

The problem with the problem – on student orientation in an advanced problem based teaching and learning¹

Friedhelm Eicker (fe@eicker-bbw.de), Christoph Bohne (cb@eicker-bbw.de),
Gesine Haseloff (haseloff.tvd@uni-siegen.de)

Abstract

Problem based education is not always desirable and does not lead to a good student orientation automatically. Rather, pivotal elements, the quality of the problems and the type of solution of the problems matter. The problems must contain pivotal tasks of prospective activities of the students. The students must be addressed by the problems. In vocational education, the problems must contain pivotal tasks of the prospective vocational activities of the students. The problems must invite the students to acquire a competence, namely shaping competence, by finding a solution more or less on their own and under consideration of possible alternative solutions. This will not only lead to the acquisition of information/knowledge/skills. Furthermore, it will not only lead to the ability to more or less skilfully combine information/knowledge/skills. Alone or in a group, the students must learn how to define and solve real problems of their everyday life and of their work life meaningfully and they need to justify the solution on their own. In this respect, the students need guidance and support. This article delineates and justifies an advanced problem based teaching and learning (PBL). Especially the requirements for a problem and the student orientation will be discussed. An adequate learning project will be described and discussed.

Key words

Problem based teaching and learning (PBL), student orientation, shaping competence, learning project, learning task

¹ Track number 4.

1 Introduction

No education can ever succeed without orientation on the interests of the students. This holds true for the (further) education of teachers as well as for the education of students. But sheer student orientation, which orients solely on subjective student interests, is not meaningful too. This essay describes which student orientation can be desirable in which PBL. A learning project in practice from a lesson will illustrate it further.

It will be argued for a pragmatic student orientation in PBL, which targets essential shortcomings of the traditional PBL. As far as possible, it will orient on specific students and their interests. The focus lies on students (trainees) in the dual vocational educational system in Germany and on the teachers (in companies, in vocational schools and in other setting for vocational education). Teaching competencies will be targeted, which need to be acquired by teachers in vocational education, to initialise the sustainable acquisition of educational competencies of their students, which will then allow the trainees to participate in the shaping of their working practice². Therefore, the targeted pragmatic student orientation in the advanced PBL has basically a double practical relevance: From a vocational education point of view, the focus is on the working/teaching practice of the teachers and in line with this, the underlying (prospective) working practice of the trainees is aimed at.

In traditional PBL or in student orientation, the problem is the pivotal element. The targeted advanced PBL and the then expected student orientation do not necessarily question this pivotal element. But the problem needs to be constituted on a constructivist basic position, consequently in educational scientific theory, on a didactic model concept, which influences concepts for lessons and on principles for teaching and learning. In vocational education, a pragmatic constructivist approach needs to be followed oriented on vocational education

² On the orientation on shaping competence in vocational education see various articles in Eicker, 2009.

under the consideration of scientific disciplines³. Therefore, the problem needs to be problematized and PBL needs further consideration.

2 Concerning PBL and the problem

Usually, PBL is understood as a form of education, an educational strategy or as an educational concept. It traces back to the 1920's and to the pragmatist John Dewey, who developed an educational model, which is oriented on projects, and who coined *learning by doing* (see i.a. Dewey, 1910 and 1951). His works are based on constructivist pedagogy (Neubert et al., 2001, p. 255). PBL was being developed further over decades⁴. PBL is seen as innovative with its central problems and can be found in vocational education too until today. Critics argue that the (central) learning problem in PBL is more or less dictated by the teacher, that the generation of the problem does play a minor role and that the solution of the problem is often predetermined for the student. This leads to a student behaviour which is questionable.

Instead, Wikipedia describes *PBL* as a form of education, which has the characteristic to enable students to find a solution for a – still – prescribed problem on their own. Self-initiated, self-determined, self-regulated and self-evaluated learning as well as discovery learning and interdisciplinary learning were highlighted here – either with the support of a tutor or even without any teacher⁵.

³ This is part of a field, where research has been going on for several years in general didactics and in vocational educational didactics. It is ambitious because the (radical and the) favoured moderate constructivism cannot be assigned to the traditional scientific theoretic basic positions. Here, it is assumed that pragmatic constructivism can be assigned and is useful next to dialectics or dialectical materialism with the focus on the needs of vocational education. It cannot be elaborated on this further at this point. See Jank and Meyer, 2011, especially p. 133 f., 144, 187 ff., Rauner and McLean, 2008; Eicker and Haseloff, 2013, p. 11 ff.

⁴ Noteworthy in particular is the educational concept of Roth (1957), which is used in teacher education until today, but it does not meet the necessary flexibility of real educational processes (Reinisch, 2014, p. 5-6).

⁵ See de.wikipedia.org/wiki/Problembasiertes_Lernen.

It is striking that the – still – prescribed problem, an authentic and complex written problem statement⁶, is the starting point in the learning process. This is advantageous: While teaching oriented on technical knowledge focusses traditionally on the uncritical acquisition of isolated know-how or on the related application, problems make sure that real life and work practice are in the focus. However, the focus then lies more or less on the students finding the “optimized“ solution for a problem, which was posed from the outside. It is not or less important, what problem is used, or at least it is not described in particular. The student must become a successful problem solver. Of course, it is important for any lesson that the student knows and masters various patterns to solve a problem. But learning must not solely or mainly concentrate on the form of education like Wikipedia suggests for PBL. Furthermore, the education must not orient on behaviouristic educational approaches on the one hand (like the traditional theoretic subjects in vocational schools), on the other hand it must not orient on educational approaches from behavioural psychology (like in some companies: learning to act) or on more or less clever combinations of both (like in many laboratories or experimental sessions in vocational schools).

In PBL, it is essential that the aspiration for the lesson / for learning is demarcated and motivated. Therefore, the desired aims and contents need to be presented and to be questioned initially. In PBL, the desired student orientation gives reason to expect that the requirements / the aims and contents were demarcated and motivated together with the students by means of a learning problem. Traditional PBL lacks this component or it only gets marginal attendance – which seems more or less obvious when the problem is prescribed. It poses a danger that “simple“ solutions are suggested or only “thought solutions“ or “applied solutions“ or some further combinations of both will be taught and learned – or in the best case, “multi-

⁶ de.wikipedia.org/wiki/Problembasiertes_Lernen.

dimensional” or “multi-perspective” solutions will be aimed at⁷ and that the more or less complex requirements cannot be met fully or in partially. There is the risk that the more or less complex competencies, which are needed to solve real practical tasks, cannot be acquired. The competencies are part of any realistic problem, which should be arranged more or less in learning problems. Furthermore, there is the risk that traditional PBL puts the focus of the student’s concentration solely on the patterns to solve problems and therefore competencies cannot be acquired or can only be acquired marginally. At least, it seems unlikely that the student acquires shaping competence, participates in the motivation of – alternative – learning tasks or discovers and realises – alternative – processes of solution. Hence, the desired student orientation is unlikely in traditional PBL.

The student orientation, which is aimed at, gives reason to expect that PBL is primarily motivated by aims and contents – which are traditionally neglected or left out entirely but which are still internalised in the problem. It is not a minor matter in a desirable PBL what problem to solve. On the contrary: The problem does not appear from nowhere. A problem always contains more or less natural, technical or other circumstances and shortcomings or they can be expressed by means of the problem. Even and especially these need to be described.

The expectation in the student must not mainly be to attack the prescribed problem in PBL. The student must not just learn how to get along in the environment or in work practice without questioning. It must be displayed, why the prescribed problem is posed and no other problem is posed, how the problem has arisen and why it has arisen, and what effect the desired solution will have etc. In this way, the possibility for the student opens up for

⁷ Regarding questions on „multi-dimensional“ and „multi-perspective“ teaching and learning see Eicker, 1999, especially p. 210 ff.

conceptual cognition and to shape vocational and therefore social realistic circumstances and relationships. And it matters.

So the question is posed, how a problem can become the starting point and pivotal element in advanced PBL, without having the shortcomings of the problem of traditional PBL. On that point, some illustrations follow.

3 Didactic Modelling: An educational concept ... and modified PBL: The learning project “wine consulting“

Several vocational education projects⁸ have approved the following didactic model over the last years, which approaches the complete path from work to learning (and back to work)⁹. This model cannot be explained in detail here because of the lack of space. The learning project “wine consulting”, which was planned, realised and evaluated during the project LAGL¹⁰ together with VET teachers and trainers from companies and of course with the trainees/students¹¹, illustrates basic didactic considerations and instructional consequences. So, the desired PBL and the new approach on the learning problem will be presented for further discussion.

⁸ See several references on the projects on www.eicker-bbw.de.

⁹ To enhance and concretise earlier didactic models. In relation, see i.a. Eicker, 2007, especially p. 20 ff.

¹⁰ LAGL: Lehr-Lernkonzept zur Aneignung beruflicher Gestaltungskompetenz in einer digitalen und vernetzten Lernumgebung im Tourismus und Gastgewerbe. Forschungs- und Entwicklungsprojekt. Bundesministerium für Bildung und Forschung (BMBF)/Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR). Duration: 01.07.2015 to 31.10.2016 (in English: Educational concepts to acquire vocational shaping competence in a digital and networked educational setting in tourism and gastronomy. R&D project).

¹¹ Prospective restaurateurs in their third year of training before their final exam.

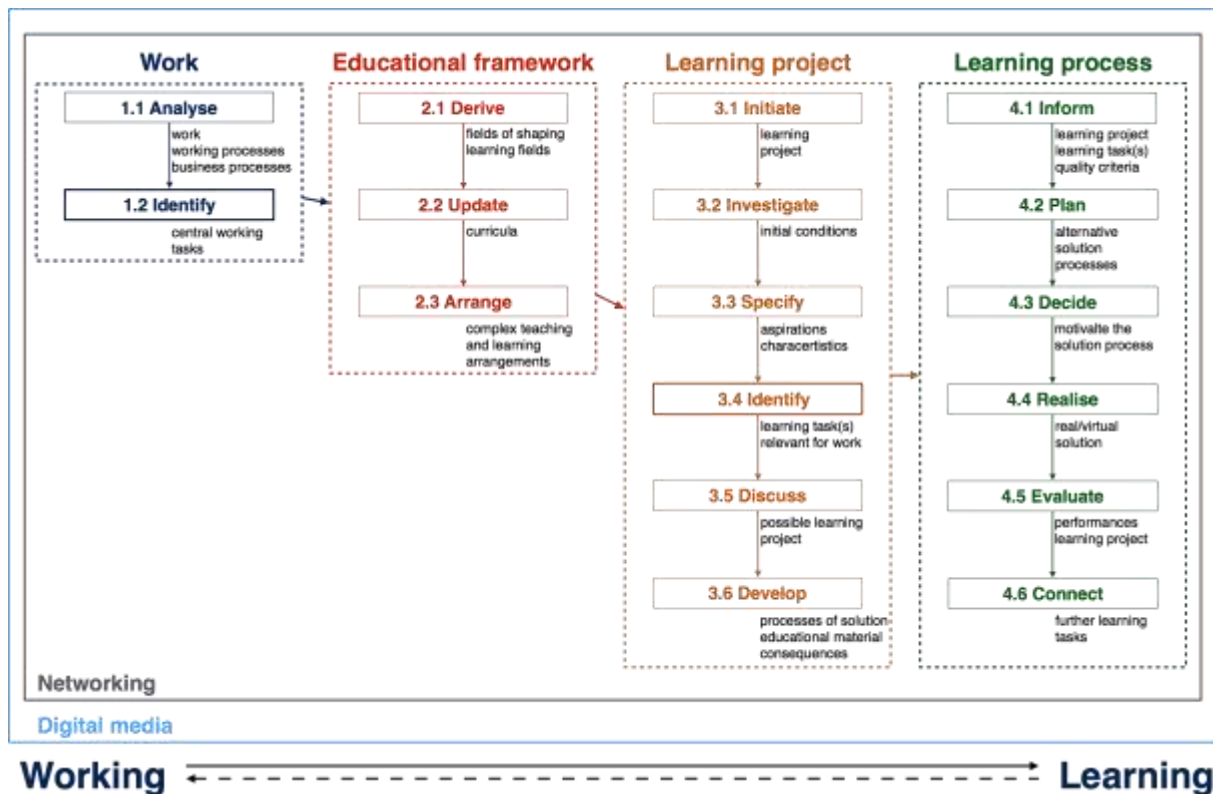


Figure 1: Didactic model (Source: Own).

The learning project „wine consulting“ is understood – like all VET learning projects – as work(-process) oriented, task oriented, complex, planned and organised project – as an educational project, which connects working and learning practice. It connects subjects or different teaching sessions like presentations, laboratories etc. using an interdisciplinary approach and it is motivated by realistic situations. The project puts the emphasis on self-dependent and active action of the students and the outcome is a (material or immaterial, regional or cross-regional useful) product¹². An overriding, work relevant and interdisciplinary problem is the central idea of the learning project – a learning task, which needs to be solved by the students and which enables them to acquire shaping competence.

The learning project “wine consulting” was initiated by VET teachers at the Regional Centre for Vocational Education in the VET school in Waren/Mecklenburg-Vorpommern and it was

¹² The learning project aims to initiate a realistically (in companies, society and individual) demanded and meaningful (work and educational) process, where students are supported to act in a self-determined, independent and self-active manner. This is a complex, planned, organised and product-oriented project and it connects subjects and fields of action in an interdisciplinary way and is motivated by realistic situations.

accompanied by the Siegen University (see number 3.1 in the figure). VET teachers and trainers in companies investigated the initial conditions (3.2). They specified their demands and characteristics for the pragmatic and student oriented learning project (3.3). The following *overall learning task*, which is relevant for work, was identified (3.4):

The students develop a concept for wine consulting as autonomous as possible. They discuss and describe possibilities for customer oriented wine consulting. Approaches are to be discussed and it is arranged how the wine consulting can be tested in detail. Small groups develop proposals, which are then presented to all students. The students agree on one kind of wine consulting, which is then realised during a real tasting with customers in the VET school. During the tasting or thereafter, advantages and disadvantages are evaluated. Quality criteria support the evaluation, which were formulated, discussed and motivated by the students before. During the project, students make use of prepared modern digital media to inform, analyse, structure and communicate¹³.

By means of the learning project, the students should be enabled to plan, realise and evaluate customer-oriented concepts for (wine) consulting as independent as possible.

The learning task was motivated because the students and prospective restaurateurs have contact with customers in almost every process of their work and business life. It was of utmost importance that the students were able to manage occurring individual processes of communication in a customer-oriented way. Furthermore, wine can be found on any drinks menu of any restaurant. Therefore, it is a relevant work task for any restaurateurs to have knowledge about wine and to advise the customer in this respect in a competent manner. The

¹³ Here, emphasis is put on the importance of digital educational media in an advanced PBL. See Eicker and Bohne, 2015.

topic is also authorised by the national curriculum (see field 3.2) (KMK, 2014, p. 24) and therefore it was relevant for the upcoming exam¹⁴.

The learning project “Wine consulting“ and the intrinsic learning tasks were presented to the student and discussed (3.5). The students (and the teachers too) shared their interests, ideas and experience and all together decided to run the learning project in the conceptualised manner. Primarily, this meant sessions in small groups, presentation of results, role plays, realistic testing, joint evaluation of success and performance.

Thereupon, the teachers developed possible ways of solution for the problem, the learning task, and they compiled educational material. Consequences for teaching were discussed too (3.6).

An introduction by the teachers initiated the learning process (4.1). The problem/tasks and possible ways of solution were presented as a problem statement and discussed. Framework conditions of the solution process, which was planned by the students, were explored for the further course of the learning project. It was agreed upon quality criteria to check that the wine consulting was competently planned, realised and evaluated (e.g. how the customer orientation was realised). Criteria were discussed and set, which are concerned with the presentation of the concept (e.g. giving a presentation), with the role play (e.g. analysing types of customers) and with the realisation of the wine consultation (e.g. customer’s satisfaction). Furthermore, it was thought about a scheme of evaluation and agreed upon it together. The students were introduced how to use educational media. It was necessary and it accompanied the process – the prepared digital media was presented and tested¹⁵. Anytime, the students could access the current state of the project digitally. It was agreed that every

¹⁴ See www.kmk.org/fileadmin/Dateien/pdf/Bildung/BeruflicheBildung/rlp/Gastgewerbe97-12-05-idF-14-03-28_11.pdf.

¹⁵ The Learning Management System ILIAS, the cloud service and the Android-Tablet were briefly presented. Afterwards, every student could take a photo of the provided wine bottles and could upload the photos in the “LAGL-Cloud”. Any student could upload wines and their characteristics individually in the “LAGL-Cloud”.

students researched at least two wines, which are in harmony with the menu, and that they upload them in the “LAGL cloud“ until the next session. For this purpose, the students could install the developed “LAGL-App“ on their smartphones or other devices or open the “LAGL-cloud“ from any browser. The students were supported individually at it. The learning results were integrated in the software at the end.

As a next step, the students researched relevant information on wines (growing region, quality criteria, basics for consultation etc.). Each student brought one bottle of wine and motivated the choice (according to the relevance in their training company) – the respective characteristics of the wine were placed in the “LAGL-cloud” (4.2). The developed and compiled educational material including the digital media were consulted to develop a concept. It was discussed, which wine was chosen by the students and how the consulting should take place and should be evaluated. The students weighed alternatives, discussed and motivated their strategies and solution processes in groups.

The concepts were presented in class by means of digital media and tested by means of role plays in order to decide which concept is most suitable and why (4.3). Analysis and evaluation took place afterwards. Discussion and constructive feedback have shown that one concept was preferred. This concept seemed to be worked out in a well-founded manner, was professional and seemed practically realizable. The concept met most of the initially specified quality criteria. Nevertheless, stimulations from other concepts were adduced to further improve the chosen concept (e.g. presentation of the wine and characteristics).

The concept for wine consulting, which was presented and motivated in that way, was realised practically. Furthermore, the student’s learning results were transferred to a digital educational software. It was programmed in a way to allow the teachers, students and prospective student to learn with it (4.4).

The learning project and the performance by students were evaluated together (4.5). Likewise as a summary, suitability for practice, customer orientation and possibilities to improve the learning project and the wine consulting were discussed. A specific questionnaire was developed with mostly closed items to evaluate the learning project, where the intervals were scaled according to school grades.

Finally, it was discussed how to link the project to the lesson in the future (4.6): Which questions remained open and can they be dealt with in future learning projects? What additional learning tasks derive from the learning project? For example, several students answered that they would like to learn in a learning project how to plan, realise and evaluate a conference.

4 Instead of a summary: Two tables on the educational principles and on student orientation in the planned PBL

It seems important for a successful organisation of PBL with a central problem (the task) to put emphasis on the question how teachers should plan, realise and evaluate with the aim that students are likely to acquire the desired shaping competence on their own through the problem/the task. Thus, the first following table summarizes what the students should investigate and do before the learning project, during the project and at the end of the project, and how the teachers should support the activities of the students. The second following table describes the desired student orientation in PBL of vocational education.

What teachers should consider and do...	What students should investigate and do ...
Before the introduction of project in class (only for the teachers)	
<p>The teachers investigate/discuss/motivate/formulate/prepare ...</p> <ul style="list-style-type: none"> • ... their / the teacher's aspiration for the prospective learning project – the result is a general orientation (which is oriented on the acquisition of vocational and general shaping competence by the students) – in detail, it is described – mentally or written – what the characteristics of the aspired competence/shaping competence are and which characteristic are essential for teaching and learning • ... the conditions for working, teaching and learning in the vocational school, in the companies and in other (regional) VET institutions, which are linked to the school or to the companies; administrative guidelines need to be consulted too; possible partners of the learning project must be informed • ... determine the learning field which the learning project will or should be oriented on • ... a general problem of work – better yet, two or three general problems of work, which can be “transferred“ to a general learning problem or to several general learning problems. It is justified how the solution of these allows the students to acquire work relevant competence/shaping competence. • ... the general and vocational significance of the educational, working and learning competencies, which can be acquired by the students. • ... the description(s) of alternatively possible problem statements in a manner which is understandable for the students – in such a way that the expectations in the learning process and in the learning results are clearly expressed (e.g. alternative processes of solution need to be investigated and to be used, the learning outcome (the product) needs to be developed and to be presented to the “customer“ in concrete terms or through PowerPoint, the progress and the results of the learning process need to be evaluated in a certain way etc.) • ... the information for the students at the beginning of the learning project, especially possible ways to present the problem statement • ... how the solutions of the problem can be realised in the vocational school, in the companies and in other VET institutions and through their connections with each other (e.g. preparation of internet access, availability of laboratories and of equipment for experiments etc.) 	
At introduction in the class	
<p>The teachers present all possible general problem statements to the students and offer the investigation of background information (information of the learning field, which are relevant for the problem)</p>	<p>The students investigate the addressed learning field with the help of the offered possibilities to get information (e.g. with a Learning Management System, with informational sheets and/or books, and also with teacher's presentations) – especially all possible general problem statements are acknowledged and they develop a first understanding of them</p>
<p>The teachers initiate and, where required, moderate a discussion of all the possible general problem statements</p>	<p>The students discuss the relevance of the offered possible general problem statements – if necessary, modifications and other connected problem statements are presented and motivated</p>
<p>The teachers ask the students to decide on one or more problem statements and motivate the decision. This can be the general problem statements or other, modified problem statements; the result</p>	<p>The students decide on one or more problem statements and motivate it – they agree upon general definitions of tasks during the prospective learning project and formulate them understandable and in a concrete way.</p>

should be presented in written form.	
	The students inform their companies and other participants on the prospective learning project
After introduction in class	
The teachers think of possible alternatives how the students could solve the general problem as a series of sequences (e.g. as a flow chart or other sequence plans)	
The teachers motivate the significance of educational, learning and working competence for the students – the competences, which the students can acquire in the single sequences.	
The teachers think of possible ways how students create a sequence plan (for alternative solutions and also for single sequences), where possible strategies to solve the problem are presented	
The teachers initiate and moderate activities, where the students create, discuss and motivate the sequence plan to solve the problem	The students acknowledge the presented alternative sequence plans to solve the problem, discuss their relevance and maybe create (if necessary in small groups) own sequence plans to solve the problem. They agree on one (or more) plan(s) to solve the problem and motivate the decision – the result(s) will be recorded in writing by the students (e.g. in a flow chart or in another way)
After rough (sequential) planning to solve the problem	
The teachers create descriptions of (alternative) possible partial learning problems for each sequence – understandable for the students (taking into account that the solution of all partial problems add up to a solution of the whole problem of the learning project)	
The teachers think of possibilities how the (alternative) partial problems can be made accessible to the students.	
The teachers initiate and moderate a discussion on the partial problems and on the decision which (partial) problems to solve.	The students acknowledge the proposed – alternative – partial problems, discuss them, bring in own ideas if applicable, agree on one partial problem to solve and motivate the decision – the results will be recorded (in writing)
The teachers make sure that the students acquire the aspired competences while approaching the planned (partial) problem.	
The teachers create descriptions for (alternative) possibilities how students can solve the (partial) problems.	
The teachers investigate possibilities how to make the (alternative) solution processes accessible to the student.	
The teachers make sure that the students acquire the aspired competences while approaching the planned solution process to solve the partial problem.	
The teachers initiate and moderate a discussion on the (alternative) solution processes and on the	The students acknowledge the proposed – alternative – solution processes to solve the partial problem, discuss them, bring in own ideas if applicable, agree on one (or more) solution process(es) to solve the partial problem and motivate the decision – the results will be recorded (in writing)

decision which solution process to use.	
Before solving the partial problems	
The teachers compile and prepare, if necessary: possible suggestions, educational material and experiments etc. – to help the students in their process to solve the problem	
The teachers discuss how to make suggestions, educational material, instructions for experiments accessible to the student	
The teachers inform the students and give suggestions how to solve the (partial) problems and make any educational material and experiments accessible to the students.	The students acknowledge the suggestions to solve the problem and the relevant material and instructions for experiments to solve the problem (if applicable by means of new media, like information and Learning Management Systems on the Internet etc.); if needed relevant knowledge and skills need to be acquired
The teachers discuss and present: possible alternatives of reflection, which accompany the solution process to solve the problem, if necessary corrections and evaluation of the solution process(es).	
The teachers initiate a discussion on reflection and evaluation in the learning project and on the decision, which procedure to use.	The students acknowledge the proposed alternatives for reflection and evaluation, bring in own ideas, agree upon a procedure for reflection and evaluation and motivate their decision – the results will be recorded by the students (in writing)
During the solution process to solve the problem	
The teachers initiate and moderate the solution processes to solve the partial problems	The students solve the partial problems and therefore solve the whole problem – the progress in the solution process is reflected from time to time and if necessary, corrections are made
The teachers give suggestions during the partial learning processes if needed	The teachers are seen as experts and their competence is used.
If necessary, the teachers support the documentation of the results of the solution process to solve the partial problem	If necessary, the students create a documentation of the learning project.
At the ending of the solution process of the whole problem	
The teachers instruct and support the reflection and the evaluation (if needed) of the whole process and if needed, of the whole documentation of the learning project	The students evaluate the whole solution process and its documentation; maybe external participants can be included into the reflection („customers“, experts (the teachers and others)) – if needed, a rating/grading of the student’s performance will be done

Table 1 (Source: Own).

In advanced PBL, student orientation means that...

- the students do not simply accept the pivotal element(s), the prospective problem(s), from the teachers, but that they take part in motivation and identification of the problem(s) and in the decision-making process – connected especially to the investigation and the demarcation of central working tasks of the (prospective) vocational activities in the profession of the students.
- the teachers investigate possible alternatives for the central problem statements (tasks) before and they make these problem statements accessible to the student in an understandable manner – considering the general relevance which exceeds the vocational activity(-ies) of the students and which has sustainable significance(s), and considering the respective educational standards (the subjective teaching and learning abilities of the teachers and students, the conditions for teaching and learning in the vocational school, in the companies and in other regional and maybe also supraregional educational institutions and on the internet etc. – in other words: using various abilities and conditions of different educational settings in a „network” to teach and learn).
- the teachers investigate possible solution processes to solve the problem beforehand and they make these accessible to the students in an understandable way – having complex problems means to point out a useful partition into partial problems.
- the students acknowledge possible alternatives of the solution process to solve the prospective problem/s or explore alternatives for themselves. They discuss advantages and disadvantages of the alternatives and agree upon one solution process and motivate their decision.
- the students not only acquire relevant (professional) knowledge and/or connected skills while solving the problem(s), which derive from tasks relevant for work and are more or less complex, but they are able and should acquire relevant shaping competence, enabled through alternative problems and solution processes.
- the teachers prepare and arrange the learning situations, where students are encouraged and guided to solve the partial problems (and therefore the whole problem) on their own – the teachers support as initiators, moderators, experts, counsellors etc.
- the students solve the partial problems and therefore the whole problem more or less on their own – they evaluate their success during the solution process by defining quality criteria from time to time (formulate hypotheses), monitoring them (accuracy of the hypotheses) and changing them if necessary.
- the teachers prepare possible educational material beforehand (material for information, experiments (no “recipes“ but stimulations for more or less open solutions), material to support documentation and monitoring, material to support reflection and evaluation etc.) and they make this material accessible to the students – using new, digital media can be useful in this respect (e.g. a Learning Management System).
- the students do not only solve the partial problems and therefore the whole problem „theoretically“ but also „practically“ – by realising the solution of the problem under the given teaching conditions, in (prospective) work practice of the students (e.g. installation

of an electronic system at a weekend home) or in the school laboratory (e.g. installation of the system with laboratory equipment and experiments) or by means of further abstractions of reality (designing graphically or depicting orally and discussing – also depending on the given competences of the students).

- the students present their solution(s) of the problem(s), they discuss and evaluate the relevance of the problem solution(s) or of the partial solutions and of the learning progress – it makes sense to do this together with the person who posed the problem (the teacher, the client/customer etc.).

Table 2 (Source: Own).

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