Deliverable 2.1

Data-Driven PBL model

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### Abstract:

This deliverable describes in detail the problem based learning (PBL) approach and its potential for open data education. The first section provides a theoretical description of PBL with the purpose of offering a platform for the design of open data learning activities. Section two describes the current practice of open data training within the ODEdu partners along with international initiatives.
The last section provides pedagogical recommendations for the process of designing the open data courses and online platform aimed at in WP3.

**Keyword List:** Problem based learning, open data, learning environments, design for learning, learning strategies, open data education.
## Consortium

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List of Abbreviations

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<td>Collaborative Action Learning Project</td>
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<td>ICT</td>
<td>Information and Communication Technology</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>OD</td>
<td>Open Data</td>
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<td>PBL</td>
<td>Problem Based Learning</td>
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<td>PBLE</td>
<td>Problem Based Learning Exercise</td>
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<td>PLE</td>
<td>Personal Learning Environment</td>
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<td>SL</td>
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Executive Summary

This deliverable reports the overall outcomes of “WP2 – D2.1: Data-Driven Problem Based Learning in Open Data”. D2.1 focuses on identifying innovative practices and methods that will underpin the training and teaching of the required skills, knowledge and attitudes derived from WP1.

The document is structured in three sections: section one presents the overall theoretical understanding of PBL. In this section, the reader will find a description of the philosophy behind PBL, the different components and the main principles of the approach. This part is followed by a large subsection presenting the different modalities of PBL. The section ends with an overall description of the use of information and communication technology within the PBL field. Section two analyses the different current learning activities within the field of open data. The analysis includes the experience of the ODEdu consortium and international initiatives to promote open data education. At the end of this section, the most innovative types of open data training activities are described in detail with the aim of presenting them as good practices within the ODEdu project. Section 3 presents the main pedagogical recommendation for continuing the ODEdu project in WP3, as well as arguments for the potential of PBL to educate students and professionals about the OD subject. This section provides specific criteria and elements to guide the design of open data-PBL learning activities.

During the elaboration of this report, we have identified the many variations of PBL and the challenges to design learning activities following PBL. The main recommendation for the ODEdu project is to define the learning goals for the different courses (as recommended in D1.1) and start an alignment process among the different PBL elements: problem, group, facilitator, learning objectives, organization, evaluation and duration.

It is not possible within the scope of this report to point out the precise route for the ODEdu project to follow, this should be defined through a process of shared decision when evaluating the different aspects that influence learning activities. However, the document does offer the outline of a roadmap for the decision-making process at WP3.
1 Introduction

Open data provides many valuable opportunities for different sectors, sparking business innovation, creation of new businesses and increased transparency in government. The full potential of open data is not yet realised and the field of open data (OD) is still facing many challenges, such as developing skills on different professionals and creating awareness about its benefits. This report provides a comprehensive presentation of the problem based learning (PBL) pedagogical approach, which has a lot of potential to overcome some of the challenges of education and the use of open data. Furthermore, the report provides an overview of current different forms of training activities within open data, the aim being to evaluate the opportunity to apply PBL approach to open data training. Finally, the report proposes some methodological recommendations for the ODEdu project regarding the design of learning activities in WP3.

1.1 Scope

The presented document is the Deliverable 2.1 “Data-driven PBL model” of the ODEdu project. The report covers two main objectives of WP2:

- To examine the use of student-centred, problem-based learning methods in the training and teaching of Open Data.
- To identify innovative learning processes and activities to support the participatory and engaging acquisition of the skills, knowledge and abilities that emerged from WP1.

1.2 Audience

The report is for:

- The ODEdu project partners who will organise training activities.
- The European Commission.
- Practitioners who want to design open data learning activities.

1.3 Structure

The structure of the document is as follows:
- Section 1: Problem Based Learning – a theoretical description.
- Section 2: Open Data education – current practice within the consortium and international initiatives.
- Section 3: Data Driven PBL methodological recommendations for WP3.
2 Methodology

The aim of D2.1 is to identify innovative practices and methods that will underpin the training and teaching of skills, knowledge and attitudes derived from WP1. We carried out four different activities to collect data and produce the outcome of this document:

1. Literature review of PBL approach: First, a literature search was done using ‘Open Data’ as keyword in combination with ‘PBL’, ‘learning analytics’ and ‘active learning’. Next, we integrated different theoretical and empirical research on PBL to give an overview of PBL to the ODEdu partners.

2. Analysis of qualitative interviews with open data trainers/educators from the partners. Nineteen interviews were conducted by five different partners. We expected to have six interviews by each ODEdu partner, however, some partners had a lot of difficulties to find relevant open data training activities and we ended up with nineteen interviews. The details about the data collection and analysis is given in section 2.

3. Desk study of different open data initiatives: we used a ‘snowball approach’ (one reference leads to another) to identify relevant international open data international initiatives. A first filter was applied based on the website activity (post, recent news, projects, etc.). Twelve initiatives were selected and their Open Data training activities were reviewed. Open Data Institute validated the relevance of the selected organizations.

4. Design workshop with PBL and open data experts. A three-hour workshop was held exploring how PBL can be integrated into Open Data education practice. In the workshop three PBL academic staff members from AAU (with extensive experience within PBL) and two PhD students from the faculty of Computer Science (who have open data as part of their research) participated.

The literature search on good practices of PBL within Open Data education shows a lack of empirical research within this field. In the same path, the international initiatives and the current teaching and training activities among the ODEdu project partners, show that most of the training activities do not follow a stated pedagogical approach. This led to the decision to include a section on the theory of PBL. This section will allow teachers, trainers and designers to get a good understanding of PBL.
Furthermore, the knowledge from the interviews and international initiatives influenced the model presented in section 3.
3 Section 1: PBL a Theoretical Description

Open data is a new field, which is growing fast and gaining more influence and attention both in practice and within research. Technologies, techniques and tools within the field of Open Data are not yet fully developed; this means there is a need to teach future experts techniques and competences that are not yet elaborated or defined. Thus, it is necessary to find an innovative educational approach that is able to support learners in developing the skills and competences of professionals regarding Open Data. Training in Open Data will require constant update of the content and of the teaching approaches. In the ODEdu project we explore the use of Problem Based Learning (PBL) as an appropriate pedagogical approach to teach and learn about open data.

There is a huge amount of literature on PBL, which describes its educational advantages and challenges, its different models, its components and its examples of implementation (Andersen & Heilesen, 2015; Poikela & Nummenmaa, 2006). Therefore, for the ODEdu project, we base the description of the PBL approach in sets of references identified by Aalborg University. The selected literature provides an understanding of the PBL approach that would inform the WP3: Course models and platform development.

In the first part of this section, we briefly introduce PBL, its definition and common principles from the literature. In the second part, we elaborate on various theoretical descriptions of the key aspects of PBL. In the third part, we present a detailed description of the main components of PBL: the problem, the group and the facilitator. In the fourth part, we discuss the different PBL models that have been developed around the world, focusing on 3 models: the Aalborg University model, the Maastricht University model and action learning as a problem based model of adult education. The final part contains a brief presentation about the use of information and communication technology (ICT) to facilitate the teaching and learning processes within a PBL context.

3.1 Introduction to Problem Based Learning

Many point out the medical curriculum of McMaster University in Canada as the first application of PBL. The motivation to use PBL in McMaster University was to develop the skill of life-long learning for medical professionals, as they need to keep up with updated information and knowledge. Since then, PBL has spread worldwide. Maastricht University, Holland, Linköping University, Sweden, and
McMaster University, Canada, Aalborg University and Roskilde University, Denmark, are examples of universities created in the 1970s with PBL as their pedagogical foundation and university-wide approach. Each university apply PBL in their own way, but these different models are all underpinned by common theories of learning (Dewey, 1933; Kolb, 1984; E. Wenger, 1998).

Many researchers and practitioners see PBL as a paradigm shift from traditional teaching (lecture based) to student-centered learning. In PBL, learning is active, constructed and a collaborative process. According to Hmelo-Silver (2004, p. 240), PBL support students to a) construct an extensive and flexible knowledge base, b) develop effective problem solving skills, c) develop self-directed, lifelong learning skills, d) become effective collaborators and e) become intrinsically motivated to learn.

In contrast to traditional teaching methods (lecture based), which are based on transmission of knowledge/information, PBL aims that students learn to be professionals with the capacity to a) identify and solve problems, b) collect and analyse data, c) design a strategy, d) be able to apply the theoretical knowledge acquired to a real life situation and e) develop so called soft skills (learn to learn, teamwork, collaborative learning, etc).

Savery (2006, p. 12) defines PBL as “an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem.” Savery’s definition focuses on the aspect of integrating theory and practice. In this understanding, knowledge and learning are contextual and situated. In that sense, knowledge acquisition and the use of knowledge are not separate processes. Students acquire knowledge while applying it. Therefore, there is a process of action and reflection. This definition is related to the experiential learning theory (Kolb, 1984).

Another definition is given by Savin-Baden (Savin-Baden, 2000, p. 3): “The focus here is in organizing the curricular content around problem scenarios rather than subjects or disciplines. Students work in groups or teams to solve or manage these situations but they are not expected to acquire a predetermined series of ‘right answers’. Instead they are expected to engage with the complex situation presented to them and decide what information they need to learn and what skills they need to gain in order to manage the situation effectively.”
Savin-Baden’s definition focuses on the role of the problem in the learning process and the kind of knowledge acquired within the PBL approach. PBL is oriented to construct flexible knowledge, which goes beyond the learning facts of a domain. Flexible knowledge integrates previous knowledge and information across multiple domains to solve a problem in a given context (Hmelo-Silver, 2004).

In general, PBL is a student-centered approach, where students take on the responsibility of their own learning and solve or address the problem. The teacher has the role of a facilitator who guides the learning process. In this process of solving or addressing problems, students combine resources, tools, theories and previous knowledge, and they often engage in empirical investigations. The approach allows the students to deal with real world problems associated with their field of study, whilst simultaneously developing collaboration, critical thinking, and problem solving skills.

A substantial number of empirical studies have shown the benefits of PBL. The approach has shown that students become more motivated and the learning process more meaningful (Awang & Ramly, 2008). Students also became more creative and critical (Zabit, 2010). Compared to more conventional teaching approaches, PBL can be an effective way to develop different discipline-specific and transferable skills for innovation, and it appears to be beneficial for developing thinking and creativity skills, different social and behavioural skills such as motivation, interest, self-confidence, self-directed learning and teamwork (Hoidn & Kärkkäinen, 2014). Furthermore, the study of Holen (2000) concludes that PBL provides important training in giving and receiving feedback, and also in helping the student to become aware of the determinants of constructive social interaction in professional relationships.

As mentioned before, although there are many different ways of implementing the PBL approach, all these different modalities have common principles. Savery (2006) elaborates on Barrows’ work to present the characteristics of PBL:

1. Students must be given the responsibility for their own learning
2. The problem simulation used in PBL must be ill-structured and allow free inquiry
3. Learning should be integrated from a wide range of disciplines or subjects
4. Collaboration among students is essential
5. What students learn during their self-directed learning process must be re-applied to the problem in re-analysis and resolution

6. Analysis must be made of what has been learned from working with problems and theories

7. Self and peer assessment should be carried out following the solution of each problem and at the end of every curricular unit

8. The activities carried out in PBL must be valued in the real world

9. Student examinations must measure student progress toward the goals of PBL

In the following sections, we present details about some of the key principles of PBL, the understanding of which would facilitate the understanding of the philosophy of this pedagogical approach.

### 3.1.1 Key Principles of PBL

The main concern of PBL is not to learn specific content but rather to develop lifelong learning competences. As knowledge gained through formal education rapidly loses its value for working life, PBL does not focus on the matter of content of a discipline; PBL focuses on developing skills about how to learn continuously. In this sense, the epistemology of PBL understands knowledge as changing and context dependent.

Working life demands continuous acquisition of new knowledge and skills, and PBL aims to develop students’ general learning competences, thus preparing them to overcome new challenges in their professional careers. Some of the PBL premises that are to ensure the acquisition of such learning competences and the effectiveness of the teaching process are: collaborative learning, critical thinking, reflection and self-directed learning.

These four PBL key principles—collaborative learning, critical thinking, self-directed learning and reflection—are related. Collaborative learning is related to critical thinking, as critical thinking requires the ability to respond constructively to peers during discussions and gain a common understanding of a specific problem. At the same time, collaborative learning gives learners the opportunity to engage in discussion, take responsibility for their own learning processes, and thus nourish their competence for critical thinking. Furthermore, critical thinking is a prerequisite for self-
directed learning; in effective self-directed learning, students are more aware of themselves as learners. Finally, reflection is necessary for being a self-directed learner and critical thinker. Critical thinking researchers recommend collaborative work/learning as a method of fostering critical thinking because the influence of social interaction promotes cognitive development.

3.1.1.1 Collaborative Learning

Constructivism and social constructivism are two of the learning theories behind PBL (Poikela & Nummenmaa, 2006). These theories assert that learning is a process in which learners create a worldview through interacting with their environment and interpreting such interactions. Collaboration among learners is one way in which learners may interpret the environment and develop understanding.

There is no firm consensus about the concept of collaborative learning; however, there are underlying features that may be generally agreed to. Laal & Laal (2012, p. 491) define collaborative learning (CL) as ‘an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. In the CL environment, the learners are challenged both socially and emotionally as they listen to different perspectives, and are required to articulate and defend their ideas. In so doing, the learners begin to create their own unique conceptual frameworks and not rely solely on an expert’s or a text’s framework’. The collaborative principle behind PBL promote that learners support each other in their construction of knowledge while at the same time developing competences for working in teams.

The understanding of a problem may vary among individuals and also between individuals and the group, and this tension is the driving force that promotes collaborative learning. Students work collaboratively to formulate and solve a problem. Students must come to a mutual agreement and interpretation of what is to be learned (common goals) and how to approach the situation (agreement about shared responsibilities, delegating individual tasks, mutual dependency and agreeing how to work) (Van der Linden, Erkens, Schmidt & Renshaw, 2000). The process of sharing and discussing points of view, explaining material to each other and trying to construct collaborative explanations support higher order thinking and promote knowledge sharing and knowledge construction among teams (Hmelo-Silver, 2004). Furthermore, through PBL experiences, students learn how to function as part of a team.
Within PBL, this collaborative process demands that students: a) negotiate a common understanding of the problem, b) identify learning issues and goals, c) brainstorm of preliminary project plans or a problem solution, d) continue rethinking and evolving their problem formulation and project plan, e) agree on the problem’s solution and f) evaluate the final solution and write down the conclusions.

Collaborative learning represents a significant change from traditional teacher-centred or lecture-centred learning because the role of listener and note taker changes to one where learners are more involved in discussion and actively engaged with the course material. Therefore, some researchers have pointed out that a facilitator must support the students in becoming collaborative learners.

### 3.1.1.2 Critical Thinking

The concept of critical thinking has received a lot of attention in the educational field. Over the last few years, critical thinking has become a 21st century skill (Partnership for 21st Learning, n.d.). It is related to the concept of teaching ‘how to think’ rather than ‘what to think’. Critical thinking develops the capacity to adapt, select and shape our interactions with the environment; in that sense, critical thinking promotes adjustment to current circumstances by generating knowledge and adapting to multiple perspectives.

According to Lai (2011, pp. 42–43), critical thinking is ‘believed to include skills of analysing arguments, making inferences by using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems. Critical thinking entails cognitive skills, or abilities and dispositions. These dispositions, which may be understood as attitudes or habits of mind, include open- and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints’.

According to Zabit (2010, p. 25), another definition of critical thinking is ‘the practice of processing this information in the most skilful, accurate, and rigorous manner possible, in a way that it will lead to the most reliable, logical, and trustworthy conclusions, by which one can make responsible decisions about one’s life, behaviour and actions with full knowledge of assumptions and consequences of those decisions’.

Ward & Lee (2002) suggest that the PBL approach actually increases students’ critical thinking skills. The identification of problems, judgment of what ‘the real problem’ is, the constant discussion with
the peer group about theories and assumptions, the collection and analysis of data and the decision-making based on evidence and theories are some of the activities within the PBL process that foster the development of critical thinking skills in learners.

The development of critical thinking in open data training is very relevant, as this skill is related to the generation of innovative solutions and an independent decision process - a decision process based on practical judgment and evidence. Working with open data requires a continuous process of analysing, understanding, applying/using, producing products and drawing conclusions from data - all within a context-related perspective. Workers, learners and officers in the public sector or among entrepreneurs should go through this cognitive process in order to benefit from open data.

3.1.1.3 Self-directed Learning

Self-directed learning is a fundamental aspect of PBL, as this ability helps learners regulate their own learning process, aims and priorities, which is quite different from self-teaching or self-study (Silén & Uhlin, 2008). In self-directed learning, students play an active role in planning, monitoring and evaluating the learning process. They are active promoters of their academic achievement by defining what they know and what the new task demands, and by coming up with a specific strategy for gaining the knowledge that they lack to achieve the desired goals and objectives (Ertmer & Newby, 1996).

Within the PBL process, students are guided to identify a hypothesis about their problematic situation, develop a well-defined starting point to begin their learning process, and, as the PBL process progresses, integrate new information (theories and data) and redefine their self-directed learning goals. It is a constant process of identifying gaps of knowledge and figuring out how to acquire that knowledge.

3.1.1.4 Reflection

PBL has a strong component of reflection. The reflection process is what promotes the learning aspect in this approach. In this sense, PBL encourages students to learn from what they do when solving the problem, how they work as a group, and how they seek to improve the process. According to Schön (1983), two types of reflection can be identified in PBL: reflection ‘in action’ (while the group is developing the project/solving the problem) and reflection ‘on action’ (after the
assignment is completed). The proposed outcome of this dual reflection process is to strengthen conscious learning in the individual as well as the group.

Likewise, Kolb (1984) emphasises the reflection element of the learning process and has pointed to reflective observation as one of the stages of his learning cycle. With their distinction between single loop learning and double loop learning, Argyris & Schön (1996) claim that a deeper level of reflection is required to achieve double loop learning, which aims at not just correcting errors but also questioning and changing values and assumptions in organizations.

As mentioned, the PBL process promotes the reflection in action and on action at the individual and collective level. The ongoing discussion within the PBL group is similar to what Schön describes as a “virtual world”. During the discussion, students are designers; they are testing and discussing possible ways, but not putting their ideas into practice at that moment. Schön notes that: “Virtual worlds are contexts for experiment within which practitioners can suspend or control some of the everyday impediments to rigorous reflection-in-action” (Schön, 1983, p.162).

The back-and-forth, the discussions and the clarification of ideas help the participants to reflect in action during the problem solving phase and help them to be better prepared when they face similar situations in real life.

Within the process of PBL, it is the responsibility of the teacher/facilitator to promote and scaffold the process of reflection. When the students are done with the project, they should be asked to reflect on the experience. This reflection process should not be missed in the PBL process, as it is one of the key aspects of the method (Major & Palmer, 2001). During the process, students will focus on solving the problem, and, therefore, sparking reflection over the learning process itself will demand rounds of team self-reflection, allowing students to evaluate the team’s way of working and make concrete statements on how to approach future similar situations, concepts and principles.

3.1.2 Components of PBL

There are three main components of PBL: the problem, the group and the facilitator. The problem is the motor of the learning process. The students, individual and in groups, are obviously another
fundamental part of the learning process. The tutor facilitates and promotes the learning process of the students using a PBL approach.

### 3.1.2.1 The Problem

The problem is the main component of PBL. It may be described as a puzzling phenomenon that might not have a clear or single answer. The problem in PBL is similar to the concept of the research problem, it does not have a simple solution and it does not have the negative connotations implied in everyday language (Poikela & Nummenmaa, 2006). According to Hmelo-Silver (2004), problems need to be complex, ill-structured, open-ended, realistic and resonant with students’ experiences, promote conjecture and argumentations and require multidisciplinary solutions. Furthermore, Moust et al. (2005) state that a problem should be authentic, engage students in discussion, stimulate self-directed learning.

For an effective PBL application, the key aspect is the definition or delimitation of the problem, also called the problem formulation. A good problem formulation facilitates the achievement of the PBL goals. Therefore, it is important to develop the competencies of faculty and students to formulate good problems in order to foster the learning process.

Problem formulations differ depending on the modality of the PBL being followed. This variation depends a lot on who controls the process: students or teachers. For example, at Aalborg University, the problem is not defined by the academic staff but in collaboration between the students and the supervisor. At Maastricht University, the problem is defined by the academic staff.

In this regard, Arana-Areolaleiba et al. (2013) have pointed out two PBL processes: 1) teacher or system-directed and 2) student-directed. In the former, students are only responsible for the analysis and development of the problem, while in the latter, students are responsible for the problem definition and co-responsible for the evaluation. These processes are shown in Figure 1. From their empirical work, they conclude that the student-directed process increases student engagement.

As an example, in an AAU course, where students are expected to acquire knowledge of:

- Theory and methods of system development
- User-driven techniques and tools
• Formalisation and categorisation as regards formal models for the preparation, visualisation
  and communication of design solutions
In the first scenario (system/teacher-directed) the students would receive a problem formulation such as: “Using the module literature and based on the case description, discuss what would be your roadmap for the design process to build the online community to promote knowledge sharing and creation within the school staff.” While in the second scenario (student-directed), students would be instructed to work within the theme of the course: “Design and development of information technology”. In the first scenario the context, the type of system and final product are already decided by the teacher, while in the second, the students are free to decide on all those elements with support from the supervisor.

Figure 1 – Adapted model of PBL processes (Arana-Arecolaleiba et al., 2013, p. 57)

Another way to approach the problem is to design the problem taking into account the knowledge that students need to acquire in a program. With this view, different types of problems are identified to guide learners towards the development of that particular type of knowledge. In Figure 2 - Type of problem (Dolmans & Snellen-Balendong, 2012), a summary of the six types of problems within PBL used at Maastricht University is shown (Dolmans & Snellen-Balendong, 2012). This classification of problem types depending on learning goals may be a way to scaffold the PBL process for the novice PBL teacher-supervisor.
The objective of ‘an explanation problem’ is that students explain and understand underlying structures and mechanisms. This type of problem is mostly used in years 1 and 2. It consists of a more or less neutral description of a number of interrelated phenomena for which an explanation must be sought.

Students learn to reflect critically on the standards and values of the profession and society and their own personal standards and values. In this way, students are stimulated to think about topics connected with their professional sector on a meso-level and macro-level and develop a well-founded personal standpoint. The students are not expected to come up with solutions to the problems described in an explanation problem.

**The strategy problem**

The aim of ‘the strategy problem’ is that students learn rational reasoning and decision-making based on knowledge and understanding of underlying processes. The focus of a strategy problem is the question: what is the appropriate course of action in this situation and why? This problem addresses strategy and decision-making skills rather than the explanation of underlying processes.

**The study problem**

The purpose of ‘the study problem’ is for students to independently study a particular subject. Mostly, a study problem is concluded by a specific assignment to study specified topics.

**The application problem**

The aim of this type of problem is that previously acquired knowledge is applied in a simulated practice situation using assignments. The students must apply their knowledge in an integrated manner in a different context together with other knowledge acquired earlier.

**The multi-level problem**

These problems present a detailed case history. Each consecutive phase is accompanied by additional information about the case. For each phase of the problem, questions are prepared by the tutor to stimulate group discussion. These questions are specifically designed to stimulate in-depth study of the case.
Figure 2 - Type of problem (Dolmans & Snellen-Balendong, 2012).

The 3C3R model is another guideline to support the process of problem formulation. The model is presented in Figure 3 (Hung, 2006, p. 57). The 3C represents the three core components included: content, context and connection. These core components are used to support the content/conceptual learning. The 3R are the processing components: researching, reasoning and reflecting, which support the students’ cognitive process of learning problem solving skills.

![3C3R PBL Problem Design Model](image)

Figure 3 – 3C3R PBL problem design (Hung, 2006, p. 57)

In order to facilitate the definition of PBL problems for the ODEdu training curriculum we may follow the guidelines of (Poikela & Nummenmaa, 2006, p. 88):

1. What is the background of the problem?
2. How does it relate to work and professional practices?
3. When is the problem typically encountered?
4. What kinds of skills and knowledge are needed in solving the problem?
5. What is the student expected to learn during the process of problem solving?
6. What kinds of learning results are aimed for?
7. What characteristics of the problem situation match best with learning goals?

8. What are the most appealing aspects of the problem that will awaken students’ interest in learning and problem solving?

3.1.2.2 The Tutor/Facilitator

PBL is not only an educational method but also a teaching philosophy. Philosophically, PBL is focused on the student and the problem first. The teacher becomes a tutor or facilitator (not an expert who transfers knowledge). One should design learning environments to facilitate critical thinking, collaborative learning, reflection in action and on action and self-directed learning, problem-solving competences. PBL challenges, and at the same time encourages, educators to rethink their role.

The role of the tutor is related to the modality of PBL used, as well as the type of learning activity (a day, a week, a semester, etc.); another variable is the level of expertise and authority assigned to the tutor and the students. For example, in a semester course, a tutor may initially have a dominant role and guide the students towards self-directed or collaborative learning, then gradually reduce facilitation.

Another relevant aspect is the characteristics of supervision styles. Gatfield (2005) presents a supervisory management grid to discuss supervision styles. The grid is created by two axes: support (concern for people) and structure (concern for production)—creating four quadrants: Laissez-faire, Directive, Contractual and Pastoral (see Figure 4). The style of supervision is linked to the modality of PBL and the type of learning activity.
Figure 4 – Characteristics of supervision styles (Gatfield, 2005)

Schmidt & Moust (1995) present five attributes of PBL facilitators: a) engaging learners in key concepts, issues and themes according to the lesson objectives, b) helping learners reason effectively and develop deep understanding, c) helping learners collaborate meaningfully with their peers, d) helping learners be self-directed in their learning approach and e) helping learners to be reflective about their learning process.

Goh (2014, p. 162) presents examples of facilitator action in relation to PBL facilitator attributes, which may serve as guidelines for the ODEdu project trainers.
### Table 1 – PBL facilitator attributes (Goh, 2014, p. 162)

<table>
<thead>
<tr>
<th>PBL facilitator attributes</th>
<th>Examples of facilitator actions in the classroom</th>
</tr>
</thead>
</table>
| 1. Engaging learners in key concepts, issues, and themes according to the lesson objectives | - Connect with learners’ starting point and use appropriate scenario settings such as contexts or examples familiar to learners.  
- Scaffold learning by making connections between prior and new knowledge in order to gradually help learners reach the next level of understanding.  
- Use appropriate language, references, and analogies to help learners overcome the challenge of difficult terms.  |
| 2. Helping learners reason effectively and develop deep understanding | - Prompt learners to justify their claims and provide examples when explanations are vague or unconvincing.  
- Encourage learners to critique ideas by considering their value and limitations within the context of the problem scenario.  
- Comment on the quality of arguments presented.  |
| 3. Helping learners collaborate meaningfully with their peers     | - Help learners build on one another’s knowledge by modelling how feedback and constructive criticism are given.  
- Include reticent or quieter learners in group discussions.  
- Create opportunities for sharing meaning across groups.  |
| 4. Helping learners to be self-directed in their learning approach | - Identify learning obstacles and suggest strategies to manage them.  
- Sharpen learners’ research and information management skills.  
- Develop professional habits of working in learners such as agenda-setting and action-planning.  |
| 5. Helping learners to be reflective about their learning process  | - Set clear criteria so that learners can evaluate themselves.  
- Draw attention to blind-spots, misconceptions, and weak reasoning so that learners can address them.  
- Give feedback regularly.  |
3.1.2.3 The Group

The PBL approach is based on the assumption that small groups make it easier to develop certain skills, to develop a deeper learning and understand content better. Therefore, the PBL is developed in groups. According to Holen (2000), the PBL group has three aims: a) facilitate learning, b) develop the attitudes and skills that will foster self-directed and lifelong learners and c) develop social skills that would facilitate integration with future work environments. Furthermore, it is expected that the groups will support the social, intellectual and affective dimension of the students’ learning. During the working together, students will ask questions, offer explanations, explore different perspectives, discuss ideas with each other, test and challenge their understanding, read and discuss theories, all of which activities will foster critical thinking skills and cognitive learning. The affective and social aspects help students during phases of ambiguity and frustration.

Going through PBL group work, participants may develop learning strategies for lifelong learning, self-directed learning, conscious reflection (as individual and as group) and the receiving and giving of feedback (Holen, 2000).

According to Holen (2000), the main features of a good PBL group dynamic are: security, freedom, mutual respect, openness and tolerance for diversity. We may add the need to develop the competences of listening and asking insight questions. Finally, as mentioned before, the group should spend some time assessing their work as a group. They should assess at three different levels: themselves (how I am doing and how do I interact with the group?), others (what are the contributions of other members?) and the group (how has the group operated as a whole?) (Holen, 2000).

Within PBL, the group formation is initiated by the academic staff. The group goes through a normal process of group formation and the supervisor should help in each of the phases, depending on the group’s experience with working in teams. The PBL groups might have between 3 and 10 members, depending on the PBL model. How many hours and how often they meet depends, again, on the modality of PBL. At Aalborg University, groups would meet almost every day in the last two months of the semester, while at Maastricht University, the groups met twice a week.
3.2 Different Models of PBL

PBL cannot be referred to as a singular well-defined practice because, as mentioned before, several innovative universities around the world have developed their own models of PBL. These variations may be expressed through or apply to a particular practice, area, discipline or even cultural setting. Therefore, many authors seek to define principles of PBL that go beyond individual PBL models. Du et al. (2009) state that defining PBL as ‘PBL learning principles’ allows variation in the development of PBL models and allows them to be adjusted to a given institution and setting. The PBL principles and components were presented above. It might not be possible to develop PBL activities that cover the full range of PBL principles – this would depend on the duration of the educational activity.

Barrows (1986) identifies two main variables that define the different types of PBL:

- Design and format of the problem. In this variable, in some types of PBL, students are presented with problems that are very well structured and include many details. With these types of problems, students decide what should be done based on the evidence provided. Another type is when students are provided with open problems with little data, leaving students to define the problem. In this case, they assemble the important facts through free inquiry. Finally, some problem designs have a format that lies between these two extremes: selected facts are given to the students and they have to decide on a limited number of inquiry actions and decisions.

- Degree of direction by the teacher. This variable is related to who determines the amount and sequence of information to be learned within a course. In some types of PBL, students are given this responsibility; in other cases, it is the teacher who defines those aspects, including during the reflection process and the selection of information to be explored and discovered by the students. This is more focus on who controls the process.

Similarly, Ryberg et al. (2006) argue that one way to understand differences amongst PBL models, but also to design for various PBL orchestrations, is to focus on how responsibilities over various central PBL processes are distributed between students and teachers. They identified three central processes: The problem, the process and the solution (outcome), that can be thought of as extended between teacher and participant control. Figure 5 and Table 2 show the model of Ryberg et al. (2006).
The problem

Who controls or owns the definition and framing of the problem: teacher, students or others?

The process

How are working processes organized and who controls them? Who chooses in which way to investigate the problem (theories, methods, empirical investigations, etc.) and who is in control of the collaboration/cooperation?

The solution

Who owns ‘the solution’ (is it open-ended or fixed)? To what degree are students expected to reach a predefined conclusion/solution (or, in other words, to what degree is the process one of exploration and genuine knowledge construction)?

The model can be used to analyse a concrete PBL practice (i.e. who defines the problem? Do students or teachers decide which theories and methods to work with? Is the solution open-ended?), thus identifying i.e. whether the PBL orchestration in question is either student-driven or teacher-driven. Further, the model can be used to reflect on and design for new educational PBL practices. For example, in a course, the teacher team could reflect on the distribution of responsibility and leave the students to identify the problem, but demand that they use certain tools to solve that problem. One can also enter more deeply into distinguishing between different types of problems.
Barrows (1986) presents a taxonomy of PBL varieties commonly used in medical education, and he analyses the degree to which each of the four educational objectives are addressed by these PBL varieties (see Table 3.) The educational objectives are: structuring knowledge for use in a clinical context (SCC), developing an effective clinical reasoning process (CRP), developing effective self-directed learning (SDL) and increased motivation for learning (MOT). He uses a scale of 0-5. It is important to note that these are common educational objectives that also apply to other fields. Barrows’ taxonomies are:

- Lecture based cases: students are presented with information through lectures and then case material is used to demonstrate that information
- Case-based lectures: students are presented with cases before the lectures
- Case method: students are given a case study that should be researched and prepared for discussion during a class
- Modified case-based: students are presented with some information and are asked to decide on appropriate forms of action
- Problem based: students are presented with a client in some form of simulated format that allows for free enquiry to take place
- Closed-loop problem based: this is an extension of problem-based. The students are asked to consider the resources they used in the process of problem solving in order to reflect on how they might have reasoned more effectively.

<table>
<thead>
<tr>
<th>Taxonomies</th>
<th>Structuring clinical context</th>
<th>Clinical reasoning process</th>
<th>Self-directed learning</th>
<th>Motivation for learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture-based cases</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
A another interesting classification of the types of PBL is provided by Kolmos et al. (2009) in Table 4, in which they summarise the work of Savin-Baden (2000, 2007). Savin-Baden proposes different models of PBL covering the objectives of PBL, and includes the perception of knowledge, learning, problems, students, teacher roles and assessment.

<table>
<thead>
<tr>
<th>Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-based lectures</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Case method</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Modified case-based</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Problem-based</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Closed-loop-problem-based</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Table 4 – Models of PBL based on Savin-Baden (A. Kolmos et al., 2009, p. 14)

<table>
<thead>
<tr>
<th>Models</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Model I: Problem-based learning for epistemological competence** | Knowledge: propositional knowledge  
Learning: use of propositional knowledge  
Problem scenario: limited problems with known solutions  
Students: receiving propositional knowledge  
Facilitators: guiding students to understand knowledge correctly  
Assessment: test of knowledge according to objectives |
| **Model II: Problem-based learning for professional action**    | Knowledge: know-how  
Learning: skills for workplace  
Problem scenario: real life  
Students: learning to solve real problems in order to undertake practical action  
Facilitators: demonstrating practical skills  
Assessment: test of skills for the workplace and supporting knowledge |
| **Model III: Problem-based learning for interdisciplinary understanding** | Knowledge: a cross-over between know-how and know-what  
Learning: knowledge and skills across discipline boundaries  
Problem scenario: centred around knowledge through action  
Students: integrators across boundaries  
Facilitators: coordinators of skills and knowledge across boundaries  
Assessment: skills and knowledge in a relevant context |
| **Model IV: Problem-based learning for**                 | Knowledge: understanding existing boundaries  
Learning: critical thinking and understanding discipline borders |
| trans-disciplinary learning | Problem scenario: dilemmas  
Students: independent thinkers with a critical stance  
Facilitators: flexible  
Assessment: opportunity to demonstrate integration across disciplines |
|-----------------------------|------------------------------------------------------------------|
| **Model V: Problem-based learning for critical contestability** | Knowledge: contingent, contextual and constructed  
Learning: interrogation of frameworks  
Problem scenario: multidimensional, offering alternative ways of understanding  
Students: explorers of underlying structures and beliefs and developing new hypotheses and knowledge  
Facilitators: commentators, challengers and decoders of cultures, disciplines and traditions  
Assessment: open-ended and flexible |

In the next pages, we present two well-known PBL models; Aalborg University Model and Maastricht University Model, followed by a description of action learning as a type of PBL approach within organizational contexts.

### 3.2.1 Aalborg University Model

In the particular case of Aalborg University, PBL is used in a combination between problem based and project oriented approaches (A. Kolmos, Fink, Krogh, Fink, & Krogh, 2004). Some have called this the Problem Oriented Project Pedagogy (POPP/PBL), which is based on principles of productive learning through joint project organization, construction and goal orientation (L. Dirckinck-Holmfeld et al., 2009). The Aalborg model entails a very close interaction and dialogue with the surrounding society.

Dirckinck-Holmfeld et al. (2009, p.157) define the POPP/ PBL as a dynamic pedagogy where participants bring in new problem areas to be studied. The problems to work with are not pre-defined by the curriculum or faculty, but brought in by the students and further elaborated in discussions and negotiations between peers, faculty and external stakeholders. In most cases, the
problems to be investigated are related to students’ work practices. It is especially the problem formulation, in conjunction with the problem solution, that brings dynamics to the learning environment. Students are forced to critically rethink the problems to be studied: What is the problem? Who has the problem? When did the problem become a problem? Why is it a problem? How can the problem be solved?

The principles of the Aalborg model are based on Illeris’ ideas about problem orientation, project work, interdisciplinary participant centred learning, and teamwork (Illeris, 1976). Students analyse and define a problem within an interdisciplinary theme or frame. In many cases, the problem is presented by an organization outside the university. The students work together in a group on their project and submit a common project report. As a group, they have a common exam but they receive individual grades (Kolmos et al. 2004).

The Aalborg model works around three dimensions: the problem, the content and the team. The problem is the vehicle for learning and the starting point for the learning process. The formulation of the problem facilitates the link between theory (content) and context.

The traditional Aalborg model is founded on problem based project work, which means that around half of the students’ time is spent on project work in teams. The other half is spent on lectures. The organisation of the semester is visible in Figure 6.

![Figure 6 – Traditional Aalborg PBL model (A. Kolmos et al., 2004, p. 14)](image-url)
Components of the Aalborg Model  (Barge, 2010)

- **Problem**: As in any PBL approach, the problem is the starting point for the learning process. Within the AAU model, the problem ‘grows out’ of the students’ wondering within different disciplines and professional environments. The problem directs the students’ learning process and helps to situate learning in a context. At AAU, a problem can be theoretical, practical, social, technical, symbolic-cultural and/or scientific. A basic principle of the PBL model is that the problem formulation must be allowed to evolve. The reformulation and improvement of the problem formulation is part of the learning process as it allow the development of critical thinking and self-reflection (R. C. Thomsen & Zhukova Klausen, 2012).

- **Project**: a project is a complex situation that needs to be analysed, and a proposal needs to be developed to change the current situation. The project should be completed within the semester. Projects are diverse regarding scope and definition (as described in section 3.1.2.1). It is very common to work with external organizations.

- **Team**: the team is a group of students working together on a project. They get together in a process of design, decision-making, analysis and reflection related to the project (find details on the group characteristics in section 3.1.2.3).

- **Supervisor**: this is a faculty member serving as facilitator for the team. Each team has a supervisor. At AAU, there is face-to-face supervision, Skype meetings or/and feedback by email. The supervisor has the responsibility to read students reports and offer comments, guide students during the project, and assess the final project report together with a co-examiner.

- **Project courses**: these are courses offered as part of the study program, related to the semester theme and to the project work.

- **Study courses**: these are part of the study program and introduce students to the concepts, theories and skills of a specific area.

The process
There is no single way of doing PBL at Aalborg University, and the practice of implementing PBL differs from faculty to faculty. However, the overall principles and components are the same throughout the university.

In describing the teaching practice at Aalborg University, a distinction needs to be made between the project module (15-20 ECTS) and course modules (normally 5 ECTS). The project module is based on the PBL approach, and this is where the students complete the semester project, while the course modules are designed around a problem or may apply more traditional teaching approaches.

In the semester project, Kirchner et al. (2005) distinguish two parts: the first starts from a lack of knowledge: a student (or a group of students) wonders about some question within the semester theme, and from this wondering, a problem formulation emerges. The second part is related to the thinking process where steps are defined and implemented to solve the problem; in other words, the second part is about solving the problem using empirical data and theory (Kirchner et al., 2005). The process may be compared to the spiral cycle of action research; as students progress in the process of reflecting, planning and acting, they gain a better understanding of the problem and the theories that they are dealing with.

Shinde & Kolmos (2011) describe the process of the PBL Aalborg model for one semester (see Figure 7). The semester coordinator organises a project day, in which students form groups and choose the topic for their semester project. The activity starts by brainstorming about project ideas. Students may be presented with a project catalogue (from which they choose a project). Students form groups according to their interests and learning motivations. The group then starts working on the project. The first days of working together are focused on gaining a common understanding of the project and defining the problem formulation. It is also a time for team building (learning about each other’s strengths and weaknesses, ways of working, etc.), if the students have not worked together previously. During the project, the students ask for supervision when they believe it is necessary. Should the students not ask for a meeting, the supervisor will schedule one. Close to submission deadline, students spend much more time on their project. They submit a written report, and about three weeks later, they have an oral exam. An external examiner and the supervisor (the latter being the main examiner) conduct the oral exam.
In summary, the general process of project development at Aalborg University follows these steps:

1. The semester module is organized around an interdisciplinary theme.
2. The whole class is presented with a range of lectures where students are introduced to the core theories of the semester.
3. After maximum one month of teaching, the semester coordinator organizes a project selection and group formation. In this session, students may come up with their own ideas for projects or/and real life problems from external partners are presented.
4. The groups are asked to send a first description of the problem formulation and their motivation to work on that particular project.
5. Supervisors are assigned to the groups.
6. Groups start working on their projects, while still participating in some learning activities (course modules and project module).
7. Problem formulation (writing down all ideas and thoughts that might be relevant to the topic and defining a course of action. As described before, there is a process of redefining the problem formulation).
8. The planning phase (each group decides on a methodology and a theoretical framework and finds more specific material that is directly related to the problem).
9. The completion phase (continued cycle of reflection, planning, action).
10. During steps 7, 8 and 9, students receive supervision.
11. The presentation phase (students hand in a project report).
12. The evaluation phase (students have an oral group examination with the supervisor and an external examiner).
The classic components of a project report at Aalborg University are described by (R. C. Thomsen & Zhukova Klausen, 2012).

Table 5 – Classic components of an AAU project report (Thomsen & Zhukova Klausen, 2012)

<table>
<thead>
<tr>
<th>Elements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Purpose, problem formulation:</td>
</tr>
<tr>
<td></td>
<td>- What is the problem that this project seeks to explore?</td>
</tr>
<tr>
<td></td>
<td>- Why is this a relevant/topical/interesting problem?</td>
</tr>
<tr>
<td>Method</td>
<td>Method(s) of analysis/approach:</td>
</tr>
<tr>
<td></td>
<td>- How will you approach and explore this problem?</td>
</tr>
<tr>
<td></td>
<td>- Why did you choose this particular research design (incl. particular kinds of sources/data)?</td>
</tr>
<tr>
<td>Theory</td>
<td>Presentation and critical discussion of theories relevant to the identified problem.</td>
</tr>
<tr>
<td>Analysis</td>
<td>Critical use/discussion of data and sources. Make sure to apply theory actively in your analysis.</td>
</tr>
<tr>
<td></td>
<td>You may choose to include discussion in your analysis or separate these into different chapters.</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Summary of findings, answering the questions posed in the introduction.</td>
</tr>
<tr>
<td>List of references</td>
<td>Works cited.</td>
</tr>
</tbody>
</table>

3.2.2 Maastricht University Model

Maastricht University – MU – started its medical studies using PBL in 1976. The teaching and learning instruction method is based on three principles: learning as a collaborative process, learning as a constructed and contextualised process, and learning as a student-centred and active process. In PBL curricula at Maastricht, students are taught in consecutive courses or units of 6 to 8 weeks in which course content and skills are integrated around a central theme.
MU has institutionalised a way to guide students through the learning process, naming this method ‘the seven-step approach’ (7-step) or ‘seven-jump’. Moust et al. (2005, p. 667) define this approach as “a strategy that students use to explain underlying mechanisms, processes or principles of phenomena described in a problem. This strategy comprises well-known problem-solving procedures as well as scientific approaches used in research”.

Within the MU model, we can identify the components and the process (Maurer & Neuhold, 2012; Moust et al., 2005).

The components

a) **The assignment**: to get to start on a certain topic, students get an assignment (the problem, which is the starting point of students’ learning). The students should read the assignment before their tutorial. Academic staff develop the problem, based on the course literature. The assignment should meet the standards of a ‘good problem’, as described above.

b) **Tutorials**: tutorials consist of about 10-12 students who work on a problem together. Students have to analyse the problem based on their prior knowledge and come up with a procedure to address or solve the problem. The tutorial is divided in two parts: a) post-discussion of the assignment that students prepared in their self-study and b) pre-discussion of the next assignment. Each tutorial should take two hours.

c) **Tutor**: each tutorial is guided by a member of the academic staff who is meant to facilitate the learning process of the group. The tutor asks provocative questions, guides by following the seven-step approach and supports the reflection process. In the ideal case, students run the tutorials themselves; the tutor is not allowed to lecture.

The process (7-step approach)

Before the first tutorial, students are presented with the assignment. They meet together with the tutor and go through the following steps:

1. **Clarification of terms and concepts**: See that all students understand well the assignment.

2. **Formulation of a problem statement**: Describe exactly which phenomena have to be explained or understood.
3. **Brainstorm:** activate prior knowledge to give as many explanations as possible. Furthermore, share expectations and collect potential interests that students may have.

4. **Classification and structuring of brainstorm:**

5. **Formulation of learning objectives:**

6. **Self-study:** during 2 or 3 days, students individually try to find new information to answer their learning objectives. In the first years, students are provided with key literature after each assignment. Later on, they get a list of references and they are encouraged to find relevant literature. This step is related to their self-responsibility as students for knowledge acquisition.

7. **Post-discussion:** after the self-study period, students meet again in their tutorial group to report back and exchange their answers. They try to come up with a collaborative answer for the learning objectives. This is usually a very rich phase of the learning process, where students present each other with different perceptions of questions and phenomena; they listen to different arguments and discuss different interpretations of the same reading.

8. Sometimes, an eighth step can be included. It is about reflecting on the learning process: that is; the self-assessment of the students in the learning process, individually and as a group. Students should be encouraged to become aware of what works well and what could be improved. This reflection process promotes feedback to each other.

As shown here, the problem creates a context within which the students are going to work. The first group discussion is suited to activate previous knowledge that students have about the problem; this discussion on the grounds of previous knowledge allows students to compare/contrast their own experiences with the knowledge of their peers, but also to put together all the knowledge and information found among the group members in order to gain a better understanding of the problem. Individual study time may be similar to normal practice: however, students are guided by the same key questions, defined in the group, during individual study time. When the group meets again, a second group discussion allows the sharing and creation of knowledge based on theoretical concepts and the potential re-defining of the problem. Then, the cycle starts again, including
perhaps further development of the problem or the introduction of a new problem provided by the tutor.

Poikela and Nummenmaa (2006, p. 78) present the PBL cycle of knowledge acquisition, which may help to understand the PBL process at Maastricht University (Figure 8). The PBL process starts with the definition of a shared understanding and conceptualisation of the problem. The team then moves to the second step where the team brainstorms about their current knowledge of the problem. In the third step, students start connecting similar ideas and create categories. In the fourth step, students select a category to work with and finish the first tutorial with a definition of the learning task and the objects of study (step 5). In step 6, individuals collect information and knowledge for the tasks defined in step 5. In the second tutorial, students bring in their new knowledge and construct the problem in a new way (step 7). In step 8, students clarify aspects of the PBL process or knowledge about the problem, and they move to a more advanced level to continue learning. They repeat this cycle of problem based learning as many times as the course design requires it.

![Figure 8 – PBL cycle and knowledge acquisition (Poikela & Nummenmaa, 2006, p. 78)](image-url)
3.2.3 Organizational Approaches of PBL

When discussing open data training in the workplace, we need to be clear from the start that the learners are adults, different from young adults in a university environment. The development of competences within an organisational context may look quite different from the learning environments in universities. The organisational approaches are more related to learning at work. There are many different perspectives to develop skills, competences and learning processes in the organisational context. Some of those approaches include Schön’s (1983) work on reflection ‘on action’ and reflection ‘in action’ for professionals. Another well-known model was developed by Kolb (1984) in his ‘learning cycle’. A third framework that should be mentioned is ‘communities of practice’ (Etienne Wenger, 1998), which is based on situated learning and social learning. Finally, we should mention ‘learning organisations’ as an approach for knowledge creation in organizations (Senge, 1997).

Effective approaches to competence development through work practice see learning as a process of individual or group understanding of the knowledge lacking to solve a problem. The most powerful training approaches pose, as a starting point, the need to solve a problem. Yeo and Marquardt (2010) state that problem solving increases the potential for learning. Training approaches based on the transmission of knowledge may not have the same impact on the organisation and on individuals as approaches that include solving work problems.

Yeo and Marquardt propose PBL as a approach to promote individual and organizational learning, because of its strong emphasis on collaborative learning and contextual understanding. They argue that “PBL sets the platform for participants to respond to complex, open-ended daily problems that motivate them to think about wider issues that would have an impact on organizational performance. As the propeller of organizational learning, PBL encourages collaborative learning allowing participants to seek and evaluate information sources they constantly need to improve organizational systems, processes, strategies, and purposes”.

3.2.3.1 Action Learning

Another well-known approach to adult learning with emphasis on the solving of real work problems is action learning. Action learning was developed by Revans (1998) as a method for management
learning and development. Revans started to use action learning for the first time in 1945, but it was not until 1960 that the concept was developed in more detail.

Many definitions of ‘action learning’ may be found in the literature, and they are often interwoven with other organizational practices or learning strategies. Revans defined action learning as follows: “Action learning is a means of development, intellectual, emotional or physical, that requires its subject, through responsible involvement in some real, complex and stressful problem, to achieve intended change sufficient to improve his observable behaviour henceforth in the problem field.” (Revans, 1982, p. 627).

Revans stated that learning is more effective when a person is solving real problems of everyday life, in which he/she is engaged. People are more efficient when they are allowed to work in their own way and reflect upon their own success or failures.

The keystone of action learning is the capacity to ask insightful questions. Revans believed that we acquire knowledge by looking at existing knowledge and by asking critical questions. This previous knowledge could be our experience, lectures, books, experts and so on. When there is no expert who knows the right solution to the problem, or there is no one to explain how to reach it, then it is during this process of finding a solution that the skill of posing fresh questions and come out with new ideas is strengthened. This allows the person to develop great reflective, critical and learning competences.

### 3.2.3.1.1 The Process of Action Learning

The common cycle of action learning is a process of **plan, act, observe and reflect**. The process of action learning takes at least four months; to create a well-functioning learning group and be able to go through the learning cycle.

The common elements of action learning are: the problem, the action learning group, the set meetings, the role of the facilitator, commitment to take action, a focus on learning and the reflection process.

**The problem**

In action learning, each learner should be involved, with power of decision, in a problem or opportunity, which will be used as a vehicle for the learning process. Ideal projects are focused on
important, challenging and complex issues for which there are no known solutions and the solution of which require creativity and innovation. Revans distinguishes between a puzzle (there is a right solution and the challenge is to find that) and a problem (there is not a single correct solution).

**Action learning set**

It is a small group (6-8) of peers working and learning together in order to solve the problem that each one is facing. They will help each other define the problem and identify possible solutions, and, during the action taking period, they will share information about the outcomes of the actions taken.

**Action learning meetings**

The action learning meetings constitute a space for reflecting together in the group. It is recommended that these meetings take place away from the work environment. They offer a platform for sharing problems and progresses. These meetings are normally facilitated by a professor, a researcher or a senior manager. The exchange of experience, knowledge and problems is the essence of the successful action learning set, as is the progress achieved, too (Revans, 1982). The dynamic of action learning meetings is shown in Figure 9.

![Figure 9 – Adapted from National Primary and Care Trust Development Programme. Welcome to Action Learning](image)

**Reflection**
This is a conscious process of reflecting about questions such as “what have I done? And what have I learned?” This reflection task includes the reframing, both individual and collective, of the problem, the challenging of assumptions and the promotion of self-awareness (reflection on mental models). Action learning is based on asking the right question. Marquardt has modified Revans’ learning formula in order to equip it with a more explicit reflection component: \( L = P + Q + R \), where \( R \) is reflection, which means “recalling, thinking about, pulling apart, making sense, trying to understand” (Marquardt, 1999).

**The facilitator**

During an action learning process, a coach is assigned to facilitate the learning environment. They could be part of the team or external, but not an expert on the problematic subject in question, because such an expert could block the action learning process by assuming the role of consultant. The facilitator should make sure that the group is following action learning principles.

**Taking action**

Some actions must be taken at the work place: otherwise, it would not be action learning. To plan actions of problem solving and observe the outcomes in ‘real life’ is the momentum of any action learning process.

**Learning**

Participants enter the action learning process with the commitment to learn with and from their peers.

In summary, we see PBL at work and action learning may be highly relevant when working with open data training in governmental institutions as well as in the private sector. As with PBL in the academic context, companies may work on their everyday problems, using these as vehicles to promote professional development and organizational learning.
3.3 Use of Technology for PBL – online PBL

As the previous sections have shown, there is much and very diverse research into PBL and many different ways of practicing it. This complexity is not made simpler by adding technology to the equation. In fact, the research area of e-learning, distance learning, technology enhanced learning or digital education is vast, with multiple conferences, journals and specialized areas of research. PBL seems to exist across all these sections, rather than having a particular subsection within the educational technology circuit, i.e. a journal or conference dedicated specifically to technology and PBL. There are particular journals on PBL (e.g. *Journal of Problem Based Learning in Higher Education*, *Interdisciplinary Journal of Problem Based Learning*), but these are not focused on the use of technology per se.

Therefore, one can find work on PBL and technology scattered across a range of different areas of research within the umbrella of educational technology. Furthermore, as we shall see, the variance of PBL models and orchestrations of PBL in practice also call for different technological solutions.

Therefore, to sharpen our focus, we would like to refer more specifically to Networked Learning as an area of research, the theoretical and philosophical underpinnings of which align particularly well with PBL.

The area of networked learning has roots in humanist, emancipatory perspectives on education and critical theory (Hodgson, McConnell, & Dirckinck-Holmfeld, 2012; Jones, Ryberg, & Laat, 2015; Ryberg, Sinclair, Bayne, & de Laat, 2016). It is an area of research that is committed to a particular set of values that are well-aligned with PBL. The values are summarized by Hodgson et al. (2012, p. 295) as follows:

- Cooperation and collaboration in the learning process.
- Working in groups and in communities.
- Discussion and dialogue.
- Self-determination in the learning process.
- Difference and its place as a central learning process.
- Trust and relationships: weak and strong ties.
- Reflexivity and investment of self in the networked learning processes.
- The role that technology plays in connecting and mediating.
Although not everyone within networked learning would necessarily agree with each and every one of the values, they do reflect a general ethos within the networked learning community (Hodgson, Laat, McConnell, & Ryberg, 2014; Jones et al., 2015; Ryberg et al., 2016). However, looking back at the values already mentioned in relation to PBL, it is clear that there are obvious overlaps between the values and principles of PBL and Networked Learning. These connections are also pointed out by McConnell et al. (2012). For example: Self-determination, working in groups, discussion and dialogue are key principles in both Networked Learning and PBL.

However, the phenomena of ‘learning and working together’ may take many forms; from very strongly tied collaborations where participants are mutually dependent on each other to more loosely-tied organizations of work where the connections to others may be weaker, such as e.g. inspiration and exchange rather than working closely together as a team. This also reflects the fact that PBL is practiced in many different ways (See Section 3.2). For example, in the Aalborg PBL model members of the groups are heavily dependent on each other for completing semester projects, whereas in the Maastricht model, groups are used for discussions and inspiration, the final product often being an individual enterprise. Therefore, to distinguish between different ways of working together, it may be useful to define different types of interactional dependencies.

### 3.3.1 Different Types of Interactional Dependencies

Understanding types of interactional dependencies is an important step in establishing which technologies could be employed to support the desired mode of working or how the same tools can be adopted for widely different purposes. In general, the principles and values associated with both PBL and networked learning are well aligned with recent socio-technical developments or trends referred to as Web 2.0 and, more recently, social media. For example, the educational interest in Web 2.0 has given rise to concepts such as learning 2.0 and e-learning 2.0 (Downes, 2005; Redecker, Ala-Mutka, & Punie, 2010). Furthermore, Web 2.0 has spurred an increased interest in notions such as ‘collaboration’ and ‘communities’ because of the emerging technologies’ capacity for collaboration and exchange. At the same time, Web 2.0 technologies have also attracted interest due to their strong focus on personalized networks and self-directed learning articulated as an interest in personal learning environments and personal learning networks (Attwell, 2007; Dabbagh & Kitsantas, 2012).
These tensions between, on the one hand, individualization and personalization and, on the other hand, collaboration and collective action are captured well by a model developed by Dalsgaard & Paulsen (2009):

![Diagram showing interactional dependencies (Dalsgaard & Paulsen, 2009)](image)

**Figure 10 – Interactional dependencies (Dalsgaard & Paulsen, 2009)**

In the model, we see a continuum stretching from individual learning, over cooperation in networks to collaborative learning in groups. This continuum reflects different interactional dependencies; from having no dependencies on others (individual learning - alone), to having more loosely tied dependencies in a network of learners who support and help each other, to collaborative engagements where students are heavily dependent on others. Thus, we would classify the Maastricht Model as based on a cooperative organization, whereas the Aalborg Model is of a more collaborative nature. However, both models also include individual learning where individual students work on their own – furthermore, at the end of any such shared production process, the fruits of collaboration do have to be carried on by individual learners.

The important question here for designing a particular PBL orchestration is: how do we, as learning designers, imagine students should work together and what are their interactional dependencies?

Across such orchestrations there are, however, some more general or generic processes, which take place as part of PBL work.
3.3.2 Generic PBL Processes and Technologies to Support them

In this section, we briefly outline work or interactional processes that are relevant across a wide range of PBL orchestrations and we discuss how these can be supported by various technologies. In establishing these processes of collaboration, we take our point of departure in insights generated through studies of long-term, collaborative, student-driven problem based projects. This type of problem oriented project work, which is practiced e.g. at Roskilde and Aalborg University (Andersen & Heilesen, 2015; Lone Dirckinck-Holmfeld, 2002; Holgaard, Ryberg, Stegeager, Stentoft, & Thomassen, 2014; Anette Kolmos, Fink, & Krogh, 2004) exemplifies some very complex student-managed collaboration processes and are as such a good point of departure for understanding ‘interactional’ processes. Such complex and collaboratively demanding forms of PBL can be used to identify work processes that would also be part of shorter-lived and less collaboratively intensive forms of PBL. We also draw on more general models and a model specifically attuned to the 7-step PBL model.

In their paper on ‘virtual project based learning’, Tolsby, Nyvang and Dirckinck-Holmfeld (2002) identify three central collaborative processes: coordination, resource management, negotiation of meaning. Coordination concerns the organization of work, i.e. who is doing what and when; resource management is about sharing and organizing tools and resources that are part of the work; Negotiation of meaning is the two-fold process of continuously debating, discussing and engaging (participation) as well as deciding and giving form to the decisions and thoughts (reification) (Etienne Wenger, 1998). Similarly, Khalid et al. (2012, pp. 563–565) identified a number of PBL activities: Sharing, discussing, reading, presenting, writing, communicating, reflecting, arguing, and diagramming, and further relate these to particular tools and different phases in a problem-oriented project work.
### Table 6 – PBL activities (Khalid et al., 2012, pp. 563–565)

<table>
<thead>
<tr>
<th>Phases</th>
<th>Activities</th>
<th>Web tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Forming</td>
<td>Brainstorming</td>
<td>Twitter, Etherpad, Blogger.com, Wordpress</td>
</tr>
<tr>
<td></td>
<td>Group creation</td>
<td>Email, Twitter</td>
</tr>
<tr>
<td>Problem formulation</td>
<td>Brainstorming</td>
<td>Mindmap, vue.tufts.edu, Mindmeister, Google docs, EtherPad</td>
</tr>
<tr>
<td></td>
<td>Literature searching</td>
<td>AAU digital library, Google scholar, Google, Bing</td>
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<tr>
<td></td>
<td>Literature Storing</td>
<td>Dropbox, Zotero groups, Diigo, Digg, Mendeley</td>
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<tr>
<td></td>
<td>Referencing</td>
<td>Wiggio, Refworks, Zotero, Mendeley</td>
</tr>
<tr>
<td></td>
<td>Arguing</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td></td>
<td>Writing</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td></td>
<td>Presenting</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td>Task formulation</td>
<td>Scheduling</td>
<td>Google calendar, Doodle</td>
</tr>
<tr>
<td></td>
<td>Diagramming</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td></td>
<td>Resource allocation (tools, spaces, locations, people)</td>
<td>Basecamp, MS project</td>
</tr>
<tr>
<td>Data gathering</td>
<td>Data Collection</td>
<td>surveyexact.dk, Google docs</td>
</tr>
<tr>
<td></td>
<td>Data Transformation</td>
<td>surveyexact.dk, Google docs</td>
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<tr>
<td></td>
<td>Data Storing</td>
<td>surveyexact.dk, Google docs</td>
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<tr>
<td></td>
<td>Data representation</td>
<td>surveyexact.dk, Google docs</td>
</tr>
<tr>
<td>Analysis</td>
<td>Data analysis</td>
<td>surveyexact.dk, MS Office</td>
</tr>
<tr>
<td></td>
<td>Arguing</td>
<td>Table3: Common activities</td>
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<tr>
<td></td>
<td>Diagramming</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td>Design</td>
<td>Development/Production / Testing</td>
<td>Etherpad</td>
</tr>
<tr>
<td></td>
<td>Experimenting</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Modelling</td>
<td>Dabbleboard</td>
</tr>
<tr>
<td></td>
<td>Writing</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td></td>
<td>Simulating</td>
<td>SecondLife</td>
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<tr>
<td></td>
<td>Prototyping</td>
<td>Dabbleboard</td>
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<tr>
<td></td>
<td>Diagramming</td>
<td>Table3: Common activities</td>
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<tr>
<td>Reporting</td>
<td>Report writing</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td></td>
<td>Report submitting</td>
<td>Email, Google project, AAU project</td>
</tr>
<tr>
<td></td>
<td>Presenting</td>
<td>Table3: Common activities</td>
</tr>
<tr>
<td></td>
<td>Arguing</td>
<td>Table3: Common activities</td>
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<tr>
<td></td>
<td>Publishing</td>
<td>AAU project library</td>
</tr>
</tbody>
</table>
Table 7 – PBL activities (Khalid et al., 2012, pp. 563–565)

<table>
<thead>
<tr>
<th>Common activities</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing</td>
<td>Dropbox, Zotero, Diigo, Youtube, Facebook, Flickr, twitter, Blogger, Delicious, Digg, Box.net, Slideshare, LogMeIn, TeamViewer, LogMeIn</td>
</tr>
<tr>
<td>Discussing</td>
<td>Facebook, LinkedIn, Skype, MSN, Yahoo messenger, twitter, Blogger, Doodle, SignAppNow, Mahara, Moodle, Quickr, Adobe Connect, Lectio.dk, Microsoft OneNote, FirstClass</td>
</tr>
<tr>
<td>Reading</td>
<td>Google</td>
</tr>
<tr>
<td>Presenting</td>
<td>Prezi, Google docs</td>
</tr>
<tr>
<td>Writing</td>
<td>Google docs, Typewith.me, MS Office with Dropbox</td>
</tr>
<tr>
<td>Communicating</td>
<td>Skype, MSN, Yahoo messenger, twitter, Blogger, Doodle, SignAppNow, Mahara, Moodle, Quickr, Adobe connet, Lectio.dk, Microsoft OneNote, FirstClass</td>
</tr>
<tr>
<td>Reflecting</td>
<td>Facebook, LinkedIn, Youtube, Flickr, Skype, MSN, Yahoo messenger, twitter, Blogger, Moodle, Mahara, FirstClass</td>
</tr>
<tr>
<td>Arguing</td>
<td>Facebook, LinkedIn, Youtube, Flickr, Skype, MSN, Yahoo messenger, twitter, Blogger, Mahara, Email, Microsoft OneNote, FirstClass</td>
</tr>
<tr>
<td>Diagramming</td>
<td>Gliffy, Diagramly, Dabbleboard</td>
</tr>
</tbody>
</table>

Hack (2013, p. 233) maps various literacies to the different phases of the 7-step PBL model (e.g. clarify terms = locate information; define the problem = identify important questions) and then relate these steps to various Web 2.0 technologies.

Table 8 – 7-step PBL model (Hack, 2013, p. 233)

<table>
<thead>
<tr>
<th>Seven-Step PBL Method</th>
<th>Leu Literacies</th>
<th>Web 2.0 Examples</th>
<th>Scaffolds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clarify terms:</td>
<td>Locate information</td>
<td>• Collabulary: The group can develop a collective vocabulary of terms and concepts needed to analyse the problem</td>
<td>• Provide glossary</td>
</tr>
<tr>
<td></td>
<td>Identify all known and unknown concepts, words and phrases in the problem description</td>
<td>• Glossary: Develop a formal list of definitions, which can be</td>
<td>• Encourage students to create their own glossary within their project workspace</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Prompt students to provide source of</td>
</tr>
</tbody>
</table>
### 2. Define the problem: What are the underlying issues, concepts, phenomena that need to be understood in order to solve the problem

#### Identify important questions

- Mindmapping: promote brainstorming and creative thinking through visualising the problem.

#### Critically evaluate information

- Social networks: group communication
- Wikis: Webpages produced and edited by the group

### 3. Analyse the problem: Brainstorm the problem to generate ideas and hypotheses

- Provision of mind mapping tool can provide a prompt to structure and organise ideas and classify knowledge or it can be provided with predefined prompts.

### 4. Review collated ideas and information: Construct viable hypotheses

- Social networks: group communication
- Wikis: Webpages produced and edited by the group

### 5. Formulate learning objectives

- Prompting questions can be added to wiki/social network sites
- Prompt students to identify personal skills and knowledge
- Provide links to resources
- Provide procedural assistance
- Provide pages with title prompts (wiki)

### 6. Independent Study: To fill gaps in knowledge and meet learning objectives

- Locate information
- Synthesize information
- Disseminate Information

- Develop folksonomy to tag information for sharing within the group
- Provide updates to group through the wiki, share resources and definitions through creation of collabulary or formal glossary on wiki
- Blogs: Keep a log of individual opinion, information, and/or diary entries throughout the

- Tutor can comment on blogs/wikis to help diagnose misconceptions and promote evaluation of multiple perspectives
D2.1 Data-driven PBL Model

| 7. Synthesis and Reporting: Share findings with the group to identify viable solutions to problem, or identify further learning objectives | Disseminate Information | • Use wiki to publish and disseminate findings to group/tutor | • Prompting questions: What is presentation trying to achieve? Who is the target audience? • Prompt with examples of alternative reporting formats |

Dalsgaard & Sorenson (2008, p. 273) identify four particularly important functions for creating a typology for web 2.0 and for learning more generally (dialoguing, networking and awareness-making, creating, sharing).

![Figure 11 – Important functions to create a typology (Dalsgaard & Sorenson, 2008, p. 273)](image)

Dabbagh & Kitsantas (2012, p. 7) developed a framework for three levels of social media use in relation to supporting Personal Learning Environments (PLEs), ranging from personal information management to social interaction and collaboration to information aggregation and management,
and suggest particular Web 2.0 technologies and learning activities related to each of those across the three levels (e.g. how blogs and wikis can be used).

A framework for using social media to support self-regulated learning PLEs is shown in the following Table.

Table 9 – Framework for social media use in PLEs (Dabbagh & Kitsantas, 2012, p. 7)

<table>
<thead>
<tr>
<th>Level 1: Personal Information Management</th>
<th>Level 2: Social Interaction and Collaboration</th>
<th>Level 3: Information Aggregation and Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogs</td>
<td>Instructor encourages students to use a blog as a private journal to set learning goals and plan for course assignments and tasks.</td>
<td>Instructor encourages students to enable the blog comment feature to allow for instructor and peer feedback enabling basic interaction and sharing.</td>
</tr>
<tr>
<td>Wikis</td>
<td>Instructor encourages students to use a wiki as a personal space for content organization and management.</td>
<td>Instructor encourages students to enable the wiki’s collaborative editing and commenting features for feedback.</td>
</tr>
<tr>
<td>Google Calendar</td>
<td>Instructor encourages students to use Google Calendar for personal planning.</td>
<td>Instructor encourages students to enable the calendar sharing features to allow feedback and collaboration to complete course tasks.</td>
</tr>
<tr>
<td>YouTube or Flickr</td>
<td>Instructor encourages students to use Flickr or</td>
<td>Instructor encourages students to enable the</td>
</tr>
</tbody>
</table>
All of these models illustrate central PBL processes and technologies that, to a varying degree, can be used to scaffold particular aspects of PBL processes. Some are more general (e.g. Dalsgaard & Sorensen, 2008 and Dabbagh & Kitsantas, 2012), and some are aligned with particular PBL models (e.g. Hack, 2013 and Khalid et al., 2012, who reflect the 7-step model and the Aalborg University PBL model respectively).

These various categorizations have further been distilled into four categories by Holgaard et al. (2014):

- Inquiry and exploration
- Resource management (sharing, storing, annotating)
- Dialogue and communication
- Production (sharing and collaborating)
These are quite generic collaborative processes that are not intimately connected with particular technologies and are modes of work that feature across the PBL models that we previously discussed (see Section 3.2). We shall return to these four categories, but what is worth noting at the moment is that ‘interactional’ processes within and across PBL models encompass a number of processes that are in different ways connected to particular phases in PBL work as well. Furthermore, what particularly the model by Dabbagh & Kitsantas (2012) and also the model by Dalsgaard & Paulsen (2009) suggest is that these processes can also span continuums from more individualized to more cooperative and collaborative forms of work. We find this particularly important as PBL covers a multitude of practices/models; all of them, however, containing both individual and collective elements. This means that although we as designers would, for instance, be particularly interested in instilling collaborative patterns of work, it might also be very fruitful to ponder how students as individuals might use PBL for their own purposes and how the learning platforms and the resources offered become a personal resource, too. In this regard, we can think of Dabbagh & Kitsantas’ model and how we can cater for Personal Information Management, Social Interaction and Collaboration, and Information Aggregation and Management. As we read their model, the Social Interaction and Collaboration phase encompasses a type of work we would characterize more as a ‘cooperative mode’ where students find inspiration in each other’s work rather than being dependent on the outcomes of others’ work. In terms of formats of a collaborative nature, we would argue that Information and Aggregation needs to take place at two different levels: a collective level, where the resources and discussions feed into a common product (e.g. a project report), whilst simultaneously feeding into each student’s Personal Learning Environment. Tentatively, we can model this in the following way:

<table>
<thead>
<tr>
<th>Individual level</th>
<th>Cooperation</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each student comes with their own experiences and work from their ‘personal learning environment’, which has both digital and non-digital aspects.</td>
<td>Students get inspired by others and we can design learning activities that encourage exchange and communication. This feeds into students’ own</td>
<td>Students get inspired by each other, but are also required to construct a learning product that they are mutually responsible for, i.e. a collective</td>
</tr>
</tbody>
</table>

Table 10 – Three levels of student work
They build a personal repository of notes, experiences, collection of literature etc. | learning goals and individual constructions of learning products. During the process, students might also collaboratively produce common resources | learning product, such as a project report, a design or other product. This requires that they build not only individual repositories but construct, for the purpose of the project, a collective environment of resources, that can later feed into their personal repository

The boundaries between cooperation and collaboration may seem fuzzy and fleeting. For example, Hack (2013) suggests that students build collaborative products as part of the problem exploration phase, but the 7-step model does go into a more individual phase where more cooperative traits are outlined, e.g. developing a folksonomy for sharing within the group. Also, in more collaborative oriented PBL models, a lot of ‘teamwork’ is, in fact, often handled by distributing work among group members, who then work on separate, individual parts of the project.

From this, we shall now return to describe in more detail the four categories developed in Holgaard et al. (2014). We choose this categorization as it is not intimately connected with one particular PBL model, while at the other hand it is not as general as e.g. Dalsgaard & Sorensen’s (2008) model. The model represents an attempt to describe generic processes in PBL work that also span variations in the interactional dependencies, i.e. whether the work is more cooperative or collaborative.

### 3.3.2.1 Inquiry and Exploration

By the words ‘inquiry and exploration’, we are referring to the process of initially and continuously exploring the problem space that one is working with. Whether the problem is defined by the facilitator/teacher or has to be formulated by the students, there is usually in PBL processes a need to consult and collect more knowledge to understand or contextualize the problem. This concerns ‘information search’, but it equally concerns the development of personal and collective learning networks (Dalsgaard, 2009; Haythornthwaite & de Laat, 2010; Ryberg & Larsen, 2008; Sie et al.,
2013), as well as becoming knowledgeable about other types of resources that might be available outside the professionally curated spaces of a library.

In terms of information search, it encompasses processes (as mentioned by Khalid et. al, 2012) such as literature search and brainstorming, but equally what Hack (2013) refers to as locating information, identifying important information and critically evaluating information. In relation to this, Hack also mentions mind-mapping and ‘building glossaries’ (in a wiki). In addition, she mentions social networks, which seem to be particularly oriented towards use amongst the students, but we would equally think of this as a more outwards oriented activity. For example, social networks like Twitter have been explored and found useful for students and researchers in building social learning networks and we might also mention academic social networks such as researchgate.net and academia.edu, where students and researchers can connect to others or upload and comment on papers, or services where researchers and others share and build public or group based bibliographies (zotero.org, mendeley.com) as well as social bookmarks (delicious.com, diigo.com).

For students and researchers, identifying and connecting to external learning networks is an alternative entrance into curated knowledge networks. The identification or creation of relevant learning networks and the collection of resources could constitute a new dimension of scholarship. Thus, in relation to exploration and inquiry, the information search via library databases and search engines can be supplemented by exploration of relevant social online networks, as part of constructing social learning networks.

These engagements also span the continuum of interactional dependencies. In PBL groups, the individual members may use their different learning networks and resource persons to take charge of self-driven, individual exploration, which then feeds back into a group’s shared repository. We can view this as rhythmic pulsations where members set out to explore their extended learning networks, and then come back with refreshed perspectives and new information. To re-iterate the model in the previous section, we can view this process as happening across the interactional dependencies.
Table 11 – Three levels of exploration inquiry

<table>
<thead>
<tr>
<th>Individual level</th>
<th>Cooperation</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students explore and find literature and other resources on their own through established sources. This feeds into the personal repository.</td>
<td>Students share resources with each other through social media service, e.g. reference management software such as Zotero and Mendeley on topics of common interest.</td>
<td>Students build common resources that feed into their particular shared project or product, e.g. a Zotero database on relevant literature for their project.</td>
</tr>
<tr>
<td>They use brainstorming tools (Mindmeister, mindmap) to inspire each other’s further work.</td>
<td>They use brainstorming tools to explore how to formulate their common problem and how to work on it.</td>
<td></td>
</tr>
</tbody>
</table>

However, many of these activities flow naturally into and overlap with the next category, which is resource management (sharing, storing, annotating).

3.3.2.2 Resource Management (sharing, storing, annotation)

An important aspect of collaborative and individual PBL processes is the management of resources. This includes storing, sharing, and annotating references, bookmarks, documents, pictures etc. which is relevant both at group and individual levels. For a group, the management of resources is important to complete a piece of work, and for the individual it is important to create personal repositories for future work. There is a great number of online services which learners can use to store and share resources:

- notes, clippings, bookmarks (Evernote)
- images (Pinterest)
- bookmarks (Diigo, Delicious)
It turns out, though, that in spite of students being very knowledgeable about some aspects of social media, e.g. file sharing, they are often not familiar with academically oriented services (such as bibliographic referencing systems). These are often services and practices that students need to be introduced to (Clark, Logan, Luckin, Mee, & Oliver, 2009; Luckin et al., 2009; Ryberg, Dirckinck-Holmfeld, & Jones, 2010; D. L. Thomsen, Sørensen, & Ryberg, 2016). Much like other social media, these services are layered and allow for sharing and annotation at different levels of scale – from the individual to the small group to a wider network of people. For example, with the aid of such services, students could choose to maintain a group and share relevant resources across a cohort, as well as creating smaller online groups for sharing resources related to their PBL group work. Thus, students can utilise networks of different scale and ties (from a few persons to the wider cohort) in retrieving relevant resources, which can potentially provide more diverse and rich networks for the individual student (Dalsgaard, 2009; Ryberg & Wentzer, 2011).

**Table 12 – Three levels of resource management**

<table>
<thead>
<tr>
<th>Individual level</th>
<th>Cooperation</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students explore and find literature, write notes, store bookmarks and other resources. This feeds into their personal repository</td>
<td>Students share notes, bibliographies, bookmarks with each other, e.g. across a semester cohort. They can use this for common inspiration</td>
<td>Students build common resources that feed into their particular shared project or product, e.g. a Zotero database on relevant literature for their project and share bookmarks relevant for their project</td>
</tr>
</tbody>
</table>
3.3.2.3 Communication and Dialogue

to group work, online technologies clearly add a level of flexibility. Learners can work in groups with people with whom they never or very rarely meet physically, and for groups who cannot meet on a regular basis it extends the communicative flexibility of the group. They can communicate asynchronously in-between the physical meetings or meet synchronously online if more convenient. Also, groups can use various technologies to organize the work, e.g. to manage the tasks and time:

- Messaging, texts, mails
- Video or audio calls
- Forum/discussion boards
- Shared Calendar or project management tools

We may again distinguish between three types of processes (although rather than using the term ‘individual’, we speak of ‘coordination’ as the first aspect): Coordination, cooperation and collaboration (Dalsgaard & Paulsen, 2009; Holgaard et al., 2014; Tolsby et al., 2002). They represent steps of increasing mutual dependency and commitment. Coordination concerns the management of ‘simple’ planning processes – who does what and when? When to meet, who works on what parts of a project? Cooperation involves a higher level of complexity. It entails the distribution of complex tasks. For example, working on different parts of a shared report where people work in parallel or sequentially (dependent on input/output of others). Finally, collaboration is the mode requiring a high degree of mutual commitment and attention; for example, when agreeing on which problem to address in the project or when working collaboratively on writing specific parts.

These different modes of work also require different levels of communicative bandwidth. While it is possible to coordinate a meeting via texts, it would probably be difficult to organize a collaborative brainstorming in that way. Increasing the complexity and collaborative dependencies call for higher ‘communicative bandwidth’ such as video-calls with screen sharing, or asynchronous dialogues where there is more time for reflection.
Table 13 – Three levels of communication and dialogue

<table>
<thead>
<tr>
<th>Coordination</th>
<th>Cooperation</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding out how and when to meet. Who is doing what at present time?</td>
<td>More complex distribution of labour and modes of work, where one is dependent on the input or output of others</td>
<td>Modes of work that require mutual attention and thinking-together. Agreeing on the overall direction of a project, writing together, brainstorming</td>
</tr>
</tbody>
</table>

3.3.2.4 Production – Sharing and Collaboration

In PBL processes where there is a collaborative product, co-production and sharing of texts or other outputs (code, models, designs etc.) is very important. For this purpose, online word processing tools (e.g. Google Docs, Office365) are useful. They allow students, in smaller or bigger groups, to share documents online and they offer collaborative, synchronous writing. This reduces the need for version management as everyone is always working in the same and most recent versions; they allow for parallel or synchronous writing.

Another branch of services is file sharing or file syncing services (Dropbox, Owncloud, Box). These allow students to share files and folders which are then synced and updated across all devices after one member saves a file. These support primarily serial or asynchronous writing, i.e. where two members cannot work on the same file at the same time. Thus, these two types of service afford different ways of managing collaborative writing.

Apart from technical affordances, collaborative writing is also about agreeing on common norms for editing. Even though all members can edit the whole document, are members ‘permitted’ to work on each other’s’ texts? Do students see the document as a ‘collaborative whole’ or are members responsible for particular sections and chapters (there may be institutional requirements in terms of visibility of authorship)?
3.3.3 Brief summary of PBL and Technology

In this section, we have highlighted four aspects of PBL processes and how they can be mediated or supported by technology:

- Inquiry and exploration
- Resource management (sharing, storing, annotating)
- Dialogue and communication
- Production (sharing and collaborating)

We have further highlighted that there are different ways of working together, spanning from individual networking over loose-network cooperation to focused collaboration where learners are highly dependent on each other. Our purpose is not to recommend one form above others, but merely to point out that different orchestrations of PBL are underpinned by different communicative and collaborative dependencies. These dependencies call for different networked technologies or different use of those.

So far we have introduced the main theoretical aspect of PBL. In summary there are three key components of PBL: group, facilitator and the problem. We have described in detail each of these components and presented some aspect to take into consideration when design learning activities. Moreover, we describe the four main PBL principles: collaborative learning, critical thinking, self-directed learning and reflection. The third main topic of this theoretical section is the description of different modalities of PBL. We close the section with a presentation of a wide range of technologies that can support the PBL process.

In the next section we will discuss some relevant training practices within the field of open data and in the last section we will give some pedagogical recommendations to the design of educational open data activities using PBL.
4 Section 2: Open Data Education

The aim of this section is to present an overview of the current teaching practice within open data, in order to establish an understanding of the different pedagogical designs used within the field as well as of the closeness of the current practice to PBL. We make a distinction between teaching open data (open data is the subject) and open data for education (open data is a means). We focus on teaching open data as that is the area of concern of the ODEdu project.

The section is built on two different information sets:

1. The current methods and learning activities used among the partners of the ODEdu project. This information was collected through interviews and provides an overview of the current practices of teaching of the project partners.

2. The current learning activities used by international organizations to promote open data. This information was collected by looking at the websites of the main international organizations working with fostering the use of open data. We excluded Open Data Institute as they are part of the ODEdu project and their experience would at all rates be collected through interviews.

In Deliverable 1.1, ProXML described some of the teaching activities of Open Knowledge Foundation and Open Data Institute. In this Deliverable, we look at the different pedagogical designs of those teaching activities, and include other international organizations.

4.1 Current Practice of Open Data Education

According to Mikroyannidis et al. (2016), the current challenges for managers are to train their staff to become proficient data practitioners and entrepreneurs and that surviving in the data economy depends on hiring data professionals who master both the technical and non-technical aspects of data. Some of these professionals have been defined as data scientist (Davenport & Patil, 2012).

Guy (2016) defines “open educational data” as all openly available data that can be used for educational purposes (data sets used in teaching and learning, though they might not be designed for that purpose) and open data that is released by education institutions (release of data from academic institutions about their performance, students, courses, staff, etc.).
According to Radcheko & Sakoyan (2016), there are several possible directions for the use of open data in educational environments: a) use data and the connected technologies to make educational tools more efficient and flexible, b) use open data in educational environments to provide students with more options to organize their schedule and learning process and c) use open data as a material to underpin the educational process. This last direction is related to the concept of open educational resources.

Open educational resources are defined by Atkins et al. (2007, p. 4) as follows: “OER are teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge”.

In the ODEdu project, we aim to use data and technology to train people in the subject of open data. The ODEdu project will be concerned with the first definition by Guy (2016) and with the direction A and C of Radcheko & Sakoyan (2016).

4.1.1 International Initiatives Fostering and Promoting Open Data

Many different initiatives are aiming to promote the use of Open Data. We went through many of those initiatives to get to know their pedagogical approach to teaching and training open data. We reviewed the following organizations and created a summary of the teaching activities developed by them, as shown in Table 14:
Table 14 – Summary of teaching activities

<table>
<thead>
<tr>
<th>Institution</th>
<th>Description</th>
<th>Course</th>
<th>Pedagogical aspects</th>
</tr>
</thead>
</table>
| Open Knowledge Foundation    | It is a worldwide non-profit network aiming to unlock information and enable people to work with it to create and share knowledge. School of Data is the division of OKF that is doing the training. | Open Knowledge meet-ups, hackathons, data expeditions. Open Knowledge Labs. | Learning by doing  
They present cases and different types of projects within the field of OD |
| School of Data               | The School of Data works to empower civil society organizations, journalists and citizens by giving them the skills they need to use data effectively in their work. | They have courses and data expeditions. Learning modules are all stand-alone and can be taken in any order. They curated modules into a series of courses. Many of the modules will take 1 hour to cover. | The approach at the School of Data focuses on learning by doing and problem solving. They urge learners to teach what they learn in their organizations  
The courses are online and self-study based (step-by-step, visual instructions) |
| School of Open               | They are outdated.                                                          | They have online courses, workshops and training programs. They have stand-alone courses and facilitated courses. | Self-study courses  
Learning by doing (hands-on)  
Real context |
| **Open Data Day** | One-day event. Open Data Day is a gathering of citizens in cities around the world to write applications, liberate data, create visualizations and publish analyses using open public data to show support for and encourage the adoption of open data policies by the World’s local, regional and national governments. | Global extension. This is an event hosted and supported by Open Knowledge Foundation. | Real context |
| **Open Nepal** | Open Nepal is an initiative to promote more effective development through the increased use of data and information. | They have Webinars and library resources where people can find introductory information about open data. | Self-study material |
| **Open Data Monitor** | Open Data Monitor provides the possibility to gain an overview of available open data resources and undertake analysis and visualisation of existing data catalogues using innovative technologies. | They do not offer training. | |
| **Open Data 500** | The Open Data 500 Global Network is an international network of organizations which seek to study the use | They do not offer training. | |
and impact of open data. Coordinated by the Governance Lab (GovLab), the Open Data 500 Global Network enables participating organizations to analyse open data in their country in a manner that is both globally comparative and domestically specific.

| P2PU (Peer 2 Peer University) | This is a non-profit organization, which facilitates learning outside of institutional ‘walls’. Designing and leveraging open educational tools and resources, P2PU strives to cultivate a high-quality, low-cost model for lifelong learning. | Learning Circles are peer-led study groups for learners who want to take online courses together and in-person. | Solving problems
Peer learning / Collaborative learning |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Education (this is part of Open knowledge foundation)</td>
<td>Open Education is often associated with the popular concept of Open Educational Resources, but Open Education is much more than just OER and involves aspects like opening up relevant educational data and changing both institutional and wider culture.</td>
<td>They do not have courses but instead offer online resources from different projects and initiatives. It is a platform for promoting openness in education.</td>
<td>---</td>
</tr>
</tbody>
</table>
The strongest organization promoting the use of open data is Open Knowledge Foundation, which is described in detail in Deliverable 1.1. Open Knowledge co-ordinates around 20 different domain-specific Working Groups that work around different areas of open knowledge. Among these are the Open Education Working Groups, whose goal is to develop actions, cross-sector and cross-domain, around open education, including open data (Guy, 2016).

In general, there is not a lot of training on the open data subject and the practice of training open data is a mix between traditional and PBL approaches. However, none of the organizations stated any concrete pedagogical approach for their designs. We decided to explore deeper the three most innovative types of training: Data expeditions, hackathons and learning circles.

**Data Expeditions**

School of Data defines Data Expeditions as “quests to map uncharted territory, discover hidden stories and solve unsolved mysteries in the Land of Data. In a team you’ll tackle a problem, answer a question or work on a project”. Radcheko & Sakoyan (2016, p. 167) define it as a “project-oriented format, which makes it possible to immediate apply learnt skills to a specific task with a prospect of getting an actual result. Another important aspect of this format is team work based on peer-learning approach and experience exchange”.

The central philosophy of Data Expeditions is learning by doing, working with real problems, group work and role-play. Expeditions may be online or offline. They last between 3 hours and 3 weeks. The outcome depends a lot on the group’s ability to work together. The roles in the data expedition are: storyteller (a person who is good at finding interesting angles to explore, producing interesting outputs for the audience), scout (the one who hunts down data from across the web), analyst (the one who breaks the data and tests the hypotheses) and designer (the one who designs the presentation of the outputs and make sure the story really comes through).

**Hackathons**

Komssi et al. (2015, p. 60) state that “in hackathons, small teams produce working software prototypes in a short time period. Hackathons are good for collaboration, experimentation, and learning but require that additional mechanisms are in place to commercialize their key results”.

There are many different purposes and formats of hackathons - but all of them have the following aspects in common: a) they center on a common theme or technology, b) they begin with ideas and

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1. [http://schoolofdata.org/data-expeditions/#sthash.02SaV1wM.dpuf](http://schoolofdata.org/data-expeditions/#sthash.02SaV1wM.dpuf)
team building, c) they have a starting and stopping time, d) the teams are provided with all the things that they need, e) each team develops and prototypes an idea, f) each team presents their prototype in front of the audience, and g) one idea is chosen as the best (sometimes they get funding for further development) (Komssi et al., 2015).

There are similar methods such as innovation games, challenges, and tournaments that offer fast-paced ideation and prototyping with social, fun, and competitive aspects (Komssi et al., 2015).

Hackathons are internal (within a company) or external (public) events. For companies, they have social and educational benefits, as employees and stakeholders may learn or try something new (Komssi et al., 2015).

In the pedagogical area, Zoras (2015) argues that within hackathons “students are utilizing their skills and knowledge to solve problems. It is project-based learning, inquiry-based learning, and STEM all wrapped up into one activity! It is about design thinking and truly a 21st-century learning opportunity. Students are working collaboratively within mixed-ability groups to examine problems and come up with solutions.”

**Learning Circles**

P2PU defines learning circles as peer-led study groups for learners who want to take online courses together and in person. In this way, Learning Circles facilitate the social aspect, developing the interpersonal skills and the space for participants to engage with online courses. A relevant aspect is that the facilitator is a peer and not an expert on the topic.

P2PU use open source technologies and free online courses, for example MOOCs, and through Learning Circles groups, they connect individuals who would follow the online course in an ‘offline way’ (they describe it as “online courses, offline”). Online Learning Circles also exist, but they are not implemented in P2PU.

The concept, principles and process of Learning Circles are very similar to action learning. The method has been used in many settings, such as schools (Luschei & Vega, 2015; Swaminathan, Byrd, Humphrey, Heinsch, & Mitchell, 2014) and companies (Richard Scriven, 1984).

**EUCLID project**

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In the search for different training activities, we found some open data teaching modules developed by EUCLID project\(^3\), which we found relevant as a reference for the ODEdu project. It is an EU project, which aims to develop the skills and competences of data scientists. This project differs from the ODEdu project regarding the target group and the subject. EUCLID’s subject is Linked Open Data (LOD) and their target group are practitioners and professionals, who already use or aim to adopt LOD as a means for publishing and accessing structured data over the Web. However, they state that their products are useful for a much broader audience.

The outcomes of the EUCLID project that are relevant for the ODEdu project include:

- Their curriculum and their learning design principles: practical orientation and use of examples, real collection of data sets and tools that are deployed and used in real life, and showcase scalable solutions. Those principles are similar to PBL, though the project does not identify itself with a specific pedagogical approach.

- Their recommendations for designing Open Educational Resources: Industrial relevance, interdisciplinary design teams (pedagogical, academic and professional partners), explicit learning goals, use of real systems and tools and use of real data sets.

- Their methods for delivering their curriculum: online and by professional trainers. They use self-training and distance learning. Webinars have been very successful, enabling a high number of simultaneous views and overcoming geographical boundaries. Distance learning provides more guidance to the students regarding the learning plan and by supporting interaction with trainers.

\(^3\) [http://www.euclid-project.eu/](http://www.euclid-project.eu/)
4.1.2 Data Analysis of Training/Teaching Activities Regarding Open Data within the Consortium

To inform about open data PBL initiatives in the project member countries, an interview study was carried out (see annex 1 with the interview guide). Five partners participated in the data collection: LOLA, ODI, ProXML, UOM, and AAU. The purpose was to identify the extent and nature of PBL activities carried out in open data education. An interview guide was developed for the study, consisting of a combination of open and closed questions. Elements of the interview guide could be repeated and used in interviews, if the interviewee took part in various teaching activities. The interviews were carried out as individual interviews, either face to face or via skype or the like. Some interviewees were part of the partner companies, while others were external. 19 interviews were conducted, representing 25 teaching activities. The interviews cover teaching activities distributed between the core sectors in the project: Nine teaching activities take place within research and education, four aim at the public sector, two aim at the private sector, eight are described as open courses with a mixed group of participants, and finally two teaching activities have specific target groups of youngsters (15-25 year-olds) or journalists.

The interviews reflect that the majority of teaching activities concern teaching about open data. Using open data as a teaching method is less common, according to answers. The majority of the activities are carried out within a few hours or a full day. Courses stretching over days, week, and months are less common – except in university teaching. The predominant form of teaching is face-to-face, but there are also a few examples of online and blended learning. Below, we will present more detail on the specific interviews carried out.

Insight in training and teaching activities by ODEdu partners

The Open Data Institute (ODI) has long experience in doing open data teaching and training activities. The six interviews conducted by ODI cover seven different teaching activities lead by ODI trainers or freelance trainers. Examples of course titles are:

- Open Data in a Day
- Open Data for Smart Cities
- Law and Licensing
- Business Innovation Workshop

Some courses are general introductions to open data while others have a specific focus such as licensing, business models etc. The overall goals of these training activities are to introduce the participants to open data, build an understanding of how open data can create impact and equip participants with skills in how to benefit from open data. All seven courses can be categorized as
courses teaching about open data, whereas only one of the courses also uses open data data sets as part of teaching. Most of the teaching activities are courses and workshops open to everyone interested, whereas a few courses are targeted at either the public sector or a specific group of professionals. For example, the course titled “Finding Stories in Open Data” has mid-career journalists as a target group. The ODI courses covered in these six interviews are mostly short courses (either half-day or full-day) with 5, 10 or 20 participants. All courses are taught face-to-face, but three courses out of six move towards blended learning. The teaching methodology applied varies across courses, but they all use a mix of different learning activities such as theoretical introductions, hands-on exercises, case studies and existing examples to teach and activate the participants.

University of Macedonia (UOM) conducted three interviews describing four university courses related to open data. The courses are taught at different departments and include both selective and mandatory courses. Course titles and target groups are:

1. Teaching the creation of visualizations using RDF data. The course targeted post-graduate students at the University of Macedonia, attending a Web Technologies and Web Analytics course, 2nd semester.

2. Linked Open Data for e-Government class. A selective course targeted at students of the Applied Informatics Department.

3. Linked Open Data Web Technologies and Web Analytics. A selective course targeted at students of the Post-graduate Programme of the Applied Informatics Department.

4. Statistical analysis of Scotland data sets using the R environment. A course targeted at students of the Business Administration Department, Information Systems Development course, 8th semester.

The course duration varied from two weeks (course one above) to twelve weeks (course four above). Common to all four courses is that they are taught face-to-face, include a variety of teaching activities including lectures in combination with hands-on exercises or project work with open data data sets. In courses three and four above, the students work with larger assignments, defining the problem themselves, whereas in courses one and two, the students worked with weekly assignments.

ProXML is a service provider in the field of publishing and consuming Open Data. ProXML carried out three interviews with external course providers, all three concerning teaching about open data. Two of the providers deliver teaching related to government, whereas one concerns university teaching. The titles of the activities offered are:
• Workshop on open data (government)
• Open Data Support onsite training (government)
• Business cases in IT: Open Data (university)

All activities last up to four hours. The two initiatives directed towards government have two different purposes, though both having the purpose of being introductive to open data. One aims at informing civil servants about the possibilities of transforming open data into useful and findable applications. The other takes a data feeding perspective and introduces employees to data life cycles, data management and licences of metadata. Both initiatives build upon face-to-face teaching, one in an instructive, lecture-type approach, whereas the other includes a presentation followed by hands-on exercises for the participants. The university course is directed towards informatics students (with an expected certain prior knowledge of computing). The content of the course focuses on the importance and use potential of open data in government. The course activities are based on lecturing with limited use of questions to the participants.

**Linked Organisation of Local Authority ICT Societies (LOLA)** is a non-profit organisation of ICT professional associations. LOLA conducted five interviews in a mixture of private and public external organizations, reporting on seven different teaching activities, the majority of these with the purpose of informing about the potential of open data from a user perspective, and one illustrating the potential of sharing data for data owners. All teach about open data, but none use open data to teach. Teaching is delivered to public employees, students and young people, and the general public. Examples of titles offered count:

• Introduction to Linked Open Data
• Leiedal: Gastles Open Data
• Introduction to Open Data
• Open Data Advocacy

Not all courses have indicated their length, but the ones that have last between a half and three hours. Two courses are directed towards the general public. Both have the purpose of informing about open data in order to increase the use of it. One is conducted face-to-face, while the other is an online course. The online course uses lectures, cases and examples from government to teach the content. A third interview reports on a two hour face-to-face guest lecture directed towards ICT students. Lastly, LOLA reported on two initiatives directed towards public employees. One serves the purpose of convincing data owners to share their data, while the other was supposed to present the
potential of using open data in government. Both use face-to-face teaching. The latter lasts about half an hour and is followed by a hackathon.

**Aalborg University (AAU)** is a university built upon PBL principles of teaching. Aalborg University does not at present teach any course directly related to open data. Therefore, the two AAU interviews were both with external public organizations. The first interviewee represents government and is enrolled in teaching, both for the general public (hackathons), public employees, and education. All activities teach about open data. Regarding the employees, the purpose was to convince them to share data and show them how. For the remaining groups, the purpose was to demonstrate how to apply data. The activities ranged between a few hours (education and government) and a couple of days (hackathons, general public). All activities were face-to-face teaching.

The second interviewee is a researcher within the field of learning analytics and she describes three open data learning activities:

1. **Learning Analytics.** A selective 5 ECTS module targeted at master degree students in ICT and Learning.

2. **LASI Aalborg – Learning Analytics Summer School.** A one-day open masterclass with 20 participants including researchers and practitioners from learning, learning analytics, and related fields.

3. **Crowdsourced Learning and Assessment in MOOCs.** A one-day tutorial held at the Computer Supported Collaborative Learning Conference 2015.

The learning analytics course is taught using a blended learning approach. It includes one afternoon of face-to-face teaching with presentations and hands-on exercises. During the following weeks, the students work on group projects supported by online supervision meetings and a webinar with presentation and instructions about a specific visualization software. During group work, the students choose and define their own problem statements and the process and outcome are also rather open.

The second and third activities used a shared approach. They are taught face-to-face and included presentations related to learning analytics followed by hands-on exercises on MOOC data and data visualization.

**Successful experiences on teaching open data**

The interviewees were asked to give examples of successful experiences with teaching open data.
A number of aspects were touched upon. The following experiences of success were mentioned in the interviews:

The **content of a teaching activity should be relevant to the participant**, and they should be able to see the benefits and potentials of working with open data.

**Exercises are an important element in teaching**, e.g. data cleaning, licenses, possibilities, and visualizations, to name but a few. It is important that the exercises are not too technical, relevant to the participants, and have a tangible output.

To ensure relevance to the participants, it is **important that the latter have chosen ‘their problem’ on their own** to maintain engagement towards the end-product.

To improve the end-products, it is beneficial to **compose groups with different competences** in regards to open data, if possible.

**Main challenges related to teaching open data**

From looking at the successful experiences with teaching open data, we now turn to the main challenges related to teaching open data. All interviewees were asked to describe three challenges to teaching open data. Despite the variations in teaching aims, methods, audiences etc., the analysis shows similarities between the challenges described by interviewees. The following five main challenges were identified across the interviews:

**Open data is a complex and abstract concept** and therefore it can be difficult to define and also to communicate the practical usefulness and possible added value of open data.

Teaching open data is fairly new and therefore several trainers point to the **limited number of learning materials available** such as relevant and interesting datasets, supporting examples, successful case studies and user-friendly tools to publish and visualize open data.

It can be a challenge to fight the perception that **open data is highly technical** and instead bridge the technical side to the everyday practice of the target group. At the same time, there are many technical aspects of open data, and the concept can more easily be made tangible if participants have programming skills.

**Non-homogenous background of participants in relation to their prior knowledge and skills** may pose a challenge as it can be difficult to teach a multilevel group of participants.

Finally, **reluctance to open data** is reflected in the willingness to open up data and recognize the potential and relevance of open data. Working with open data challenges the mind-set of people and previous business models.
Summing up

The interviews on open data training and teaching activities within the ODEdu consortium reflect that teaching open data is a fairly new and also complex topic. Therefore, it can be a challenge to open data trainers and lecturers to identify relevant learning materials, cases etc. Especially in short training sessions it can be difficult to explain the full potential of working with open data. Some participants show reluctance towards the topic because of its technical aspects and reluctance towards opening up their data sets. Across the interviews mostly traditional teaching methods were applied with limited use of PBL elements. However, the successful teaching experiences described in the interviews support that PBL can be a useful approach to teaching open data.
Section 3: Designing Open Data Learning Activities

In this final section, we focus on the first version of a methodology to design educational and training activities within the ODEdu project. The development of this version will be continued in the second task of the WP2. We expect to apply the methodology to one of the current open data courses (hopefully in collaboration with the Open Data Institute) and provide more details for WP3. The methodology is based on a) the literature review on the topic of PBL, which includes the established Aalborg PBL model and other models, b) data collected from the current open data training activities among the partners and c) the international open data educational activities.

5.1 Data Driven PBL Methodology

The main goal of the ODEdu project is to find innovative approaches, techniques and methods to train and educate people on open data.

During the design workshop, the experts, both from PBL and open data, discussed the benefits of using PBL for teaching open data. It was argued that due to the nature of open data, there is a need to think creatively and critically, and a need to work interdisciplinary and in teams. The development of such competences are vital for the extraction of the real potential of open data, as otherwise professionals and students would remain at the less challenging ‘pure’ technical level. The real challenge emerges when practitioners want to create new knowledge from open data, in order to innovate and add value to their organizations. Therefore, the competences developed and promoted with PBL are key competences for exploiting the potential of open data. Students may define their own problem statements, so they have the opportunity to ‘create a problem’ by analysing data. When students define their own problem statements, they have a special interest in solving those problems.

Students develop skills while working creatively together on the solution of problems, which would also strengthen their interdisciplinary learning skills.

Furthermore, participants that by using PBL, students learn to focus on both the problem and the actual people involved in it, and not just technical issues and aspects of analysis. Students learn how to ask questions, enabling them to approach more effectively the data that they find interesting. Asking relevant questions is crucial to defining and formulating ‘good problems’ when looking at data.

PBL helps in creating a setting for students that guides them through a series of problems, in the manner, more or less, of a physical expedition with checkpoints along the way. PBL seeks to give students an awareness of having gained operational knowledge, through processes of ‘learning by
doing’ and through students’ own forth-running documentation of progress and viable routes towards successful completion of tasks.

When using PBL, understanding data and forming questions is no linear process, as new questions form every time data is approached from a new perspective. Students, thus, learn to ‘challenge’ data in order to keep several potential perspectives open and be on the look-out for new ways of understanding problems.

Another aspect mentioned by students was the role of the lecturers. PBL makes it possible for lecturers to “design for frustration”, presenting students with questions that have no ‘correct answer’, though lecturers may present students with milestones and paths to follow. Lecturers are given extensive room for experiential learning and flexibility when designing courses, enabling them to design courses in close interaction with users’ specific demands and interests.

Finally, students mention one of the most challenging aspects of PBL: the assessment. Measuring students’ learning experiences and progress is not easy in a context dominated by concepts such as ‘critical thinking’, ‘collaborative work’, ‘problem solving’, etc.

The purpose of following methodological considerations is to assist trainers and educators in designing open data training activities using problem based learning as a pedagogical approach. We propose to use four aspects to create an effective learning environment.

The first layer of the methodology represents the need to combine content, technology and pedagogy to design learning environments. We recommend using the technological-pedagogical content knowledge (TPACK) model to maintain a balance between the three aspects that are involved in the ODEdu educational activities.

The second layer of the methodology refers to the different modalities of PBL. It is necessary to maintain an alignment between the different components and learning principles of PBL; to overcome this challenge, we recommend using the model for problem and project based alignment (A. Kolmos et al., 2009).

The third layer of the methodology refers to the instructional design of educational activities. We recommend using the 10 principles of the instructional design quality (Margaryan, Bianco & Littlejohn, 2015).

The fourth layer is concerned with the need to support trainers and educators of the ODEdu project by developing competencies to design PBL learning activities. We would choose to apply a demonstration approach, in which we present trainers with different kinds of PBL designs, considering the components of the model for PBL element alignment.
The overall picture of the methodological recommendations is shown in Figure 12.

5.1.1 The TPACK model and Open Data Learning Activities

In section 3.1, we presented the many benefits of PBL as a pedagogical approach, and in section 3.3 we described well-designed project based learning initiatives supported by ICT; furthermore, WP1 colleagues from ProXLM have presented potential content for the training activities. Additionally, in the second task of WP2, our partners from the University of Macedonia will work on the subject of learning analytics as a tool to support the open data training. Therefore, the main challenge of the ODEdu project is to integrate the three main aspects of effective learning environment designs. The challenge is even more difficult when we consider that empirical research shows that even when teachers/trainers have a theoretical understanding of PBL pedagogy, they have difficulties integrating technology tools, content representations and pedagogical strategies (So & Kim, 2009),
therefore, we recommend using the TPACK model as the overall methodological guideline to design training activities.

The TPACK model is based on the idea that pedagogically sound applications of technology require teachers to integrate their knowledge of content, pedagogy and technology, rather than see them as separate domains. The model addresses the complex interaction and intersection between three forms of knowledge: technological knowledge, pedagogical knowledge and content knowledge (Figure 13).

![Figure 13 – TPACK model (http://www.tpack.org)](http://www.tpack.org)

To apply the TPACK model for ODEdu training activities, we need to design an online learning environment that would support the realization of the PBL principles – collaboration, critical thinking, reflection, self-directed learning, and active learning, plus facilitate the learning of specific content. This means that the learning environment should provide a multitude of tools that enable teamwork, the giving and receiving of feedback, group discussions, sharing knowledge and information, etc. The ODEdu project should create a balance between the following types of knowledge, but be most directly concerned with nurturing the last one:

1. Content knowledge: open data
2. Pedagogical knowledge: problem based learning
3. Technological knowledge: learning analytics and various technologies
4. Pedagogical content knowledge: how to teach open data with PBL
5. Technological content knowledge: how to teach open data using technology
6. Technological-pedagogical knowledge: how to use technology to support the PBL process
7. Technological-pedagogical content knowledge: how to represent open data content with technology in a PBL way.

5.1.2 Alignment of the PBL Elements

PBL as a dynamic and multi-variable environment is a complex matter, and the combination of different dimensions will produce different approaches and different outcomes. This provides flexibility to adapt PBL to different contexts and needs, while at the same time posing a challenge for the PBL novice designer.

We recommend the model for problem and project based alignment, developed by Kolmos et al. (2009), suitable for the ODEdu project as a tool for scaffolding during the design process of PBL learning activities. The model will help provide a clear overview of all the main elements that should be considered and their impact on each other. A learning activity with a more structured problem definition, for example, will perhaps lower the demands on students’ critical thinking skills as well as affecting the scope of knowledge they are presented with.

Kolmos et al. (2009) have developed a model with seven elements that must be aligned in a problem and project based curriculum. The principle of alignment is based on a holistic understanding of PBL and is based on the premise that a change in one element will affect all elements. The seven elements that must be contained and aligned within the ODEdu project are:

1. **Objectives and knowledge**: definition of the kind of knowledge that is sought promoted

2. **Types of problems and projects**: definition of the problem and project type: closed problems, open-ended problems without solutions, ill-defined problems, interdisciplinary problems

3. **Progression and size**: time allocated to the PBL activity and for the learning activity itself

4. **Students’ learning**: facilitation of the learning process and awareness of the types of skills that are addressed in the curriculum: teamwork, collaboration, project management, knowledge construction, etc.

5. **Academic staff and facilitation**: facilitation and supervision by academic staff

6. **Space and organisation**: classroom organisation and space for project work, which includes the use of technologies

7. **Assessment and evaluation**: individual, group, formative assessment, etc.

Playing around with the alignment of these PBL elements will give the ODEdu project the flexibility to design learning activities that respond to the needs of different partners, and a framework for
keeping in mind the different (interdependent) elements involved when designing PBL learning activities in WP3.

5.1.3 Instructional Design Principles

The third aspect of the methodology is related to instructional design. We found the work of Margaryan, Bianco & Littljohn (2015) to be well-suited as a checklist for the ODEdu project. They present 10 criteria to assess the instructional design quality of MOOCs, which are very relevant to the ODEdu project. The first five criteria were developed by Mirill (2013), and were abstracted from key instructional design theories and models. The criteria are:

1. **Problem-Centred**: learning is spurred when learners acquire skills in the context of real-life problems. This principle demands the design of a course that give participants an opportunity to solve real-life problems. Working their way through interrelated and progressive tasks, starting with the least difficult, this design should present participants with the complexity of real-world settings.

2. **Activation**: This principle is related to learning theories on the relevance of activating existing knowledge and skills as a foundation for acquiring new skills. Learning activities should help participants to recall and describe their previous experiences and, furthermore, to relate that experience to what they learn during the course. Activation is also related to learning activities that stimulate the development of mental models and schemes that can help participants incorporate new knowledge or skills into their existing knowledge.

3. **Demonstration**: This aspect is related to presenting participants with ideas on how to apply new knowledge in future situations, offering participants a platform of inspiration for their own further explorations.

4. **Application**: a necessary condition for effective learning is the opportunity to apply newly acquired skills in the solving of real problems. The course must provide multiple opportunities for participants to apply their new knowledge to a wide range of real-world problems.

5. **Integration**: Learning is promoted when learners reflect on (revise, synthesize, recombine and modify), discuss and defend their newly acquired knowledge.

6. **Collective knowledge**: learning is promoted when participants contribute to collective knowledge, learning from each other.

7. **Collaboration**: learning is promoted when participants collaborate with others (course participants and real-world partners).
8. **Differentiation**: learning is promoted when the individual learning needs of participants are met. This is about offering different options regarding learning activities, learning resources and media.

9. **Authentic resources**: learning resources are drawn from real-world settings.

10. **Feedback**: participants are given expert feedback on their performance. This includes considerations of whether participants receive feedback by course instructors during learning activities and assignments and whether the process and criteria of feedback are clearly explained to the participants.

In Table 15, we have included Margaryan et al. (2015) data collection instrument as a check list for the future design of the training courses in ODEdu.

<table>
<thead>
<tr>
<th>Principles of Instruction and related components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem-centred</strong></td>
</tr>
<tr>
<td>To what extent are the course objectives relevant to real-world problems?</td>
</tr>
<tr>
<td>To what extent are the problems in the course typical of those that learners will encounter in the real world?</td>
</tr>
<tr>
<td>To what extent do the activities in the course relate to the participants’ real workplace problems?</td>
</tr>
<tr>
<td>To what extent are the problems ill-structured – i.e. have more than one correct solution?</td>
</tr>
<tr>
<td>To what extent are the problems divergent from one another?</td>
</tr>
<tr>
<td>To what extent do the activities build upon each other?</td>
</tr>
<tr>
<td><strong>Activation</strong></td>
</tr>
<tr>
<td>To what extent do the activities attempt to activate learners’ relevant prior knowledge or experience?</td>
</tr>
<tr>
<td><strong>Demonstration</strong></td>
</tr>
<tr>
<td>If there are examples of solutions, to what extent do these solutions represent a range of quality from excellent examples to poor examples?</td>
</tr>
<tr>
<td><strong>Application</strong></td>
</tr>
<tr>
<td>To what extent do the activities require learners to apply their newly acquired knowledge or skill?</td>
</tr>
</tbody>
</table>
## Integration
To what extent do the activities require learners to integrate the new knowledge or skill into their everyday work?

## Collective knowledge
To what extent do the activities require participants to learn from each other?
To what extent do the activities require participants to contribute to the collective knowledge, rather than merely consume knowledge?
To what extent do the activities require learners to build on other participants’ submissions?

## Collaboration
To what extent do the activities require participants to collaborate with other course participants?
To what extent do the activities require participants to collaborate with others outside the course?
To what extent do the activities require that the peer-interaction groups be comprised of individuals with different backgrounds, opinions, and skills?
To what extent can the individual contribution of each learner in the group be clearly identified?

## Differentiation
To what extent are there activity options for participants with various learning needs?

## Authentic resources
To what extent are the resources reused from real-world settings?

## Feedback
Is there feedback on activities by the instructor(s) in this course?
If there is feedback, is the way in which feedback will be provided clearly explained to the participants?

### 5.1.4 Examples of PBL
In this section, we have selected examples of many different variations of PBL to describe how each of them looks. We present examples that cover the educational and organizational setting. We describe in detail the PBL process of the following examples:

1. Semester project at AAU
5.1.4.1 Semester project at AAU

This is the description of a typical semester project at Aalborg University – Human Centered Informatics.

**Table 16 – Typical semester project at AAU**

<table>
<thead>
<tr>
<th>PBL Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the educational Program</td>
<td>Human Center Informatics – 8th Semester</td>
</tr>
<tr>
<td>Theme of the semester</td>
<td>Development and design of Information and Communication Technology (ICT)</td>
</tr>
<tr>
<td>Duration</td>
<td>One semester</td>
</tr>
<tr>
<td>Type of problem</td>
<td>Project with an open problem. The students are not given any problem formulation. They receive the description of the theme, the skills, competences and the knowledge that they are expected to acquire. Students, in collaboration with the supervisor, define the problem formulation</td>
</tr>
<tr>
<td>Objectives and knowledge</td>
<td>Interdisciplinary knowledge with the following areas: the theory of science, theory and methods of system development user-driven techniques and tools organisational change and organisational culture in relation to system development and system design pertaining to ICT</td>
</tr>
<tr>
<td>Student learning</td>
<td>Disciplinary content with systems design, self-directed learning, collaborative learning, critical argumentation, problem solving, application of theories and methodologies</td>
</tr>
</tbody>
</table>
Progression | Around 60% of the time is dedicated to project work
--- | ---
Supervision | Each group has a number of hours depending on the number of students. For example, a group of 3 students would have 45 hours of supervision, this includes the time for the exam
Space and organization | One semester, 20 hours of lecturing, group work and use of Moodle as communication platform
Assessment | Written report and oral exam, group examination with individual grades

Detailed description of the process and activities

1. The semester started on February 1st, 2016. That day, students were introduced to the semester in general and the theme for the semester project, and there was a brainstorm about project ideas. This with the aim of activating students to think about the project and activate their previous knowledge, so that they might relate the lectures of the semester with their project ideas and previous experiences. Furthermore, they were also presented with the problems that some companies were facing and which could become semester projects, as well, if they were interested.

2. Throughout February, students attended lectures on different theoretical concepts.

3. By the end of February, they had another project brainstorming and group formation session, after which they were given 3 days to develop their first project description (2 pages).

4. On March 7th, there was another project session. Before this session, each group had uploaded their project proposal in Moodle. During the session, the different proposals were assigned to different groups. Each group was given the task of reading the two-page project description and give feedback to their peers (What must the group consider? What is missing? How does the proposal fulfil the study regulation requirements?). This was done with the aim of helping students to develop feedback skills and supporting collaborative learning and self-reflection (when they assessed their peers’ proposal, they identified their own weaknesses, as well). After this session, each group sent a revised project proposal to the semester coordinator.

5. The semester coordinator assigned supervisors according to the project focus area.

6. From this point, students started working with the supervisor.

7. Around the middle of April, there was a joint supervision. The semester coordinator asked each group to prepare a presentation of their problem formulation, theories and methodology. Three or four groups worked together with their respective supervisors. Each group was given 30 minutes to present their progress. They received questions, comments and feedback from their peers, their own supervisor and the other supervisors.

8. After this midway joint supervision, the groups continued on their own, aided by the supervisor.
9. Students presented their written report in the middle of May, and they had their oral exams in the middle of June.

10. In this kind of semester project, students are allowed to continue working on their project until the oral exam, but without supervision.

11. Normally, at the last supervision meeting, the supervisor will ask the students to reflect on the process and product so far.

12. The semester coordinator calls for a feedback meeting after students hand in the written report. The idea is to get student input about the semester organization and project work.

5.1.4.2 Use of PBL for designing a lecture

<table>
<thead>
<tr>
<th>PBL Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the course</td>
<td>ICT for Learning, Knowledge and Content Management</td>
</tr>
<tr>
<td>Topic of the class</td>
<td>Enterprise systems</td>
</tr>
<tr>
<td>Duration</td>
<td>4 hours class + 4 hours outside class</td>
</tr>
<tr>
<td>Type of problem</td>
<td>Close problem. The students are given a context and a task</td>
</tr>
<tr>
<td>Objectives and knowledge</td>
<td>Knowledge on selecting, configuring and adapting ICT to enterprises</td>
</tr>
<tr>
<td>Student learning</td>
<td>Argumentation competences, team work and critical thinking</td>
</tr>
<tr>
<td>Progression</td>
<td>Around 90% of the time is dedicated to problem solving. The students are supposed to have read the literature before the class</td>
</tr>
<tr>
<td>Supervision</td>
<td>The lecturer acts as facilitator during the 4 hour-class</td>
</tr>
<tr>
<td>Space and organization</td>
<td>In the classroom, students form groups of 3 or 4 students</td>
</tr>
<tr>
<td>Assessment</td>
<td>Formative assessment. Each group presents their solutions and receive feedback from the other groups and the teacher</td>
</tr>
</tbody>
</table>
In order to improve its services, the Muesli Company decided to upgrade its inventory management process and an ERP solution seemed to be the logical answer, in order to provide the ability to integrate accounting, inventory and materials management.

The primary goal for the company is to increase organizational efficiency, to achieve internal control, to reduce the time spent on certain basic functions and finally to increase their effectiveness.

Your tasks as a team:

a. Select a software for the ERP system (Choose a specific software from the market or define if you will develop an in-house system). Justify your choice.

b. Get familiar (as much as possible) with the software and decide if you are going to implement all the modules or only some of them; if only some of them, define which and why those.

c. How are you going to approach the implementation of the ERP from the user-centered / participatory design approach (give sound arguments in this discussion). At the end of the document, there are references that will help you in this discussion.

d. Using Shari Shang & Peter B Seddon. (2002), identify which benefits you aim at and how you ensure them.

e. Using Rajiv Malhotra and Cecilia Temponi (2010), in your proposal consider the different critical decisions (team structure, implementation strategy … )

Find out how The Muesli Company is using social technologies to communicate with the customers.

### 5.1.4.3 Course at Aalborg University using ICT

**Table 18 – Course at Aalborg University using ICT**

<table>
<thead>
<tr>
<th>PBL Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the course</td>
<td>ICT and Globalization</td>
</tr>
<tr>
<td>Duration</td>
<td>4 weeks (4 hours of face-to-face classes per week + 20 hours per week outside class)</td>
</tr>
<tr>
<td>Type of problem</td>
<td>Each activity addresses a different kind of problem. The main activity has an open-ended problem, introduced with a scenario and well-defined aspects to be addressed</td>
</tr>
<tr>
<td>Objectives and knowledge</td>
<td>The role of technology and globalization and the implications for advanced and less advanced</td>
</tr>
</tbody>
</table>
Student learning | Argumentation competences, team work and critical thinking, data analysis
---|---
Progression | Many of the activities are aimed at developing PBL skills. The final mini-project has the greatest workload
Supervision | The lecturer acts as facilitator during the course. However, written instructions are quite detailed.
Space and organization | In the classroom. Students form groups of 3 or 4 students.
Assessment | Formative assessment. Each group present their solutions and receive feedback from the other groups and the teacher. To pass the course, the students should complete all the activities in accordance with certain quality standards

### Detailed description of the activity

Each class has its own dynamic and design, but general activities are:

a) **Online learning diary:**

Each student had an online ‘learning diary’ in which they wrote down their learning outcomes after each lecture. This was an open learning diary, so peers could share experiences with each other. The idea behind this activity was to enable the student to reflect on their learning experience. This process of recalling is important to knowledge formation. As diaries were open, students were able to learn from each other and double-check their own understanding of certain concepts. The lecturer, too, was able to check whether students understood concepts, principles etc.

b) **Open forum:**

Each student would select a short article about “globalization and ICT” from any perspective and would then host their own forum for discussion. They would assume the role of moderator, introduce the topic and initiate a discussion. It was expected that the rest of the class participate in the discussion. The aim was to develop students’ discussion skills and sound arguments from different perspectives and points of view. Furthermore, students were supposed to search for content related to the course theme. Because each student defined their own topic, personal
interest in the course was more easily achieved.

c) Representative of a country:
Each student chose a country that they would be ‘ambassador’ for. They had to search for information, such as ranking in the ICT global index, ranking in the HDI, digital divide, achievement regarding the millennium development goals, etc. In each class, when developing a topic, each of them would share specific information about ‘their’ country. This activity demanded the application of theories or models relevant to the reality of a specific country. It was expected of students that they bring new information from different contexts to the classroom. Having the role of ambassador provided students with a feeling of ownership during this process.

d) ICT proposal to achieve the millennium goals:
Each student selected a millennium goal that could be addressed using information technology in the country that they were working with. Students had to define and provide an overview of the issue, the role of technology, an analysis of the issue based on research, facts, theories, etc. The focus of the project was the design of a proposal or plan to achieve one of the millennium goals using ICT. The activity was divided into two elements: a document and a presentation. During the presentation part, students had to “sell” their proposals and also evaluate the proposals of their peers. They received a table with indicators of relevance, effectiveness, feasibility, and sustainability to help them evaluate proposals. A similar table is also used by the European Commission to evaluate projects. The activity aimed at linking the course with students’ specific master programmes, as well as allowing students to apply theoretical concepts.

These were the main activities of the course, but each lecture contained small activities aimed at spurring discussion, reflection and learning together. An example was a case study of “Denmark: globalization and the Welfare State”, where students used interactive touch screens to build concepts together, scrutinized online maps to see the ranking of countries according to different global indexes, and discussed specific statements derived from theory.

5.1.4.4 PBLab
This case presents an example of a traditional lab course transformed into PBL. The lab consists of three sub-labs: Advanced Power, Power Electronics and High Voltage. The case is presented in (Bahri, Azli, & Samah, 2013).

<table>
<thead>
<tr>
<th>PBL Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the education Program</td>
<td>“Problem/Project-based Laboratory”</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Theme of the semester</td>
<td>To transfer and practice theoretical knowledge from prior semesters into laboratory work</td>
</tr>
<tr>
<td>Duration</td>
<td>The students have 4 weeks to solve a given problem/project for each of the laboratories. They have a 3-hour lab-session every week, and have to spend at least 24 hours per week outside of the laboratory working in groups</td>
</tr>
<tr>
<td>Type of problem</td>
<td>Closed-end problem. Based on the course, the students are given a problem or project. They have access to a ‘student pack’ with the information that they will need to solve the problem/project</td>
</tr>
<tr>
<td>Objectives and knowledge</td>
<td>Based on the course, the students should be able to understand and solve unpredictable real-world problems, design and conduct experiments as well as analyses, and interpret data. Furthermore, they should evolve their multi-disciplinary skills – practical skills, team working and problem solving skills</td>
</tr>
<tr>
<td>Student learning</td>
<td>The students should learn to transfer and practice theoretical knowledge from former classes into laboratory work. They should develop their own experimental procedure before conducting experiments as part of the project or problem solution</td>
</tr>
<tr>
<td>Progression</td>
<td>The majority of the time is dedicated to group work on a problem or project</td>
</tr>
<tr>
<td>Supervision</td>
<td>In the PBLab, the lecturers have changed their roles and become facilitators. Supervision is provided by the facilitator assigned to each group. Each group is assigned a facilitator, but all students have access to a ‘facilitator pack’. The facilitator pack have defined a probable solution for the problem/project</td>
</tr>
<tr>
<td>Space and organisation</td>
<td>The course lasts 4 weeks, and has weekly lab-sessions. Furthermore, the students have group work. The course has</td>
</tr>
</tbody>
</table>
been running with a PBL approach since 2007

Assessment

The students are assessed on individual performance as well as group performance

Detailed description of the process and activities

The activities in each lab are planned across 4 weeks.

In week 1, the students are given a problem/project designed by experienced lecturers.

By the end of this week, students have to understand the problem they are given, and brainstorm to solve the problem. The group has to identify their resources and tools, the knowledge that exists in the group and the knowledge that is needed to solve the problem. This is done during lab-session 1.

Outside the lab, each group has to agree to a solution and divide work among the group members.

During week 2, each group has to present their solution to the facilitator. The group begins the design process when the facilitator is sure that the group is on the right track. Finally, the group confirms the experiment layout. This is done during lab-session 2.

Outside the lab, the groups conduct simulations to confirm their designs. The students make sure that the tools and equipment needed for the experiments are available and prepare schematic or connection diagrams for the experiment.

During week 3, the groups begin to conduct their experiments and receive the results from their experimental work. This is done during lab-session 3.

Outside the lab, the groups prepare slides for presentation of their completed work and start preparing their reports.

During week 4, the groups share a group presentation, a demo, and they write their report – all during the 4th and final lab-session.

Outside the lab, the groups write their reports and submit them exactly one week later to the lab technician, to be recorded and given to facilitators.

### 5.1.4.5 Course Using the 7-step Model

This is an example of The Master of Education (Science Education) degree in Universiti Pendidikan Sultan Idris (UPSI). The complete case is described in (Borhan & Yassin, 2013).

<table>
<thead>
<tr>
<th>PBL Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme of the semester</td>
<td>To enable students to analyse the management of learning in science education</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Duration</td>
<td>The course runs over 14 weeks, with 3 hours per week. There were 32 students assigned to the course, and they were divided into 7 groups. The course was divided into three tasks, and the students had 2 or 3 weeks to complete each task</td>
</tr>
<tr>
<td>Type of problem</td>
<td>The course was constructed around PBL scenarios. Each new scenario was more complex than the previous one</td>
</tr>
</tbody>
</table>
| Objectives and knowledge | The course had 5 learning objectives:  
To analyse management theories in terms of their characteristics and purposes as well as their relevance in science education;  
To evaluate the effectiveness of various types of management models;  
To discuss critically the best practices to maximize learning and teaching;  
To discuss and develop instruments to assess learning;  
And to collaborate with group members to perform assigned tasks |
| Student learning      | To work with a PBL approach and group work |
| Progression           | The majority of the time is dedicated to group work |
| Supervision           | The groups have a facilitator that “floats” between the groups in the class sessions. The facilitator helped the groups to activate their prior knowledge and experiences. Furthermore, each group had to keep a logbook to monitor their progression |
| Space and organisation| One course over 14 weeks, with a combination of group work and individual studies. Communication between the students through email and internet, as some of the students are part-time and away from the university |
| Assessment            | The students are assessed based on group work and individual performance. Each of the three PBL scenarios counts for 25% of the assessment, adding up to a total of 75%. The remaining 25% are |
D2.1 Data-driven PBL model

<table>
<thead>
<tr>
<th>based on individual performance</th>
</tr>
</thead>
</table>

**Detailed description of the process and activities**

The first class meeting was an introductory course in PBL. The students received pre-course notes with an introduction to PBL, characteristics of PBL, rationale for learning through PBL, depiction of PBL process, proposed steps to approach the problems, expectations towards students, to guide the class through a sample case, as an introduction to the PBL process.

The students were presented with three PBL scenarios, in which they were expected to make different deliverables for each scenario. The two first scenarios were expected to last 3 weeks, and the final scenario 2 weeks.

The students had a short tutor introduction to issues, followed by a scenario presentation and group discussions. The students received tutor-prepared learning materials.

The course followed the 7-steps PBL model (see page 58). Thus, students were suggested to answer the following questions:

1. Fact: What do we know?
2. Idea: What do we think?
3. Learning needs: What do we need to know?
4. Action plan: What should we do?

The first group discussion revolves around a brainstorming session about the case, listing information, thoughts and opinions, questions and inquiries, ending up by defining learning issues. The learning issues guide the students in answering the case. The students are also presented with heading suggestions, serving as a tool for articulating information during discussions. Before the class is dismissed, each group is expected to divide tasks among the group members.

The week before the second class, the students carry out their individual studies.

The students search for relevant resources, and create drafts for the next group discussion.

The students share and criticize resources and keep journals to support the group process during the individual studies. They maintain contact through email and the internet.

During the second class, students present their drafts and their findings verbally.

Based on the total work of the group members, the groups decide on a solution to their problems, after reaching consensus. When the groups have reached consensus, the whole class has a discussion and a presentation of solutions.
5.1.4.6 Computer Science Example

This is an example of using PBL for a programming course. The complete description is in (Ibrahim & Abd.Halim, 2013).

<table>
<thead>
<tr>
<th>PBL Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the education Program</td>
<td>Programming Technique 1</td>
</tr>
<tr>
<td>Theme of the semester</td>
<td>An introduction to programming</td>
</tr>
<tr>
<td>Duration</td>
<td>14-week course; 2-hour lecture and 2-hour lab tutorial each week</td>
</tr>
<tr>
<td>Type of problem</td>
<td>Each group were given a problem to solve during the semester. The semester is divided into three phases. For each phase, the complexity increased</td>
</tr>
<tr>
<td>Objectives and knowledge</td>
<td>Theory and practice on problem solving techniques, improvement of communication skills and self-directed learning</td>
</tr>
<tr>
<td>Student learning</td>
<td>To solve problems systematically using problem solving methods, to construct a C++ program correctly from the analysed problems while using a structured approach, to construct and develop complete C++ programs for simple to moderate problems individually, and to solve problems within a given time frame using C++ programming and tools</td>
</tr>
<tr>
<td>Progression</td>
<td>The majority of the time is dedicated to group work</td>
</tr>
<tr>
<td>Supervision</td>
<td>Lecturer (instructor) monitors and guides the students</td>
</tr>
<tr>
<td>Space and organisation</td>
<td>One semester, two hours of lecture each week, 2 hours of lab tutorial each week, group work</td>
</tr>
<tr>
<td>Assessment</td>
<td>Three milestones, one milestone per phase, meetings-log and peer review assessment. All assessment is based on group work and the logs and review</td>
</tr>
</tbody>
</table>

Detailed description of the process and activities

The semester is divided into three phases:
- Onset stage
- Execution stage
- Closure stage

The onset stage consists of group formation, defining the case study and the problems, defining the group members’ learning styles, followed by a brainstorm.

The execution stage consists of a cycle with defining requirements, analysing and designing, developing and testing. This step is repeated and documented through meetings-log, peer reviews within the group, lecturer evaluation and team reflection.

The closure stage consists of a review and an exit survey.

5.1.4.7 PBL at Work

The Facilitated Works Based Learn (FWBL) is a training approach for workplace settings. The aim of this approach is to transform PBL into a practice-oriented method of continuing education of highly educated employees working in practise (Nikolaj Stegeager, Anja Overgaard Thomassen, & Erik Laursen, 2013).

As described in Stegeager et al. (2013), the objectives of FWBL is to provide a) knowledge to busy employees within the industry without offering formal courses, b) immediate integration of course knowledge in job activities, and to ensure that learning is linked to a development project relevant to the company.

A FWBL course is centred on work related problems that employees find relevant and interesting. The course is designed and conducted according to the specific needs and requests of the participating employees.

Yeo and Marquardt (2010) describe two cases of the use of PBL within an organizational context.

**Case 1:** A legal firm uses PBL as "on the job training", and they want to train their new lawyers in actual cases but the senior lawyers do not have time for the training. Instead of using a traditional approach to teaching the new lawyers about specific legal practices, they are presented with specific case questions. The new lawyers think about the questions, find relevant information and learning issues. They return to their mentor (a senior lawyer) for clarification questions and feedback. During this meeting, the tutor will post new questions about the case. The learners look around for answers and look up legal documents for confirmation of these. They have periodical meetings (20 minutes), where learners present answers to the case, the tutor confirms them, expands the questions or points to new directions. The tutor ‘guides’, as opposed to ‘trains’. The learners are responsible for doing the work. The programme has a duration of six months.

**Case 2:** A local bank wants to improve its customer service and use PBL as a training strategy for its officers. External consultants identify solvable actual scenarios, which are used to start the learning process. During the training, a role-play technique is used to enact scenes that serve as problem
settings. Participants are involved in customers’ observations of employee behaviour, data analysis from the observations and identification of trends/patterns in their observations. Furthermore, the trainers organize dialogue sessions with star officers (those who have received many compliments from customers) to find out how they would deal with difficult customers. The training lasted for 15 weeks.

As we can see, PBL elements change a lot between contexts. However, the common aspect of using PBL within an organizational context is the fact that courses are designed and conducted according to the specific needs and requests of the participating employees. The tutor, likewise, will often be a senior person in the company (who has been trained in PBL), if not an external consultant.

5.1.4.8 Collaborative Action Learning Project
Camacho (2010), defines collaborative action learning projects (CALPs) as concrete initiatives, where practitioners from industry, government and university meet in order to develop a concrete ICT project in small and medium sized enterprises. The projects are guided by the principles of action learning. The objective of a CALP is to improve a company’s business processes by using ICT. These projects last at least six months, and they are related with internships but are totally focus on the companies. They are not seen as university courses instead as professional development.

A CALP run in Costa Rica is described as follow:

The action learning set: it was composed by 8 people: 4 people from two different companies, three students from computer science, a professor from university and one person from a governmental institution.

The problem: Each company identifies a real problem that may be solved with ICT; the problem must be relevant to the company in question. University students and companies work together, via action learning, on defining, designing and developing a solution based on the ICT. For example, one of the companies: They have loss of product of around 10%. In the investigation of root cause they identified: problems with the information received from the points of sales, low literacy of employees and erroneous data, among others. Their aim for the project was to find and IT solution to reduce shrinkage and improve the utility.

The facilitator: the processor of the university was the facilitator of the action learning set.

Workshops: the companies participated in four workshops, which had a learning by doing approach. The workshops were about: action learning, discover the problem, define the problem and project management.
**Action learning meetings**: These are carried out every three weeks during the project. They provide room for reflection, for clarifying and defining new action lines and for learning with and from each other. During each meeting, every company is given time to present issues related to the problem that they are working on. The rest of the group will listen and give feedback in order to help them clarify the problem and identify future actions.

### 5.1.4.9 PBL in the Public Sector

This example is from the field of professional development in the public sector; a training programme for police called Community-Oriented Policing and Problem Solving⁴. The programme aims to provide officers with a more comprehensive understanding of problems through in-depth analysis and guides them in the development of a collaborative response depending of the context. The programme follows the 7-step PBL model. It runs for 15 consecutive weeks, which includes one week of integration, 12 weeks of training (with three-week phases), and two weeks of evaluation.

The programme is composed of three main activities:

1. **Problem based learning exercises (PBLE):** these are scenarios with a description of a real, everyday and local problem. They are used to develop the trainees’ problem-solving skills. There are a number of potential responses available to the trainee but no right answer. The PBLEs are designed to train a variety of departmental procedures, legal topics, and individual skills. These PBLEs should be completed within three weeks. There are three PBLEs during the programme.

2. **Neighbourhood portfolio exercise:** the trainee develops a detailed geographical, social, and cultural understanding of the area where he or she works. The design aims at giving the trainee a sense of the community where he or she works, and encouraging the trainee to develop community contacts.

3. **Coaching and training reports:** the trainer and the trainee each complete weekly reports that evaluate the trainee’s performance. The report includes 15 boxes for comments by both the trainee and the trainer. This reports aims at having the trainer write less and the trainee more. It is expected that the trainee, in this way, assumes more responsibility for learning.

Within the programme, the trainees will confront what they know as well as what they do not know. They will formulate questions, do research, and determine what actions to undertake, followed by a process of reflection. The steps of the programme are:

1. The trainer presents the trainee with a real-life problem

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2. The trainee works with the problem and considers initial ideas
3. The trainee identifies what he or she knows about the problem
4. The trainee identifies what he or she needs to know about the problem and seeks information from available resources, including relevant community sources
5. The trainee develops an action plan based on his or her research
6. The trainee evaluates his or her performance and learns to transfer the new knowledge to future problems
7. The trainee records daily calls and activities in their journals and reflect upon and develop ideas for weekly coaching and training reports

5.1.4.10 An online PBL Course for Professional Development

This course was developed within the framework of a European Union project. The project was named Community of Integrated Blended Learning in Europe and it was a collaborative project between four European Universities (Aalborg University, Tartu University, The University of Applied Sciences Wildau and Maria Currie Sklodowsken University). The “Blended Learning Train-the-Trainer Course” focused on the integration of face-to-face and virtual learning methods with special emphasis on the use of innovative didactical approaches to foster self-organised and collaborative learning. The course was based on the Aalborg University Model and used action learning as a design principle.

The course was online and used mainly two technologies, which were the conventional virtual learning environment (VLE), Moodle and the 3D virtual world called Second Life. Second Life (SL) was chosen to support formation of group identity and provide a good solution for synchronous communication. It was considered an added benefit for participants to experience first-hand and innovative learning environments so that they might use it afterwards in their teaching practice.

Moodle was chosen because most of the partners had experience with the platform. There was a common Moodle space for all the participants and a group Moodle space, only for the members of each group. In these private spaces, participants were to create a forum called “Facilitation forum” which was to be in English and in which the groups could post questions for the facilitators. Other discussions and group work was held in their mother language.

It ran for 6 weeks. It included a preparation week and a 5-week course. During each week, there were two hours of lectures in SL, an optional visit in SL, asynchronous communication by Moodle,
mandatory readings and some short learning activities. In general, the course had a workload of 15 hours per week.

All activities were designed to create the conditions to support collaborative learning, problem-solving and sharing experiences and knowledge in order to solve problems.

As a part of the course, the participants were involved in the following activities:

- A week of preparation to learn to use Moodle and Second Life. Here, students were introduced to accessing Moodle and Second Life step-by-step. It was also a social forum, where participants introduced themselves and shared their expectations for the course (personal and professional). This first week, individual guidance was very intense, in order to avoid frustrations over technological issues.

- Lectures in Second Life presenting the different topics of the course. A learning environment was designed in Second Life, the participants attended online lectures in the virtual world. They were given opportunity to discuss in-person, but also via chats going on during the lecture. After each lecture, there was time for questions and answers, as well as a short time for social interaction.

- Asynchronous discussion and group work in order to strengthen collaborative learning.

- Use of problem-solving tools to address the mini-project as well as facilitation/mentoring/coaching from the supervisor. The participants were divided in groups (by countries) and they identified problems and projects. The problems were real work problems, as all the participants were professionals with many years of experience.

- Sharing ideas, practices and experiences – synchrony – asynchrony. Participants were encouraged to meet in Second Life as well as participating in forums to discuss their ideas and to work on their projects.

- Tours in SL that allow for operational knowledge about options for using SL as a learning strategy as well as an education resource. The facilitator organized different ‘islands’ in SL tutored by experts who gave talks about their activities in Second Life.
6 Conclusion

The aim of this deliverable has been to present to the ODEdu partners the different elements to consider when designing learning activities based on a PBL approach. As the first section of this report shows, there are many variations of PBL and the design is dependent on the context and the learning goals. The ODEdu project may decide to go for a specific model of PBL, for example the Aalborg University Model or the Maastricht University Model, or may decide to choose different aspects of PBL to design courses according to the different contexts and local challenges. The conclusions of this report are focused on offering recommendations for WP3.

The aim of WP3 is to develop Open Data courses (for university students and private and public sector employees). To this end, the WP3 will exploit the project results of WP1 and WP2 in order to produce such open data courses. Therefore, this report provides the basis for informed decision during the design of the courses.

By using a PBL approach, the ODEdu should commit to the learning philosophy behind PBL. PBL is founded on the principle that an effective learning process is promoted by trying to solve or address a problem that is relevant to the learner. By trying to solve that problem, the learner will develop critical competences and knowledge that would help her or him to become a long-life learner. Therefore, the design of learning activities focuses on the learning process rather than the content.

In the process of developing Open Data courses, WP3 leaders may link this deliverable to D1.1 "Stakeholders’ Needs Regarding Open Data". D1.1 presents a curriculum development guideline and clearly states the need to define the learning outcome, skills, and competences for the ODEdu curriculum. D1.1 presents Bloom’s taxonomy (remembering, understanding, applying, analysing, evaluating, creating) to guide the definition of the learning outcomes. Furthermore, D1.1 presents a skeleton of the ODEdu curriculum based on the partners’ needs. One might say that D1.1 sheds light on the content of the training while D2.1 offers recommendations about pedagogical considerations.

To discuss this balance between content and process, we should look to the model 3C3R; while 3C refers to the content, the balance between context, content and connections, 3R refers to the process, the fostering of research, reflection and reasoning.
Furthermore, WP3 should go through a process of decision-making regarding the alignment of the different elements of PBL: problem, group, facilitator, learning objectives, organization, evaluation and duration (presented in section 5.1.2). As presented previously, the modification/definition of one aspect influences the others. The first task in designing a curriculum is the definition of learning objectives, which also applies to future PBL learning activities within the ODEdu project. These learning objectives should not only address the content but also the kind of competences sought developed through a PBL approach. The second question would be related to defining kinds of problems: what kind of problem is appropriate for achieving learning objectives? (explorative problems, explanation learning, cases, etc. – see section 3.1.2.1 for different kind of problems). A follow-up question is: how does the facilitator support learning processes? There is a need to reflect on the different types of facilitator roles during teaching and learning processes (see section 3.1.2.2). Furthermore, student support is needed: how do we prepare the participants to function as a PBL group? What kind of activities should we design to foster collaborative learning, critical thinking and reflection? Another aspect to consider is the role of media and the learning environment. The technological tools that we are going to use need to be aligned with the kind of knowledge and the PBL competences that we want to promote. The different kinds of ICT tools that may feasibly be used together with PBL are described in section 3.3.

In an effort to provide high-quality learning activities that respond to the partners’ needs, the ODEdu courses should consider the target group (sector and level within the organization) and the type of content in order to decide the modality of PBL or type of PBL problem. However, all activities should have some degree of PBL principles underpinning them (collaborative learning, critical thinking, self-directed learning and reflection).

For example, D1.1 has proposed 4 different categories of the ODEdu curriculum:
1. **Culture category:** A focus on getting to know what Open Data is and what it does, identifying the benefits and opportunities and overall creating an Open Data mind-set.

2. **Management category:** knowledge of items that will help to set up an Open Data project; items for basic first steps for Open Data but also items that focus directly on the management of processes (collaborating with stakeholders, etc.).

3. **Business category:** the entrepreneurial side of Open Data. For beginners as well as businesses and organisations that want to integrate Open Data in their way of working.

4. **Open Data skills category:** obtaining data, scrubbing data, exploring data, visualizing data, modelling data, interpreting data and presenting data. These are the basic skills that cover all of the aspects of working with (open) data.

5. **Advanced technical skills category:** for those with more experience in working with data and Open Data, who want to gain more advanced skills.

Category one and two could be approached with closed types of problems and cases, while for category three it would be preferable to use an open-ended/ill-structured problem. Furthermore, the best approach for this type of target group and content would be an action learning approach, where business people may learn with and from each other. The best way to approach category four might be applying explanation and application problems. Whereas, with the last category, it might be adequate to use multi-level types of problems, because this kind of problem are specifically designed to stimulate in-depth study of a case.

Regarding the learning material: it should be developed within ODEdu, as the development of adequate material is one of the biggest challenges against creating successful courses, according to the empirical data and literature review. There are only few educational materials and even less educational materials following the PBL principles.

It is crucial to develop good learning materials to guide learners along the PBL pathways selected. Three characteristics are important in learning materials: context-relation (target group), use of real data sets and real/current technologies.

A final remark about the future work within the ODEdu project should address the development of the online learning platform. To support online PBL courses, the platform should also include features that allow the kind of interaction needed to facilitate PBL.

The use of technology is always dependent on the form of PBL adopted in projects, as well as on other contextual aspects. We have highlighted models by Hack (2013) and Khalid et al. (2012) that address specific PBL models, and we have also highlighted central PBL collaboration and communication processes that would benefit from the support offered by networked technologies. We have emphasised that there are different ways of working together, spanning from individual
networking, over loosely networked cooperation, to focused collaboration where learners are highly dependent on each other. Our purpose is not to recommend one form above others, but merely to point out that different orchestrations of PBL are underpinned by different communicative and collaborative dependencies. These dependencies call for different networked technologies or different use of these technologies.

Finally, the different learning activities and examples presented in this report, may be used as inspiration for the design of the ODEdu courses. For example, the ‘learning circles’ for students or groups of people from one single company. The game component could be included as used in Data Expeditions. In the same way, the ten principles for a good instructional design could be used to guide the courses and online platform (see section 5.1.3). The ten criteria might guide the design of the courses and the online platform, but they might also be used as evaluation criteria during Task 5.1 of the ODEdu project.
D2.1 Data-driven PBL model

References


Luschei, T. F., & Vega, L. (2015). Colombia: educating the most disadvantaged students: Colombia’s learning circles provide one model for an innovative approach to supporting the academic success of youth whose traditional education has been interrupted for a variety of reasons.(Report), 97(3), 49.


Education, 1(1), 151–175.


Annex A – Interviewguide

Interview Guide for data collection about teaching activities related to Open Data (WP2)

Introduction

The overall aim of WP2 is to develop a DD_PBL model and innovative learning processes to address the need for pedagogical underpinning of educational and training activities. This model will be based on the established Aalborg PBL model and extended with new data-driven features so as to accommodate the needs of Open Data education and training as well as current developments in the promising field of learning analytics.

One of the specific aims is to identify innovative learning processes and activities to support the participatory and engaging acquisition of the skills, knowledge and abilities that emerged from WP1. To achieve this goal, WP2 is developing two activities:

1. Identify the main pedagogical approaches for teaching and training of all the partners and some of their national partners.
2. Identify different events to promote Open Data and get to know their philosophy and teaching strategies (such as Hackathon).

In order to collect data to complete those activities we aim that our partners can carry out some interviews. With the interviews we aim to collect data about teaching/training initiatives about Open Data.

Instructions

1. Please, follow the recommendations from WP1 about interviews
2. A teaching activity could be: a course, a module, a session with in a course, seminar, a workshop, etc.
3. We divide those initiatives in two forms: Professionals who teach/train about and Professionals who use open data to teach/train
4. You should use different terms depending of the setting, for example teaching in the education context and training in the government and private sector.
5. We expect to have at least 6 interviews from each partner (The best is to have representation from the three sectors: educational, public and private sector)
6. We expect the partners to fill the reporting template that is in the Drive (WP2 Folder) We would like to have a kind of transcription of the interview, in order words as much raw data as possible.
7. For partners who are working with open data could interview people of their own institution.
8. Any question please contact Heilyn Camacho, Aalborg University: hcamacho@hum.aau.dk
9. Deadline to send the data to Aalborg University: April 18th, 2016. Please upload the reporting template to the Drive.
Please print these two figures to facilitate the interview in the theme about pedagogy:

You should discuss with the interviewee who controls the following dimensions:

1. **Problem/project**: Who controls or owns the definition or framing the problem/project
2. **Work process**: Who decides how the problem should be investigated? Who decides the flow and structure of the things that need to be done?
3. **Solution/outcome**: Who owns the solution? Is the solution open-ended or closed?

**Instructions:**
1= teacher control and 5= student control. For example, are students totally free to select the problem that they want to work with? If yes, the mark should be in the line of “the problem” and aligned with the 5. If the teacher decides the problem, the mark should be in the line of “the problem” and aligned with the 1. If, it is a negotiation between the teacher and the student, the mark should be aligned with the 3.

Figure for discussion about **problems** as a tool for teaching

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Teachers** ← The process → **Students**

**Control**

Figure for discussion about **projects** as a tool for teaching

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The project</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Teachers** ← The process → **Students**

**Control**
Annex B – Interview reportings
Lola -1

Interview reporting template

Instructions
1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data)
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

The Interviewee is

Theme 1: General Information

Type of initiative: Teaching session on Linked Open Data, “Een les over data, open, linked”

X Teaching about Open Data
☐ Using Open Data to teach

Field:
X Government,
X Private sector
X University
☐ Education
☐ Other: ____________

Name of the institution iMinds

Country Belgium
The title of the activity

*Introduction to Linked, Open, Data*

The target group

*Syntra: everyone, people of all walks of life that want to learn more to use in their jobs.*

The goal(s) of the activity

To teach people about data, open, and linked, to learn if there is something they can apply in their daily activities, both publishin and using

The content of the activity

0. Data (definitions, things to define such as Q, Interoperability)
   1. Judicial Interoperability (Open)
   2. Semantic Interoperability (Linked)
1. Examples

The datasets used

*KBO (Flemish Registry of Companies)*

*VisitGent (Touristic data on the city of Ghent)*

The duration of the activity

3 Hours

_____ Days

_____ Weeks

_____ Months

Modes of teaching:

X Face to face

☐ Online

☐ Blended learning (face to face and online)

**Theme 3: Pedagogy**
Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

Standup session for 20 people

The use **projects / problems** as a tool of teaching

X Projects

X Problems

☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

- **Problem: what do you think of this dataset, can you use it for this or that**

Please show where the interviewee put the mark.

---

Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

*The respondent describes a guest college he gave at the Flemish institutions AGIV and ABB*
The main reason why he considered it to be successful was because it was well understood, people were enthusiastic and had many suggestions on how and where to use Linked Open Data. They can actually apply the problem they examined in their own projects.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. *The subject matter is quite abstract, it’s important to let them know/feel what data really is and what it can mean for them*
2. *Often it’s not for people that are not into programming, so it’s difficult to make it tangible*
3. *There are many technical questions, preconceptions about server needs.*
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data).
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative: Guest college for an inter-communal organisation of local governments, Leiedal, in West-Flanders, taught by Jan Vansteenlandt.

X Teaching about Open Data

☐ Using Open Data to teach

Field:

X Government,

X Private sector

X University

X Education

☐ Other: ____________

Name of the institution We Connect Data

Country Belgium

Theme 2: Activity description

The title of the activity

Leiedal: Gastles Open Data

The target group

Public servants
The goal(s) of the activity

*Introduce people to the benefit of open data, how to do open data, what are the best practices, what are the arguments for not doing it, and why they are wrong*

The content of the activity

0. *Parko presentation*

1. *Intro talk: who are we, what is open data*

2. *Some examples of existing open data within govt*

3. *What are the benefits*

4. *What tools, CKAN, DataTank*

5. *QA*

The datasets used

*Random datasets, some demographic datasets from Ghent*

The duration of the activity

0.5 *Hours*

____ Days

____ Weeks

____ Months

Modes of teaching:

X Face to face

☐ Online

☐ Blended learning (face to face and online)

**Theme 3: Pedagogy**

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.
A guest college was organised by Intercommunale Leiedal in 2012 to learn more about open data and what it could mean for their organisation. There were a number of speakers, including PARKO, a parking company, and WE CONNECT DATA, an open data company founded by Jan Vansteenlandt.

The session was held in an auditorium with a large number of attendees (~50) and was mostly an introduction to open data and how to publish it. It consisted out of a standup session, with a number of examples from other cities, and a Q&A session.

The use of projects/problems as a tool of teaching

X Projects
X Problems
☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

- Project: hackathon
  After the presentation, Leiedal organised a hackathon to see what open data could mean for them. One team created a map that show all the recreational places, and a routing app for sporters.

- Problem: How to publish open data
  The civil servants at Leiedal were wondering how to start publishing open data. Presented the DataTank, and demonstrated how it could be set up quite easily, and how data could be added to the portal without changing existing business processes, etc.

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

*Open Belgium Gent (2014)*

1. *Open Data was new and a hot topic at the time, and a large number of attendees joined the session. A lot of contacts made, and awareness about open data was created.*

2. *Participants saw many examples of what exists abroad and what they can do with open data themselves, thus making open data more tangible*

3. *A lot of discussions between the participants themselves were started, and a lot of networking was going on. Partly due to the nice location.*

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. *A lot of preconceptions exist about open data, specifically on how it is hard to manage people’s privacy, the cost of publishing about data, and the risks that systems will be “hacked” etc.*

2. *Many participants don’t really know which data they have or manage themselves, which implies that it remains quite intangible*
3. It’s hard to manage expectations, in the sense that people often believe that publishing open data will automatically lead to “apps being created”, but it requires a lot more in terms of community engagement to make this happen.
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
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3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

The Interviewee is

Theme 1: General Information

Type of initiative: Online non-linear video courses for youngsters learning about open data called “Datawijs” (http://www.datawijs.be)

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
☐ Education

X Other: 15 - 25 year-olds

Name of the institution Open Knowledge Belgium

Country Belgium

Theme 2: Activity description

The title of the activity
**Datawijs**

The target group

*Anyone between 15 and 25 years old that wants to learn about open data, for instance: students that have already had a first encounter with open data but want to learn more.*

The goal(s) of the activity

- goal is giving them better understanding of open data
- promote open data as a concept
- To get non-coding or non-open data ppl join a hackathon

The content of the activity

*Datawijs is nonlinear so attendants can choose where to join in. The video series consists out of 4 topics: what is open data (and what isn’t), what is the impact, what is the impact, where can i find data, how can i use it. The series focusses on practical examples or challenge which can be solved using open data.*

The datasets used

- *Car speeding data Kortrijk*
- *Criminal data Kortrijk*
- *Pictures and poster of Antwerp on a timeline*
- *Used ghent data for search request: registered dogs, tell me where the most registered dogs live*

The duration of the activity

*Cannot define*

Modes of teaching:

- [ ] Face to face
- [x] Online
- [ ] Blended learning (face to face and online)
Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

*Online non-linear video courses with:*
  - *Ex cathedra teaching (theory)*
  - *Specific challenges (use cases)*
  - *Examples from (local) governments*

The use **projects / problems** as a tool of teaching

X Projects

X Problems

☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

- **Problem 1: hide and seek challenge: “find the dog”. Imagine someone wants to walk dogs to earn money, which routes could he or she take. Solve this question using open data.**

Please show where the interviewee put the mark.
Problem 2: Criminal data from Kortrijk. Use case: make a visual of criminality in Kortrijk.

Please show where the interviewee put the mark.
Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

The respondent considers Datawijs to be a very successful teaching activity, because:

- It is easy to explain to a 12yo
- A lot of participants got interested in open data after taking the courses, and were reaching out to ask questions; such as “does this dataset exist”, “can I publish open data myself”...
- He received a lot of positive reactions.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. Explaining open data to youngsters is difficult because it’s a concept that is often not present in their day-to-day experiences.
2. It is difficult to convey that open data can be easy to use, even if you’re not a programmer. Many people stick with their first reaction, which is “this is not for me”
3. It’s difficult to scale learning activities if you have to be physically present. Datawijs is a great example of open data training that is very scalable
Interview reporting template

Instructions

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2. Remember that we want as much information as possible (raw data).
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

The Interviewee is

Theme 1: General Information

Type of initiative: Teaching session on Linked Open Data, “Een les over data, open, linked”

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: ____________

Name of the institution Stad Gent

Country Belgium

Theme 2: Activity description

The title of the activity
Introductie tot Open Data

The target group

ICT-students

The goal(s) of the activity

Together with the teacher introduce the students to open data and open data policy in general and focussing on what Ghent is doing

The content of the activity

0. What’s the resasing behind open data
   - Transparancy
   - App development
   - Technical aspects
   - Challenging
     - Hwo to publish
     - Barriers to reuse

The datasets used

Mainly from a powerpoint, no real room for exercises focussing on a powerpoint, if you’re not focussing on a real task it’s harder
   - Parking app
   - Ghendetta (foursquare based game)
   - Thrash collectron

The duration of the activity

2 Hours
   _____ Days
   _____ Weeks
   _____ Months

Modes of teaching:
Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

*We gave examples of links between published datasets and developed apps, we gave a guest lecture twice, once for 80 and one for 60 students. Big auditoria*

The use **projects / problems** as a tool of teaching

☐ Projects

☐ Problems

☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

- **Problem:** data collection to inventtorisa all the datasets present in the administration, how can you stimulate reuse, what are the results of publishing this data.
- **Project:** define a challenge and work together with students to shed more light. Blended co-creation with teaching. For instance the semester with student Digitale Grafische Media - 6 students. We pitched and the students chose

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

The Datadive for library data: we invited different speakers from different institutions to pitch about their data, the formats, and so on. The people were introduced to the data and the specificities. They could ask questions and familiarize themselves with the data.

- Very high attendance for a technical topic 60 participants
Results during the hackathon, really using the data in a good way
- They understood the data
- Quality of the questions

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. *Bridging the technical side to the everyday experience of the target group, make it relevant to them, beyond just programming*
2. *The format: you can talk about theory but hands-on journey is more rewarding*
3. *The follow-up: additional questions will arise after working with the data. It’s*
Interview reporting template

Instructions

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The Interviewee Noël Van Herreweghe, Open Data manager at the Flemish Government

Theme 1: General Information

Type of initiative: describes his overall interaction with public services when promoting the publication of open data. He considers it a learning exercise in itself to get all government administrations to know what open data means and how they should publish it.

X Teaching about Open Data
☐ Using Open Data to teach

Field:
X Government,
X Private sector
X University
☐ Education
☐ Other: 15 - 25 year-olds

Name of the institution Vlaamse Overheid

Country Belgium

Theme 2: Activity description
The title of the activity

Open Data Advocacy

The target group

The respondent describes a set of interactions with public services, government agencies and public companies. His method for promoting open data consists mostly out of bringing these people into contact with the actual re-users of their data so they can see for themselves which needs there are. So the target group is civil servants in particular but can be described as “anyone working with open government data” in general.

The goal(s) of the activity

Convince public institutions to publish their data, provide them with an intrinsic motivation to do so, and realise a sustainable publication process.

The content of the activity

The respondent has described numerous interactions with public institutions instead of a single teaching activity. In general these will consist out of face-to-face meetings. Apart from this, the respondent has also done a large number “ex cathedra” teaching sessions on conferences, guest lectures etc.

The datasets used

The respondent did not talk about a specific dataset used in a specific activity. Instead he described multiple activities which each deal with the datasets owned by the institution(s) he is reaching out to

The duration of the activity

Cannot define

Modes of teaching:

X Face to face
Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The respondent considers his way of dealing with public institutions as a way of doing Problem Based Learning. Instead of explaining in detail what needs to be done or which are the technical or legal requirements, he defines the “problem” as “why and how should I, as a public institution, publish open data”. He then proceeds to find actual or potential re-users of the data owned by the public institution (he is often contacted by such re-users ad hoc). Through the discussion both parties are having, the requirements and possibilities of both sides quickly surface.

The use **projects / problems** as a tool of teaching

X Projects

X Problems

☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

- **Problem 1: Re-users want to create a multi-modal route planner**

Please show where the interviewee put the mark.
Project: Plantentuin in Meise has a few million pictures of plants, can they be published as open data?

Please show where the interviewee put the mark.

Theme 4: Teaching experiences
Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

The respondent has a broad experience in teaching about open data. His first step is to identify the barriers which exist within the administrations.

Intrinsic motivation can be that open data creates internal value. This is culture shift that needs to be applied from individual level

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. Civil servants are used to working with data but often don’t realise that it can (should) be open data as well. Open Data is something that is scary and is coming their way.
2. Civil servants are now being forced (due to the new PSI law) to publish their data for economic purposes. This is horror for them.
3. As a Flemish open data manager the challenge is to create intrinsic motivation for individuals. This can often be realised by letting people see for themselves that opening data can create value for their administration internally.

Setting up a dialogue between all related parties, any civil servant can get a better view on what is possible in terms of use cases, and what the challenges are of re-users.
Interview reporting template

Instructions

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4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: Third, non-profit, though the ODI does training for all of the above fields.

Name of the institution: The Open Data Institute

Country: UK

Theme 2: Activity description

The title of the activity:
Business Innovation Workshop

The target group:

- Startups
- Established businesses that are looking to innovate
- Groups vary between 4-16 participants

The goal(s) of the activity:

- Equip participants with the skills to add open data to their business models and to be able to pitch the value proposition of open data

The content of the activity:

- Impact that open data could have on business models
- Unique opportunities that open data can present

The datasets used:

- Datasets are provided by the participants.
- Previous examples have included restaurant opening hours, traffic data

The duration of the activity

**3.5 Hours**

_____ Days

_____ Weeks

_____ Months

Modes of teaching:

☐ Face to face

☐ Online

☐ Blended learning (face to face and online)

The title of the activity:

- Open Data for Smart Cities

The target group:

- Anyone interested
Groups vary between 4-16 participants

The goal(s) of the activity:

- Demystify the concept of smart cities
- Equip participants with tools

The content of the activity:

- Definitions
- Design principles
- Practical steps
- Ecosystems

The datasets used:

- Transport
- Energy
- Data.gov.uk
- From public and private sectors

The duration of the activity

7 Hours

_____ Days

_____ Weeks

_____ Months

Modes of teaching:

☐ Face to face

☐ Online

☐ Blended learning (face to face and online) - primarily face to face

Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The following are applicable for Open Data for Smart Cities and Business Innovation

- Start with the theory (definitions, core concepts)
 ● Case studies and existing examples
 ● Principles of subject
 ● Hands on, group work
 ● Plenary and peer review

The use projects / problems as a tool of teaching

☐ Projects
☐ Problems
☐ They do not use

*The below question is not applicable*

Describe the discussion about who control the dimensions of problem/project, process and outcome
Please show where the interviewee put the mark.

Theme 4: Teaching experiences
Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

**Write your own licence activity.**

**Successful because:**

- Participants can see why licensing is important
- Participants can see what you can/can’t do
- Participants empathise with the person putting the licence on the data, as well as with the user

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

- Defining open data and challenging preconceptions
- Fighting the perception that open data is technical
- Keeping a balance of exercises as some of the concepts can be complex and dull

What is the best approach to teaching open data?

- Hands on, although not necessarily with datasets
- Not too much theory
- Concrete exercises to put theory into practice
Interview reporting template

Instructions

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4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: Third, non-profit, though the ODI does training for all of the above fields.

Name of the institution: The Open Data Institute

Country: UK

Theme 2: Activity description

The title of the activity:
The target group:

- Anyone:
  - Government/public sector
  - Private sector
  - Education sector
- Groups vary between 3-20 participants

The goal(s) of the activity:

- Introduce participants to open data
- Equip participants with the skills to talk about open data

The content of the activity:

- Definitions
- Impact of open data
- Global development
- Law and Licensing
- Quality check on data

The datasets used:

- FCO UK spend above £25,000 (transactional, applicable, relevant)
- Health data - GP data
- Political donations

The duration of the activity

7 Hours

Days

Weeks

Months

Modes of teaching:

- Face to face (though moving towards blended learning)
- Online
- Blended learning (face to face and online)
Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

- Interactive
- Case studies and key points via presentation
- Formative assessment (assess as you go)
- Learning Outcomes that build based on Bloom’s Taxonomy
- Feedback
- Evaluate on continued engagement with the ODI

The use projects / problems as a tool of teaching

☐ Projects

☐ Problems

☐ They do not use

The below question is not applicable

Describe the discussion about who control the dimensions of problem/project, process and outcome
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

**OpenRefine - hands-on, data cleaning exercise**

Successful because:

- Reassures participants as people care about quality
Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

- Definitions: open, shared, closed personal, big etc.
- Digital divide
- Culture divide - people who aren’t willing to learn.
- Continued engagement in topic. Open data is a brand new to some people who are likely to go home and ignore what they have learnt.

What is the best approach to teaching open data?

- Interactive, hands-on
- Activities, could be problem based learning
- To improve, apply more theory of learning

‘Problem based learning is not the solution to bad teaching, it’s another tool in your toolkit of good teaching techniques.’
Instructions

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2. Remember that we want as much information as possible (raw data)
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending on how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: Third, non-profit, though the ODI does training for all of the above fields.

Name of the institution: The Open Data Institute

Country: UK

Theme 2: Activity description

The title of the activity:

- Law and Licensing

The target group:
Anyone:
- Beginners
- Publishers
- Data scientists
- Managerial level

Groups vary between 3-10 participants

The goal(s) of the activity:
- Enable participants to understand the basics of open data licensing
- Give participants the necessary resources and best practices to licensing open data

The content of the activity:
- Intro to open licensing
- Basic background - copyright and database licences
- Intro to personal data
- Anonymisation resources

The datasets used:
- A range of datasets are used:
  - Satellite images
  - Dengue fever in Singapore
  - Companies data
  - Contents page of a poetry book

The duration of the activity

7 Hours

_____ Days
_____ Weeks
_____ Months

Modes of teaching:
- Face to face (though moving towards blended learning)
- Online
- Blended learning (face to face and online)

Theme 3: Pedagogy
Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

- Exercises, done both individually and in groups
- Case studies
- Theory
- Evaluation through checklist building exercise (write a checklist for a licence)

The use **projects / problems** as a tool of teaching

- [ ] Projects
- [ ] Problems
- [x] They do not use

*The below question is not applicable*

Describe the discussion about who control the dimensions of problem/project, process and outcome
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

Identifying different licences (open and not open)

Successful because:

- Participants demonstrate that they have learnt
Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

- Huge topic, can be overwhelming for participants
- Easy for experts to go too deep and create divisions in the room

What is the best approach to teaching open data?

- Get the participants to make the decisions
- Being a real expert on the topic - it’s very easy to confuse participants
Interview reporting template

Instructions

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3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:

☐ Government
☐ Private sector
☐ University
☐ Education
☐ Other: Journalism and Media

Name of the institution: Freelancer. Has done work for BBC, European Broadcasting Union, ODI, Centre for Investigative Journalism

Country: UK

Theme 2: Activity description

The title of the activity:
Finding Stories in Open Data

The target group:

- Mid career journalists
- Groups vary between 6-12 participants

The goal(s) of the activity:

- Make journalists aware of open data and its benefits for them

The content of the activity:

- What is open data
- Where and how to find open data
- Cleaning, sorting and filtering
- Basic data visualisation

The datasets used:

- A range of datasets are used:
  - Price paid data from Land Registry
  - UK Political donations
  - Road safety data

The duration of the activity

7 Hours

_____ Days

_____ Weeks

_____ Months

Modes of teaching:

☐ Face to face

☐ Online

☐ Blended learning (face to face and online)

Theme 3: Pedagogy
Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

- Theoretical introduction
- The rest of the session is hands on.
- Use one dataset throughout
- Trainer demonstrates, then participants do. 3x per exercise

The use **projects / problems** as a tool of teaching

- [ ] Projects
- [ ] Problems
- [ ] They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome.

Please show where the interviewee put the mark.
Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

**Donations to political parties**

**Successful because:**
- It gets participants thinking how to interrogate data like a person - by asking it sensible questions.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

- Open Data is not statistics
- Getting all people to see how open data is relevant

What is the best approach to teaching open data?

- Depends on the audience
- Finding the right audience and levelling it at the correct level
Interview reporting template

Instructions

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4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:

☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other:

Name of the institution: **The Open Data Institute - Devon Node**

Country: UK

Theme 2: Activity description

The title of the activity:

- Exploring and Discovering Open Data

The target group:
The goal(s) of the activity:

- Reassure participants that open data is doable and not too technical

The content of the activity:

- Why open data?
- The challenges for (local) government
- Existing practical examples to alleviate doubt
- Tools for publishing and using

The datasets used:

- Open Data Portals eg.:
  - Leeds Data Mill
  - Devon County Council
  - data.gov.uk

The duration of the activity

7 Hours

_____ Days

_____ Weeks

_____ Months

Modes of teaching:

☐ Face to face

☒ Online

☒ Blended learning (face to face and online)

Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

- Suitable for all learning styles - visual, audio, kinesthetic
D2.1 Data-driven PBL model

- Case studies
- Interactive exercises

The use **projects** / **problems** as a tool of teaching

☐ Projects

☐ Problems

☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome.

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

Data representation through people
Successful because:

- Participants understand that visualisations don’t have to be technical - it’s about communicating the story

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

- Giving examples that are relevant to participants (some are easier than others)
- Logistical infrastructure - wifi / firewall issues
- Ensuring that the attendees are prepared

What is the best approach to teaching open data?

- Starting with a relevant problem or challenge
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data).
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:

☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: ____________

Name of the institution _____ Freelance, teaching via ODI

Country ________ Mostly UK

Theme 2: Activity description

The title of the activity - Open Data Business Models

The target group - Anyone with a gap in understanding of the benefits of open data to a business model.

The goal(s) of the activity - To enable learners to apply the use of open data to strengthen any business. NOT to use cookie cutter business models.
The content of the activity

1. Impact of technology on business in general
2. What is a business model in general
3. Deeper understanding of business models, looking at case studies
4. Taking a look at open data
5. Combining open data with business models

The datasets used - None - learners are asked to imagine what datasets a business might have that could be made open and the benefits - theoretical

The duration of the activity

___ Hours
1 Day as part of a wider 3 day course

___ Weeks

___ Months

Modes of teaching:

☐ Face to face

☐ Online

☐ Blended learning {face to face and online}

Theme 3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

Face to face and very interactive, guided learning from a trainer but with lots of input and participation from learners. This happens through exercises and general discussion. Exercises build upon each other, starting with use of basic knowledge until knowledge is much deeper. Example exercise: Learners are given a short list of known businesses to choose from, they then must imagine what data sets that business could have that they could open and the benefits of this to the business.

The use projects / problems as a tool of teaching
Projects

Problems - thought ‘problem’ was not the correct term, not trying to fix something per se but trying to encourage innovation and a positive outlook.

They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

Please show where the interviewee put the mark.

<table>
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</tr>
</thead>
</table>

The problem = 2

Teachers

The process = 5

Students

The outcome = 4

Control

Project = N/A

---

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

The project

Teachers ——— Students

The process

The outcome

Control

Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.
The approach which I have used that I’ve found successful: learners are encouraged to discuss their own experiences and knowledge of open data and separately their understanding of how businesses work - the aim of this is to ground / contextualise what they are being taught and to help them come up with their own ideas to strengthen the value proposition of businesses by using open data. This is opposed to just giving them a list of business models based upon open data, which would restrict their ideas and possible creativity.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. **Businesses using open data is a fairly new field, so I’m often creating teaching from scratch.** There are limited case studies and the challenge is showing learners how to apply open data to strengthen any business, existing or new.

2. **Learners are not often business specialists and therefore need to think differently about the ways a business can make money and other indirect benefits of using open data.**

3
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data).
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending on how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☒ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☒ University
☐ Education
☐ Other: ____________

Name of the institution: University of Ghent

Country: Belgium

Theme 2: Activity description

The title of the activity

Business cases in IT: Open Data.
(Putting informatics into practice. Session related to informatics used in the public sector)
The target group
Students of business informatics

The goal(s) of the activity
1. Concrete example of how informatics can be used in the public sector
2. Introduction of Open Data and the importance for the public sector

The content of the activity
1. What is Open Data and why use it?
2. Open data examples
3. Publishing of open data
4. Open data licences
5. What to do with open data datasets: quality check, visualising, ...
6. Linked open data

Powerpoint: https://app.minbox.com/files/jOunD3U
https://app.minbox.com/files/jOunD3U
https://app.minbox.com/files/jOunD3U

The datasets used
- US government: overview of IT projects in the US
- KBO: Belgian enterprises database

The duration of the activity
2,5 Hours (once a year)
_____ Days
_____ Weeks
_____ Months

Modes of teaching:
☒ Face to face
☐ Online
☐ Blended learning (face to face and online)
Theme 3: Pedagogy

80% is lecture, combined with some questions to the group. No problems or projects.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use projects / problems as a tool of teaching

☐ Projects
☐ Problems
☒ They do not use

Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

The teaching activity discussed above created interest. Several students made their thesis about Open Data.

1. Lack of user-friendly tools to publish and use Open Data

2. Data available is not good enough

3. Mindset needs to change (too many excuses not to use or work with Open Data)

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☐ Using Open Data to teach

Field:

☒ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: ____________

Name of the institution: PricewaterhouseCoopers

Country: Belgium

Theme 2: Activity description

The title of the activity
Open Data Support onsite training (multiple EU countries – EU project)

The target group
Government officials

The goal(s) of the activity
Create awareness and give an introduction to Open Data
The content of the activity
1. Open Government Data and the PSI Directive
2. Introduction to Linked (Open) Data
3. Introduction to Metadata Management
4. The Linked Open Government Data Lifecycle
5. Design and Manage Persistent URIs
6. License your Data and Metadata

The datasets used
Respondent couldn’t recall. Different trainings in different countries and this would vary.

The duration of the activity
4 Hours

Modes of teaching:
☒ Face to face
☐ Online
☐ Blended learning (face to face and online)

Theme 3: Pedagogy

Big groups and very introductory, so more a lecture and one way. They tried creating interaction using case studies, examples and asking questions. The groups were very formal (usually a minister and government officials, groups could be 80 people) so this was quite hard.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use projects / problems as a tool of teaching
☐ Projects
☐ Problems
☒ They do not use
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

Workshop with government officials, very technical. Introducing them to Open Refine and publishing a dataset. Really getting them get to work. They were very enthusiastic and want to work further with this when they saw the potential and what they could do.

1. Because it’s very new to most people, it’s mostly giving information and more of a lecture. You have to know who your public is and prepare the session. Possibility of a miss match of subject and public.

2. Language can be an issue. Abstract concept and not easy when it’s about technical topics.

3. Big groups are not a good idea when you want to go further than the introductory lecture.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
Interview reporting template

Theme 1: General Information

Type of initiative:

☒ Teaching about Open Data
☐ Using Open Data to teach

Field:
☒ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: ____________

Name of the institution: City of Ghent

Country: Belgium

Theme 2: Activity description

The title of the activity
Workshop Open Data

The target group
Civil servants – city of Ghent

The goal(s) of the activity
Showing civil servants the app building opportunities for Open Data

The content of the activity
1. What is Open Data
2. Which datasets are there
3. Which format to use
4. How to put this in an app
5. How to make adjustments to the data & app (visualization, ...)
6. How to make my app discoverable

The datasets used
http://datatank.stad.gent/4/milieuennatuur/bomeninventaris (used as example) They could choose the dataset they wanted to use.

The duration of the activity
4 Hours

Modes of teaching:
☒ Face to face
☐ Online
☐ Blended learning (face to face and online)

Theme 3: Pedagogy

Trainer started with information first, then an example and then he performed a step by step exercise. After that the students did the same but with the dataset they wanted and he would give one on one tips.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use projects/ problems as a tool of teaching
☒ Projects
☐ Problems
☐ They do not use
Describe the discussion about who control the dimensions of problem/project, process and outcome.

The students had to follow to set up (building app, within a certain format), but could choose their own dataset and apply this. After that there was a lot of freedom to adjust this to their own preferences.

Please show where the interviewee put the mark.

**Theme 4: Teaching experiences**

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

The training he gave was very successful. The workshop setting was a big advantage. People got the feeling, hey I can do this! This was a revelation for them. Moreover, the fact it was a small group made it successful and also because they went home with a tangible result that they created themselves.

1. Trainers have to have a very broad and deep knowledge about (open) data. You have to be technical in order to answer to questions. However, you have to have this background, but need to be able to talk on a basic level to start with when giving an introductory course and be able to talk about policy.

2. Mix of audience can be a challenge. You need to know your audience in advance in order to prepare a good course/workshop made to measure.
3 It has gotten better, but still there are people who are reluctant to opening up their data and will use all excuses to fight it.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
Interview reporting template

Instructions
1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data)
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☒ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☒ University
☐ Education
☐ Other: ________

Name of the institution _____ University of Macedonia (Applied Informatics Department)______________

Country
________ Greece__________________________________________

Theme 2: Activity description

The title of the activity

Teaching the creation of visualizations using RDF data

The target group

Postgraduate students at the University of Macedonia (Web Technologies and Web Analytics course 2nd semester)

The goal(s) of the activity

The creation of multiple visualizations (graphs, maps, tables etc.) that depict RDF data
The content of the activity

| 1. Exercises with SPARQL queries on retrieving data from data stores (e.g. dbpedia, Nobel prizes etc.) |
| 2. Basic information on HTML and Javascript |
| 3. Basic information on the svgizler library |
| 4. Multiple exercises on retrieving data from a SPARQL endpoint and presenting them on a dynamic webpage |

The datasets used

- Dbpedia data ([http://dbpedia.org](http://dbpedia.org)) e.g. information about Thessaloniki and its Mayor
- Nobel prize data ([http://data.nobelprize.org/](http://data.nobelprize.org/)) (e.g. information about the people that have won Nobel Prizes)

The duration of the activity

- ___ Hours
- ___ Days
- ___ Weeks
- ___ Months

Modes of teaching:
- [X] Face to face
- [ ] Online
- [ ] Blended learning (face to face and online)

**Theme 3: Pedagogy**
Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The learning process includes:
1. Slides that contain the necessary learning material (i.e. SPARQL concepts and examples, introduction to the technologies involved such as HTML and Javascript, introduction to the sgvizler library)
2. Numerous exercises that students carry out during class (access a SPARQL endpoint, perform SPARQL queries that will answer the questions of the exercises etc.)
3. Assignments for after class where students create interesting visualizations

The use projects / problems as a tool of teaching
☐ Projects
☒ Problems
☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

The teacher provides an introduction to the main concepts and hands-on examples that will provide students with the skills to use the taught materials more actively. The students then choose interesting to them scenarios when applying the learned knowledge to the assignments.

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

The most successful teaching activity is the one where students develop their own visualizations using Open and Linked data. The actual visualization of their work provides them with a sense of accomplishment that motivates them to learn more about the subject of Open Data.

Thus, the usage of existing tools and technologies that allow students to create such visualizations and access stored data from the web is important during Open Data courses.

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.
Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

1. Finding interesting Open Data on the web for creating intriguing scenarios

2. Finding representative vocabularies for semantically annotating your data (RDF ontologies)

3. Finding open source tools that allow easy and user-friendly development of visualizations with open, RDF and linked data without high programming skills requirements.
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data).
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending on how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

- Teaching about Open Data
- Using Open Data to teach

Field:

- Government,
- Private sector
- University
- Education
- Other: ____________

Name of the institution University of Macedonia (Business Administration Department) ____________

Country Greece

Theme 2: Activity description

The title of the activity

Statistical analysis of Scotland datasets using the R environment

The target group
The goal(s) of the activity

Introduction to Open and Linked data, experimentation with utilization of Open and Linked Data, data analysis

The content of the activity

1. Theory on Open Data
2. Case studies on existing applications created with Open Data
3. Examples of SPARQL queries and RDF graphs
4. Experimentation with the R environment

The datasets used

Scottish government Open Data portal (http://statistics.gov.scot/)

The duration of the activity

_____ Hours
_____ Days
12___ Weeks
_____ Months

Modes of teaching:

☒Face to face
☐Online
☐Blended learning (face to face and online)

Theme 3: Pedagogy
Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The teacher allows full freedom to students on their assignment. The teacher provides the Scottish government data portal and allows students to browse and select the dataset that each student finds interesting. Each student needs to think of a problem that requires solving, identify the datasets that will help create the solutions, think of innovative relations / links that should be created and create meaningful visualizations.

Each week the students experiment on a specific step on the Open Data lifecycle using the datasets they have chosen (they are free to change datasets if they see their choices were not that interesting).

Students also perform exercises inside the class in order to be familiarized with the datasets they have selected and interact with each other via Facebook and within class to support each other and ask / answer questions.

Students also create different statistical analyses and various visualizations (e.g. graphs) using R for the chosen datasets and determine the added value of each result and whether it is meaningful for decision making and for solving the main problem.

The use **projects / problems** as a tool of teaching

- [ ] Projects
- [x] Problems
- [ ] They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

Full control is given to the students on how to structure their work and problem.

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

The biggest success in this Open Data course is the full freedom students have in structuring their work. This way, the end result is meaningful to them; a problem they themselves have chosen finds a solution because of them. This creates high level skills, a great sense of satisfaction and accomplishment and motivates students to become more active in general.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
1. Finding good and interesting datasets.

2. Finding actual case studies that show the business value of re-using and opening up data from the real world.

3. Finding proper documentation on the datasets for re-use.
Interview reporting template

Instructions
1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data)
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:
☒ Teaching about Open Data
☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
☐ Education
☐ Other: ____________

Name of the institution ____________University of Macedonia_______________________

Country _____________________________Greece__________________

Theme 2: Activity description

The title of the activity
1. Linked Open Data for e-Government class
2. Linked Open Data Web Technologies and Web Analytics (WTWA) postgraduate class

The target group
1. Students of the Applied Informatics Department – Course “e-Government” (selective)
2. Students of the Postgraduate Programme of the Applied Informatics Department – Course “Web Technologies and Web Analytics” (selective)

The goal(s) of the activity
1. (e-Gov) Understanding the technologies of Open Data, being able to use the technologies and apply them in the context of e-government, applying and re-using e-gov data and e-gov applications.

2. (WTWA) Understanding the technologies of Open Data, being able to use the technologies and apply them in multiple domains.

The content of the activity

1. “e-Gov course”
   a. Introduction to Open Data
   b. RDF graphs and structure (theory and exercises)
   c. Vocabularies for describing data
   d. Simple SPARQL theory and exercises
   e. Discussion around e-government portals and existing applications for e-government services with Open Data

1. “Web Technologies and Web Analytics course”
   a. Introduction to Open Data
   b. RDF graphs and structure (theory and exercises)
   c. Vocabularies for describing data
   d. Advanced SPARQL theory and exercises
   e. Introduction to R (theory and exercises)

The datasets used
Dbpedia datasets (http://dbpedia.org/)
Nobel prize winners (http://data.nobelprize.org/)
Tim berners lee FOAF file (http://www.w3.org/People/Berners-Lee/card.rdf)
Greek Open Data portal (http://data.gov.gr/)
Greek dbpedia datasets (http://el.dbpedia.org/)

The duration of the activity
__e-Gov: 5 classes of 3 hours each__ _WTWA: 4 classes of 3 hours each__ _Hours
_____ Days
_____ Weeks
_____ Months

Modes of teaching:
☒ Face to face
☐ Online
☐ Blended learning (face to face and online)

Theme 3: Pedagogy

Students are introduced with a unit of learning every week that corresponds to a specific step of the Open Data re-use and publishing lifecycles.
Each unit of learning involves both the theory and multiple exercises (both solved and unsolved). Students practice hands-on with the unsolved exercises during the lab sessions of the courses. The exercises start on a simple level with an introduction to each topic and become more complex as students get familiarised with the main concepts and principles.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

In regards to the assignments, the structure changes in each course, as follows:
1. (e-Gov) Weekly assignments on the respective taught theory
2. (WTWA) One large assignment in groups

The use **projects / problems** as a tool of teaching
- Projects
- ☒ Problems (2. WTWA course)
- ☒ They do not use (1. e-Gov course)

Describe the discussion about who control the dimensions of problem/project, process and outcome

For the Web Technologies and Web Analytics course, the control is mostly given to the students. They define the problem and the process which they will follow to solve it. However, the types of outcome are defined by the teacher, who specifies the different parts that should be included in each assignment.

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.
The hands-on experimentation with existing datasets is the most important and successful experience within the courses. Students get more involved in the learning process, they develop skills while applying the theory they are taught and they feel satisfaction when they solve a given problem. Practical exploration and active practice has also led to improved performances in the end of the semester.

1. Limited time for in-depth practice with all the different units of learning.

2. Non-homogenous background of students in regards to their prior knowledge and skills.
3. Limited learning material to consult, supporting examples, successful case studies that can increase motivation.

4. It is challenging to communicate the practical usefulness and added value of Open Data to the students.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
Interview reporting template

Instructions
1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data)
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
x☐ Using Open Data to teach

Field:
☐ Government,
☐ Private sector
☐ University
x☐ Education
☐ Other: __________

Name of the institution ________ University College of Northern Denmark____

Country ______ Denmark_____________________________________________________

Theme 2: Activity description

The title of the activity
Learning analytics (5 ects, elective module)

The target group
Master degree students in ICT and Learning. The students are professionals working full time and studying for a master degree part time (not a full master). The students come from the educational sector including 1) School teachers, 2) lecturers from University College of Northern Denmark, who train teachers, 3) employees from public administration working with education.

The goal(s) of the activity
The aim of the activity is to give insight into the research area of learning analytics:
1. To give a general overview of the research area with the aim to optimizing learning
2. To give insight into working with data. Data analytics. Data analysis.
3. To see learning analytics in a learning theoretical framework and discuss opportunities and strengths.

The content of the activity

1. learning analytics
2. Learning theory and learning analytics
3. Introduction to the visualization software Tableau
4. Data filtering
5.
6.

The datasets used
Different datasets were introduced to the students but they could choose themselves which datasets they preferred working with.

The duration of the activity
___ Hours
____ Days
___x__ Weeks
___x_ Months

Modes of teaching:
☐ Face to face
☐ Online
x☐ Blended learning (face to face and online)

Theme 3: Pedagogy

Blended learning approach.

One afternoon of face-to-face teaching:
- Presentations from two lecturers
- Hands-on exercises

Student project work with online supervision. Group work. About two online supervision meetings per group.

Webinar with software presentation and instructions about Tableau.
Written exam assignment. The two lecturers did not agree about the content and form of the assignment. In the end, the interviewee’s approach was chosen. The exam assignment should include a data visualization and only little text explaining the problem, context and conclusion. As an alternative the students could also choose to develop a concept for learning analytics instead of a data visualization. The lecturer would have preferred a more academic assignment reflecting a theoretical discussion. The interviewee calls for new ways of doing exam assignments.

There were 15 students in the class. This was the max according to some internal decision. The interviewee, however, would have liked to have more students participating. 50 students or up to 100 in order to get more inputs, comments and discussion.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use **projects / problems** as a tool of teaching

- [x] Projects
- [x] Problems
- [ ] They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

**Problem:**
The problem formulation and framing of project was very much up to the student. => 5
The process and outcome was also rather open => 4
The interviewee first said “3” but later corrected to “4”
The students were introduced a specific dataset and visualization software but they could perspectives.

**Projects:**
The project: The interviewee describes the project formulation as rather controlled => 3
The process: => 4, people at our age decide for themselves
The outcome: very open. The students could choose between different deliveries, e.g., a paper, a data visualization with a little text, or a video presentation => 4

Please show where the interviewee put the mark.
Please show where the interviewee put the mark.

```
1  2  3  4  5

The problem

Teachers        Students
The process
The outcome

Control

1  2  3  4  5

The project

Teachers        Students
The process
The outcome
Theme 2: Activity description

The title of the activity
LASI – Learning Analytics Summer School

The target group
Researchers and practitioners from learning, learning analytics, and related fields. 20 participants.

The goal(s) of the activity
Introduce participants to the field of learning analytics.

The content of the activity
1. Presentation on learning analytics
2. Presentation on assessments and learner behavior in MOOCs
3. Learning analytics and how it is used at Clio Online
4. Presentation – a critical perspective on Learning Analytics
5. Hands-on session in data visualization
6. Link to program: https://sites.google.com/site/lasiaalborg2015/program

The datasets used
The dataset used was on educational data. The interviewee found that the dataset had been too complex for the participants to work with. The participants had either no or only little experience in data visualization. In this years LASI she will use a much more simple dataset.

The duration of the activity
__6__ Hours
___ Days
_____ Weeks
_____ Months

Modes of teaching:
x☐ Face to face
☐ Online
Theme 3: Pedagogy

In the hand-on part of the day the participants worked with chosen dataset on MOOC data. The interviewee describes that the dataset was far too complex so the different exercises were too difficult.

Next time she will spend more time on data filtering, use a more transparent and simple dataset, and use much more specific hands-on exercises.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use projects / problems as a tool of teaching
☐ Projects
☐ Problems
x☐ They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

Please show where the interviewee put the mark.

Theme 2: Activity description

The title of the activity
Crowd-Sourced Learning and Assessment in MOOCs
A one day tutorial held at the Computer Supported Collaborative Learning (CSCL) Conference in 2015

The target group
Computer Supported Collaborative Learning Conference participants

The goal(s) of the activity
Develop insight into teaching and learning in a MOOC. Review the filed of learning analytics and the different tools it provides to investigate learning. Experience hands-on qualitative and quantitative approaches. Hands-on with Tableau software.
The interviewee held the tutorial together with a colleague.

The content of the activity

1. Link to tutorial program: https://sites.google.com/site/csclmooc2015/program
2. 

The datasets used
A dataset on Mooc data. The interviewee describes the dataset as complex but since the participants were mostly researchers within the field of learning analytics or related fields it worked well. All participants had prior knowledge and skills in working with visualization softwares such as Tableau

The duration of the activity
___x_ Hours => a full day tutorial
____ Days
____ Weeks
_____ Months

Modes of teaching:
x☐Face to face
☐Online
☐Blended learning (face to face and online)

Theme 3: Pedagogy

Presentations of topics related to MOOCs and learning analytics. Practical sessions in data visualization. Finale sessions with discussion and showcasing of work.

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use projects / problems as a tool of teaching
☐ Projects
☐ Problems
x☐ They do not use
Describe the discussion about who control the dimensions of problem/project, process and outcome

Please show where the interviewee put the mark.

Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

Hands-on exercises are important. Important to work with relevant examples and cases that participants can easily relate to and see the relevance of. Provide links to other resources to help people explore the topic on their own.

1. Time. In relation to the 5 ects module on Learning analytics (students in ICT and learning) the interviewee would like more time. At least 3 lectures of four hours. Also, the students needed more time to work on their projects.

2. Important to rethink how students do exam assignments. The interviewee stresses the importance of supporting the students’ process. The best way is not to hand in written reports. Other types of assignments are needed if we want to support creative use of Open Data.

3. Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data)
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

☐ Teaching about Open Data
☒ Using Open Data to teach

Field:

☐ Government,
☒ Private sector
☒ University
☐ Education
☐ Other: ____________

Name of the institution ____________Alexandra
Instituttet__________________________________________________

Country
_________________________________________Denmark__________________________________________________

Theme 2: Activity description
The title of the activity

The interviewee is a consultant in the private company Alexandra Instituttet but he also teaches a little at Aarhus University. This activity dates back 1-1.5 years and was not deeply covered in the interview since this is not his core professional activity.

He taught a 20 ECTS module on introduction to programming.

The target group

University students, second semester at DIGITAL DESIGN - IT, ÆSTETIK OG INTERAKTION at Aarhus University. He taught a 20 ECTS module on introduction to programming.

The goal(s) of the activity

Learn to programme

The content of the activity

1. Programming
2. One lecture on open data

The datasets used

Datasets from Open Data Aarhus or other open dataset of their own choice.

The duration of the activity

____ Hours
____ Days
____ Weeks
__x____ Months
Modes of teaching:
- [x] Face to face
- [ ] Online
- [ ] Blended learning (face to face and online)

**Theme 3: Pedagogy**

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

12 lectures including presentations from lecturer, exercises, student presentations, writing a project, oral examination

The use **projects / problems** as a tool of teaching

- [x] Projects
- [x] Problems
- [ ] They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

The students wrote an assignment (project?). The aim of the assignment was to develop a concept based on open data.

The students could formulate their own problem. They had to use a specific programming language and some kind of open dataset.

We did not cover the “arrows” below about problem and project. Because he could not really recall some of the points about teaching this module.

Please show where the interviewee put the mark.
Theme 2: Activity description

The title of the activity

Hackertons

Again this activity was not in focus in the interview and the interviewee was a little vague about it.

The target group

Private business and students
The goal(s) of the activity

Generate new concepts

The content of the activity

1. 
2. 
3. 
4. 
5. 
6. 

The datasets used

They had invited some data owners to deliver datasets. I don't know which ones?

The duration of the activity

___ x Hours – 24 hours
___ Days
___ Weeks
___ Months

Modes of teaching:

x ☐ Face to face
☐ Online
☐ Blended learning (face to face and online)

Theme 3: Pedagogy
Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

It was a 24 hours hackerton. The organizers (Alexandra Instituttet and Erhvervsstyrelsen) had formulated three concepts that they pitched in the beginning of the event. They participants formed groups according to interest in these concepts. Presentation of developed concepts at the end of the hackerton.

The use projects / problems as a tool of teaching

- [ ] Projects
- [ ] Problems
- [ ] They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

I’m not able to answer this question based on this interview.

Please show where the interviewee put the mark.
Theme 4: Teaching experiences

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)

Working with real-life datasets motivates students
1. Difficult to find up-to-date and interesting datasets

2. The quality of datasets can sometimes be low
Interview reporting template

Instructions

1. We have organized the reporting template in four themes.
2. Remember that we want as much information as possible (raw data).
3. Theme 2 and 3 could be duplicated, if the same interviewee described two different activities.
4. You could change the structure of the reporting template depending of how your interview went (add/delete/reorganize items).

Theme 1: General Information

Type of initiative:

- Teaching about Open Data
- Using Open Data to teach

Field:

- Government,
- Private sector
- University
- Education
- Other: ____________

Name of the institution _______Aarhus Municipality

Country

_Denmark__________________________________________________________

Theme 2.1: Activity description

The title of the activity
Teaching about open data

The target group

Students at a business academy, ICT and cross disciplinary settings (market economists, multimedia designers and technical students)

The goal(s) of the activity

To increase students’ awareness of open data, invite for participation and use, and activate the use of datasets

The content of the activity

1. Lecture about what is open data and what is going on in the field, locally and nationally
2. Presentation of specific data sets
3.
4.
5.
6.

The datasets used

Not specified

The duration of the activity

____ Hours
____ Days
____ Weeks
D2.1 Data-driven PBL model

_____ Months

Modes of teaching:
X Face to face
☐ Online
☐ Blended learning (face to face and online)

Theme 3.1: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The interviewee acts as “the example from the real world”, presenting the concept of open data and the possibilities in the field. Then the course teachers takes over and use the example for further teaching in regards to the specific education in question. Could for instance be to demonstrate specific datasets in a sql database for further work. Could also be presentations of innovation tools and idea generation tools. The idea is to combine various competences to the students to prepare them for working with open data.

At times the interviewee has been connected to the course as such and has seen the final products of the students. Other times the introductory presentation has been a part of a hackathon-like intensive teaching period of a couple of days, where the students work across domains to come up with ideas for potential use of the data. For the presentation and assessment of the final products (concepts or ideas), the interviewee (or her colleagues) has been a part of the assessment committee.

The use projects / problems as a tool of teaching
☐ Projects
☐ Problems
☐ They do not use

Theme 2.2: Activity description
The title of the activity

Local hackathons

The target group

Anyone with an interest in developing ideas on the basis of open data, that has been accepted for participation on the basis of their application and area of competence

The goal(s) of the activity

To increase the use of available open data in the municipality and nationally and to generate ideas for use on this basis

The content of the activity

1. Introduction to the event by data owners who present their data and an introduction to what is needed in society or challenges that can be solved by means of open data. The participants do not have to take the challenges presented. The purpose of the presentations is to inspire the participants to generate their own ideas.

2. Introduction to the groups

3. Private companies as councilors throughout the weekend (IT companies, attorneys, PR agency, and an accountant company)

4.

5.

6.

The datasets used

Various

The duration of the activity

___ Hours

___3___ Days
Modes of teaching:
- X Face to face
- Online
- Blended learning (face to face and online)

Theme 3.2: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The idea about having companies available for counseling is that the participants can approach them for any specific question they may have in relation to the idea, concept or product, they are working on. The teaching is tailored towards the problem at hand. The students can approach the companies and the companies circulate between the groups to see how things are progressing and if anything should be discussed along the way.

For the upcoming hackathon it is considered to have an external facilitator to maintain the energy of the participants throughout the weekend. Could be someone who facilitates some movement, speed talks or other kinds of inspiration for the participants.

A pre-event is scheduled a couple of weeks before the event to start the participants in thinking about ideas, so they don’t have to come up with ideas in a very short time window through the real event.

The use **projects / problems** as a tool of teaching

- Projects
- Problems
They do not use

Describe the discussion about who control the dimensions of problem/project, process and outcome

The participants are chosen on the basis of an application to ensure cross disciplinarity in the outcomes and thereby improve the quality of the products. The groups are defined by the coordinators to further ensure cross-disciplinarity in the products. This way the work carried out becomes more ambitious.

Theme 2.3: Activity description

The title of the activity

General teaching about open data

The target group

Teachers at ICT educations

The goal(s) of the activity

Preparing teachers to teach students about open data

Theme 3.3: Pedagogy

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The use projects / problems as a tool of teaching
Describe the discussion about who control the dimensions of problem/project, process and outcome

(\textit{goes for both hackathons and business academy teaching})

The teacher keeps a very open mind towards the issue of control in both teaching situations. The students are provided with tools to be able to develop ideas, and there might be a theme for the hackathon (like “Energy” or “Culture”), but apart from that the participants/students decide themselves, which problems they want to approach, how they approach it, and what the outcome is.

The facilitators/teachers are aiming to increase seriousness in the working process of the hackathons by composing groups on the basis of participant characteristics (applications). Also, instead of giving money as the award for winning a hackathon, the organizers has decided to give entrepreneur assistance instead, to urge the winners to continue the work with the winning product.

The voluntary nature of the hackathons in opposition to the mandatory nature of course work on the business academies may influence on the enthusiasm of the participants – more enthusiasm and engagement on the hackathons than in teaching.

\textbf{Theme 2.4: Activity description}

The title of the activity
Afternoon meetings

The target group

Municipal employees

The goal(s) of the activity

Informing employees of the importance of making data available

The content of the activity

1. Presentations about open data
2. Introduction to potential use by external companies
3. 
4. 
5. 
6. 

The datasets used

Not specified

The duration of the activity

____ A couple of Hours
____ Days
____ Weeks
____ Months
Modes of teaching:

- [ ] Face to face
- [ ] Online
- [x] Blended learning (face to face and online)

**Theme 3.4: Pedagogy**

Describe in detail the teaching methodology. For example: learning activities that take place during the teaching, the use of cases, the use of lecturers, exercises, assignment, project work, etc.

The purpose of the meeting is to engage more employees in the sharing of data. The external partners are invited to emphasize the importance of open data and to strengthen the argument towards employees.

The initiatives are supplemented by open data ambassadors, who informs about open data on a more frequent basis.

The use **projects / problems** as a tool of teaching

- [ ] Projects
- [ ] Problems
- [x] They do not use

**Theme 4: Teaching experiences**

Describe a teaching activity (related with Open Data) that you consider very successful. Describe why you consider it successful.

Describe three big challenges of teaching Open Data / teaching using Open Data (from your experience)
1. The very diverse knowledge about open data between students can be a challenge, because it is difficult to know in advance at what level to teach the field. With students the open mindedness is greater because they have the possibility to be more investigative.

2.

3