<i>Step 2: Define the problem</i>	7.08	1.25
<i>Step 5: Formulate learning issues</i>	7.00	1.45
<i>Step 3: Analyze the problem</i>	7.00	1.28
<i>Step 6: Collect additional information outside the group</i>	6.93	1.75
<i>Step 7: Synthesize and test the newly acquired information</i>	6.73	1.61
<i>Step 1: Clarify terms and concepts not readily comprehensible</i>	6.61	1.50
<i>Step 4: Draw a systemic inventory of explanations from step 3</i>	6.43	1.37

Table 2: Performance of the seven steps (n = 101)

The combination of the performance and importance scores in an Importance-Performance matrix (table 3) shows that four of the seven steps are classified high on performance and importance, two steps are qualified as low performance and low importance, and step seven is classified as low in performance and high in importance. The high importance-low performance cell of the matrix is generally considered as an issue needing immediate attention.

	High Performance (> 6.83)	Low Performance (< 6.83)
High Importance (> 14.29)	Step 2 , Step 3, Step 5, Step 6	Step 7
Low Importance (< 14.29)		Step 1, Step 4

Table 3: Importance-Performance Matrix.

In table 4, the total amount of time spent on the seven steps adds up to about 133 minutes. The largest amount of time is spent on self-study outside the group ($M = 42$ minutes) and the smallest amount on step one ($M = 8$ minutes).

	Min	Max	Mean	SD
Step 6: Collect additional information outside the group	0	150	42.05	40.63
Step 7: Synthesize and test the newly acquired information	0	90	25.82	21.66
Step 5: Formulate learning issues	5	60	16.69	8.09
Step 3: Analyze the problem	5	40	15.41	7.56
Step 4: Draw a systemic inventory of explanations from step 3	5	50	15.35	7.39
Step 2: Define the problem	3	30	11.11	4.88
Step 1: Clarify terms and concepts not readily comprehensible	2	20	8.09	3.62

Table 4: Time spent on each of the seven steps (n = 101).

Overall mark for problem-based learning, seven-step procedure and Blue Card

In table 5, the overall mark for problem-based learning, the seven-step procedure and the Blue Card are shown.

	Year 1	Year 2	Year 3	Overall	SD
PBL	7.85	7.00	7.32	7.45	1.28
Seven-step procedure	6.98	6.97	5.58	6.71	1.18
Blue Card	6.65	7.06	5.47	6.57	1.70

Table 5: Overall report mark for problem-based-learning, seven-step procedure and Blue Card (n = 101)

ANOVA shows significant differences between the three years regarding their rating of problem-based learning ($F_{2,96} = 4.768$; $p = .011$), the seven-step procedure ($F_{2,96} = 13.477$; $p = .000$) and the Blue Card ($F_{2,96} = 5.931$; $p = .004$). The more senior students have a lower appreciation for PBL, the seven-step procedure and the Blue Card. This is also reflected in the significantly negative correlation of the three variables with the amount of credits earned. No significant differences in ratings of PBL, seven-step procedure, and Blue Card were detected between males and females or different nationalities.

Perceived application of Blue Card guidelines

In the last section of the survey, students were asked to indicate to what extend they agreed with the guidelines in the Blue Card. The aggregate means per step in table 6 shows the following ranking of perceived performance: step 2 (M = 3.99), step 1 (M = 3.82), step 3 (M = 3.81), step 5 (M = 3.56), step 4 (M = 3.27), step 6 (M = 3.25) and step 7 (M = 3.09).

	Mean	SD
Step 1: Clarify terms and concepts not readily comprehensible	3.82	.59
Step 2: Define the problem	3.99	.49
Step 3: Analyze the problem	3.81	.66
Step 4: Draw a systemic inventory of explanations from step 3	3.27	.74
Step 5: Formulate learning issues	3.56	.49
Step 6: Collect additional information outside the group	3.25	.67
Step 7: Synthesize and test the newly acquired information	3.09	.56

Table 6: Perceived application of Blue Card guidelines (n = 101)

The ranking of the perceived performance of the seven steps in table 6 does not match the one listed in table 2.

DISCUSSION

The main goal of this study was to investigate how students apply the seven-step procedure in problem-based learning because the execution of the seven-step procedure reflects the way students learn in a problem-based curriculum. If students interpret or apply the procedure in the wrong way, or spend insufficient time on critical steps in the process, that will harm the amount and quality of learning by the group members.

Performance of the seven-step procedure was measured by an overall mark for each of the seven steps and by 27 statements about the perceived application of Blue Card guidelines. The ranking of the seven steps in both approaches did not exactly match. This raises the question about the concurrent validity of the two measurements, which could be investigated by a sample of PBL-groups assessing one single PBL-session with both instruments.

The total amount of time spent per task ($M=133$ minutes) is way below the overall targeted figure of 400 minutes per task. Especially the limited amount of time ($M=42$ minutes) students spend on self-study in step six leaves a lot to be desired. Therefore, tutors could pay more attention to the quality of the execution of steps five, six and seven of the seven-step procedure. What learning goals do students formulate and is it clear to all students how much study time they need to spend on self-directed study? The focus of step seven should rather be on discussion of the findings and elaboration on knowledge than on just reporting. That will enhance not only the amount of active self-study time but also the opportunities for deep learning instead of surface learning.

Students experience difficulties with step four of the seven-step procedure. Both the importance and performance scores on step four are low. Students often don't seem to grasp the essence of step four and find it difficult to critically review and systemize the diverse ideas and explanations into a conceptual framework. Recently, we introduced concept mapping in step four to restructure the prior knowledge of the students by visualizing the relations between the various concepts. As the problems with step four persist, more research is needed to determine the format and conditions that would make concept mapping a useful operationalization of step four in the seven step procedure (Authors, 2012).

The Importance-Performance matrix showed that step seven (Synthesize and test newly acquired information) was classified as an important but underperforming part of the procedure. Although students spent on average 26 minutes per task on this step they rank it fifth in the Performance rating ($M = 6,73$) and last using the Blue Card guidelines. Since the Importance-Performance matrix was based on a relative norm we should be careful with the interpretation of the position of the different steps in the matrix. Although the mean score for step 7 ($M = 6.73$) falls below the aggregate mean of all seven steps ($M = 6.83$), the mark is far from insufficient.

When looking at the description of step 7 (*Synthesize and test the newly acquired information*) our personal experiences as a tutor in problem-based learning do confirm the weak performance of step 7. Students tend to report what they conceive of as the ‘answers’ to the learning goals, mostly relying on and limiting themselves to the basic textbooks, uncritically quoting sources, hardly ever asking for explications from other group members, never formulating additional learning goals, and never redrawing, adapting, expanding or elaborating on the conceptual map if any was developed in step 4. Linking the task to other problems in the module and making the connection to the module theme or module objectives is a great exception and not the rule. In order to improve the execution of step 7 we recommend to pay more attention to conceptualization, integration, critical evaluation and generalization of student contributions. It is clear that improvement of student performance on step seven should be given priority.

IMPLICATIONS AND RECOMMENDATIONS

The seven-step procedure seems to be primarily focused on what might be called the task-oriented dimension of problem-based learning and less on the group-oriented or social dimension. The seven-step procedure deals with cognitive and constructive learning from problems but offers little support for collaborative and self-directed learning. Our experiences with problem-based learning support the need for adaptation and extension of the seven-step procedure that would include tools for managing and monitoring group dynamics and the social dimension of the PBL-process. Students experience how difficult it can be to collaborate with one another in PBL-tutorials and how group dynamics may influence learning processes. More attention could be given to the social learning dimension by providing training for the PBL-tutors and students in productive collaboration and in diagnosing and managing group dynamics.

One of the difficulties in applying the seven-step procedure is distinguishing and managing the individual steps. Discussions in the PBL-tutorials do not always follow the sequence of the seven-step procedure. For instance, when in step one of the seven-step procedure a difficult concept that needs explanation is encountered, students tend to immediately translate that into a learning goal. Moreover, it is not always clear in which step of the seven-step procedure the discussion is. There seems to be a substantial overlap or interaction between the first five steps. Reducing the seven steps to three phases might be helpful. Research on the problem-based learning process often distinguishes three cyclical learning phases (Hmelo-Silver, 2004; Taylor & Miflin, 2008; Yew, Chng, & Schmidt, 2011):

Phase 1. The problem analysis phase with emphasis on orientation, task analysis, conceptualisation and goal setting (step one to five of the seven step procedure).

Phase 2. The self-directed study phase regards the collection of additional information outside the PBL-group and the individual study (step six of the seven-step procedure).

Phase 3. The discussion phase focusing on the reporting of findings, discussions, reflection, evaluation, and restructuring of information and knowledge (step seven of the seven-step procedure).

Next to the traditional seven-step procedure an e-PBL five-step model and a seven-step Optima model have been developed to provide more explicit scaffolding (Rienties, Giesbers, Tempelaar, Lygo-Baker, Segers, & Gijselaers, 2012). The Blue Card is used in this study to support problem-based learning as a scaffolding tool. However, the explicit use of the Blue Card as a guide for the seven-step procedure may be too restrictive for students who are able to study more autonomously. This study shows that third-year students have a relatively low appreciation for the seven-step procedure and the blue card which may indicate that they have become self-directed learners who's autonomy and freedom by using the Blue Card may become too limited which may have negative consequences for their motivation and contribution to collaborative learning in PBL-tutorials, while first-year students who often have more conventional conceptions about education might need even more support and guidance.

Balancing the amount of scaffolding and the need for autonomy differs over the years of study. Students in the third year value the use of the seven-step procedure and the Blue Card significantly lower than students in the first and second year. These students may need more freedom for pursuing individual learning goals and less scaffolding and guidance. The aim of successful scaffolding is to find a dynamic balance between learning autonomy and guidance to further self-directed, constructive and collaborative learning in the consecutive phases of curriculum. For senior students less structure and guidance, and more complex and challenging problems and cases might be indicated. Senior students can be challenged to go beyond a pre-structured procedure and find new and creative ways with more flexible scaffolding for dealing with problems (Wijnia, Loyens, & Derous, 2011). Instead of a ritualistic application of the seven-step procedure with marginal problem analysis, little studying beyond the learning goals, and spending less than half of the allocated study time outside the PBL-tutorials, students should be challenged to spend time and energy on profound problem analyses, studying beyond the learning goals, search for new information to attain in-depth knowledge by discussing the findings and evaluating the results in the PBL-tutorials (Segers & Dochy, 2001).

The seven-step procedure was developed at the beginning of the computer era when students were still largely dependent on books and journals in a library. Developments in information technology have made it possible to access information anytime and anywhere. How students search for relevant and reliable information outside the PBL-tutorial in step six of the seven-

step procedure could be supported by sophisticated and state-of-the-art digital information facilities to enhance the quality of self-directed learning.

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