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James Lovatt, Paul Grimes & Eilish McLoughlin

# Volume 4: Educational Design Research for Teacher Professional Learning

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James Lovatt, Paul Grimes & Eilish McLoughlin

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## ABOUT THE PROJECT:

The ERASMUS + Project KA2 2017-1-SI01-KA201-035523 Three Dimensions of Inquiry in Physics Education (2017-2020) focused on commonalities and differences between inquiries at three different levels and the final results are comprised in an e-book in four volumes.

These dimensions are.

- Inquiry by students who use the inquiry-based learning approach to learning physics;
- Practitioner inquiry of teachers inquiring the processes in their classrooms;
- Inquiring processes in collaborative professional learning communities of teachers; and in addition
- Inquiring and evaluating all processes in the project using educational design research.

The project actively involved seven partners from four different countries (Slovenia, Belgium, Ireland, Poland), more than one hundred teachers from all partner countries and indirectly more than one thousand students taught by these teachers. The acquired knowledge was shared with several teachers who were not involved in the project and we hope that they will benefit from the presentation of our results in these volumes.

Mojca Čepič, the project leader

# PREFACE

This is Volume 4 of the eBook produced in the Three Dimensions of Inquiry in Physics Education (3DIPhE) project. This volume consists of two parts. Part A, presents a paper on the Education Design Research (EDR) Framework used to inform the structure and derive the learnings of the 3DIPhE project. Part B, provides a collection of case-study examples which detail the learnings of the second iteration of 3DIPhE courses across four countries in Europe. It is intended that this volume will provide the reader with perspectives on how Education Design Research can be used to inform and generate learnings in complex large scale projects as well as providing insights into the learnings of 3DIPhE.

The Introduction describes the project and includes an outline of the background, rationale and structure of 3DIPhE.

The first chapter is arranged in three sections. Firstly the theoretical underpinnings of design research are described. This is followed by a discussion of different models of EDR and finally the EDR Framework designed for the 3DIPhE project is presented.

In the second chapter, the EDR Framework is elaborated upon in three sections. These describe the indicators used to inform data collection in the project. The project timeline and tools designed to generate data and learnings from the work of 3DIPhE are detailed.

In the final chapter, learnings from 3DIPhE are presented through a synthesis of case-studies and analysis of the final partner evaluation tool. In this synthesis, reference to learnings throughout the EDR cycles are inferred. The chapter concludes with a discussion of the partners learnings and reflections on the use of EDR in 3DIPhE.

# GLOSSARY

This refers to the glossary of definitions for the purposes and context of the 3DIPhE project.

Title	Description
Professional Learning Community	A professional learning community is considered to be a group of teachers and/or educators working together in a supportive, collaborative and positive environment. It is characterised by a shared vision, responsibility and values, and equitable participation.
Practitioner Inquiry	Practitioner Inquiry refers to the professional learning of coaches, teachers/educators who are engaged in a planned study on their practice leading to recommendations enabling evidence informed changes
Inquiry Based Learning	An active learning method in which students, in order to develop knowledge or find solutions (e.g. to discover trends, measure quantities of objects or quantities related to phenomena, find out the limits etc.), follow a scientific method used by researchers in science studies. IBL emphasizes the students' role in the learning process in which they are encouraged to explore the scientific issues, ask questions, and share ideas. Instead of memorizing facts and rules students discover them by doing. The teachers' role is to support students in their learning process, and not to instruct them.
Educational Design Research	Educational Design Research (EDR) is an iterative process where learning is systematically studied in the context in which it happens. The EDR process allows researchers and educators (often the user of EDR acts as both) to design, develop and evaluate educational programmes and interventions. By systematically studying this development, the EDR process can generate knowledge and theory relevant to the educational settings in which it is used.
Cycle	A clearly defined phase of the project in the context of the EDR Framework.
Iteration	This refers to the implementations of the PLCC and PLCT courses during the 3DIPhE project. These happened during Cycle 3 and Cycle 4 of the EDR framework.
Partner	Partner institution or its representative that is officially involved in the project.
Coach	Individual who designs, organises and guides activities in professional learning communities.
Facilitator	Individual who facilitates an activity or protocol as part of a workshop. A facilitator can be a coach or teacher in a workshop.
Participant	Individual attending an event e.g. course, conference, meeting,... This can refer to partners, teachers, future 3DIPhE coaches or external stakeholders
Teacher	In-service teacher who practices in a formal school setting
Student	Child, aged 10-18, in a formal school setting
Course	A coherent set of workshops aimed at a targeted learning process for participants
Workshop	A single meeting of a course with clearly defined goals.

Tool	A specific teaching and learning material used by coaches and teachers
Activity	A general noun for a part of a workshop where some action takes place, e.g. following a protocol, group discussion, watching an instructional video, etc. An activity is more general than protocol.
Protocol	A set of instructions, used during a workshop, with clearly defined goal(s), that has a strict order of actions and timing of those actions.
Worksheet	A learning support material e.g. used by participants of workshops or students in a classroom.
IBL Unit	A collection of inquiry based learning activities centred around a theme, topic or concept.
Information sheet	Additional background information to support an activity.
Course Guide	A guide book for coaches that details the structure, activities and rationale for planning and implementing a course.
Course Workbook	A complete collection of all teaching and learning materials that is used by participants of a course.
Inquiry	<p>Inquiry (IBL): In the context of Inquiry Based Learning, inquiry refers broadly to the activities that students carry out in the classroom.</p> <p>Inquiry (PI): In the context of Practitioner Inquiry, inquiry refers to the planned study that coaches, teachers/educators carry out in the context of their own practice.</p>

### Table of Acronyms

Professional Learning Community	PLC
Professional Learning Community of Teachers	PLCT
Professional Learning Community of Coaches	PLCC
Practitioner Inquiry carried out by a teacher	PIT
Inquiry Based Learning	IBL
Education Design Research	EDR
University of Ljubljana, Faculty of Education, <i>Slovenia</i>	UL
Jagiellonian University in Kraków, <i>Poland</i>	UJ
Dublin City University, <i>Ireland</i>	DCU
Catholic Education Flanders – vzw VSKO, <i>Belgium</i>	CEF
Artevelde University College, <i>Belgium</i>	AHS
UC Limburg, <i>Belgium</i>	UCLL
National Education Institute, <i>Slovenia</i>	NEI

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Catholic Education Flanders Belgium Case Study, Wim Peeters

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# **PART A:**

# **EDUCATION DESIGN RESEARCH**

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# Introduction

## Project Background and Rationale

It is well established that there are challenges regarding engagement of students in science disciplines. In the 2015 European Commission report ‘Science Education for Responsible Citizenship (Hazelkorn, 2015) it is highlighted that ‘Europe faces a shortfall in science-knowledgeable people at all levels of society and the economy’ (p6). This is an ongoing issue as previously raised in the 2007 European Commission report ‘Science Education Now: A renewed pedagogy for the future of Europe’ (Rocard, 2007). Similarly the OECD (2017) reported that in the OECD countries only 6% of new entrants to university choose to study natural sciences. Accepting that it’s not essential that all students study science disciplines at third level,

it is critically important for society that all students engage in science studies to develop fundamental knowledge and an inquisitive mindset that gives them the necessary skills to make informed decisions

on societal challenges such as climate change, food, water and energy shortfalls. While all of the science disciplines face challenges engaging students, it is particularly pronounced in the physics context for a multitude of reasons such as shortages of qualified teachers, perception of being difficult, perception of being a male subject to name just a few.

Inquiry based learning (IBL) has been identified as an appropriate and effective pedagogy for teaching science to enhance student engagement, student understanding and to develop students’ critical thinking skills (Rocard 2007, Hazelkorn 2015, OECD 2015). The teaching approach systematically fosters critical thinking, as experimental or logical evidence are required to substantiate explanations and reasoning. A range of skills are required for core activities, such as observation, data collection, formation and verification of hypothesis and scientific reasoning. In physics, students often gain experience of inquiry through specially designed problems illustrated by experiments. This is possible as several phenomena can be easily explored through interesting, motivating and fast hands-on experiments which allow a straightforward control of variables and cause-consequence analysis (McDermott 1996, Etkina 2014a-c). Indeed through EU funded projects, such as ChReact, FIBONACCI, ESTABLISH and SAILS a tremendous amount of educational materials have been developed for physics inquiry lessons and the pedagogy has been shown to be effective in improving motivation, knowledge acquisition and students’ basic skills.

The partners in the 3DIPhE consortium have engaged and led these forementioned EU projects to promote the use and dissemination of Inquiry Based Science Education. These projects have developed many excellent IBL resources and educated thousands of teachers in IBL approaches. However, even with the success of these initiatives, there still exists challenges regarding the effective implementation of IBL, its long term use in the classroom and the sustainability and scalability of the teacher education offered by such programmes. Additionally, issues of teachers’ self-confidence in using an IBL approach exist (Gostinčar-Blagotinšek, 2016) and further obstacles such as curriculum time demands and national assessments pressures still persist and are hindering the use of IBL in schools.

These persistent challenges have given rise to the 3DIPhE project. The partners aim to support the sustainable use of IBL in physics classrooms in order to enhance students’ interest, motivation, knowledge and skills in science. It is believed that teachers are central to realisation of this goal and that they must be supported to teach using IBL in a context where they reflect and evaluate their classroom practice in relation to impact on student learning. To support teachers in this endeavour the partners have identified practitioner inquiry (PI) as a model that empowers



teachers to make evidence informed professional judgements and transformations in their practice. PI or teacher inquiry is a form of professional learning defined as the systematic, intentional study of one's own professional practice (Cochran-Smith and Lytle, 1993). It involves teachers identifying problems, constructing inquiry questions, gathering and analysing data to make evidence-based conclusions and recommendations with respect to their chosen problem. They engage in systematic reflection and take action for change by asking questions or “wonderings”, gathering data to explore their wonderings, analyzing the data, making changes in practice based on knowledge constructed, and sharing learning with others (Dana & Yendol-Hoppey, 2014). Adopting this approach where the teacher operates as a reflective practitioner to inform their own practice has been shown to lead to more sustainable pedagogical impact.

A variety of models of teacher professional learning exist such as one-off lectures, week long summer courses and online webinars. Each of these models have their own inherent benefits and weaknesses. There is a growing consensus that for teacher professional learning to be successful it needs to take place over an extended period of time, needs to be valued by teachers and should focus on the learning needs of students (Timperly et al., 2007). Often, one-off inputs are beneficial for increasing short-term motivation but generally they do not lead to sustained impact in teacher practice or enhanced student learning. In this project, Professional Learning Communities (PLCs) were chosen as a model of teacher professional learning to overcome this challenge. PLCs serve to connect and network groups of professionals to learn from practice together (Dana & Yendol-Hoppey, 2014). Usually educators in a PLC use deliberate conversation and dialogue to discuss student work and student learning. In this way, opportunities are created to work together toward the shared purpose of improving the students' learning. In PLCs, teachers collectively take responsibility to learn new content and approaches to increase the effectiveness of their teaching. [Hord, 2009] It is this collective responsibility, shared values and vision that are often attributed to the success of this model of teacher professional learning.

## Project Structure

The 3DIPhE project was implemented over a three year period and included two implementations (iterations) of PLC courses. These courses were approximately 30 hours in duration and delivered over a period of approximately 10 months. They focused on the coaching of teachers in PLCs to learn how to use PI to inquire into their practice of using IBL in the school classroom. For the purposes of the project these learning communities were labelled as professional learning communities of teachers (PLCTs). The PLCs were used to foster a community of support and learning where teachers discussed, shared and analysed data from their practice with colleagues to develop evidence informed conclusions to propose solutions regarding the implementation of IBL in Physics lessons. These workshops were facilitated by coaches from the consortium who also used PI to inquire into their coaching of these workshops. The community of partner/coaches in each country was known as a professional learning community of coaches (PLCC).

In addition to the courses for teachers, the DCU partner ran a parallel course for coaches on facilitating PLCs (also known as a PLCC). The participants of these courses were teacher educators working with pre-service and in-service teachers. They learned about PI and conducted inquiries into their role as coaches. The learning from this course was used to support the partners in their role as facilitators for PLCTs and to inform the course on coaching which was developed as an output of the 3DIPhE project and is available in [Volume 3](#).

Teachers from the first iteration of the project were invited to partake in the second iteration. In this case their communities became known as PLCTe where the ‘e’ stands for experienced group. The community of new teachers in the second iteration became known as PLCTn where the ‘n’ stands for a novice group. The continuation of PLCs from the first into the second iteration was instigated as an attempt to encourage the sustainability of the

communities. In these PLCs, additional discussions reflecting on the role of the facilitator were included to raise the possibility of the teachers hosting their own PLCs beyond the lifecycle of the project. It was intended that these PLCTe teachers would be invited to attend a week long course on coaching PLCs to use PI, however due to the Covid 19 pandemic this course could not be delivered.

The project also included national and international multiplier events. At these events the participants from the PLC courses were provided the opportunity to share their inquiry findings with teaching colleagues and education stakeholders such as school managers and policy makers. In Chapter 3 a detailed description of the project activities and timeline is presented.

Education Design Research (EDR) was used to inform, structure and elicit learnings from all aspects of the project.

EDR is the systematic study of designing, developing and evaluating educational interventions as solutions for complex problems

in educational practice, which also aims at advancing knowledge about the characteristics of these interventions and the processes of designing and developing them. Informed by prior research and review of relevant literature, researchers, in collaboration with practitioners, design and develop workable and effective interventions by carefully studying successive versions in their target contexts, and in doing so they reflect on their process with the purpose to produce design principles.

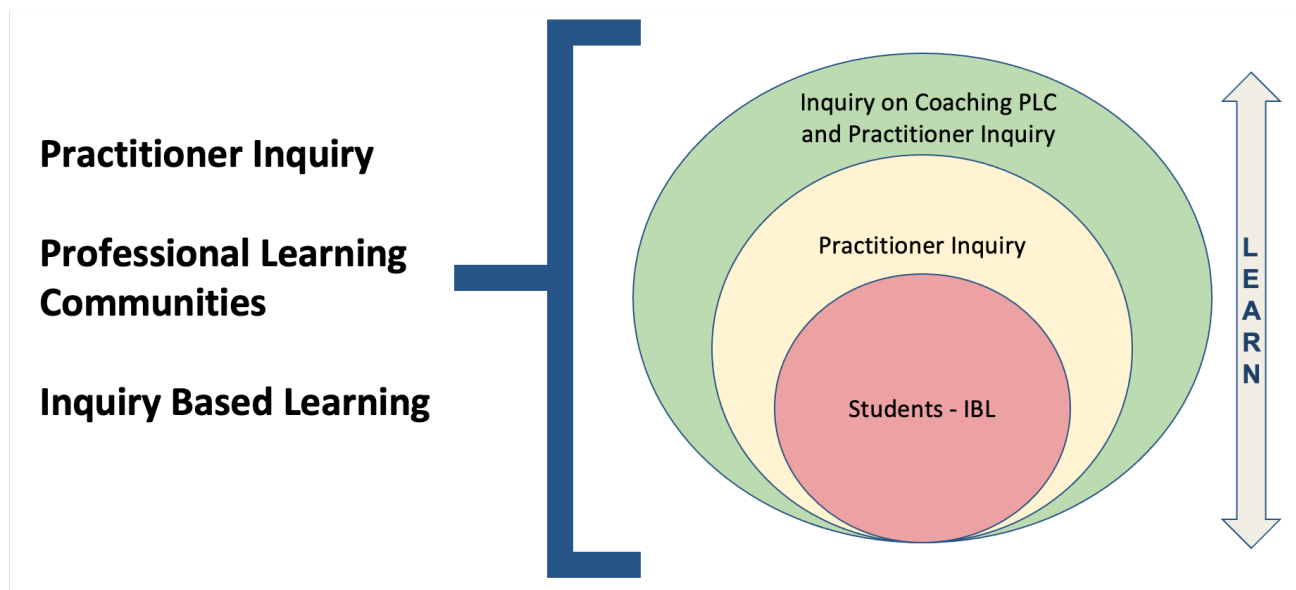


Figure 1: The three dimensions of the 3DIPhE project

EDR was specifically chosen due to the complex nature of this project. In Figure 1 the three dimensions of the project are presented. Specifically, these are inquiry into coaching PLC and PI by partners, inquiry using PI by teachers into their teaching of physics using IBL and inquiry by students using IBL in the physics classroom. The EDR framework had the role of supporting the partners to elicit learnings at each of these dimensions and to determine the interrelationships between these levels. The EDR Framework developed for the 3DIPhE project is explained in detail in Chapter 2.

## Project Aims and Outputs

As noted, the origins of this project stem from the challenges of engaging and motivating students to study physics. It is also influenced by the need to find a strategy to sustainably embed the use of inquiry pedagogies in teaching of physics. It was intended that through courses structured as professional learning communities which taught teachers how to use practitioner inquiry to inquire into their practice of using inquiry based learning would lead to improved student learning. The partners believed that the use of PI would help to develop in teachers, an inquiry stance that would encourage them to continually inquire into their practice and that the use of PLCs would model an approach to teacher professional learning that they could continue to use beyond the life cycle of 3DIPhE.

The key aims of 3DIPhE were to:

- Educate practicing teachers in practitioner inquiry
- Improve the quality and frequency of IBL usage through evidence informed inquiries
- Enhance students interest, motivation, knowledge base and skills in physics
- Provide effective courses on coaching of PLCs for consortium partners, teachers and teacher educators/ pedagogical coaches
- Inform policy makers and education stakeholders of the learnings of the project to encourage a greater use of inquiry approaches in the school system at different levels including the level of the teacher (PI) and student (IBL).

The final outputs produced from the project are available as an eBook with four separate volumes.

- [Volume 1](#) provides information on and classroom examples of IBL. These materials can be used to support daily practice of teachers and partners acting as coaches.
- [Volume 2](#) is a course on 'PI Training'. It provides a guide and course material on how to conduct Practitioner Inquiry (PI) in the context of Inquiry Based Learning (IBL).
- [Volume 3](#) is a course 'training for coaches'. It provides a guide and course material for persons interested in coaching PLCs
- Volume 4 describes the EDR Framework used in this project. It provides details of the research based design that was used to elicit and inform learning from each cycle of the project.

# Chapter 1: Developing a Framework

This chapter is organised in three sections. Section 1.1 gives a history and overview of design research in education. In section 1.2 an overview of different EDR models is provided. Finally, in section 1.3, the EDR framework designed for the 3DIPhE project is described in detail.

## 1.1 Design Research in Education

Educational Design Research or EDR, stemming from the ‘family’ of design research, addresses educational problems in real-world settings. It is a problem-oriented approach that focuses on reflection and cycles in order to achieve the most efficient solution (McKenney and Reeves, 2019). John Dewey emphasised the importance of “*reflective learning by experience*” (Dewey, 1910, as cited in Janssen et al., 2013, p.759). This is at the heart of all design research. EDR is the act of interacting systematically with the subject of study and taking the learnings from that to improve practice. EDR has two primary goals, developing knowledge and developing solutions. Like other research approaches, it aims to develop scientific knowledge, but it also strives to develop interventions in practice (or reusable knowledge). EDR extends theoretical knowledge through data collection and analysis embedded in the cyclic development of a solution to the problem being tackled. The nature of these solutions can be educational products, processes, programs or policies.

### Characteristics of Design Research

*“The underlying philosophy of design research is that you have to understand the innovative forms of education that you might want to bring about in order to be able to produce them.”* (Gravemeijer and Cobb, 2006 p. 45)

One of the first uses of the term *design experiments* was by Anne Brown in 1992. Brown discussed how researchers would systematically adjust various aspects of the context being designed, allowing researchers to generate theory in naturalistic contexts. diSessa & Cobb (2004) claimed that design based studies should make significant contributions by addressing the gap between theory and practice.

The Design Based Research Collective (2003) propose that design research is characterised by five features:

1. The goals of designing learning environments and developing theories are “intertwined”
2. Research takes place through continuous cycles of design, enactment, analysis and redesign
3. Research must be shareable and must have relevant implications for other practitioners
4. Research must “account for how designs function in authentic settings”
5. These accounts must rely on methods that “document and connect processes of enactment to outcomes of interest

## Describing Educational Design Research

While there are several definitions and descriptions of EDR, there is common agreement on the essential aspects, and common features appear in both the descriptions of design research, design based research and educational design research. Barab and Squire (2004) define Design Based Research as

*“a series of approaches, with the intent of producing new theories, artifacts, and practices that account for and potentially impact learning and teaching in naturalistic settings.”* (p.2)

This description captures the essential elements of several of the descriptions of what EDR is. Plomp’s (2013) description of EDR also succinctly describes the key ideas that most descriptions of EDR are based upon. Plomp (2013) describes EDR as

*“...the systematic study of designing, developing and evaluating educational interventions as solutions for complex problems in educational practice, which also aims at advancing our knowledge about the characteristics of these interventions and the processes of designing and developing them.”* (p.11)

Van den Akker et al. (2006) synthesised the work of several researchers to characterise the following features of (educational) design research. They characterise it as being interventionist, iterative, process oriented, utility oriented and theory oriented. Based on the work of van den Akker (2006) we can outline the key features of EDR as being:

- Interventionist: A purposeful change is made in an educational context
- Theoretical: Theory is used in the design of interventions
- Generative: EDR generates theory through studies application in the original and subsequent contexts in which the innovation is used
- EDR uses and produces scientific knowledge
- EDR strives to develop both interventions in practice, and reusable knowledge

## 1.2 Models of Educational Design Research

### General Method

Usually, EDR evolves through three main phases, in an iterative way, where each of these phases may be repeated multiple times. These phases can be broadly defined as:

- **preliminary research phase**  
In this phase, analysis of the general needs of the problem combined with a literature review and the development of a conceptual or theoretical framework
- **prototyping phase**  
An iterative design phase consisting of iterations, each being a cycle of research on its own. This phase is characterised by formative evaluation as the most important research activity, which is aimed at constantly improving and refining the intervention.
- **evaluative/assessment phase**  
In this phase there is a focus to gain evidence for the effectiveness of the intervention, a so-called summative or semi-summative evaluation, where we conclude whether the solution or intervention meets the predetermined specifications. This phase often results in recommendations for improvement of the intervention.

In the research phase, researchers and educators talk to one another and possibly to others (such as students) and learn about the root causes of the problem. During prototyping, a creative, multidisciplinary team reviews the theoretical knowledge relevant to the problem; brainstorms innovative solutions; considers various options; and creates prototypes to try in real educational settings. Once a prototype solution is developed, evaluation takes place to test and revise both the design and the ideas/assumptions on which it is built. These three phases interact with each other closely, and might be presented in specific order or with specific relationships depending on the problem and context. The following section will explore some of the different approaches to EDR, each of which indicates how these board phases look in a structured model.

## Approaches to EDR

While the preliminary research phase, the prototyping phase and the assessment phase are features of all models of EDR, the specifics of how they interact with each other and which aspect applies to what phase and how this all relates to timing will differ from one model to the next. This is an essential characteristic of EDR, in that it allows for flexibility in approaches depending on the context in which it is being used. Difference in initial condition, requirements, expectations and timing will lead to different approaches of the design process itself. In order to design a suitable EDR framework for 3DIPhE, it was first necessary to explore different models of EDR to look for features that are suitable for the 3DIPhE project.

## Models of EDR

In describing design research from a technological perspective, Reeves (2006) starts the EDR process with problem identification and analysis (Figure 2). This is followed by prototype solutions and iterative testing cycles and reflection. This model mainly stresses the linear progress from one phase to the other, and focuses on the learnings and reflections on the end of the process, which then reflects back to all phases of the design process. This makes this model useful for a project evaluation, where from its very nature these different phases at certain moments in time are present, since a project will chronologically go from start through implementation to final evaluation.

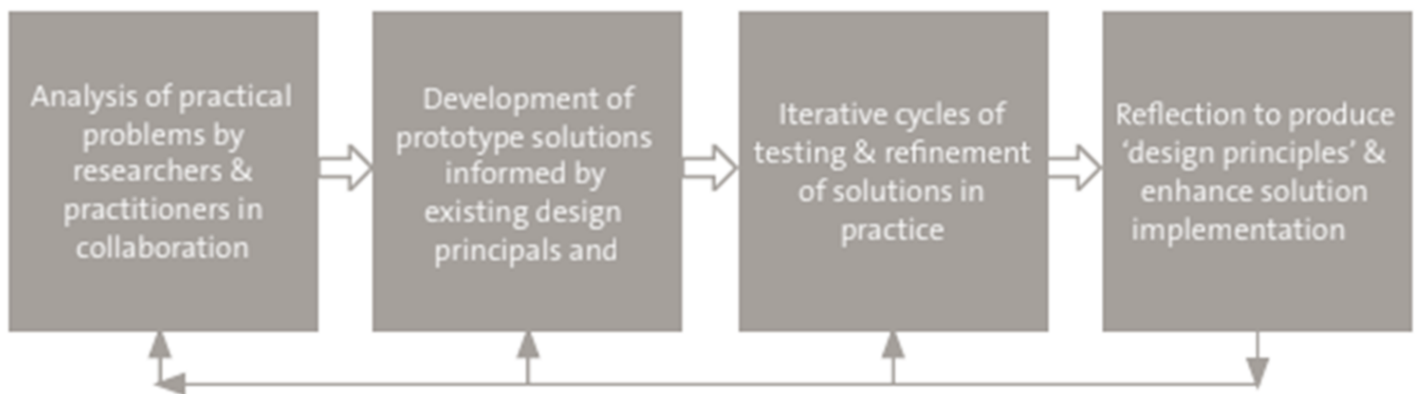


Figure 2: Reeves' (2006) model of EDR (cited in Plomp, (2013), p.18)

Another important example of an EDR model to take into consideration is that of McKenney (2001). This model (Figure 3) shows the same analysis-design-evaluation approach described earlier, but is more focused on the iterative nature of each of the phases. This model stresses how each phase, even the proto-phases such as literature

review and explorative visits, carry an iterative ‘loop’-process in itself. The graphical representation of this model conveys not only information about the structure of the project and the interdependencies of the phases, but also the length of each phase and the size of the testing population.

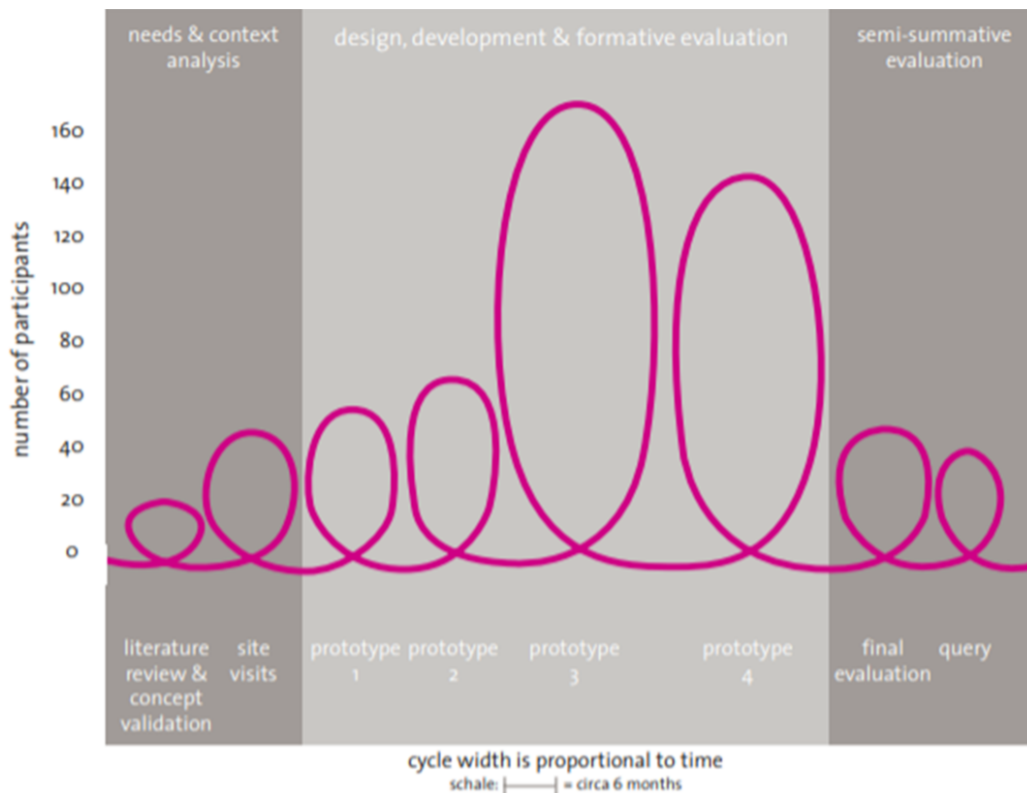


Figure 3: McKenney’s (2001) model of EDR (cited in Plomp (2013), p.18)

## Developmental Studies, Validation Studies and Design Principles

Validation studies have a focus on designing learning environments or trajectories with the purpose to develop and validate theories about the process of learning and how learning environments can be designed. Validation studies (Nieveen et al., 2006) aim at advancing learning and instruction theories. These instructional theories (Gravemeijer and Cobb, 2006) can be described as micro-theories (at the level of instructional activities), local instruction theories (at the level of instructional sequence) and domain-specific instruction theories (at the level of pedagogical content knowledge).

Development studies (Nieveen et al., 2006) primarily aim to develop design principles that can be used in practice. In a developmental study, the research is problem driven. The research is “problem driven, situated in the educational field, and involves close interaction between practitioners, researchers, experts, and other stakeholders” (p. 153). During the process of a developmental study design decisions (both implicit and explicit) are unearthed. It is through the study of this design process that design principles are developed. Development and implementation of the process (and of future studies) and then be informed by these principles.

Van den Akker (1999) distinguishes two categories of design principles: principles that are substantive, and principles that are procedural. Design principles that are substantive in nature refer to the characteristics of the intervention, i.e. “how it should look like” (p.5). Procedural design principles have to do with the characteristics of the design approach, i.e. “how it should be developed” (p.5).

Substantive knowledge is knowledge about essential characteristics of an intervention and can be extracted (partly) from a resulting intervention itself. Procedural knowledge refers to the set of design activities that are considered most promising in developing an effective and workable intervention (van den Akker, 1999).

Figure 4 shows how Plomp (2013) schematically represents the place of design principles in the design research process. They explain “the how, and the why” (p. 32) of a particular intervention and are the link between the intervention and the particular outcomes in the design process.

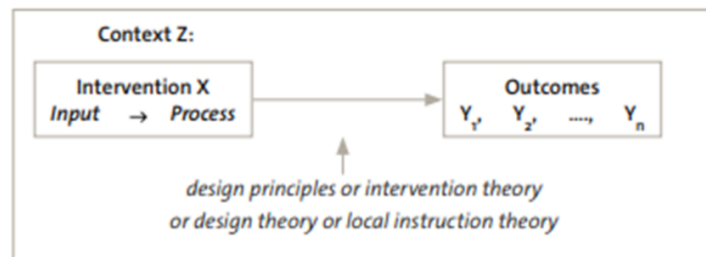


Figure 4: The place of design principles in the design research process. From Plomp (2013, p.32).

Eliciting learnings based on design principles would become central to the development of the 3DIPhE EDR framework, and the design of the 3DIPhE process. However, as Nieveen et al. (2006) point out, design principles should not be seen as recipes for success. The context in which they are being used is highly relevant. The purpose of this volume is to inform others, who might be carrying out design research in an educational setting, how we developed the framework and to outline what we learned from the process. Therefore, in order for the design principles for 3DIPhE to become “...heuristic guidelines to help others select and apply the most appropriate knowledge for a specific design task in another setting” (Nieveen et al., 2006, p.153), we describe in detail the context and development of these design principles in the sections that follow.

### 1.3 The EDR Framework for 3DIPhE

#### Central problem for 3DIPhE

EDR starts with recognizing and identifying a complex educational problem. As already outlined in the introduction to this volume, the central problem being addressed in the 3DIPhE project is that there still exists challenges regarding the effective implementation of IBL. These include challenges around its long term use in the classroom and the sustainability, and challenges relating to the scalability of teacher education resources and programmes developed through previous European projects. These projects do have a significant impact, but do not manage to create a sustainable change in the practice of many teachers. The reason for this could be attributed to the method of professional development used to influence this teacher practice. Therefore the 3DIPhE project aims to improve upon this method of professional development by focussing on increasing the intrinsic motivation of teachers themselves to use Inquiry Based Learning tools. Increasing this motivation would have a long lasting sustainable impact on their classroom practice (Timperley, 2011). Our approach to achieve this increased motivation is by improving their professional learning by using Practitioner Inquiry (Timperley et al. 2007).



EDR is the amalgam of learning through iterative cycles informed by the gathering of evidence through a range of data collection tools and internal and external reflections that are continuously gathered throughout a study. The EDR Framework developed for the 3DIPhE project was designed to represent the cyclical nature of the project, as well as capture and integrate the learning from one cycle of the framework to the next, as good practices and insights about project activities were shared between partners. The framework designed consists of five cycles, each representing a stage of the project where a certain learning moment took place. These cycles represented project activities such as moments where information and learnings were interchanged between the partners, like during the PI coaches training in EDR Cycle 2 or the implementation of 10 month training courses such as the teacher (PLCT) and coaches training (PLCC) that took place in EDR Cycle 3 and 4. A graphical representation of the 3DIPhE framework is presented in Figure 5.

EDR Framework for 3DIPhE

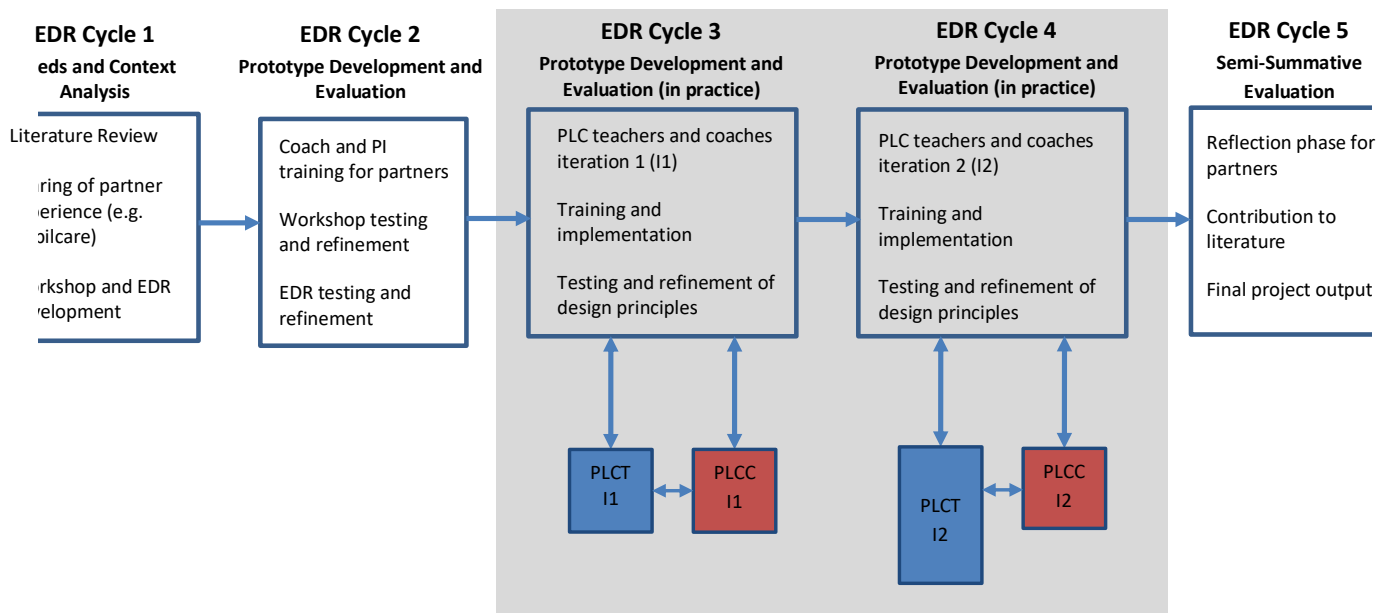


Figure 5: Graphical representation of the 3DIPhE framework

The five cycles designed include the initial Needs and Context Analysis cycle, three Prototype Development and Evaluation cycles, first internally and then two in practice, and finally a Semi-Summative Evaluation cycle. Each cycle had its own intentional data collection plan where learnings derived from these were used to inform subsequent cycles.

The first cycle, our own needs and context analysis (McKeeney, 2001) consisted of a needs analysis of the project aims as identified in the proposal and noted previously in the Introduction. This focused on providing effective and sustainable professional learning for teachers to enable them to inquire into their own practice regarding the teaching of school physics in an IBL context. The needs analysis was completed by the project writers who assembled a project team with a wide variety of expertise concerning PI, IBL, PLC's, and EDR. This multidisciplinary team completed an extensive literature review and shared their practice in order to design a plan to address the outlined aims. They proposed to use PLC's as a model for professional learning to introduce teachers to PI and to develop their understanding, confidence and practice of IBL in the context of teaching school physics with the ultimate intention of enhancing students' learning. In the PLCs teachers would learn Practitioners Inquiry, which enabled them to collect their own evidence of the applicability of IBL in their classrooms. The project team hoped that by doing so the teachers would be more motivated to integrate IBL teaching into their regular practice.

In Cycle 1, workshops were provided by each intellectual output leader during the first Transnational Project Meeting. These allowed for knowledge exchange and learning between the project team in relation to the three core dimensions of the project, i.e. IBL, PI and PLCs. In this meeting materials and learnings from other projects and experiences of partners were also shared. This amalgamated knowledge was used to inform the design of the EDR framework and to develop design principles for the prototype development in the second cycle.

Cycle 2 functioned as an early internal development and prototype cycle where various materials and principles were tested and reflected upon. As was clear from the Cycle 1 learnings, it was deemed important to have many iterative cycles within the project. Therefore while this cycle centered around the coach and PI training (C1) for the partners, many other aspects of the project and the EDR framework were piloted as well. The workshops to be developed for testing and delivery in the third cycle were refined at this time through continuous and real-time input and reflection from partners. At this point, data collection and knowledge gathering approaches, together with the analysis and synthesis tools that are part of the EDR framework, were piloted. The result of this learning was synthesised through a case study of C1 and analysis and discussion of the coaches (partners) questionnaires. This analysis was used to elicit learnings which informed the further development of the PLCT and PLCC trainings which were implemented in Cycle 3 with in-service teachers and teacher educators.

Cycle 3 (and Cycle 4 which followed) were the main prototyping phases of the project. They represented the first iteration of the PLCT and PLCC workshops that were developed in Cycle 2. All partners organized an extensive PLCT training course in their own countries with in-service teachers. The PLCC courses of the project refer to the lead partners and their colleagues who collaborated as a professional learning community of coaches who implemented the PLCT courses. In one partnerer country, Ireland, the DCU team also implemented a separate PLCC course which consisted of teacher educators/coaches who conducted PI on their practice supporting in-service and pre-service teachers.

These PLCT courses consisted of approximately 20-30 hours of workshops, spread over approximately 10 months. The time period and duration of the courses varied due to local contexts and in-service teacher availability. Learnings from this first iteration were gathered using a range of data collection approaches such as pre-post questionnaires, analysis of coursework materials, coach and participant reflections, SWOT analysis, reflection diaries and coach debrief sessions - more details on these are provided in Chapter 2. The learnings and inferences from this data collection was synthesised into case-studies by each partner. These served as a knowledge transfer tool, multiplying the interactive learning of each partner many times over by sharing it among the project team.

The project team reflected on the learnings from Cycle 3 and used them to refine and redevelop design principles for the second iteration (I2) courses. The practice of gathering data and eliciting learnings was repeated in Cycle 4. Once again, ongoing reflection and sharing of learnings was conducted by the project team. At the end of the cycle, each partner analysed their data and shared their learnings in the form of case-studies which are available in Part B of this volume.

Cycle 5 was identified as the semi-summative evaluation stage in the EDR framework. It served as the final reflection opportunity for partners. The EDR team reviewed the partner case-studies from Cycle 4 and with data gathered from a final partner questionnaire, they completed a synthesis of the learnings from the project which is available in Chapter 3 of this volume. This synthesis was used to unearth learnings on each of the three dimensions of the project at the partner/coach, teacher and student levels. They have been used to inform the design of the project outputs, namely a course on coaching, a course on PI in IBL and a resource providing examples of IBL in practice which are available in Volumes 1-3 of this eBook. Furthermore the learnings have been disseminated through various multiplier events and the final conference in order to contribute to the field of study. This volume also represents an attempt to contribute to the field of literature on teacher professional learning to promote IBL in Physics teaching as well as the use of EDR as a strategy to inform, structure and elicit learnings from complex multidimensional projects.

# Chapter 2:

## Eliciting Learnings through EDR

The background, rationale and aims of the 3DIPhE project have been described in the introduction to this volume. In Chapter 1, the theoretical framework underpinnings of EDR as well as the designed framework for this project have been described. In this chapter, the framework is elaborated upon in order to describe how EDR has been employed to support the work of the project and elicit learnings used to inform the design of the project outputs.

### 2.1 Project Indicators

The intended aims of the 3DIPhE project have previously been discussed. These were developed by partners through extensive discussion at the project proposal stage and were refined during Cycle 1, the Needs and Context Analysis aspect of the EDR framework. At this time the aims were formulated as project indicators in order to inform the data collection aspect of the EDR Framework. Refinement of these indicators were discussed by partners at the first transnational partner meeting held in Ljubljana (September 2017). This resulted in the development of a draft list of 21 indicators which were characterised under four initial headings, i.e. EDR Overarching Indicators, PLC Indicators, PI Indicators and IBL Indicators. Further refinement of these indicators was completed by partners with responsibility for Intellectual Output 1 (IO1) - DCU and AHS. This produced 53 direct indicators and 5 indirect indicators. (See Table 1). These were presented for partner review and agreement in advance of the Coaches Training (C1) in Krakow (January 2018). The Indicators are categorised into five levels. Level 0 guides the elicitation of learning at the partner level, level 1 refers to teacher learning, level 2 to learning at the students level and level 3 to learnings at the coaches level. The final level refers to the elicitation of learnings regarding external stakeholders or indirect aspects of the project i.e. if and how the work of the project can be disseminated to relevant external stakeholders (teachers not involved in the project, school management, policy makers, teacher educators) with the purpose of motivating further engagement in the project learnings. It should be noted that for later analysis the partner and coach level learnings are merged as partners and their colleagues served as coaches of the PLCTs. In reading the indicators it should be evident that the partner, coach, teacher and external stakeholders level address learnings in relation to the three dimensions of the project, IBL, PI and PLC. The learnings at the student student level relate to IBL only and the partner level is further subdivided to include indicators related to learnings regarding the use of EDR within the project.

**Table 1: 3DIPhE Project Indicators (Detailed indicators derived from project aims)**

<b>Partner level</b>	
L0.1	Partners are confident and proficient as coaches
L0.2	Partners are confident and proficient in IBL
L0.3	Partners are confident and proficient in coaching PI
L0.4	Partners are confident and proficient in using EDR
L0.5	Reports on learning from each phase of the project were captured and analysed to inform and adapt subsequent phases and design principles using the EDR framework
L0.6	Partners report a change in their professional practice in regard to teacher education based on their learnings from the project
L0.7	Partners have collaborated to co-develop design principles for ‘The training for coaches’ and ‘The PI Training’
L0.8	Partners have collaborated to co-develop assessment tools and criteria for evaluating outputs of IBL, PI, PLCTs and PLCCs
L0.9	Partners perceive the EDR approach is helpful in developing design principles
<b>Teacher level</b>	
L1.1	Teachers have a positive attitude and openness towards PI
L1.2	Teachers indicate an openness to professional collaboration
L1.3	Teachers completed at least one cycle of PI
L1.4	Teachers are confident using PI
L1.5	Teachers are able to identify problems and construct research questions
L1.6	Teachers are able to gather data relevant to their developed research questions
L1.7	Teachers are able to critically analyse data relevant to their developed research questions
L1.8	Teachers are able to make evidence-informed conclusions and recommendations linked to their research questions which enhances their classroom practice
L1.9	Teachers accessed relevant research literature to support their PIs
L1.10	Teachers in the PLCs worked collaboratively to support each other doing PI
L1.11	Teachers have a positive attitude towards IBL
L1.12	Teachers are confident using IBL approaches
L1.13	Teachers use IBL approaches more frequently
L1.14	Inquiries conducted by teachers generated evidence for improving IBL
L1.15	Teachers recognise IBL as an effective strategy to motivate students learning and interest in physics
L1.16	Teachers implementation of IBL in the classroom is enhanced by taking the inquiry evidence into consideration
L1.17	Teachers are empowered to use and develop evidence informed teaching approaches
L1.18	Teachers indicate an intention to engage in PI and IBL beyond the lifespan of the project
L1.19	Teachers have developed an ‘inquiry stance’ and adopt this approach as a regular mode of work in their daily practice
L1.20	Teachers collaborated international with participants in the project

L1.21	Teachers are able to self-reflect and peer evaluate inquiries using agreed assessment criteria
L1.22	Teachers are confident to work autonomously in their professional environment
L1.23	Teachers are confident to share their work practices with the intention of influencing policy within their school and at national levels
L1.24	Protocols are perceived to be effective strategies for developing teachers PI skillset
L1.25	The format and delivery of the PLCT course were appropriate for the context and participant needs
L1.26	The design principles for 'The PI Training' are effective and adaptable for different contexts
L1.27	Teachers (some) volunteer for to attend the 'Training for coaches' course
L1.28	Teachers who have completed the PLCT have set up PLCTs within their own community to run beyond the lifespan of the project
<b>Student level</b>	
L2.1	Students develop inquiry skills (such as communication skills, experimental design, collecting data, making observations etc.) during the project
L2.2	Students hold positive attitudes towards physics from IBL experience
L2.3	Students hold positive attitudes towards practical aspects of science
L2.4	Students have engaged in collaborative learning
L2.5	Students are confident as autonomous learners
<b>Coaches level</b>	
L3.1	Partners, as coaches, are able to facilitate and support teachers to conduct PI on IBL in Physics classrooms
L3.2	Partners, as coaches, are able to facilitate and support participant coaches to conduct PI on coaching PLCs
L3.3	Coaches have completed a cycle of PI on their own practice of coaching teachers
L3.4	Coaches are able to identify problems and construct research questions
L3.5	Coaches are able to gather and critically analyse data linked to developed research questions
L3.6	Coaches are able to make evidence informed conclusions and recommendations linked to their research questions which will enhance their facilitation of PLCTs
L3.7	Coaches highlight how their learning from the PLCC course can be used in their work with pre-service and in-service teachers
L3.8	Coaches accessed relevant research literature to support their PIs and PLC facilitation
L3.9	Coaches are able to self-reflect and peer evaluate inquiries and coaching using agreed assessment criteria
L3.10	Coaches indicate an openness to professional collaboration
L3.11	Teachers who have completed the coaching course have set up PLCTs within their own community to run beyond the lifespan of the project
L3.12	Protocols are perceived to be effective strategy for developing coaching skills
L3.13	The format and delivery of the PLCC were appropriate for the context and participant needs
L3.14	The design principles for 'The training for coaches' are effective and adaptable for different contexts
L3.15	Coaches are confident to share their work practices with the intention of influencing policy within their organisation and at national levels

External Stakeholder/Indirect Level	
LID.1	Policy makers and School Stakeholders attended multiplier events
LID.2	Policy makers and School Stakeholders recognise the benefits of IBL, PI and PLCs
LID.3	Teachers at Multiplier events indicate a desire to engage in IBL and PI
LID.4	Participants at Multiplier events indicate a desire to attend courses on IBL, PI and PLCs
LID.5	Partners enhanced expertise allows them to engage as advisers/experts for similar complex educational problems
L0 – Partner Level Indicators L1 – Teacher Level Indicators L2 – Student Level Indicators L3 – Coach Level Indicators LID – External Stakeholder / Indirect Indicators	

## 2.2 Data Collection Timeline

In Figure 6, the key project activities and their alignment to the EDR Framework and data collection timeline is presented. In this figure, the 5 cycles of the EDR model are mapped against the overall project and the corresponding data collection points. The first two cycles were completed in the first six months of the project. This involved needs and context analysis and the prototype development on the initial PLCT and PLCC courses. There was a single data collection point for each of these cycles. The core activities of the projects i.e. the iterative implementations of the PLCT and PLCC courses were conducted between the seventh and thirty first month of the project. These involved testing and refinement of course design principles. These iterations also involved local multiplier events at the end of each course where the teacher participants shared the outputs of their inquiries with external stakeholders. At the end of the second iteration (month 31), some partners and teachers travelled and engaged in fellow partners' multiplier events allowing for international collaboration and sharings. For each of the iterations, baseline data was gathered on their commencement, data was collected during the courses and finally post surveys and focus groups were used to inform final learnings.

It is noted that due to Covid-19 the 32 hour courses on coaching PLCs (E1) and on using PI in IBL (E2) which were designed from the learnings of the project as informed by the EDR process could not be implemented. The final conference (E3) was implemented virtually and it's evaluation is included in the UL case-study. The final data collection point (DCP18) which resides in the 5th EDR cycle refers to a questionnaire completed by the partners to indicate their learnings and final levels of confidence in relation to IBL, PI, PLC and EDR. The findings of these are presented in Chapter 3.

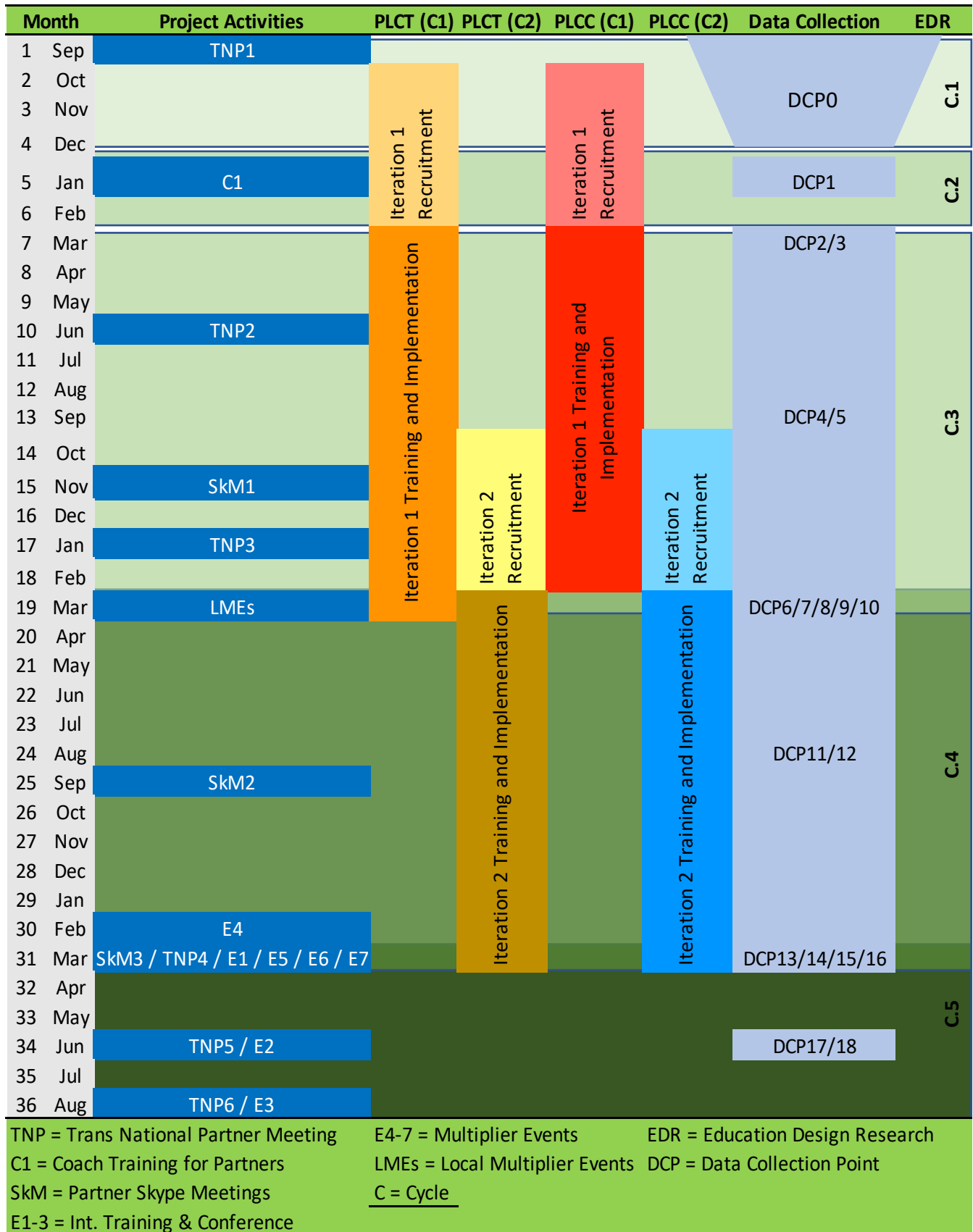


Figure 6: EDR Framework and Data Collection Timeline in context of overall project

## 2.3 Data Collection Tools

In this project a wide range of data collection tools and data gathering strategies were designed and implemented as presented in Table 2. These included a mix of quantitative and qualitative tools including questionnaires, reflection journals, individual and semi-structured focus group interviews. They also included partner reflections and debriefings on course workshops, workshop documents, teacher reflections gathered post workshop SWOTs and through other in-workshop strategies such as the use of protocols. Teacher posters presented at the showcase multiplier events were also used as data to provide information on the nature and quality of their inquiries and participant questionnaires were used to collect information from external stakeholders who attended these multiplier events. Table 2 also shows the alignment between the data collection points, the purpose of the data collection, the type of data collected, the indicators which informed the data collection design and the relevant EDR cycle which the data collection tools referred to. This table, Figure 6, the data collection timeline and Table 1, the project indicators when viewed in tandem correspond to the implementation strategy of the EDR Framework presented in Figure 1 and outlined in Section 1.3.

The core data collection tools, namely questionnaires and focus group interview protocols were designed collaboratively by project partners. Initially, first drafts, informed by the project indicators, were developed by the EDR team. These were presented at transnational partner meetings and short workshop activities were conducted where partners would engage in think, pair and share activities to provide the EDR team with feedback. This input, gathered both digitally and verbally, was reviewed by the EDR team and incorporated into second drafts of tools. These were re-presented to partners for final agreement. The tools were later translated into local languages for implementation. This process was repeated on a number of occasions during the project to agree the data collection tools for each EDR cycle and to incorporate learnings from previous cycles. The data collection tools for EDR Cycle 4 and 5 are included in Appendix A. These tools are selected as they represent the more refined tools used in the project and also relate to the final data collection stage which was used to elicit final project learnings.

The learnings from the data collection tools were elicited in a multi-step process. This involved regular partner sharing, co-created learning documents for each iteration, case-studies, peer review of case-studies and final case-study synthesis. During Cycle 3 and 4, partners engaged regularly through online and face-to-face transnational partner meetings. At these events, each partner provided an overview of their national workshops and identified key areas of achievement and areas for development. This peer sharing was captured in project meeting minutes but more specifically in learning documents (for each iteration) which were updated by partners at various stages during the project. The learning documents took the structure of a google document to which all partners had editing rights. Partners were encouraged to include their learnings from reflections, peer sharing opportunities and to note the source of evidence for that learning. The learning documents were also completed after peer review of partner case-studies; this involved a structured peer review exercise where the EDR team paired partners. Each partner had to read their pairs case-study and add feedback, in addition when they read aspects which were new to them or something that they hadn't considered before this was to be added to the learning documents. At the end of Cycle 3 and Cycle 4, the learning document was discussed and used to inform the design principles for the subsequent iteration and those included in the final project course outputs. The case-studies completed at the end of EDR Cycle 3 and 4 represented the partners analysis of their collected data. In generating these the partners made claims which they supported by the evidence gathered during their course as outlined by the EDR process. A final synthesis and analysis of the final data collection questionnaire was completed by the EDR team to elicit the final project learnings which were used to inform the project outputs. This synthesis is presented in Chapter 3.



**Table 2: Alignment of Data Collection Points with Project Indicators of EDR Framework**

<b>Data Collection</b>	<b>Description</b>	<b>Data Collection Methods</b>	<b>Indicators</b>	<b>EDR Cycle</b>
<b>DCP0</b>	<b>Needs and Context Analysis</b> This point refers to EDR Cycle One which includes literature review, sharing of partner experience and creation of the project proposal.	Project Proposal TNP1 Agenda, Minutes TNP1 Presentations and Activities TNP1 SWOT Analysis	<b>L0.2, L0.4, L0.5, L.0. L0.8, L0.9, L1.23, L3.1, L3.2, L3.12, PO.10, PO.11</b>	<b>1</b>
<b>DCP1</b>	<b>Evaluation of C1 Training</b> This data point will evaluate the C1 Coach/PI Training. This data will be used to inform the design principles of the PLCTs, PLCCs and E1 International Training Course.	Pre/Post Questionnaires Course Documents Participant Reflections Facilitator Reflections Case Study	<b>L0.1 - L0.5, L0.7 - L0.9 L1.24, L3.1, L3.2 L3.4,L3.5,L3.7,3.8, L3.10,L3.12,L3.13, L3.14 PO.4</b>	<b>2</b>
<b>DCP2</b>	<b>Start of PLCT Iteration 1</b> This data point is used to collect baseline data on teachers	Pre Questionnaire	<b>L1.1, L1.2, L1.4, L1.11, L1.12, L1.13, L1.15, L1.17, L1.19, L1.22, L1.23, PO4</b>	<b>3</b>
<b>DCP3</b>	<b>Start of PLCC Iteration 1</b> This data point is used to collect baseline data on coaches	Pre Questionnaire	<b>L3.4, L3.5, L3.6, L3.7, L3.9, L3.10, L3.12 PO4</b>	<b>3</b>
<b>DCP4</b>	<b>During PLCT Iteration 1 -Training and Implementation</b> Data for this period will be gathered during and after each workshop. It will include reflections on teachers' baseline and progression through the course.	Participant Reflections Course Documents Participant PIs Facilitator Reflections	<b>L0.1, L0.2, L0.3, L0.5, L0.6, L0.8 L1.1-L1.27 L2.1-L2.5 L3.1, L3.12 PO4</b>	<b>3</b>
<b>DCP5</b>	<b>During PLCC Iteration 1 - Training and Implementation</b> Data for this period will be gathered during and after each workshop. It will include reflections on coaches' baseline and progression through the course	Participant Reflections Course Documents Participant PIs Facilitator Reflections	<b>L0.1, L0.2, L0.3, L0.5, L0.6, L0.8 L1,24 L3.1-L3.14, PO4 LID.2</b>	<b>3</b>
<b>DCP6</b>	<b>End of PLCT Iteration 1</b> This data point will focus on the final evaluation of the course. The findings will inform Iteration 2.	Post Questionnaire Participant Reflections Facilitator Reflections Participant PIs Focus Group	<b>L0.1- L0.6, L0.8 L1.1-L1.28 L2.1-L2.5 L3.1 PO1, PO4</b>	<b>3</b>
<b>DCP7</b>	<b>End of PLCC Iteration 1</b> This data point will focus on the final evaluation of the course. The findings will inform Iteration 2.	Post Questionnaire Participant Reflections Facilitator Reflections Participant PIs Focus Group	<b>L3.1-L3.14, L1.25 L0.5 L2.1, L2.2, L2.3, L2.4, L2.5 L3.11 PO4</b>	<b>3</b>

<b>DCP8</b>	<b>Local Multiplier Event Evaluation</b>  The purpose of this data gathering is to measure the indirect indicators of the project. This will focus on the impact the event has on participants; including teachers, coaches, partners and stakeholders.	Participant Questionnaire PI presentations Focus Group Partner reflections	<b>L0.5, L0.6, L0.9, L1.18, L1.19, L1.20, L1.23, L3.7, L3.11, L3.15 LID.1-LID.4 PO2, PO4, PO9</b>	<b>3</b>
<b>DCP9</b>	<b>Start of PLCT Iteration 2</b>  This data point is used to collect baseline data on teachers	Pre Questionnaire	<b>L0.1, L0.3  L1.1, L1.2, L1.4, L1.5, L1.6, L1.7, L1.10, L1.11, L1.14, L1.17, L1.21, L1.22, L3.1, L3.3, L3.4, PO4</b>	<b>4</b>
<b>DCP10</b>	<b>Start of PLCC Iteration 2</b>  This data point is used to collect baseline data on coaches	Pre Questionnaire	<b>L3.4, L3.5, L3.6, L3.7, L3.9, L3.10, L3.12 PO4</b>	<b>4</b>
<b>DCP11</b>	<b>During PLCT Iteration 2 -Training and Implementation</b>  Data for this period will be gathered during and after each workshop. It will include reflections on teachers' baseline and progression through the course.	Participant Reflections Course Documents Participant PIs Facilitator Reflections	<b>L0.1, L0.2, L0.3, L0.5, L0.6, L0.8 L1.1-L1.27 L2.1-L2.5 L3.1, L3.12 PO4</b>	<b>4</b>
<b>DCP12</b>	<b>During PLCC Iteration 2 - Training and Implementation</b>  Data for this period will be gathered during and after each workshop. It will include reflections on coaches' baseline and progression through the course.	Participant Reflections Course Documents Participant PIs Facilitator Reflections	<b>L0.1, L0.2, L0.3, L0.5, L0.6, L0.8 L1,24 L3.1-L3.14, PO4 LID.2</b>	<b>4</b>
<b>DCP13</b>	<b>End of PLCT Iteration 2</b>  This data point will focus on the final evaluation of the course. The findings will inform the overall design principle recommendations	Post Questionnaire Participant Reflections Facilitator Reflections Participant PIs Focus Group	<b>L0.1- L0.6, L0.8 L1.1-L1.28 L2.1-L2.5 L3.1 PO1, PO4</b>	<b>4</b>
<b>DCP14</b>	<b>End of PLCC Iteration 2</b>  This data point will focus on the final evaluation of the course. The findings will inform the overall design principle recommendations	Post Questionnaire Participant Reflections Facilitator Reflections Participant PIs Focus Group	<b>L3.1-L3.14, L1.25 L0.5 L2.1, L2.2, L2.3, L2.4, L2.5 L3.11 PO4</b>	<b>4</b>

<b>DCP15</b>	<b>Evaluation of E4-E7</b>  The purpose of this data gathering is to measure the indirect indicators of the project. This will focus on the impact the event has on participants; including teachers, coaches, partners and stakeholders.	Participant-Questionnaire PI presentations Focus Group Partner reflections	<b>L0.5, L0.6, L0.9, L1.18, L1.19, L1.20, L1.23, L3.7, L3.11, L3.15, L3.16 LID.1-LID.4 PO2, PO4, PO9</b>	<b>4</b>
<b>DCP16</b>	<b>Evaluation of E1 – ‘The training for coaches’</b>  The purpose of this data collection is to evaluate the training course and to provide data for the semi-summative evaluation of the project	Pre/Post Questionnaires Course Documents Participant Reflections Facilitator Reflections	<b>L0.1 - L0.5, L0.7, L0.9, L3.2, L3.4-L3.8, L3.10, L3.11, L3.12, L3.13, L3.14, L3.15 LID.4, PO.7</b>	<b>5</b>
<b>DCP17</b>	<b>Evaluation of E2 – The PI Training</b>  The purpose of this data collection is to evaluate the training course and to provide data for the semi-summative evaluation of the project	Pre/Post Questionnaires Course Documents Participant Reflections Facilitator Reflections	<b>L.01-L05, L0.7, L0.9 L1.1-L1.6, L1.7, L1.9, L1.10, L1.14, L1.17, L1.19, L1.22, L1.23, L1.24, L1.26, L1.27, L1.28 L3.1 LID.4, PO.8</b>	<b>5</b>
<b>DCP18</b>	<b>Partner Evaluation</b>  The purpose of this data is to evaluate the project at the partner level	Partner Reflection Tool	<b>L0.1 - L0.10 L3.1, L3.2</b>	<b>5</b>

# Chapter 3: Learnings from EDR

## 3.1 Introduction and Context

In the previous chapters the EDR framework and approach adopted to elicit learnings through the iterative cycles of the project have been described. In this chapter, a synthesis of the project learnings and a discussion on the use of EDR is provided. For ease of presentation and to avoid duplication, the main discussion of this chapter will focus on EDR Cycle 4, Prototype Development and Evaluation cycle and EDR Cycle 5, the Semi-Summative Evaluation cycle which represents a synthesis of reflections by the partners on their second implementation of the project courses which occurred as part of Cycle 4.

The data used to generate the learnings at this stage includes all data collected from DCPs 9 -18 excluding DCP16 and DCP17 which specifically reference the evaluation of the project intellectual outputs E1 (Week long training course for coaches) and E2 (Week long training course for PI using IBL) which could not be implemented due to the Covid 19 Pandemic. While these courses were not implemented, they have been designed based on the extensive learnings of the project and are available in the form of course material and facilitator guides to support their future implementation as described in [Volume 2](#) and [Volume 3](#) of this eBook.

The overall learnings and recommendations of the 3DIPhE project are derived from a synthesis of each partners' evaluation of their second iteration of PLCs and multiplier events (DCP 9-15) as well as a final survey of partner learnings (DCP18). The project partners were coaches of their PLCTs and each partner arranged their members into a PLCC who completed a PI on their facilitation of their PLCTs. The partners PI evaluations were written up as case-studies and are available in Part B of this eBook Volume.

The 3DIPhE project is complex and multi-layered. As discussed in chapter 3, the EDR framework was developed to inform, structure and elicit learnings from the project. The indicators developed identify the various levels of the analysis which includes learnings at the partner/coach level in the context of IBL, PI, PLC and EDR, learnings at the teacher level in terms of IBL, PI and PLC, learnings of school students in relation to IBL and finally learnings of external stakeholders regarding IBL, PI and PLC.

In order to structure the synthesis of the case-studies and DCP18 survey, the learnings will be presented in relation to each of these levels separately and then final recommendations are presented in Section 3.2. The case-studies presented are the partner's PI evaluations of the second iteration of their 3DIPhE courses which were implemented across four countries, Slovenia, Poland, Belgium and Ireland. A total of 42 teachers completed the PLCTI2 courses and participated in 5-7 workshops over at least a five month period. The three PLCTI2 courses held in Belgium were carried out with groups of teachers from the same school while the other partners hosted courses in the Universities with teachers joining from different schools. An overview of the PLCTI2 courses hosted by the six partner organisations is presented in Table 3.

Table 3: An overview of the PLCTI2 courses hosted by the six partner organisations.

Partner	Start-End Dates	Same or different schools	Number of teachers completed	Number of Workshops	Number of Workshop Hours
Jagiellonian University (UJ) Poland	April 2019 - April 2020	Different schools	6	6	36
Dublin City University (DCU) Ireland	September 2019 - February 2020	Different schools	5	6	33
University of Ljubljana (UL) Slovenia	March 2019 - April 2020	Different schools	16	6	16
Artevelde University of Applied Sciences (AHS) Belgium	June 2019 - March 2020	Same School	4	7	30
University College Leuven-Limbourg (UCLL) Belgium	December 2019 - March 2020	Same School	8	5	11
Catholic University of Leuven (CEF) Belgium	June 2019 - March 2020	Same School	3	7	34

The design of these courses was influenced by previous learning in the project. The partners reflected on the first iteration (Cycle 3) and co-created a learning document in which they noted their combined reflections. Discussion on these led to the generation of design principles and key elements that were required to be included in the second iteration of the 3DIPhE course. It was agreed that partners should have the flexibility to facilitate their respective courses in whatever way best suited their local context and the specific needs of their teacher participants as long as they adhered to the overall design principles of the 3DIPhE project. In the figure below the various key elements are identified. One of the aims of the second iteration was to test and refine the design principles and key elements.

3DIPhE	Motivation Element
	<i>Searching for an Inquiry Question</i>
PI	Familiarizing with PI
PI	Discover your motivations for your context
PLC	Building a PLC
IBL	Familiarizing with IBL

3DIPhE	Inquiry Element
	<i>Formulating the inquiry question</i>
PI	Exploring the problem space
PI	Formulating your inquiry
PLC	Finding your Critical Friend
IBL	Recognizing examples of IBL

<b>3DIPhE</b>	<b>PI Development Element</b> <i>Planning your inquiry</i>
<b>PI</b>	Exploring solutions to the problem
<b>PI</b>	Different types of data collection
<b>PI</b>	Creating and refine an inquiry plan
<b>PLC</b>	Strengthening PLC bonding
<b>IBL</b>	Applying IBL to your own context

<b>3DIPhE</b>	<b>Analyzing PI Element</b> <i>Drawing conclusions from evidence</i>
<b>PI</b>	Drawing conclusions from data
<b>PLC</b>	Analysing conclusions of others
<b>IBL</b>	Strengthen IBL skills

<b>3DIPhE</b>	<b>Conducting PI Element</b> <i>Go out there and collect evidence</i>
<b>PI-IBL</b>	Testing PI on IBL in your own context
<b>PI</b>	Collecting different types of data (including observation)
<b>PI</b>	Refine inquiry plan
<b>PLC</b>	Giving Feedback on the design of others

<b>3DIPhE</b>	<b>Sharing Element</b> <i>Sharing is the start of something new</i>
<b>PI</b>	Learning how to create a poster / presentation
<b>PI</b>	Presenting and Sharing
<b>PI</b>	Lessons for your practice in the future
<b>PLC</b>	Learning from others
<b>IBL</b>	Lessons for approaching IBL in future

The need to offer flexibility to the partners within the context of a 3DIPhE framework is emphasised by variance in the descriptions of the respective case-studies. It is reported that a diverse group of teachers volunteered to engage in the project. The teachers were heterogeneous in terms of sectoral level (primary and secondary), experience teaching (years), subjects being taught and experience of IBL. Very few of the teachers across the project had previous experience in using practitioner inquiry or engaging in professional learning through the medium of Professional Learning Communities. In some countries the teachers worked in the same school while in others members of their PLCs had never met previously. While there were cultural and structural differences in the partner countries regarding education systems and models of professional learning, there were many common challenges faced by teachers which included:

- Limited access to equipment for doing experiments in the school
- Limited time to prepare experiments before the lesson (a demand for taking break-duties between lessons)
- An overloaded curriculum with what was perceived to be too few hours of physics per week
- Lack of student motivation

The structure of the workshops in each country was different as they were designed around the availability and needs of the teachers. In some cases teachers attended during their holidays, at weekends or directly after a full day teaching. In some contexts regular short workshops were held while in others spaced out full day workshops were used and in others clustered full day workshops were provided. The use of full day workshops were provided as many of the teachers who volunteered travelled long distances to attend workshops, in one instance a teacher

was travelling for nine hours. In this regard it was more efficient to offer full day intensive workshops for these participants. The time teachers were willing to make available for the courses demonstrates their eagerness to engage in the project. It is reported in the case-studies that the teachers were motivated for various reasons, some were inspired by their attendance at first iteration multiplier events, and others, having received mailshots volunteered because they were less confident in teaching physics and felt the project would support them in that regard.

## 3.2 Partner / Coach Level Learnings

In this section, insights into the learnings of the project partners/coaches are provided. Their reflections on the work of the teachers and their own personal growth in terms of coaching IBL, PI, and PLCs are discussed as evidenced by their case-studies on the second iteration and the final DCP18 questionnaire.

### IBL at the partner/coach level

The majority of the partners had expertise in IBL before the commencement of the project. They had various experiences in different EU projects such as ESTABLISH, SAILS, Fibonacci, ChReact, SECURE etc. Additionally, the partners were mostly employed as teacher educators or pedagogical advisors so they have experience in educating both pre-service teachers and in-service teachers. Therefore it is not surprising to see that most partners rated themselves quite highly when asked to self-rate their level of expertise in IBL at the end of the project. There was one outlier here as a small number of those working at the partner level were not directly involved in teacher education, and their involvement in workshops was more so at the PLC building level. Out of the other 12 partners, 10 of these rated themselves at eight out of ten or higher on their level of expertise in inquiry based learning.

However, as IBL is multifaceted, and many interpretations exist in the literature, a sharing of expertise as part of EDR Cycle 1 (Needs and Context Analysis) was deemed necessary. At this time, the UJ partners led workshops on IBL which provoked discussion and comparison of IBL approaches and understanding. Partners also shared resources they were involved in developing through different EU projects. It was felt after this Cycle that the partners had a coherent understanding of IBL which could be effectively incorporated into the 3DIPhE workshops.

As will be discussed later the teachers' appreciated the IBL inputs of the 3DIPhE workshops. They felt that they developed their understanding of the approach and were encouraged to use it in their practice. It was evident that they particularly valued IBL and practical activities which they could implement with their students and that they held more positive attitudes towards experimental work by the end of their courses. The partners highlighted some learnings for future IBL workshops. It was noted that development of IBL understanding and capacity to teach through IBL takes more time than is sometimes expected. The importance of emphasising assessment features of IBL and addressing teachers' fears regarding the organised chaos of IBL especially when answers to investigations are unknown was also commented upon.

A core part of the partners previous experiences recognise the importance of engaging teachers in IBL activities as learners. In this way teachers get to understand what their students will experience in IBL classes and hence realise the skills and knowledge necessary for IBL which in turn should enhance their facilitation of IBL lessons. An additional learning was identified by the UJ partners who concluded after the first iteration that in addition to experiencing IBL examples, teachers need to be guided through the different elements of the IBL cycle where they take the role of IBL teachers and unit designers. Teachers need to design each of the steps and gain experience leading these activities while being supported by a facilitator and/or other teachers. In doing this, the UJ teachers gained a deep understanding of IBL so that they could now design their own IBL activities as opposed to just using pre-designed units.

At the end of the project, partners were asked to describe their understanding of inquiry based learning. The theme that emerged most strongly from partners' responses to this question was that IBL is about students being active learners, and that it has a focus on student questioning. One partner noted that in IBL "The students are triggered to ask questions themselves and find the answers to those questions by exploring and investigating themselves. They learn to investigate in a systematic way by gathering evidence and drawing conclusions from that evidence."

Several partners also acknowledged that IBL is a pedagogy that enables students to develop their conceptual understanding of physics along with developing their skills in physics. One partner noted that,

*"Inquiry based learning is a pedagogy where students are actively involved in inquiring into physics phenomena in order to develop their conceptual understanding of physics concepts, and develop their skills in physics."*

*These skills include experimental skills, skills in developing explanations, communication skills and skills in working collaboratively. IBL can be carried out in the context of practical classes but it doesn't have to be."*

Partners did not report significant changes in their understanding of IBL when they were asked about this at the end of the project. However, some partners noted that they were exposed to more examples of IBL over the course of 3DIPhE, and that their confidence in IBL has increased. "My understanding has not changed much, but became more experienced in constructing IBL units, on facilitating teachers/students and on posing helpful questions."

Finally, as part of the final project evaluation, partners were asked to describe the challenges that they associated with supporting teachers to use IBL in their classrooms. One of the key challenges that patterns described was that in their role as coaches of IBL they found that teachers often indicated that they did not have time to implement IBL in their classrooms.

### **PI at the partner/coach level**

Coaching teachers in the use of Practitioner Inquiry was new to many of the partners (in the final project evaluations 6 out of 13 partners indicated that they had little or no experience in PI at the commencement of the project. Partners from CEF had experience in this regard through their previous work in the Erasmus+ Linpilcare project. Some of the partners had attended workshops on PI linked to the Linpilcare project and others had experience mentoring inservice and preservice teachers in conducting practitioner action research. It is felt that 'coaching PI' was the area that most learning on behalf of the partners was required. In this regard a coach and training workshop for partners was facilitated in the second EDR Cycle (Prototype Development and Evaluation). This workshop was provided by the CEF partners. The learnings and reflection on this course informed the design principles for the first iteration of 3DIPhE courses which were further tested and refined during EDR Cycle 3 and 4.

There were many learnings in regard to PI which will be discussed in this section and also later in regard to the teacher level. There are many overlaps in the learning at these levels, hence to avoid repetition, this section is discussed from the perspective of the partner/coach. At the end of the first iteration of courses the partners reflected on their experiences. While, all felt the iteration was very successful culminating with inspiring showcase/multiplier events where the teachers shared their inquiries, there was a strong sense that the design of the workshops could be improved. Specifically, it was felt that adapted approaches to support teachers to better understand PI and generate inquiry questions were required. It was also felt that further work was needed to better help teachers to analyse data and make inferences to inform decisions about their practice. The partners discussed and shared different approaches to addressing these challenges in advance of deciding upon the design principles for the second iteration. Some of these included, using examples of PIs from the first iteration as examples for the second iteration teachers, starting the teachers on a shared inquiry earlier in the workshop before completing an individual inquiry, using protocols where teachers analysed and made inferences from data before developing their



own inquiry and using new protocols that engaged teachers in IBL and PI simultaneously. The most successful and indispensable aspects of the first iteration such as peer critique and development of posters for the showcase were repeated in the second iteration.

The partners' evaluations of the second iteration as documented in the case-studies are very positive. The majority of adaptations made for the second iteration led to improvements in teacher generation of inquiry questions, plans and general understanding of PI. Many partners felt that the process was more efficient and the quality of their teachers presentations were higher than in the previous iteration. It was felt that the second iteration teachers benefited from the PI examples that were created by the first iteration teachers. In this way, they had a better expectation and understanding of the PI process. All partners strongly recognised a need to provide teachers with individualised support at different stages of the course even though they were part of a PLC. Sometimes, this was provided in workshops but in cases it was provided between scheduled meetings via telephone or Skype calls. These inputs were essential to support teachers at the data collection and analysis stages and are recommended for inclusion as design principles for the courses. While some challenges did persist, the learnings unearthed through the EDR process allowed the partners to improve their courses.

Partners' understanding of PI evolved over the course of the project. At the end of the project some partners reported that 3DIPhE allowed them to see PI "in action". However, at the end of the project, partners still identified challenges that they associated with supporting teachers to carry out PI. One of the areas they identified as being most challenging was that teachers needed a lot of support to become familiar with the PI process. This included identifying an inquiry question, "*It was difficult to support teachers in developing their initial inquiry question. They found it difficult to narrow the question down to something they could investigate as part of a lesson or a small number of lessons*" and supporting them through other aspects of PI, including both data collection and data analysis "*It is hard to convince them [teachers] that qualitative data collection tools provide valuable information as well.*"

### **PLC at the partner/coach level**

PLCs were specifically chosen as the professional learning vehicle for this project. It was hoped that the use of PLCs would help to provide the teachers with an approach for continuing learning beyond the project. It was desired that teachers would create new or sustain the PLCs established in the project. As part of the PI training provided during EDR Cycle 2, the partners also learned strategies for developing effective PLCs. The protocols and learnings from this workshop informed the approach adopted within the 3DIPhE project.

The partner reflections at the end of iteration one and two mostly report positive outcomes in regard to PLCs. Partners learned that for PLCs to be successful the participants must feel that they are equal partners and have a sense of ownership and responsibility to one another. This was also reflected in partners' comments at the end of the project. Many remarked that members of PLCs must have a shared vision.

*"Members of the learning community must share the same vision and values.*

*The vision is an awareness of the importance of continuous professional growth for a society that values curiosity, a critical mind, science and values such as altruism, openness to different ideas"*

It was felt that PLCs with clear purposes and shared values were more successful. It was recognised that coaches need to listen and adapt to the teachers needs. In the CEF case-study it was reported that the teachers identified when the coach had made adjustments for them, and their appreciation for this was acknowledged in the SWOT analysis. However, it was also noted that there is a delicate balance between providing for teachers wants and the successful running of workshops. The AHS and CEF partners note that there are tensions between allowing teachers to discuss their daily teaching challenges in order to build the PLC and the time needed to complete the intended workshop activities. In this regard, the coach needs to be skilled to know when it's appropriate to redirect

the teachers back to the tasks of the workshops without them feeling like they haven't had sufficient time to discuss their school challenges.

The importance of being flexible when facilitating PLCs has been recognised from the outset of the project. Partners demonstrated this through their negotiation of the structure of the workshops based on the teachers availability even when in some cases this meant a redesign of the courses from multiple short day courses to clustered full day or spread out full day workshops. Interestingly, though both DCU and UL who facilitated this restructuring commented that while they felt the iteration two courses were more efficient the sense of community between the second PLC didn't appear to be as strong as the bonds that were created when teachers met each other more regularly. That said, the PLC in UL has continued beyond the lifecycle of the project already meeting twice since the final conference and participants in the DCU PLC have been in contact via their WhatsApp group sharing resources for the new teaching year.

### 3.3 Teacher Level Learnings

In this section the synthesis of learnings related to the teacher level are discussed. These are informed by the partner case-studies which in turn were informed by the partner/coach inquiry into their PLCT. Data obtained during pre, post questionnaires, participant reflections, course documents, participant PIs, facilitator reflections, and focus group discussions were used to inform the writing of the case-studies. The specific case-studies informing this data relates to the second iteration of the PLCT courses as this was the final implementation and represents the last cycle of testing and refinement of the project design principles. The teacher level learnings are divided into the learnings at IBL, PI and PLC levels.

#### **IBL at the teacher level**

All of the teachers who engaged at this stage of the project, and indeed in the earlier iterations, were motivated to try and learn new teaching approaches. Some were motivated by self-perceived lack of physics content knowledge. The teachers across the project had varied experience of IBL ranging from not knowing what it was to using it regularly in their classrooms hence there mixed levels of teacher confidence in using IBL reported. Those that had used IBL previously held positive attitudes towards the approach, however while many felt IBL developed practical skills they were unsure whether the approach was effective at developing students' content knowledge. Some partners reported that their teachers had a narrow understanding of IBL which was focused on practical skills but didn't consider many of the other skills inherent in IBL such as developing hypothesis, formulating questions, planning experiments etc.

An interesting observation at the start of the second iteration was that teachers in many of the partner countries reported a low level of confidence in using practical to teach their subjects. However, by the end of the iteration the majority of teachers were more confident in teaching using practical work and in their confidence and understanding in using IBL. In UJ it was commented that the teachers were better prepared to design their own IBL units instead of using pre prepared units. This was linked to the UJ partners providing workshops where the teachers had to teach and design IBL activities linked to each stage of the Inquiry cycle and not just experience and discuss examples of IBL.

Across the consortium there were positive reports of teachers wanting to use IBL more often, being more open to using IBL and wanting to share their ideas of IBL with other colleagues. Teachers in different countries such as Slovenia and Ireland noted that they had learned new ways of planning. A Slovenian teacher reported they had learned that experimental work could be used in mathematics and this would change how they teach. An Irish

teacher commented that they were more confident in their teaching as IBL challenges you to be more prepared and another noted that they had fallen out using IBL but the project pushed them back into using it. These reflections are analogous to those noted in the case-studies across the consortium. Some partners noted that some of their teachers who had experience in using IBL before the project were somewhat less confident at the end of the project. While this might seem like a negative result, in fact, it is positive in that it demonstrates that these teachers had held a limited view of IBL and through the project learned that it is more complicated and broader than they had known, specifically, they had learned that IBL is more than just engaging in practical work. Interestingly, however, at the end of the project there were still some mixed opinions on the role IBL can play in developing student content knowledge, though many of the teachers' reservations in this regard did change by the end of the project.

### **PI at the teacher level**

The use of PI to inform practice was the most novel aspect of the 3DIPhE project for teachers. As a result it was the piece that teachers' found the most challenging but one that they were very motivated to tackle. Teachers reported that they often reflected on their practice but they didn't do so in a systematic way which used evidence to inform change in their practice. At the start many noted that they were unsure if they were able to identify teaching approaches or areas for improvement based on their regular self-reflections and some also reported being uncomfortable about inquiring into their practice.

Teachers struggled with various aspects of PI over the course, many of which was expected given this was their first time engaging with this type of work. The relationship between PI and academic research, generating an achievable and relevant inquiry question, using qualitative data and making inferences, including avoiding practitioner bias, were the areas that were most difficult for teachers. In the second iteration of the courses, these challenges were lessened as partners were aware of this and now had authentic examples from the first iteration of the project to support teachers. Partners also made adaptations to protocols and altered the timing of their use so the teachers engaged with examples of PI earlier in the process. Teachers were provided with individual feedback during the process as they needed support to better link their data collection plan to their inquiry question and to analyse and make inferences from their data. The fact that there were struggles during the process is in no way seen as a negative finding, in fact it demonstrates the engagement of teachers and the learning that occurred. There was a great variety in the PIs conducted, this shows that teachers' activity linked their inquiries to their passions and challenges faced in their practice. This is an essential feature of the PI courses as the focus on PI is to inform and impact the teachers practice and not necessarily that practice of others. In this way teachers have an ownership of their inquiry and are motivated to complete it. Many of the teachers also learned to use and value their students' feedback when conducting PIs, something which was very new to them. One teacher from Belgium commented,

*"It is so powerful to present your inquiry question to your students. It is surprising how much information you will get. Students give very interesting feedback and suggestions. We always think we have to find solutions to our professional challenges ourselves, but in many cases the answer lies in the hands of your students".*

While the teachers reported finding all aspects of the courses useful, many specifically noted that the poster generation sessions to be extremely useful as it forced them to analyse and make inferences from their data that identified practice change and hence complete the PI cycle.

At the end of the 3DIPhE course it was reported that there are still challenges with teachers' perceived value of their inquiries and the use of qualitative data. Teachers don't appear to recognise their work in the same regard as that conducted by academics. However, they were still motivated to complete further cycles of PI beyond the term of the project and to recommend PI to other teachers. Many also reported confidence in their ability to adapt their practice based on evidence generated from PI. One DCU teacher noted that as a result of the project they are now

*“Constantly reviewing lesson plans, making them more student centred, actively looking for student feedback, building IBL into my Schemes of Work in a continuous incremental process”*. This comment was echoed by many teachers across the consortium who plan to make PI a permanent inclusion in their practice.

In general the reports from partners and teachers regarding the PIs conducted was very positive. The various sharing events/multiplier events held throughout the project were inspiring and demonstrated how teachers’ PI had motivated their reflection on their practice and most importantly informed their practice for the betterment of their students. A key learning for partners and teachers is that the use of PI is an iterative process and expertise in its use is developed through continuous use and experience. It is very important to learn the basis of PI through the initial stages of the course but teachers

expertise and confidence in PI will only be developed through multiple cycles of PI.

### **PLC at the teacher level**

The use of professional learning communities as the mode to engage teachers in PI and IBL was specifically chosen as a model to provide a supportive community for teachers to share and discuss their practice. The intention was that this community would sustain the teachers in the project and would model an approach that they could adopt beyond the term of the project.

Teacher feedback on PLCs was positive throughout the two iterations of the project. At the outset of the courses, some teachers reported that they find it difficult to admit that they have challenges in delivering topics. They are not used to commenting on each others’ professional practice and some can be reluctant to share with others for fear of being criticised. In some cases, there is only one physics teacher in a school and they felt that they had no one with whom they could discuss their professional learning. Other teachers reported that there can be divides between teachers who are interested in engaging in additional professional learning and those who don’t value it. Generally, it was found

that there isn’t a strong culture of professional sharing by teachers in their daily practice.

Through the work of the project the teachers learned to value the importance of professional learning. They were more confident in sharing learnings and practice with peers though the majority still felt that the structures within their schools do not provide enough opportunity for this. A Belgium teacher commented that, *“We must rethink the way we work together as colleagues in our school. Now meetings are more about administration, purchase of material, organisation of excursions, etcetera but*

*we must have time to work on actual problems and challenges we face as teachers”*.

This point was observed in the feedback across the consortium, for example in Poland it was also noted that discussions at school level are not about how to teach for student learning; they are often about behaviour and school management. A Slovenia teacher at the final conference noted that

*“We should do this more often! Not only during these workshops... It should be part of the culture of the school”*.

At the end of the project teachers strongly referred to the benefits of peer learning, one noted that they are

*“Realising that I’m not the only one who feels the need to change the way I teach”*.

Others noted their appreciation for the work of the partners and their peers; one commented *“Thank you for your encouragement and kindness, especially for listening and taking remarks into account”*, while another noted

*“Together, we can bring about improvements in the learning process. We can learn a lot from each other - excited”.*

The UCLL partner, who was working with teachers in one school, noted that engagement in the project where teachers co-taught together led to greater trust and collaboration, one of their teachers noted that *“We find it difficult to teach as a team in the classroom. We never collaborated during our teaching practice and we really need to adapt to that. The second time assisting each other was already a lot easier”*. The multiplier events of the project also led to sharing across PLCs. Teachers from Slovenia and Poland who met at the Dublin multiplier event have reported that they are now collaborating outside of the project. While teachers have raised concerns about obstacles such as time and school structures, they were motivated to challenge these, for example all of the teachers from UJ indicated that they would like to establish their own PLC in their schools.

### 3.4 Student Level Learnings

The 3DIPhE project and courses primarily focused on working with coaches and teachers. The partners did not work directly with students however, an important aim of the project was that the teachers learning in PI and IBL would have a direct impact on their practice and as a result have an impact on the learning of their students which in effect is the ultimate goal.

The primary evidence for the learnings at the student level is evidenced by the teacher PIs as written up in their posters and presented at the various multiplier events during the project and at the final conference. There was a wide diversity of projects and impacts for students ranging from learning how to support students with individualised learning needs in an IBL setting to developing students’ understanding of variables and ability to plan IBL investigations. In the DCU case study it was noted that at the end of the project the teachers were more positive towards the use of ‘student designed experiments, student data analysis and students drawing conclusions as a way to motivate students’. Across the project there was a move towards more student centred learning. A teacher working with the UCLL partners noted that

*“We were sceptical about IBL and giving too much liberty to the students. However, very soon the students found some interesting working approaches to the problem. Discussing these different approaches in the class resulted in high learning outcomes for the students.”*

Very interestingly, in one teacher PI it was observed that the students, while enjoying the IBL activities didn’t initially perceive them as lessons that led to learning. It was only after they got used to IBL and reflected more on their learning did their opinion change. In the end they felt that IBL enabled better acquisition of content knowledge, helped them to remember lessons, and enabled them to experiment by themselves. This important learning highlighted that

both teachers and students need time to acclimatise to IBL as it is a new approach to both and only after some persistence do both appreciate it’s value.

Additional common learnings from across the project point to students discovering a passion towards scientific research and doing investigations, an increased positive attitude towards physics and practical work based on their experience of IBL and an increased skill set in collaborating with each other. In a round table discussion at the local multiplier in Ireland which involved partners and teachers from across the consortium, these learnings were

echoed. It was identified that through the work of the project students gained opportunities to develop problem solving skills, they learned to collaborate with their peers and

student voice was now considered as a stakeholder in their learning by teachers

which was a huge change from the initial reflections of teachers.

### 3.5 External Stakeholder Learnings

The project partners strongly believe all aspects of the project and desire for the learnings of the project to be shared and to inform teacher practice and policy. In this regard the work of the project was showcased through project multiplier events and additional dissemination events ranging from national teacher conferences to international conferences. A range of stakeholders including Government policy makers, school principals, teacher educators and teachers were invited to the many events. From the case-study reports it appears that most partners faced challenges attracting policy makers to their events and their main reach was to teacher educators and other teachers. However, the policy makers that did attend were motivated by the work, for example a person from the Governmental Center of In-Service Teacher Development in Poland attended their national multiplier event and now plans to incorporate learnings from the event into their practice.

These events were also very positive in that a number of the teachers who attended joined the second iteration of the project and many at the final events expressed a desire to join future projects. In the case of one partner, seven out of the eight initial members of their second iteration PLCT were recruited through the multiplier events, some of these had never encountered IBL previously. Some positive comments from attendees at these events include “great event, well organised and very beneficial to me as a teacher” and another said that

*“It was enlightening and inspiring to hear the enthusiastic honest experiences of the showcase teachers. I hope that I can incorporate more practitioner inquiry into my own work”.*

The survey responses from attendees also indicated a desire to learn about and engage in PI and PLCs and some noted their intention to encourage the use of these within their own organisations and at a national level.

### 3.6 Summary and Conclusions

Part A of this eBook Volume, has presented the background to the project, the rationale behind the use of EDR and a description of the EDR framework utilised in the project. In this chapter the learnings from the project have been presented through a synthesis of the case-studies which were generated by each partner using the data collection strategy proposed in the EDR framework.

EDR was chosen as an approach to inform, structure and elicit learnings from the 3DIPhE project. As noted, it was specifically selected due the complexity of the project. The rationale and details of the framework have been described in previous sections. EDR was a new approach for the majority of partners. It was introduced during EDR Cycle 1 through a workshop and follow on inputs were provided at each of the project meetings. EDR can be considered as the fourth dimension of the project as it involves inquiry into the other three dimensions i.e. the inquiry into coaching PLCs and PI at the partner level, the PI (at the teacher level) and IBL (at the student level).

The partners really appreciated having EDR as an approach to help structure the project and to ensure that the learnings were captured throughout the various stages. The appreciation was evident in the final evaluation of the project. All partners either agreed or strongly agreed that the EDR framework was a significant benefit to the project, while twelve of the partners agreed (4) or strongly agreed (8) that they intended to use EDR in their future practice.

Central to the 3DIPhE project was the idea that participants in the project, at all levels, would inquire, share and learn. Educational Design Research allowed us, as partners, to systematically investigate how and where learning occurred throughout the project. Inquiry for learning was the central focus of the 3DIPhE project. As we have outlined, this inquiry happened at the student, teacher, coach and partner levels. Educational Design Research provided a structure to allow us, as partners and project coordinators, to systematically investigate how and where this learning happened. The spirit of inquiry was evident when partners described how 3DIPhE changed their practice:

*Overall, 3DIPhE has really made me think more about reflection and research in my own practice. I am more aware of the ideas that small changes based on a teaching experience can be very important. But learning more about PI has made me think about how to be systematic in this*

The EDR framework also provided a structure for partners to share their experience and share their learning, which is central to all professional learning.

*“There is a huge benefit in sharing practice across international contexts. It’s important to be open and to listen so you can learn. In a PLC it’s essential to have lots of dialogue so you can process and challenge your ideas with knowledgeable others. This all leads to learning.”*

Overall we can also claim that at the partner level, at the end of 3DIPhE there was a broad consensus about what EDR is. Partners’ descriptions of EDR were quite consistent, with all partners referencing the iterative or cyclical nature of EDR. It was quite common for partners to comment that before the 3DIPhE project they had little or no experience of EDR (with the exception of the EDR team). We see through the responses to both the Likert and open questions that the 3DIPhE project influenced how the partners viewed EDR. 12 out of the 13 partners said that they used the learning gathered through EDR to inform their practice, with the same partners all agreeing that they would be confident to use EDR in their future practice.

However, there were at times uncertainties about the amount and type of data that was required to be collected in order to generate the partner case-studies. This was evident in partners’ responses at the end of the project. Managing a large amount of data, and collecting the right data, was something that several partners found challenging. One partner indicated that the challenge of “how to avoid the missing data was crucial”, saying that “In retrospective it is very easy to recognize that it would have been good to collect such and such data at such and such points. In advance, this is more difficult.” It was also noted that when working with such a large amount of data it is “...difficult to analyse comprehensive data from the practical point of view”.

Interestingly, partners faced similar challenges to the teachers in regard to PI when considering EDR. There were challenges gathering data, keeping up to date with reflections and making inferences to inform the design of future workshops and courses. There were also similar discussions in regard to the value and approaches required to analyse quantitative and qualitative data. The writing of the case-studies was one of the most important elements of the EDR process as it required each partner to review and synthesise their data collected to make inferences that could be shared with the consortium partners. In many ways the learning gained from writing up the case-studies was similar to the learning teachers experienced when making their posters. In this way it demonstrates the similarities in the inquiry processes between the different dimensions of inquiry used in the project.

One shortcoming of the EDR process as implemented was that there wasn’t sufficient time for each partner to write and read each other’s reflections during the project. While this activity was completed and two learning documents were co-created it was felt that the reflection time for all of the partners to review this work was not ideal. This was primarily due to the contextual timings of school calendars, and the Covid 19 pandemic. While

partners shared their experiences in the discussed learning documents at the end of EDR cycles and verbally at consortium meetings, it was interesting to read in the second iteration case-studies that some partners noted scenarios in workshops to avoid that had already been shared as a learning by other partners at the end of the first iteration. While this only happened in relation to a couple of small aspects it does demonstrate the importance of having sufficient time to reflect on shared learnings.

EDR is a systematic study of designing, developing and evaluating educational interventions as solutions for complex problems in educational practice. The 3DIPhE project was multidimensional and had multiple layers of complexity within each of these dimensions. The EDR approach was pivotal in identifying learnings within this context and helped to shape each iterative cycle of the project. The key learnings, gathered through using the EDR framework and elicited through the synthesis of case-studies were used to inform the development of design principles which have shaped the design of the Coaching and PI courses as presented in [Volume 2](#) and [Volume 3](#) of this eBook and demonstrate the successful use of the EDR Framework in the project.

**“We are all in the process of learning.”**

Partners, working across four different countries, have developed a common but flexible model of teacher professional learning that utilised professional learning communities to support in-service teachers’ understanding, motivation and use of IBL in the practice. They utilised practitioner inquiry as an approach to develop teachers inquiry stance to explore their practice with the shared vision of improving student learning. The partners, through inquiring, sharing and learning, realised challenges in adopting this approach to teacher professional learning but most importantly through the EDR process learned strategies to overcome these. They learned how protocols can be used to support the creation of PLCs and to develop teachers’ understanding of the PI cycle. They learned how to create well-functioning PLCs, built on shared experiences, visions and on the needs of students that can be used to support teacher collaboration across and within schools. They learned the importance of adopting a systematic approach to developing skills of teaching in IBL that requires more than modelling examples of IBL but that uses guided practice in each stage of the inquiry cycle. They learned that there are a multitude of overlaps between EDR and the PI and IBL cycles in terms of steps and skills. They learned that in each of these dimensions of inquiry, the process of sharing findings is pivotal in supporting true reflection of learnings, enabling evidence informed recommendations for practice. Above all they learned how iterative cycles of inquiry and sharing leads to learning.



# **PART B: PARTNER CASE STUDIES**

## **Introduction**

**Jagiellonian University Poland Case Study,  
Dagmara Sokołowska and Justyna Nowak**

**Dublin City University Ireland Case Study,  
James Lovatt, Paul Grimes and Eilish McLoughlin**

**University of Ljubljana Slovenia Case Study,  
Mojca Čepič, Maja Pečar and Ana Gostinčar Blagotinšek**

**Artevelde University of Applied Sciences Belgium Case Study,  
Jan De Lange**

**University College Leuven-Limburg Belgium Case Study,  
Katrien Vyvey, Renaat Frans and Jeroen Op den Kelder**

**Catholic Education Flanders Belgium Case Study,  
Wim Peeters**



# Introduction

The aims and learning outcomes of the 3DIPhE courses have been considered under three aspects, as presented in Table 1.

- Aspect 1: Learning about and conducting a PI
- Aspect 2: Becoming an active member of a PLC
- Aspect 3: Learning about IBL

**Table 1: Overview of three core learning outcomes of the 3DIPhE course.**

1. Learning about and conducting a PI	<ul style="list-style-type: none"> <li>• Develop a wondering linked to IBL in their classroom</li> <li>• Identify problems and conduct research questions</li> <li>• Develop a plan to address their wondering</li> <li>• Gather data on their wondering</li> <li>• Analyse and critique data based on their PI</li> <li>• Self reflect and per evaluate their PIs</li> <li>• Make evidence informed conclusions and recommendations linked to their wondering to enhance their teaching</li> </ul>
2. Becoming an active member of a PLC	<ul style="list-style-type: none"> <li>• Work collaboratively to support members of the PLC to conduct a PI</li> <li>• Set up a method of communication to collaborate and communicate with members of the PLC</li> </ul>
3. Learning about IBL	<ul style="list-style-type: none"> <li>• Become confident using IBL approaches</li> <li>• Use IBL more frequently</li> <li>• Improve their IBL teaching based on evidence generated through their PI</li> <li>• Recognise IBL as an effective strategy to motivate students learning and interest in physics</li> </ul>

In addition to these aspects, there were several broader outcomes, which align to the overarching aims of the 3DIPhE project that were intended to be achieved through the course. These outcomes were to:

- Build a learning community among a group of teachers
- Facilitate a group of teachers to conduct PI on IBL
- Explore how the group focuses on transformational learning including but not limited to school culture, teacher practice, student learning etc.
- Develop and refine a local instructional theory on the coaching of a PLC of teachers to conduct PI on IBL.

Following the first iteration of the project the partners agreed on Design Principles which required that activities that address the three aspects of IBL, PI and PLC should be included in each workshop. These aspects were further categorised into six elements which are identified in section **XXXX**. For the second iteration of the project it was determined that each partner should include all of these six elements into their courses but that each partner had the freedom to decide how best to do so. This flexibility was introduced so that partners could design their courses and workshops based on the specific needs of their local contexts and participating teachers.

For more detailed information about IBL, PI and PLCTs please refer to 3DIPhE Volumes 1-3. The protocols used in the 3DIPhE second iteration courses are presented in the Appendix B of this volume. Other tools, worksheets, IBL units and other materials are described and included in the Appendices of 3DIPhE [Volume 1](#), [Volume 2](#) and [Volume 3](#).



# Jagiellonian University Poland Case Study

**Dagmara Sokołowska  
and Justyna Nowak**

## Introduction

This case study reports on the implementation of a professional development course for second level science teachers facilitated by partners from Jagiellonian University (UJ) Poland. The course, which is part of the second iteration of the Three Dimensions of Inquiry in Physics Education (3DIPhE) Erasmus+ programme was designed to develop teacher's competencies and understanding of Practitioner Inquiry (PI) and Inquiry Based Learning (IBL) through engagement in a Professional Learning Community (PLC) of teachers.

## Context and background

Two groups of teachers participated during the second iteration of PLCTs at UJ - a group of novice teachers (PLCTI2n) and a group of experienced teachers (PLCTI2e) that had participated in the first interaction. The PLCTI2n course began in April 2019 and consisted of 36 workshop hours delivered over six workshops held on Saturdays. All of the PLCTI2n teachers came from different schools. Half of the PLCTI2n teachers lived in Krakow city and the other half of the teachers lived and worked in small towns or villages outside of the city and travelled for the course workshops, with travelling times between 1.5 - 9 hours each way.

The UJ PLCTI2n group of teachers began with eight participants (seven females and one male), four of the teachers were teaching physics, one was teaching physics and informatics, one was teaching physics and chemistry, one was teaching biology, and one (the male teacher) was a pedagogical advisor. During the course three female teachers of physics resigned at different stages and for different reasons, and after the second PLCTI2n meeting one more physics teacher working with learners with special needs joined the group. So at the end of the second iteration, the group of novices consisted of six teachers. Three teachers from the final group of six teachers had already been involved in the European SAILS project and one had participated in national Akademickie Centrum Kreatywności (ACK) project, so all four of them had been familiar with Inquiry-based Learning (IBL) method prior the beginning of 3DIPhE course. The other teachers had never heard of IBL. These teachers had heard about PI for the first and only time during the 3DIPhE Multiplier Event in March 2019 (eight participants) and the First Congress of Physics Teachers (two participants). So all of these teachers were motivated to join the project by the presentations from coaches and teachers from PLCTI1.

In April 2019, when the PLCTI2n course started, the educational system in Poland comprised of schools at three educational levels: primary school (six grades, ages 7-13, compulsory), lower secondary school (three grades, ages 13-16, compulsory) and upper secondary school (three grades, ages 16-19, not obligatory). However, during the 2018/2019 school year, the Educational System in Poland underwent reform to include a new grade, 7th grade, in the primary schooling system. When the PLCTI2n continued in the school year 2019/2020, the lower secondary schooling level ceased and since this school year the Educational System in Poland comprises of only two levels - primary school (eight grades, ages 7-15, compulsory) and secondary school (four grades, ages 15-19, not obligatory). As a consequence, many teachers in Poland, including the novice teachers in PLCTI2n, had to change schools or to prepare their teaching for extended grades in their school over Summer 2019. Thus the same teacher might report working in A type of school in the Baseline Pre-survey, but work in a B type of school in the subsequent school year.

Nine participants were involved in the second iteration, one teacher was employed in a primary school, three teachers were employed in lower secondary schools, two others at upper secondary schools and two others were employed in both types of schools. All of the teachers worked in mixed-gender schools. One participant was a former physics teacher currently employed as pedagogical advisor. Two of the teachers taught just physics, while the others all taught physics along with other subjects, e.g. computer science and mathematics, computer science and technology, chemistry and science or computer science. One of the teachers did not teach physics at all and was a biology, chemistry and computer science teacher.

The teaching experience of five of the teachers was longer than over 20 years, for two others it ranged from 11 to 20 years and one of them had less than 10 years of school work experience. The final group consisted of five women and one man. One teacher worked in primary school, two of them in lower secondary school, one in both, the lower secondary and high school and two others only in the high school. It is worth mentioning that this description was valid only at the time of filling out the baseline questionnaire, since two months later the lower secondary schools stopped due to the educational reform in Poland as noted previously.

The participants reported that during the lessons they tried to show the context of phenomena they talked about. In their work, the teachers used experiments, demonstrations, group work, lecture, brainstorming, computational tasks, individual work and multimedia materials. The challenges indicated by the teachers when teaching physics included:

- not enough equipment for doing experiments in the school
- no time to prepare experiments before the lesson (a demand for taking break-duties between lessons)
- overloaded curriculum, too few physics hours per week
- lack of students' motivation
- lack of adequate equipment to conduct high-level experiments

All teachers agreed that it is important to use practical activities during lessons, however one of them expressed that they did not feel comfortable implementing practical activities. Most of the teachers understood what was meant by Inquiry-based Learning (IBL) but reported that they did not use IBL method regularly. Only two of them answered that they were confident using IBL during lessons. All respondents were strongly motivated to try different or new approaches to teaching. Only two teachers agreed that students learn content knowledge when they take part in IBL activities, all other teachers were not sure about it. Six teachers were sure that their students develop skills and competences during IBL lessons. All teachers strongly agreed that students are very much motivated to learn when they design their own experiments, draw their own conclusions and collaborate. Only one teacher disagreed that students were more motivated to learn when they analysed their own data.

The teachers indicated that they regularly self-reflect on their practice but they were not sure if they were able to identify effective teaching approaches. Only three of them admitted that they encouraged peers to give feedback on their teaching. In general they did not ask students for feedback on their teaching. Five teachers believed that their inquiries into their own practice could inform and support other teachers in their practice and be helpful at school level.

In this case study a detailed overview of the course and facilitator reflections will be presented. It will also provide a rationale for some of the course activities which will be supported by learnings from the first iteration of the 3DIPhE project.

## Overview of Course

The PLCTI2n course was led by two coaches from 3DIPhE project, one employed at the faculty and one being a PhD student. PLCTI2n was the second group of teachers that these coaches facilitated in PI and development of a PLCs. One coach had a 13y experience in carrying workshops on IBL with teachers and pupils at all levels of schooling, including training in three European projects: Fibonacci, SAILS and Akademickie Centrum Kreatywności (ACK). Both coaches participated in C1 course in PI for coaches provided within the 3DIPhE project and one of them additionally participated in two other courses on PI carried out in Linpilcare ERASMUS+ KA2 project. All teachers participated in the meetings voluntarily, during their free time on Saturdays. In fact they preferred workshops on Saturday to workshops on other days, because most of them had to travel a long distance to participate in the project.

Workshop Details	IBL	PI	PLC
<b>WS1: Duration 6 hours (7 participants)</b> 1. Introduction to 3DIPhE (project process, aims and objectives) 2. Quick presentation of yourself - teachers and coaches 3. Presentation: <i>Farming vs Gardening</i> 4. Protocol: <i>Farming vs Gardening</i> 5. Protocol: <i>Passions protocol</i> (development of PI) 6. Wonderings ripped by passions- list of 8 7. Presentation: <i>Introduction to IBL</i> 8. Physlets and Tracker Workshop	       ● ●	   ● ● ● ●	 ● ●     
<b>WS2: Duration 6 hours (7 participants)</b> 1. Baseline Questionnaire 2. Protocol: <i>Compass Points</i> 3. Presentation: <i>Research in PI</i> 4. Protocol: <i>Choosing the right question</i> 5. Peer review of research questions 6. Survey on Tracker Workshop 7. Inquiry - in short 8. IBL module - Spectroscope - presentation 9. IBL module - Spectroscope - unit	     ● ● ● ●	   ● ● ●   	 ● ●     
<b>WS3: Duration 6 hours (8 participants)</b> 1. Professional Learning Community - survey 2. Protocol: <i>Consensogram</i> 3. Two dimensions of Inquiry - presentation 4. Protocol: <i>Litmus Test</i> 5. Mind map 6. IBL module - Friction 7. Developing IBL skills - part 1: Brainstorming presentation 8. Protocol: <i>Developing IBL skills - part 1 : Brainstorming</i>	     ● ● ●	   ● ●   	 ● ●     
<b>WS4: Duration 6 hours (6 participants)</b> 1. Quick presentation of your professional activities 2. Data collection in PI - presentation 3. Protocol: <i>Easy ways to collect data</i> 4. Analysing Data of IBL Class observation - activity 5. Protocol: <i>What? So what? Now what?</i> 6. Designing your PI plan 7. Peer review of PI plans - 1 8. Development of IBL unit - presentation 9. Developing IBL skills - part 2&3: Formulating a research question & designing an IBL experiment - presentation 10. Protocol: <i>Developing IBL skills - part 2: Formulating a research question</i> 11. Protocol: <i>Developing IBL skills - part 3: Designing an IBL experiment</i>	   ●   ●  ● ● ● ●	  ● ● ● ● ●	 ●      

<b>WS5: Duration 6 hours (6 participants)</b> 1. Protocol: <i>Data Driven Dialogue</i> 2. Qualitative Data Analysis 3. Fine-tuning your PI plan 4. Peer review of PI plans - 2 5. Practicing IBL - inspirations for IBL units 6. IBL assessment tools - presentation 7. Protocol: <i>Developing IBL skills - part 4: Evaluation at the IBL</i>		● ● ●	●
<b>WS6: Duration 6 hours (5 participants)</b> 1. Teacher presentations. Critical friends' remarks during and after each presentation. 2. Teacher posters. Critical friends' remarks during and after each poster presentation. 3. Self-reflection Tool for Professional Development in IBL Teaching	●	●	●

For further details on the protocols referred to in the workshops please refer to Appendix B.

## Analysis and Reflections on Training Delivery

### Workshop 1

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

After a short introduction to the 3DIPhE project teachers briefly presented themselves to each other. Then in order to give the initial feeling about the PI, the *Farming vs Gardening* protocol was implemented. Teachers did not appear to have any difficulties in collaborating in groups. They discussed the issue promptly and together agreed on features of different kinds of crops. This simple protocol, depicting one of the goals of the project, helped to launch a PLCTI2 of novices and gave a boost to collaboration that would be very important in the next stages of the project. Subsequently the Passion protocol was provided to the participants. Although having some doubts about just one right choice, teachers quite quickly came to the conclusions of what would be the driving ideas of their inquiries in the 3DIPhE project.

Almost half of the teachers had previous contact with the IBL method, e.g. in the SAILS project, so only a short presentation on IBL cycle and levels was given during the first workshop. Subsequent *Physlet* and *Tracker* activities were organized. Tracker allows the use of ICT in teaching physics, which can be helpful even in classes that are not focused on science. It can also be used practically at any level of education. The workshop was delivered by a guest from the USA, co-author of Tracker and Physlets. It turned out to be surprising and very interesting for every participant, although some teachers struggled at the beginning with lack of their ICT competences and English (the report on delivery of the Physlet workshop was published in the article, Teaching with Physlets (Christian et al., 2020).

**Which elements of the workshop would you change if you were to repeat the workshop?**

We would prepare teachers in advance for the ICT workshop with a foreigner tutor. Most of them enjoyed and appreciated the workshop, but some of them struggled with English and/or lack of their own ICT skills.

## **What design principles for future workshops would you recommend based on your experience.**

During the implementation of the *Passions* Protocol, teachers need more time than planned. It should be noted that this is a new perspective and method for them and, especially teachers with many years of teaching experience may have a problem defining their passions.

We would recommend to devote time to all three parts: building PLC, designing PI and developing IBL teaching competences in every workshop. That approach was already proposed in the Case Study on PLCTI1, as a result of our experience during the first iteration, however in PLCTI2 group of novices it could be fully implemented over all workshops.

### **Overall reflections**

For the group of teachers participating in PLCTI2n, the purpose of the 3DIPhE project, its purposes and requirements were slightly more clear than for the PLCTI1 group. The reason might be that they had a chance to attend a conference summarizing the first iteration of the project. They saw examples of teachers' research projects that could be conducted in a Polish classroom. Still, many teachers were not aware of the huge number of small tasks they would have to go through during the course. They probably did not expect that during the course they would have to look at their work from many different perspectives. We observed that the group was well established from the very beginning. No one was left alone or showed up as a leader. The group started as a community of equal colleagues, willing to learn from each other.

## **Workshop 2**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

The meeting started with the baseline questionnaire session. Afterwards the compass points protocol was proposed as one of the steps for building the PLCT. Subsequently the coach presented an overview of the research in PI and the *Choosing the right question* protocol was implemented. After a break teachers peer reviewed their research questions, giving critical but friendly remarks and advice. The part on IBL started with the survey on Physlets and Tracker activities held in the previous meeting. Subsequently a short presentation on IBL was given and the teachers went through the IBL module on spectroscopy.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

We would provide the baseline questionnaire during the first meeting. Similarly to the course in iteration 1, we did not manage to administer this survey, however due to a different reason. It was not possible in this course, since during the first meeting the *Physlet* and *Tracker* session took quite a long time, but, definitely, it is better if the baseline survey is administered as soon as possible.

### **What design principles for future workshops would you recommend based on your experience.**

Choosing the right question is a process, and not the result of a one-time protocol. Teachers need to get the message that this first approach does not bring them the final PI research question and that it does not even have to. Teachers should take this first research question with them and should be given time of a month or two to think it over and adjust it to their own practice after a few steps of reconsideration. They need to be reminded that the research question should relate to the implementation of IBL. This approach had already implemented the course in iteration 1, and since it had worked, it was repeated in iteration 2.



## Overall reflections

The group started to build up very quickly. It was obvious that teachers wanted to collaborate and help each other. Teachers did not oppose any of the activities. One could feel the atmosphere of pursuing a common goal. An exemplary IBL unit was implemented as a starting activity for the part of the course about developing skills in teaching IBL, upcoming during the next meeting.

## Workshop 3

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

As the warming up activity a *Professional Learning Community* survey was implemented, followed by the *Consensogram* protocol related to this survey. The use of the *Consensogram* protocol allowed us to better understand the entire group and identify the problems teachers are confronted with in their schools. It is also a great tool for headmasters, who would like to know some details about the functioning of their schools. Teachers indicated that there was a lot of discussion in schools, but unfortunately not much about teaching itself, and not about problems or doubts related to it, but almost all is devoted to behaviour and pedagogical topics related to students. The problem is also that in schools it happens quite often that only one person teaches physics. Teachers do not really have time to talk to each other. The participants took up a long discussion about what it meant "high level" in relation to students. All agreed that it was very important to focus on particular students and their abilities. Teachers realized that one of many ways of carrying out a PI was to focus and do research concerning just one student. Teachers agreed that yet another problem was quite common - there was no time for an individual approach with a student. Teachers in Polish schools unfortunately do not make joint plans, e.g. in the field of STEM subjects. They do not have common materials. Common or related topics (e.g. in mathematics vs. physics) are not discussed interdisciplinary. Participants also raised a problem of teachers not interested (in general) to take part in workshops and conferences outside the school, and that individuals who decided to do so (like 3DIPhE participants), were often treated with a reserve in their schools. Teachers also noticed that it was very difficult to admit in front of other teachers that you had a problem or you did not have the idea how to deliver a topic. This long discussion helped to consolidate the PLCTI2 a lot.

After a short break a presentation *Two dimensions of inquiry* was given by one of the coaches to show similarities and differences between PI and IBL cycles. Subsequently the *Litmus Test* protocol was implemented. It occurred that many of the teachers adjusted or changed their PI research questions afterwards.

As an example of an IBL unit, the Friction module was implemented. At the end of the meeting the first part of *Developing the skills in teaching IBL* sequence of activities, namely the *Brainstorming* protocol, was implemented.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

During implementation of the *Consensogram* protocol based on the *Professional Learning Community* survey, the facilitator needs to be particularly restrictive about keeping the time. It turns out that analyzing the results in this protocol is quite exciting and engaging for teachers. They willingly share their experiences and describe different situations from their schools, which can easily turn out into a never-ending sequence of life examples. However these particular activities contribute enormously to the building of PLCT, so the time devoted for the discussion cannot be too short either.

## **What design principles for future workshops would you recommend based on your experience.**

It occurs that development of skills for teaching in IBL may not be based only on examples, even if these exemplary units are implemented in practice during the workshop and teachers engage in them playing the role of students. Coaches realized that at the end of the course in iteration 1, coming to the conclusion that it was also necessary to go with teachers through different elements of the IBL cycle, by making them take the role of IBL teachers and unit designers. It should be done in 4-5 steps. This way teachers have a chance to understand and “sense” the IBL method in portions.

The first step in such an approach is to ask the teachers to lead the brainstorming around a certain topic. It turned out that even those who declared in the survey that they conducted lessons in the IBL method, might have problems with the proper start of the IBL cycle. Asking students the right question and being a good leader during brainstorming could be a crucial step influencing the process of the next steps in the IBL cycle.

### **Overall reflections**

By conducting the *Consensogram* protocol which related to the questions about mutual support at the school level, teachers better understood the need to belong to a PLC group and why PLC is so important in the teaching profession. That is why during training it is extremely important to create good relations in a group in which everyone can feel safe and is not afraid to ask or say what they really think.

Implementation of the *Litmus test* protocol on teachers’ PI research questions gave them a new perspective and reassured them in their research question choices.

By playing the role of a teacher and a student alternately, when taking part in the IBL protocol No. 1, teachers not only gained a lot of inspiration and shared their experiences from schools at various levels, but also had a great time. They experienced how hard it was to lead a vivid discussion, but at the same time they admitted that going through it together encouraged them to try to implement the IBL initial brainstorming in their classes.

## **Workshop 4**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

In this workshop we planned a lot of activities on PI and IBL, so the building PLCTI2 part was quite short and scheduled at the beginning of the session as a warming-up activity. Subsequently a [presentation](#) on data collection in PI was given by one of the coaches. Afterwards a protocol *Easy ways to collect data* was introduced. Two remarks were given by the teachers. For most of the proposed data collection tools teachers pointed out one problem - time allocation.

Some of the teachers, as a part of a research plan in 3DIPhE, took photos during lessons in the trial classes, which turned out to be helpful in creating notes, but also in analyzing the situation in groups. Thanks to the pictures, they could also see the details they were not aware of during the lesson. So they all agreed that taking photos or recording the videos was supportive evidence for their PI, not too much time-consuming.

Since in many PIs the teachers deal with loose comments, observation notes or student responses in open-ended survey questions, we wanted to help teachers get experienced in handling such a sort of data. An activity related to the analysis and categorization was offered to them. The data was a collection of notes taken by the observers of

the lesson conducted in the IBL methodology during some other training prepared by the coaches. It was a very good exercise, showing that the same data could be analyzed from different perspectives, depending on what the teacher wanted to examine. The greatest discussion was carried out by the teachers inventing the names of the main categories for observation instances given to them.

Subsequently the protocol *What? So what? Now what?* was implemented. After a very short round on clarification of the research questions, all participants had ready-to-implement research questions in their hands. We asked them to write down on large sheets of paper their research questions and a general outline of what they would like to investigate and how they want to do research. Each teacher had an idea on how to collect their data, but a short session of critical friends' remarks enabled clarification of the details and resolved the doubts teachers had about their PIs. As data collection tools teachers planned in their projects: observations, photos, surveys, reflection diaries, interviews and tests.

The next stage was a further development of skills in teaching IBL. A short presentation on development of an IBL unit was given and followed by two protocols: 1) on formulating a research question and 2) on designing an IBL unit plan. Teachers worked in two groups. It was observed that teachers had problems with considering students' independence when designing the part in which students were supposed to plan and perform the experiments. Teachers had a lot of doubts about experiments done solely by students, and were concerned about the content knowledge acquired during IBL lessons. An additional problem pointed out was, again, time allocation and curriculum demands. Teachers said that they did not have the suitable equipment at school. While discussing the design of IBL experiments, the coaches tried to propose simple solutions that did not require specialized equipment.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

In this meeting we were a bit too much in a hurry. So the next time we would probably move the protocol on formulating a research question in IBL unit to the previous session.

### **What design principles for future workshops would you recommend based on your experience.**

Delivery of development of all three parts of 3DIPhE teacher training in each training session worked for the teachers, coaches and the purpose of the course.

Even teachers a bit experienced in IBL implementation in their own classes, really appreciated the idea of going step by step throughout the entire IBL cycle with use of a series of protocols developing skills in teaching by inquiry. After this session they admitted that usually they had taken ready-to-use IBL modules and implemented them in their classes, however mastering in IBL teaching should go through a procedure of the design of each part of the IBL module, preferably in collaboration with other teachers. This way teachers shifted from a copy/paste mode to the authorship and thus to the learning ownership mode.

### **Overall reflections**

The PLCTI2 group of novices had greater ease in preparing research questions and research plans compared to PLCTI1. We believe that was so, because this group had seen during the SME several vivid examples of PI research questions and studies implemented by other teachers in Polish school settings.

A lot of data collection methods were elaborated during this workshop. Some teachers might feel overwhelmed with them. We need to remember to remind them all the time that PI is a small-scale study, for which not too many methods of collecting data at the same time are needed. This enables us to get rid of the arguments related to the lack of time.

Teachers need to remember that when they plan experiments with students the care of a fair test should be taken. Learners usually know it, but sometimes it is inevitable that they would like to change different parameters at the same time. Planning an investigation in the IBL process is often the most difficult part for students. And an ill-considered experiment can lead to chaos and discouragement.

## Workshop 5

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

This workshop was mostly devoted to presentation and experience of qualitative data analysis and fine-tuning of the PI plans. We started with the data-Driven Dialogue protocol and qualitative data analysis protocol. Subsequently teachers did some last changes to their PI plans on the sheets of paper showing the plans, prepared in the previous workshop.

Some teachers were ready to outline the tools for data collection in their PIs. All of them had already fully or partially implemented these tools and finished collection of data.

UJ-T18 was the only one that came to the meeting with a completed PI and presentation. However she failed a bit with data analysis, most probably because she did it on her own and before it was elaborated during the fifth 3DIPhE workshop. Nevertheless an activity of the feedback given by critical friends allowed her to look at her PI from a different angle and come back on the track. UJ-T11 was already halfway in her PI. UJ-T16 had two PI questions, collected evidence to support both of them, but did not decide which one would be chosen for her final presentation. Since UJ-T15 was not employed at school anymore, he conducted his PI in a class taught by one of the teachers from PLCT1. This situation forced him to change his initial research question. UJ-T17 slightly modified her research question, taking into account remarks from other participants received during the preceding workshop. However she did not start any data analysis yet. UJ-T13 was absent due to private reasons.

During this workshop some of the teachers made substantial changes, some others alternated their plans only slightly. The updated plans were exhibited on the walls for peer review on a forum, which was a very important part of the workshop. Instead of any protocol for building the PLCT we proposed a longer than usual coffee break in a non-formalized format. The IBL part started with a few exemplary investigations provided in a structured IBL as a kind of inspiration, easy to adapt to guided or even open inquiry. Subsequently a presentation on IBL assessment tools was given by one of the coaches. And finally the fourth protocol on developing the skills in teaching with use of IBL was implemented in two groups.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

The idea of prolonged coffee break was good, since the teachers had already established a good, consolidated PLCT. However next time we would like to change this particular activity into a more formalized one, e.g. World Cafe protocol.

### **What design principles for future workshops would you recommend based on your experience.**

It is very much important that care should be taken of the PI of every participant. Each teacher works at his/her own pace and sometimes they get lost at the point where PI seems to be well set. This happened twice per iteration of 3DIPhE courses, so in fact for  $\frac{1}{3}$  of teachers in Poland. However if the PLCT is well consolidated by the moment the teachers should have their plans almost ready, the rest of the group willingly helps those lagging behind in a

constructive manner and a friendly atmosphere. Indeed, in both PLCTI1 and PLCTI2 groups of novices, after the fifth workshop all teachers felt secured and ready to complete their PIs, also those lagging behind just a few hours before. That is why it is so very important that during the four preceding workshops enough time is devoted for building PLCT.

### **Overall reflections**

The activity of peer-review of PI plans turned out to be the most important element of the whole workshop, because, for example, UJ-T18 came to the meeting with an idea that she was completely unsuccessful with her PI already implemented and only during the discussion with peers she realized that actually her PI was very good and the only problem was her misinterpretation of the results. Some teachers during their PI stuck to their own (sometimes very much fixed) expectations and cannot pass the threshold of relying on evidence. Coaches should be aware of that and sensitive to this problem.

The peer-review halfway of PI implementation assured that teachers will meet the goals. Some of them were lost with data interpretation, some others with a choice of the final research topic, yet others - a bit stacked with too much data and constrained by their own expectations. All these issues were solved in a friendly, but still constructive discussion in the forum.

It turned out that PLCTI2 group of novices was more advanced in technical aspects of PI presentations than PLCTI1 group a year before. This was due to the fact that most of PLCTI2 participants taught not only physics but also computer science.

During the activity on IBL assessment strategies teachers pointed out that Polish schools treat formative assessment with a serious self-constraint. Initially in participants' opinion the formative assessment was impossible during the regular classes. Only after explanation that formative assessment needs to be implemented to each student many times over the school year and thus during one lesson only a few students should be assessed this way, most of the teachers agreed that in fact they did it already in their classes, but in a less formal way without use of any specific tools (e.g. rubrics).

## **Workshop 6**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

That last workshop in the course was almost completely devoted to the PI poster and slide presentations given by the teachers as a rehearsal for their participation in ME6. At this moment the PLCTI2 (novice teachers) were already strong enough to engage in the open discussion on each presentation, giving friendly and constructive advice. So both pillars: PI and PLCT were strengthened in one long activity. We also talked a bit about teachers' participation in ME6 in Poland and participation of the selected teachers in ME4, ME5 and ME7, as well as in the final project conference.

To wrap up the IBL activities, we proposed a self-reflection tool on teaching in IBL adapted from Casulla et al 2012 (Tools for [Enhancing Inquiry in Science Education](#), S.B. Carulla (ed.), pp. 40-43).

### **Which elements of the workshop would you change if you were to repeat the workshop?**

This approach was already repeated twice and it worked for teachers who got more confident in their research results and the format of their presentations, rehearsing in a friendly environment. It also worked for coaches, since watching presentations and having the chance to ask additional questions, they learned in detail about the final results of the PIs.

## What design principles for future workshops would you recommend based on your experience.

Presentation of the PI outcomes followed by discussions within the group and with the presenter form together an indispensable part of the course. Teachers learn from each other how to improve the content and the format of their presentation and how to behave like a critical friend. They also get feedback on advancement of their IBL approach in the classroom. Such an approach is a capstone of the entire course based on three core parts - PLCT group building, development of PI competences and development of IBL skills. Being unavoidable, the session encourages teachers to fulfil the project tasks and prepare reports on their PI on time. Inclusion of this presentation session develops also teachers' IT skills.

### Overall reflections

After this session some of the issues still remained to be solved, but we got the confidence that teachers understood the PI cycle, fulfilled their PIs in IBL lessons and got interesting results, relevant to other teachers. Participants appeared to the coaches to be ready for giving presentations to the broader audience from the outside of the project.

## Participant Reflections on Course

Only six teachers took part in the final survey. All of them agreed that practical work during learning is important and they don't find it difficult for students and their own as facilitators. In their opinion IBL is an effective strategy to motivate students to become interested in physics. All respondents said that they are motivated to try different approaches when teaching and after course they have used IBL more frequently. Teachers, however, are still not fully convinced whether students learn content knowledge when using the IBL method. But they strongly agreed that big impacts on students' motivation to learn physics have: practical work, designing their own investigations, analysing their own data, drawing their own conclusions and during collaboration with others. All teachers understand what is meant by PI, they know how to use it and they plan to do PI in the future. All of them also say that they would recommend PI to other teachers. In the context of group PLC teachers answered that they are open to collaboration in future. All of them felt comfortable working in PLC but one of them said that she wasn't confident in sharing her practice with others. They also said that working with this group helped them to learn about their practice. All teachers would like to lead a PLC in their schools, but they wouldn't like to do that outside of their schools environment. In the open part of questionnaires we asked about activities in the course which were most beneficial in preparing them for PI.

Teachers pointed out, among others:

- practical classes when we discussed and projected PI research questions, methods and analysis;
- presentation plans of research by other teachers was very interesting
- analysis of preliminary PI results with others participants and coaches

Regarding the changes in the general approach to teaching after the course, they have indicated:

- acquiring the ability to construct lessons using the IBL method
- permanent inclusion of IBL lessons in their timetable
- self-realization as a physics teacher
- continuing a self-study
- asking oneself questions like "why" in order to build the basis for teaching
- more independent work of students during lessons
- agreement for allowing mistakes during putting the hypothesis and not correcting them ex cathedra
- giving the students less detailed instructions
- more students' involvement and independence in: brainstorming, discussions, data analysis, design of investigations

Five teachers (UJ-T11, UJ-T15, UJ-T18, UJ-T13, UJ-T17) took part in the Focus Group. Teachers said that above all during the course they learned that they could approach their work in a completely different way than before. The research approach gave them the opportunity not only to verify their work, but also to see the results of other participants. They also learned that one cannot ask himself/herself too many questions at once, and that the question could not be too general. An additional aspect for teachers was learning to cooperate in a PLC and learning interesting ways to integrate the learning community.

When asked about expectations for the course and why they decided to join the PLCTI2 of novices, UJ-T11 replied: *I didn't really know anything because I only got a leaflet during the First Congress of Physics Teachers in Łódź and I just wanted to know more.* Other teachers decided to join the second iteration after the final conference, at which teachers from PLCTI1 presented their research. UJ-T13 added that despite the fact that she had already experienced IBL beforehand, it was important for her to motivate herself from time to time by participating in IBL workshops again. And *meetings with creative people are very helpful.*

Regarding the format and the method of conducting the course, as well as changes proposed to the course delivery, the teachers replied that both the format of the course and the way of delivery was appropriate for them. The positive aspects also included: the atmosphere and meeting dates tailored with care of each participant (via Doodle).

Everyone admitted they felt good in the group. They were pleased that everyone was given enough time to speak, express themselves and receive merit comments about their questions or doubts. It was important that the UJ-T18 joined the group (although a bit later) and yet, as she said, she was very well received. One teacher added: *Thanks to the use of protocols, it was easy to make contact among participants after the workshops.*

In the subsequent part of the conversation, teachers were asked how they understood the approach based on PI and what pros of conducting such a research they could indicate. UJ-T11 said that such an approach was missing in their work earlier. However, the teachers also noticed that it was an additional difficulty to work on soft skills to which they were not accustomed. The teachers also agreed that thanks to the project they changed not only the way of conducting lessons, but also their attitude to teaching. Everyone thought PI could have a good effect on their teaching practice at school. They admitted they could explore some problems globally and find common answers to questions not only related to a specific subject.

Unfortunately, UJ was unable to organize the ME at the end of the PLCTI2 course, but some teachers had the opportunity to attend conferences at other partners' institutions. When asked about their experiences and perception, they answered:

UJ-T11: *It was fantastic, I only regret that this trip was so short that there wasn't much time to talk to everyone about the presented PI research. I learned a lot, I had many questions for each presentation, the conference in Dublin had a chastening effect on me. I am thankful that I could go there.*

UJ\_T17: *It was great. The people I met were open and willing to discuss experiences. During the conference, it turned out that in other educational systems the collaboration between subject teachers is a standard and any teacher can consult an expert in their field.*

Among the difficulties encountered during the course, the teachers mentioned: changing the approach to teaching physics, fitting in the 45-minute lesson with IBL approach and PI, asking the right PI question.

Teachers said they would gladly see an IBL lesson in school practice as a part of the course. UJ-T18 added that she would gladly organize one meeting in her school - that the whole group of teachers could go through such a path.

All participants are planning to use PI in their practice. They are also willing to cooperate further not only as part of PLCT but also as coaches. Everyone would recommend the course to other teachers.

## Reflections on Multiplier Event

Due to the pandemic of COVID-19 UJ could not organize the Multiplier Event (ME6), since the university was closed a few days before the event was scheduled. All six teachers prepared well in advance for the ME6 in Krakow by preparing posters and short presentations, so all of the participants regretted not being able to present their work to the external audience.

However three teachers from PLCTI2 took part in one of each partner MEs. Two of them presented a poster (UJ-T11 in ME4 and UJ-T5 in ME5) and one of them presented a poster and gave a short presentation (UJ-T17 during ME7).

Teachers willingly participated in workshops and discussions, expressing their opinions and sharing their experiences. For them it was a great opportunity to meet teachers from other countries and learn about their implementation of PI as well as country-specific school settings. One of the teachers (UJ-T11) hooked up with a teacher from Slovenia during ME4 organized in Ireland; they started to plan common activities in the future.

## Key Learning and Recommendations for Design Principles:

1. We suggest that all workshops in the course should be devoted to 3 course elements, constituting the 3DIPhE pillars: 1) building the PLCT group, 2) development of PI competences, and 3) development of the competences of teaching with use of IBL.
2. The 3DIPhE course should be dynamic. Time devoted to different 3DIPhE pillars should not be distributed equally though. At the beginning of the course, special attention should be paid to build the PLCT and work with IBL good examples of learning units. In the middle of the course, much more time can be anticipated to activities on development of PI competences, IBL should be addressed not through examples, but in a systematic approach of development of skills in teaching IBL, and for maintaining building the PLCT only short activities may be proposed. At the last stage of the course, activities based on trust and openness built so far in PLCT are proposed (critical friends discussions). At this moment more time is devoted to wrapping up the PI cycle.
3. Care should be taken to a systematic approach to developing skills of teaching in IBL. The method is so demanding that even teachers experienced in IBL should take part in a new activity, serving as a reminder ordering element. In the first iteration of working with the group this part of the workshop can be delivered more in the manner of experiencing different IBL units, taking the role of students. In the second iteration (or in the second part of the first iteration of the course) a systematic approach to develop teaching skills in IBL method should be implemented in a series of protocols.
4. The protocols proved to be useful and effective tools for PLCT group building and development of PI skills in teachers. We suggest that the time anticipated in protocols as well as training schedules to be a bit flexible. If more time is needed e.g. for discussion, then additional time must be secured, since the overarching aim should be the development of teachers' competences and PLCT group building, not rigour of the protocols and time.
5. We suggest keeping an eye on the engagement of all teachers. If somebody lags behind, a Skype meeting or phone call to talk one-to-one can be proposed to the teacher. Some teachers need personal refinement of the goals or rules, some others - encouragement. It is better to learn in advance if teachers have enough IT skills to design and prepare the posters and the presentations on their PI.



6. An overall approach from workshop to workshop: "a big steps forward, one small step back to refine the research plan" seems to work the best for the PI development process.
7. Circulation of the materials used in workshops should happen immediately after each meeting with the teachers in order to enable the teachers to come back to the issues raised during the workshops. Teachers need to have the opportunity to reflect in order to move on effectively.
8. The last workshop devoted to the presentations of the PIs outcomes followed by discussions within the group and with the presenter is an indispensable part of the course. Teachers learn from each other how to improve the content and the format of their presentation and how to behave like a critical friend. They also get feedback on advancement of their IBL approach in the classroom. Such an approach is a capstone of the entire course based on three core parts - PLCT group building, development of PI competences and development of IBL skills. Being unavoidable, the session encourages teachers to fulfil the project tasks and prepare reports on their PI on time. Inclusion of this presentation session also develops teachers' IT skills.
9. The organization of the ME sets a deadline to the teachers and encourages them to work according to the course schedule, not lagging behind at any point. In our opinion the ME the format of: 1) short presentation of the project and its principles, 2) oral presentations given by teachers, 3) coffee break with a poster session, 4) IBL workshops, suits the project best. We would recommend it for the future courses.



# Dublin City University Ireland Case Study

**James Lovatt,  
Paul Grimes and  
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## Introduction

This case study reports on the implementation of a professional development course for second level science teachers facilitated by partners from Dublin City University (DCU) Ireland. The course, which is part of the second iteration of the Three Dimensions of Inquiry in Physics Education (3DIPhE) Erasmus+ programme was designed to develop teacher's competencies and understanding of Practitioner Inquiry (PI) and Inquiry Based Learning (IBL) through engagement in a Professional Learning Community (PLC).

## Context and background

The course, which had five teachers who completed it fully was delivered during the period of September 2019 to February 2020. It involved 24 workshop hours, more than 10 implementation/independent learning hours and a nine hour sharing event where teachers presented the outcomes of their PIs to a national and international audience. The second iteration of the course consisted of five workshops and a two day showcase event. The initial plan for the implementation involved seven workshops however, due to teachers' location to the University and their resultant availability, four of the half day workshops were provided in two back to back full workshop days. This was a very different experience to the first iteration so the coaches had to consider how best to deliver the course with this amended structure.

There were five teachers who engaged for the full 3DIPhE course. Three of the five teachers have less than three years experience. The fourth teacher has been teaching for between 3-5 years and the fifth teacher has between 11-20 years experience. All of the teachers teach lower secondary science which in Ireland, includes physics, chemistry and biology. Only two of the five teachers were qualified to teach upper secondary physics. Some of the teachers indicated that their lower confidence in physics teaching was one of the reasons they joined the project.

The teachers perceive practical work as an important aspect of their work. They have experience using investigations, demonstrations and inquiry based learning and believe that students can learn knowledge and skills through practical work. However, within the group there were mixed levels of confidence regarding facilitation of practical work which might be explained by the range of teaching experiences. All of the teachers noted that they understood Inquiry Based Learning approaches and they had a positive disposition towards the approach. They all felt that practical work motivated their students, though there were mixed responses when asked if students were motivated to design their own investigations or analyse their own data. All of the teachers were motivated to try teaching different approaches which possibly explains their engagement with the project. They were eager to enhance their teaching, open to sharing practices and regularly reflect on their teaching. Interestingly teachers didn't appear to ask their students for feedback on their teaching and all of the teachers noted that they had limited opportunities to provide and engage in peer feedback.

In this case study a detailed overview of the course and coach reflections will be presented. It will also provide a rationale for some of the course activities which will be supported by learnings from the first iteration of the 3DIPhE project.

## Overview of Course

The PLCTI2n course was led by three coaches from 3DIPhE project, with all three employed as academics and involved in STEM teacher education in the University. PLCTI2n was the second group of teachers that these coaches facilitated in PI and development of PLCs. All three coaches had participated in C1 course in PI for coaches provided within the 3DIPhE project and one of them additionally participated in another course on PI carried out in Linpilcare ERASMUS+ KA2 project. All teachers participated in the meetings voluntarily, during their free time on evenings/Saturdays. In fact they preferred workshops on Saturdays or other leave days, because most of them had to travel to participate in the project.

Workshop Details	IBL	PI	PLC
<b>WS1: Duration 5 hours (4 participants)</b> 1. Baseline questionnaire 2. Introduction to the 3DIPhE Project 3. Protocol: <i>Different cultures/getting to know each other</i> 4. Protocol : <i>Conseogram activity to learn about participants context</i> 5. Protocol : <i>Passions</i> 6. IBL Activity: Questioning 7. Protocol: <i>Silent Chalk talk</i> and Protocol: <i>Farming vs Gardening - Research vs PI</i> 8. Protocol: <i>Choosing the right question</i> 9. Workshop Reflection 10. Next steps and planning	● ●  ●	● ●  ● ● ● ●	● ● ● ●  ● ●
<b>WS2: Duration 5 hours (6 participants)</b> Review of WS1 1. Protocol: <i>Compass</i> 2. Protocol: <i>Litmus Test</i> 3. Introduction to Data Collection 4. IBL Activity - Speed 5. Analysing Data Activity using Protocol: <i>Developing data analysis skills for a PI</i> 6. Refining Question 7. Next steps	●	● ● ● ● ●	● ●  ●
<b>WS3: Duration 5 hours (4 participants)</b> 1. Reflection on WS2 2. Protocol: <i>Zones of comfort</i> 3. Protocol: <i>Manual for an Inquiry Brief</i> (adapted for use on Google Drive) 4. IBL Activity: Presentation and Subtle Shifts (shadows) 5. Protocol: <i>Attributes of a learning community</i> 6. Peer review and refinement of inquiry question 7. Protocol: <i>Zones of comfort - revisited</i> 8. Next Steps	● ● ●	● ● ● ● ● ●	● ● ● ● ● ●
<b>WS4: Duration 3 hours (2 participants)</b> 1. Report on data collection, analysis and making inferences using Protocol: Data Driven Dialogue (Phase 2,3,4)		●	

<p><b>WS5: Duration 6 hours (5 participants)</b></p> <ol style="list-style-type: none"> <li>1. Introduction to poster template</li> <li>2. Making a poster with peer feedback and data analysis support</li> <li>3. Refining poster</li> <li>4. Preparation for sharing</li> </ol>		<p>● ●</p>	<p>● ●</p>
<p><b>WS6: Duration 9 hours (23 participants) (LME)</b></p> <ol style="list-style-type: none"> <li>1. Introduction to multiplier event</li> <li>2. Plenary of teacher projects</li> <li>3. Poster session</li> <li>4. Round table discussion</li> <li>5. Certificates</li> <li>6. Introduction to day 2</li> <li>7. Poster session</li> <li>8. IBL parallel workshops x 2</li> <li>9. Poster session</li> <li>10. Practitioner Inquiry workshop</li> <li>11. Education Design Research</li> <li>12. Closing</li> </ol>	<p>●  ● ●</p>	<p>● ● ● ● ● ● ● ●</p>	<p>●  ● ●  ●</p>

For further details on the protocols referred to in the workshops please refer to Appendix B.

## Analysis and Reflections on Training Delivery

### Workshop 1

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The first workshop of the second iteration of the 3DIPhE project was held on a Saturday in mid-September 2020. The workshop was planned for a full day (5 hours). It was intended that within the workshop the teachers would engage in a variety of activities that related to the three core elements of the 3DIPhE project, namely practitioner inquiry (PI), professional learning communities (PLC) and inquiry based learning (IBL). In the table below a list of the activities included are listed. In this section, a detailed description of the activities and the coaches reflections on their implementation is provided. There were four teachers present at the first workshop. This was less than expected as more teachers had committed to engaging in the project. This was a slight challenge to the coaches as some of the activities had to be modified based on the reduced numbers. The need to be flexible and to adapt to changing numbers and needs of teachers was a learning from the first iteration. Informal introductions were held as this stage, the teachers were given recyclable cups as a gift for participating in the project and we all shared some refreshments. Teachers briefly shared their backgrounds, the schools they were teaching, where they went to college, subjects they were teaching etc.

**Activity 1: Baseline survey - used to introduced PI, PLC, IBL (Approx 30 mins)**

Following on from the refreshments. Teachers were asked to complete a baseline survey which asked questions on practitioner Inquiry, professional learning communities and inquiry based learning. A summary of the findings from this survey have previously been presented. In addition to ascertaining background information on the teachers experience, the survey was used to introduce them to some of the ideas and terminology that they would encounter during the workshop and throughout their engagement in the 3DIPhE project. In later workshops the teachers learn that data collection in practitioner inquiry is usually gathered as a natural part of classroom activities. By ‘modelling this practice’ i.e. using the baseline survey as an activity to help introduce the project the coaches hoped that the teachers would better understand how data can be gathered when they are conducting their inquiries. This approach was also a learning from the first iteration.

**Activity 2: Project Introduction (15 mins)**

In this activity the coaches introduced the project. Direct links were made to the questions on the baseline survey during this introduction. In the evaluation of the first iteration of the 3DIPhE project, teachers had noted the importance and need for information on the project so they had a clear understanding of what they were doing and what were the intended outcomes. With this in mind, the introduction was expanded and better contextualised compared to the first iteration. Teachers were provided information on the origins and rationale of the project. Specific reference was made to EU and National reports which emphasized the importance of teachers in the renewal of science education, the need for teacher networks and inquiry-based methods to increase student interest in science. It was noted that many EU projects (SAILS, Establish, Pathway, Fibonacci) had been implemented to support these intentions but that it is often observed that outputs of these do not continue and spread beyond their lifetime. In this regard, the concept of professional learning communities and practitioner inquiry were introduced as a strategy to support sustainable professional development of teachers which has students and teachers as professionals at their heart. For the Irish context, this was further contextualised in relation to the Teaching Council of Ireland's framework for teacher education and their funding of research that involves teachers as professionals and reflective practitioners. Building on this the core aspects (PI, PLC and IBL) were introduced in the context of the 3DIPhE project. This overview included, information on the EDR framework, the intended outcomes of the project and discussion on the course content.

**Activity 3: PLC Building activity - Icebreaker (15 mins)**

The third activity of the workshop was a short PLC building activity using the getting to know each other protocol. The teachers were paired with someone they didn't know well. They were asked to introduce each other and note three things about each other. They then had to report back to the main group on what they had learned. They were specifically asked to gather information that was beyond typical introductory questions such as where you live, where you work etc. The aim was to learn something different about their peers that would help the creation of the community. This idea to move away from school discussions worked really well. The teachers shared interests such as music, cars and some found out that they had similar family friends without knowing it beforehand. Later in the workshop teachers were overheard talking more about some of the information that was shared. This was evidence that the activity had helped to start building the community. Furthermore, based on learnings from the first iteration of the project, the coaches partook in the activity as equal partners. This was done to emphasise that all involved in the project are part of the learning community.

**Activity 4: PLC Building activity - learning about teachers contexts and practice (30 mins)**

A *Consensogram (Irish Version)* protocol was used as a strategy for teachers to share information about their contexts. The first question asked questions about their school context. It enquired about collaborative practice, collegiate dialogue, beliefs and pedagogical practice. The second and third questions built upon the baseline survey and asked questions about IBL experience and awareness and openness to PI. This was a very useful activity for teachers to learn more about each other and their working environments. It was clear from the results of the

conseogram that different cultures are opperting the their respective schools which they identified was highly influenced by management. This led to a sharing of ideas on how schools could encourage more teacher learning. The teachers noted that they understood IBL but were not fully confident implementing it in practice. They generally all felt open to enhancing their practice but felt there were limited structures or opportunities in place to enable this. Interestingly, they expressed delight that all in the group were open to sharing and working on practice but they wondered if the same results would be repeated if the conseogram was conducted in the schools. The key takeaway from this activity was the sharing of practice and ideas. One learning that emerged from the facilitators perspective is to know when to interject and keep the focus positive and linked to future actions. There is real danger that this activity could turn negative so careful facilitation is very important.

#### **Activity 5: PLC Building Activity - Passion I (30 mins)**

The fifth activity of the workshop was another PLC building exercise in that it involved teachers identifying and sharing their passion about education, teaching and learning. In addition to developing a sense of community the activity was the first stage in helping the teachers to think about a possible area in which they would focus their PI. The activity followed a protocol developed in the EU linpilcare project. For this iteration, the teachers' passions interestingly fell into two categories only, namely; Content Knowledge and Teaching Strategies. They were interested in:

- How to evaluate their teaching methodologies - are they effective?
- How to use certain strategies e.g. demonstrations, effective questioning?
- How to use consistent and precise language and how to avoid misconceptions
- How much to teach students on given topics (broad vs narrow)
- The link between teacher content knowledge and student learning

The act of engaging in a prescribed protocol was intended as an additional approach to developing the community. Teachers had to act as timekeepers, notekeepers and group facilitators. In doing so they had to develop a working relationship with other members of the PLC. This in addition to the act of sharing what they are passionate about gives the teachers more insights into each other's backgrounds and interests. It is felt that this sharing increases the teachers' understanding of each other's perspectives which helps in the creation of the PLC.

#### **Activity 6: IBL - Guided/open and raising/turning questions (60 mins)**

The first IBL activity used in the course was one that aimed to develop teachers' questioning skills as well as modelling IBL approaches. The key learning was to be able to write investigatable questions. The activity chosen for this purpose was an adaptation of the [Exploratorium raising questions workshop](#) (Raising Questions, 2006). In our workshop, a plasma ball was used instead of ice balloons. Teachers had to come up with questions about the plasma ball, develop criteria for investigatable questions and learn how to turn general questions into investigatable questions. While it wasn't specifically mentioned at this time, specific focus of this aspect of IBL was emphasised as the skill of creating questions parallels that required in PI. In the first iteration of the project teachers noted they found the creation of their PI question difficult. As a result in the second iteration we tried to place more focus on the development of this skill. This was a really good activity again. While it was a little quiet at the start the teachers gradually became more confident as the facilitator prompted them. They generated lots of questions related to charge and voltage. A lot of these were yes/no questions as pointed out by the facilitator who then supported them to turn them into investigatable questions. Discussions on level of openness, differences between hypothesis and research questions, fair testing, physics concepts and the new Junior Cycle ensued. Teachers engaged well and a post-discussion reflecting on the activity and how it links to inquiry in the classroom seemed to help teachers in starting to make the link between PI and IBL. The facilitators also observed that the teachers were supporting each other through the task and they were not afraid to admit if there was something they were unsure of. The facilitators see this as evidence of the community feeling comfortable with each other.

### **Activity 7: What is Practitioner Inquiry? (30 mins)**

The focus of the next activity was to develop teachers' understanding of PI. In the first iteration, it was observed that the teachers' felt a little overwhelmed by the idea of PI and initially, the idea of engaging in research. There were also some uncertainties regarding quantitative and qualitative research and indeed the value of researching their own practice. In this activity we tried to address these issues. The *Silent Chalk talk* protocol was used to introduce and close this activity. This protocol is a silent activity where teachers write responses to given questions and write their responses on a board or piece of paper without any discussion. In this regard they focus on reading each other's comments and reflect on them. This activity also has a PLC building emphasis in that teachers learn about each other's perspectives and levels of understanding. The questions posed to teachers for the chalk talk were:

*What do you think Practitioner inquiry is?; What are you certain of; What are you uncertain of?*

After the teachers identified their initial perspectives on PI, they were provided with images of a garden and a farm based on the *Farming vs Gardening* protocol. They were asked to identify these as either academic research or practitioner inquiry. After some discussion about these they were presented with some notes on 'generalised' differences between the two, though it was emphasised that practitioner inquiry is considered a form of academic research but focuses more on case-study methodology using qualitative or mixed method where the findings are often not generalisable to the field unless repeated in multiple contexts. Following this the teachers were provided with some descriptors of PI from Cochran-Smith and Lytle (1993) and Dana and Yendol-Hoppey (2014). They were also given examples of PI questions to better demonstrate the type of work associated with practitioner inquiry. Finally, they were asked to revisit their initial chalk talk activity and to update or modify their responses. The activity concluded with a group discussion in an attempt to address any uncertainties regarding understanding of PI and the expectations of their input in the course. Reflecting on the session, it was felt that there was still some confusion between PI and other forms of academic research. This is somewhat influenced by the teachers previous perceptions of action research and unfamiliarity with qualitative research. It was felt that the use of previous examples of PIs conducted in the first iteration of the project were very helpful in setting the expectations of the project. There were some questions that asked how is PI different from IBL and how does a teacher properly evaluate their practice. One core message that teachers seemed confident on was that PI required a systematic approach to evaluating their practice and one saw it was an opportunity to scaffold the development of practice.

### **Activity 8: Passion II - Developing an Inquiry question. (30 mins)**

This activity built upon the earlier activity where teachers considered their passions. They were tasked to develop their own question linked to their chosen passion and had to address the following questions:

- a. Why this question is important to me
- b. How is this question relevant to teaching and learning in my classroom
- c. What direct connections to student learning can I identify
- d. Does the question feel too specific or too broad

Each teacher presented their question and peer feedback using clarifying questions, group discussion and reflection on what was heard. Each teacher had an opportunity to present and receive feedback. While all provided feedback on each other's question, it was interesting that one teacher noted that while listening to their peers' questions their mind wondered back to their own question and tried to relate what they were hearing to learning about their own inquiry. In some of the reflections, the teachers instead of helping their peers tweak or develop their inquiry question the discussion sometimes jumped to answering the question by sharing experiences. While this was helpful it wasn't the focus of the activity and good facilitation was required. In iteration 1 on the project it was noted that clarifying questions are extremely important and can be difficult to compose. Efforts were made to give this extra attention in the second iteration. Additionally, discussion on the link between questioning and the IBL activity completed earlier in the workshop were made explicit. This was to help the teachers better see the link between PI and IBL.



**Activity 9:** Reflection - What did you learn? What do you want more of? (15 mins)

A reflection was completed as the final active learning task of the workshop. Post-its were used as a strategy to help the teachers feel part of the PLC and to give them a voice in how the course was being delivered as well as an opportunity for them to digest and reflect on their learning over the five hours. They were asked to write down any statements or questions in relation to the following aspects:

*Use the posits provided to write down*

- a. any questions that you have*
- b. something(s) that you have learned*
- c. something(s) you would like more of*

In general the teachers were happy with the day and noted they would like to continue learning about PI and IBL. They noted that they felt they were doing PI when thinking about their classes but that they needed to learn how to make it more systematic and how to properly evaluate their practice

**Activity 10:** Next steps and planning (15 mins)

The workshop closed with an overview of the course it's planned, workshops and content. A discussion was held on how best to communicate and when to have meetings. At this time, the teachers requested to have full day workshops and not multiple half day workshops. This was largely linked to the distances that they would have to travel to visit the university. This was agreed. Additionally, one of the teachers took responsibility in creating a WhatsApp group for the community. It was felt that this being led by the teacher was a positive outcome and helped cement the idea that teachers and facilitators had equal status.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

In general it was felt that the workshop went well. The teachers engaged and were enthusiastic about the project. There was a good mix of activities and opportunities for the teachers to share their experiences and get to know each other. At different times during informal sessions, they were exchanging teaching ideas, discussing different approaches adopted in their schools and they were very open about areas they felt they were less confident about.

It was felt there was some confusion about PI and academic research. In future workshops the farmer vs gardner research activity would not be used. Decision on the merits of practitioner inquiry on it's own would be more beneficial especially supported by examples that were generated in the 3DIPhE project. This approach should give added value to PI in the minds of the teachers and also reduce any anxiety they may hold about conducting their own PI.

**What design principles for future workshops would you recommend based on your experience.**

In this workshop there were opportunities to embed and reflect on learnings from the first iterations. Based on this experience there are a number of practical advice / design principles that are recommended.

- There is a need to be flexible and to adapt to your changing environment such as changing participant numbers, time teachers want to share informal experiences etc. However, when making changes it is essential that the facilitators are fully aware of their learning goals and that the adaptations consider how the intended learning is still achieved or deferred for a later point. Hence, the planning of the course needs to be completed in advance and not session by session
- When using activities for teachers to get to know each other, it's a good idea to ask them to discuss something more personal such as hobbies. Moving it away from work better helps to develop the community.

- When using activities where teachers share their current practice it is important that the facilitators know when to interject and keep the focus positive and linked to future actions. There is real danger that activities like these could turn negative so careful facilitation is very important.
- It is important to allow teachers opportunities to share their passions, personal background and experiences. Knowledge of each other's perspectives and experiences better helps to develop understanding of each other which helps in the creation of the PLC.
- Using examples of previous project practitioner inquiries is a helpful approach to demonstrate the expectations of PI.
- Links between clarifying questions, IBL activities and PI need to be modelled but also made explicit by the facilitators to help make the link and demonstrate the transferability of the skill of questioning.
- Teachers in the courses should be given a voice so they can input and inform how the course is delivered, this gives a sense of responsibility, value and ownership which also supports the construction of the PLC.
- It's important in all elements of the workshop to help teachers link the intended learnings back to practice and ultimately their student learning.
- Facilitators need to always keep in mind the learning focus of an activity. Sometimes activities can drift and it's important for the facilitator to know when to bring teachers back on task even if the off task conversation is beneficial.

### **Overall reflections**

The workshop went well. It was disheartening that all persons who had committed to attending did not join the course. However, those that did were enthusiastic and eager to engage. By the end of the day, it was evident that the group were comfortable sharing experience and even areas that they were not fully confident in teaching. There was a sense that a good community was being formed.

## **Workshop 2**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The second workshop was delivered during the school mid-term break in October 2020. It was originally planned to run workshop 2 as two separate half-day workshops, however this wasn't possible due to teachers availability. Instead they were delivered over one day. This was also the situation for workshop 3 which will be discussed later. The final result was that instead of running four half-day workshops we had to run two back to back full day workshops. In planning these, the facilitators had to consider how much and when to implement the various workshop activities. It was important not to overwhelm the teachers and to keep them motivated across the two days.

There were six teachers present at the 2nd workshop. This was the most teachers we had across the project. Unfortunately, one of the six was not able to complete the course due to other commitments.

The focus of workshop 2 and indeed workshop 3 which were closely linked was to help the teachers to better understand IBL and PI. It was intended that they would gain more experiences of IBL, refine their inquiry questions, learn about data collection methods, to refine their inquiry plan and to leave ready and confident to start their own inquiry. The workshops were to contain all three elements of IBL, PI and PLC. and there was a particular focus on the "Motivating, Inquiry and PI Development Elements" of the 3DIPhE Design Principles.

As with all of the DCU 3DIPhE workshops, the opening part involved a looking back and look forward discussion where the teachers reflected on what they had learned to date and what would be completed in this workshop.

**Activity 1: Compass (30mins)**

The *Compass* protocol was used as a PLC building exercise. In the activity the participants self-identify to a compass point based on a description of each of these e.g. a person from the North likes to take charge, to run daily operations, to get assignments in early, to drive work and get it done, whereas a person from the West likes to ask the hard questions, to live by inquiry, to challenge us to identify details. In reality people have overlapping characteristics but they are forced into selecting one for the activity. Following this they are asked questions about how best work with people from other ‘compass points’ etc. Even though the room we were in for the day was really small and had a poor layout for the exercise it went really well. The teachers really engaged with it. There was a lot of self-awareness and some of the commentary about the various attributes were very considered. Some teachers noted the strengths of others and how they were jealous of them. There was a great openness. The facilitator felt they could have probed more but had to make a decision to move onto the next activity due to time constraints but felt the intended learning was achieved.

**Activity 2: Litmus test on inquiry question (30mins)**

The second activity focused on the teachers’ inquiry questions. The *Litmus Test* protocol was implemented. In this task the teachers reviewed their passions and used the litmus mindmap to challenge themselves to determine if their question was ready to use for an inquiry. The facilitator supported the teachers during this individual task. The teachers engaged from the start. They made good progress on their questions. The main issue was a need to refine their questions into a smaller inquiry that could be investigated. The use of the mindmap helped to achieve this.

**Activity 3: Introduction to Data Collection (15mins)**

The third activity was focused on Data collection for Practitioner Inquiry. The intention was to introduce the teachers to ways of collecting data which may later inform their inquiry plan which they would develop the next day in workshop 3. It started with a brainstorming session followed by a lecture/discussion on various types of data collection including literature, field notes, pictures, interviews, focus groups surveys etc. A big emphasis was placed on the gathering of these as part of the normal activity of a class. There was a lot of discussion on how much data to collect and the necessity to design your data collection based on the inquiry question. The discussion was very engaging and it was evident that the activity was making some of the teachers reflect on their inquiry question. Unfortunately, there was enough time to delve further into the teacher contributions.

**Activity 4: IBL Activity (Speed) (45mins)**

The fourth activity focused on the IBL aspect of the 3DIPhE workshop. The Speed Activity (described in [Volume 1](#)) which originated in the SAILS Project was designed and implemented so that the teachers experienced the inquiry task as learners. In this way it was hoped that they would have a better appreciation of what their students experience when doing IBL tasks. The teachers really engaged in the activity. One teacher exclaimed, “that’s a really good idea, I never would have thought of that”. Indeed there was a lot of sharing of practice evident and teachers were discussing how the activity could be adapted for use in their Junior Cycle classroom based assessments (CBAs). From a facilitators perspective, it was noted that the workshop ran 10 minutes into lunch time and even with all the planning wondered if there were too many activities planned for the morning session.

**Activity 5: Analysing Data (85-115mins)**

The majority of the afternoon session was given over to data collection. This was another PI focussed activity. In the first iteration of the project it was found that this really helped the teachers think about their data. In this iteration we decided to do the activity earlier in the process to help the teachers write a detailed plan for their inquiry. It was felt that gaining experience analysing different types of data would help them consider how and what data to gather for their inquiry. In this task the teachers were given a fictional exemplar of a teacher inquiry. The example had a range of data including test results, photographs, teacher field notes, samples of student work

and a student survey. The teachers were also provided with the teachers inquiry plan and question. To guide them through the activity the [Developing data analysis skills for a PI](#) was used. This protocol has a number of phases namely, predictions, going visual, observations and inferences. In Figure 1, a sample of the teachers 'going visual' analysis of the data is provided. Reflecting on the activity, the facilitator felt that the introduction and description of the Data Driven Dialogue protocol could have been clearer. There was a little confusion at the start but soon the teachers understood the task. The sample data raised many good and interesting questions which enabled the teachers to reflect on their data collection. Some identified that parts of the data was irrelevant to the inquiry question, e.g. the christmas test results didn't provide any usable information that could address the question. There was also discussion on the quality of the data; some of the teachers felt that the field notes didn't provide enough information. Again this was a very helpful discussion as it made the teachers consider how to gather effective field notes and observational data for their inquiry. The teachers also discussed how to make links between different types of data in order to make inferences. The discussion on quality of data was very beneficial and the facilitator noted in his reflections that the teachers seemed to be seeing the importance of linking the data gathered to the inquiry question.

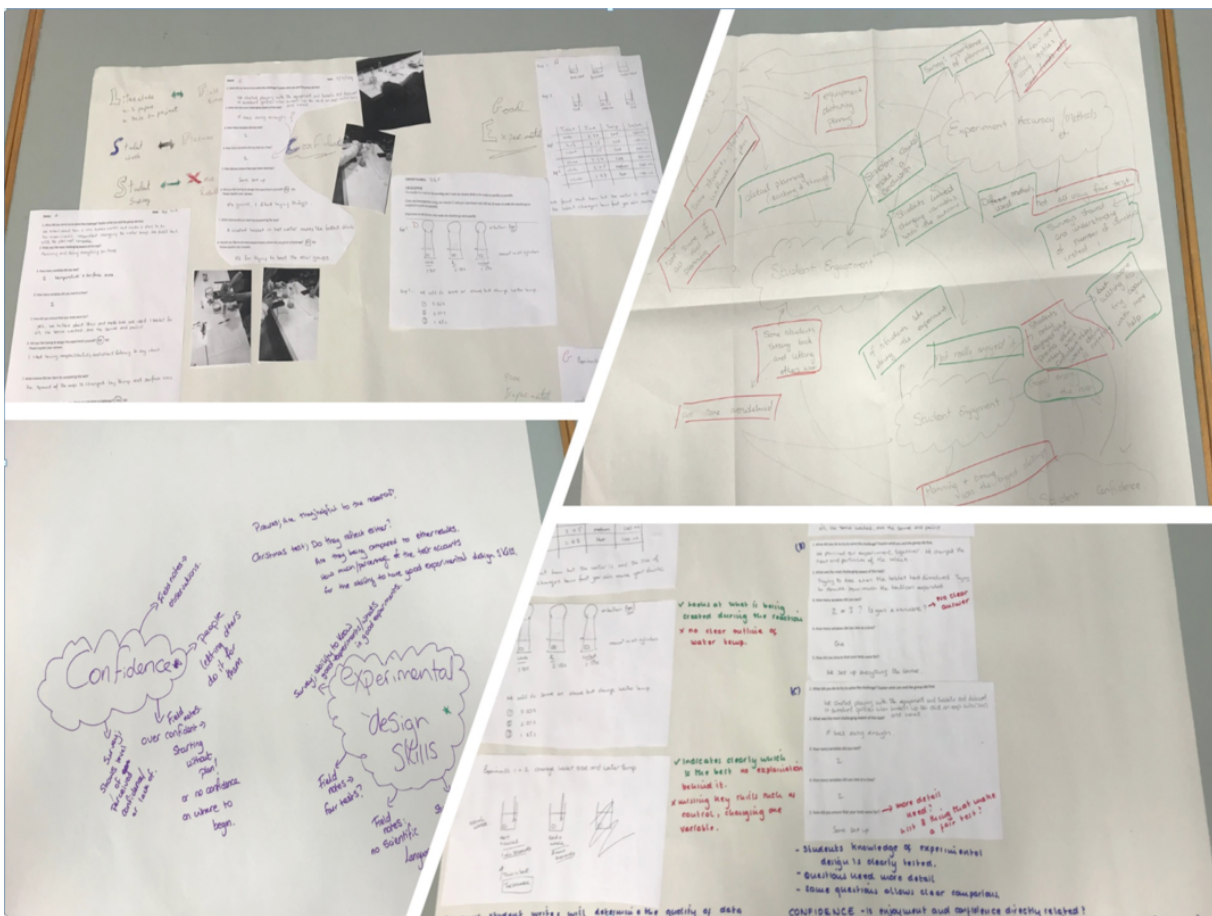


Fig 1: Examples of how teachers mapped out data from the Data Analysis Protocol.

### Activity 6: Refining Questions (15mins)

It had been planned to use the *What? So what? Now what?* protocol to allow the teachers to support each other to refine their questions, however, it was felt that the time left wouldn't allow for a thorough engagement with the task and the teachers had had a long day at this stage. Instead they were given some individual time to refine their questions. The facilitator went to each person and checked in. It was felt that the teachers had good questions, they had learned how to gather data and avoid pitfalls though there was still some concern that more input was needed on how to make observations of lessons.

### Activity 7: Next Steps (5mins)

The session closed with an overview of what was covered in the session and what would be continued in WS3 which was scheduled for the next day.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

Overall it was felt that the workshop went well. The facilitators had to make some adjustments to the schedule based on time requirements of the various protocols. Ideally, it would have been brilliant to have a longer workshop which would have allowed more time for the IBL activity and the refinement of the inquiry question. If repeating the session again, the facilitator would improve the instructions for the Data Analysis task.

**What design principles for future workshops would you recommend based on your experience.**

- Even though some activities are going really well a facilitator needs to be conscious of the entire day's schedule and may have to cut things short. In doing so they should reflect on whether the intended learning has happened and if it's appropriate to do so.
- Less is more! It's important not to overplan workshops. It's better to have more quality over quantity. This can be difficult when there is so much you want to expose teachers too especially when you have them for a short period of time.
- Instructions need to be very clear. Don't give out too many instructions at once, break the tasks into smaller chunks and give instructions as needed.

### Overall reflections

The workshop went well overall. It was a good foundation for activities planned for workshop 3. It was a good idea to introduce data analysis earlier into the overall workshop sequence as it gave the teachers a better understanding of the PI process which would help them to develop their question and plan. The teachers seemed to appreciate the mix of the three aspects, IBL, PLC and PI.

## Workshop 3

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

As noted previously, this workshop was delivered in one full day session as opposed to two separate workshops. Additionally, it was scheduled back to back with workshop 2. In essence four half-day workshops were delivered in two full days. There were four teachers in attendance at the workshop. One teacher wasn't able to continue and another teacher had family commitments on this day, however she did participate remotely for some of the activities during the day when she could access a computer.

### Activity 1: Zones of comfort (30mins)

As per usual the workshop started with a reminder of the content of the previous workshop. In this situation the *Zones of comfort* protocol was used. This gave the facilitators and teachers an effective way to discuss the previous workshop and to identify areas that they may feel less confident about. In this discussion the teachers raised some fears about the sharing/showcase event and some commented on their challenge to refine their inquiry question. They were reassured and the facilitators noted these concerns as something that would be addressed throughout the day. The activity was very helpful to assess the teachers progress and understanding of the workshop content.

## Activity 2: Development of inquiry plan (40mins)

The second activity was an opportunity for the teachers to develop their inquiry plan. Google docs was used for this task. Each teacher had their own folder where they could write out their plans. Their folders were shared with each other so peer feedback could be provided later. In the first iteration of the project we learned that the teachers need time within the workshop to develop their plans as they have limited time otherwise. The facilitator added comments to each of the teachers' plans as they were writing them. This was a great way for the facilitator to really learn about the teachers plans and to provide individualised timely feedback.

## Activity 3: IBL Activity (60mins)

This activity was used to model an IBL task and to discuss the teachers' understanding of IBL. It started with a discussion on what is IBL and why it should be used. This was useful and the teachers had similar perspectives on IBL. They related it to the Nature of Science aspect of the Junior Cycle specification and raised tensions between content and skills when teaching. It was a productive discussion as it elicited the teachers experiences and perceptions. The activity was the [Subtle Shifts activity](#) (Subtle Shifts, 2006) on shadows which had a number of take home messages including “teachers can make small shifts in existing activities to help learners strengthen the process skills needed for scientific inquiry and lessons can be modified in specific ways to achieve particular purposes”. The teachers engaged throughout the tasks and compared how each pair set up their experiments discussing the merits of different approaches. This discussion was an added benefit. They came to the conclusion that the ‘teacher way’ is not always necessary and students should be given opportunities to be creative. In the discussion at the end, some of the teachers noted a sense of being reassured that only small changes were required. The activity ended with the facilitator given the teachers an overview of different models of Inquiry. It was intended that the teachers would modify an existing lesson that they normally teach using the learning from the activity but there wasn't enough time to start this activity.

## Activity 4: PLC Activity - Attributes of a learning community (30mins)

The focus of the fourth activity was to help develop the PLC. The *Attributes of a learning community* protocol was used. The teachers had to reflect on previous learning experiences and identify why they were positive experiences. Later the teachers had to share these experiences. This was done using the protocol where different group roles were assigned including a facilitator, time-keeper and note-taker. Each participant had two uninterrupted minutes to describe their experiences. The closure of the activity involved the co-creation of a poster (Figure 2) where the teachers identified key attributes of the community they wanted to create and they all signed the final poster as a symbol of their. The teachers were very engaged through the activity. The observer facilitator noted that teachers used each other's names, they had a lot of fun using the timer for the tasks, they were clearly listening to each other and they seemed to provide moral as well as academic support to each other. Overall it was felt this activity helped to create a very good atmosphere in the group.

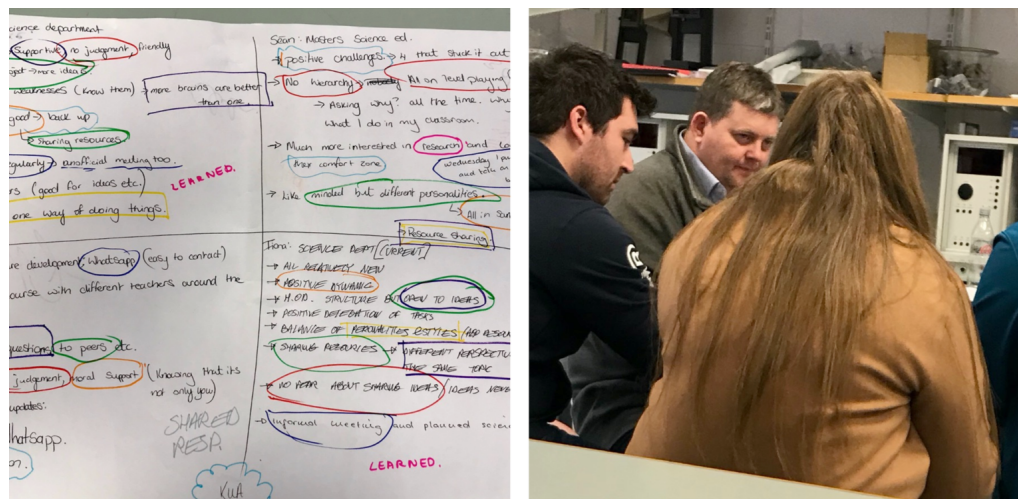


Figure 2: Teacher Poster - Attribute of a Learning Community

### Activity 5: Peer review of inquiry implementation plans (60mins)

This workshop was the last face to face opportunity to engage with the teachers before they commenced their own practitioner inquiry. This activity was used to help solidify their plans for the months ahead. The teachers were paired off and asked to review their partners plans with clarifying questions and suggestions for improvement. This was provided again by using the Google Drive function. It even involved the teacher who could not attend in person. They were given specific questions to consider:

- A. What match seems to exist (or not exist) between the data collection plan and inquiry question?
- B. Are there additional types of data that would give the participants insights into his/her question?
- C. Rate the “do-ability” of this plan for inquiry. In what ways is the participant’s plan meshed with the everyday work of a teacher?
- D. In what ways does the participant’s proposed time-line for study align with each step in the research process?
- E. What possible disconnects and problems do you see? (both in your own plan and others)

The facilitators reviewed all of the plans during this time and provided individualised feedback. The activity closed with each teacher reporting back on what they had learned and what they will do next. It was very clear their questions were more refined and they seemed to be more confident in their plans. The task of verbalising their plans helped them to clarify their thinking.

### Activity 6: Zones of comfort revisited (10mins)

The final activity was used to evaluate the teachers progress. The zones of comfort task was used again. Teachers had an opportunity to modify their earlier responses and to add any additional comments. They were specifically asked to note their comfort level in relation to (a) working in a PLC; (b) carrying out a PI; (c) I’m ready to start my own PI and (d) other. As can be seen in the image, the teachers were mostly confident in their abilities to carry out their PI. The outlier note in the ‘danger zone’ related to the preparation and presentation of data for the showcase event. Some of the comments on the post-it notes included:

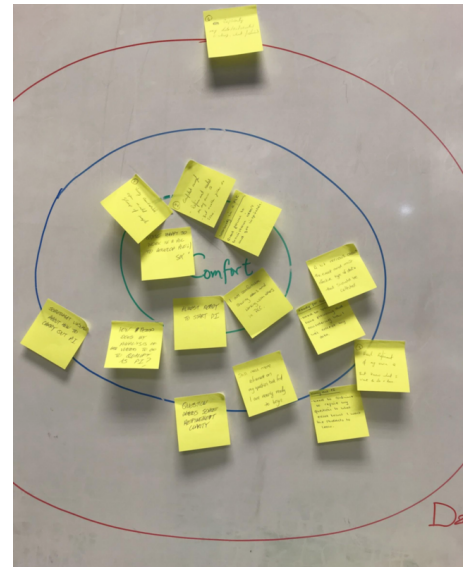
- “I’m comfortable sharing ideas and working with others in a PLC”
- “Confident enough, refinement needed on my own questions”

For the most part the teachers were confident working in a PLC but there were still some reservations about data and refining questions, one questioned “how deep does my analysis of data need to go to qualify as PI?” and another noted, “a bit nervous about the exact and most effective type of data that should be collected”. The facilitators discussed the teachers responses, reassured them and reminded them that PIs can be small and often take many cycles.

The workshop concluded with a discussion of the project timeline and an agreement to meet in early January.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

I don’t think there is anything that should be changed if repeating this workshop. Ideally, it would be nice to have an additional workshop where the teachers were tasked with doing a shared inquiry in advance and to reflect on it before starting their own practitioner inquiry. The key is for teachers to start, only then will they be ready to really internalise the learning from the workshops.



## **What design principles for future workshops would you recommend based on your experience.**

- In addition to peer feedback, teachers need individualised feedback on their plans. The use of google drive and the comment function is an effective way for the facilitator to provide timely feedback.
- PLCs need to be owned by all members. Using protocols such as the attributes of a learning community where the teachers co-create and discuss values and obligations are very helpful to get commitment to creating a sustainable community.
- Teachers need both individualised and peer feedback. Sometimes when working in a PLC there can be a focus on only using peer activities. It's important to provide individual attention too. It was found that the google drive comment option allowed for the provision of individual feedback in a group setting.
- Start teachers as early as possible doing a PI. A shared or prescribed PI could be used before they commence their own PI.

## **Overall reflections**

It was felt the two workshops, 2 and 3 which were scheduled back to back went well. It was a very different experience to the first iteration of the project where shorter, more frequent workshops were used. In this iteration the workshops were more intense as there wasn't a lot of reflection time available however, it was felt that the teachers were well prepared and had developed their questions with less difficulty than previously. It is thought the condensed nature as well as using examples from the previous iteration gave them a better insight into the practitioner inquiry process.

## **Workshop 4**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The fourth workshop was used to check in on the teachers progress. In terms of the overall 3DIPhE Key Elements. This workshop focused on the 'Conducting PI and Analysing PI Elements'. Due to work commitments only two of the teachers could attend. It was decided to merge this new group with the two teachers present from the PLCTI2e group so they could support each other. The teachers who could not attend received individual telephone calls to talk through their inquiries.

In the previous iteration of the project the facilitators had received feedback from the teachers that they needed time in the workshops to engage with their inquiries as they had limited time outside. In this three hour workshop they were afforded this opportunity and also supported individually by the facilitators. The *Data Driven Dialogue* Protocol was the main guide for the workshop.

### **Activity 1: Report on Data Driven Dialogue**

The focus of this session was to support teachers in making sense of their data. The teachers spread out all of their data over a large bench and were asked to reflect on the data they had collected and to think about what assumptions or predictions they had. Based on the observation/consideration of their own data to write down only the facts they can make about their data (Phase III of protocol). The teachers made statements on their observations of data and the prompt statements in protocol were found to be very useful in getting the teachers to make these statements.

This was a very important step for teachers - to focus on some aspect of their data and look for patterns and trends in that data set and state observations based on their own dataset.



One of the teachers had lots of different data collected from students over a period of time and wanted to see if students had improved their experimental design. When she looked at her data she realised that was too broad of a question and that she needed to consider what aspects of experimental design she would focus on. So she looked at students' use of variables and wanted to see if there was any evidence of students' understanding of independent and dependent variables changing over time. The coaches asked her to consider if she could see any pattern or changes? and in what part of her data (worksheet, lab report) she would expect to find relevant data. This really helped her to focus on one aspect at a time and to be more objective in stating observations. The other teacher reflected on her data and was more ready to state observations. She was able to state observations based on evidence in her data e.g She could could the number of students that had indicated choosing physics, chemistry or biology and record “No change in numbers choosing physics”.

The teachers needed more support to think about what inferences they could make on their data (Phase IV of protocol). The staging of questions in this part of the protocol worked well here. The inferences made by teachers were appropriate and highlighted for them the limitations of their inquiry - that you can only expect small change in one small inquiry. However, the following statements on what teachers would do next and what changes they should make in their classroom practice indicated that teachers could see what longer term approach was needed to effect change, e.g. “make sure every session has a practical element or experiment”. All of the teachers presented their observations and inferences to the whole group (displayed google doc using projector) and there was a good exchange of clarifying questions and discussion after each sharing.

Similar reflections from the workshop were noted in the follow up calls with the absent teachers. They needed support analysing their data, making inferences and refining the scope of their PIs.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

The timing and conduct of the workshop was appropriate and allowed the two facilitators to circulate and support all of the teachers. The facilitators naturally split between teachers that they worked with and it was better to have only one facilitator talking to each teacher. This was an important workshop for teachers at this stage in their inquiry and is essential that all teachers should attend and reflect on their data and be supported in making observations and inferences about their data. The teachers present benefitted from hearing how other teachers sharing their observations and inferences as it helped to clarify their own thinking.

**What design principles for future workshops would you recommend based on your experience.**

- It is important to provide teachers with individualised support when analyzing their data and making inferences. This is a critical stage in the process that requires facilitation.

### **Overall reflections**

The timing and structure of this workshop was effective. It was important to provide the teachers with lots of space to spread out their data, so they could look at different aspects and move around sheets as needed. The protocol worked well to guide the activity and provided prompt questions that the teachers could complete. The teachers were very open to discussing their data, observations and inferences with the coaches and other workshop participants, (i.e. the novice teachers were not afraid to share their thinking with the experienced teachers).

## Workshop 5

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The fifth and final workshop in advance of the local multiplier sharing event focused on the PI and PLC aspects of the 3DIPhE course. In the first iteration of the project all partners had noted that this workshop was extremely important for teachers as it helped them to clarify their thoughts and inferences about their inquiry. It was also noted that teachers needed support in representing their data in a poster structure.

Based on the learning from the first iteration, the teachers were given some time to work on their posters. They worked on their own and were supported by the facilitators who gave each person individual attention. Teachers prepared a good draft of their poster on the day.

In this workshop the novice PLCTI2n and experienced PLCTI2e groups were merged again. It was felt that this would help develop the teachers confidence in sharing their work. The final element of the workshop involved all of the participants displaying their poster on the projector in the room where the local multiplier would be held. They all received peer feedback on the content and design of their poster.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

It is really felt that this workshop was very beneficial in supporting the teachers to prepare their posters and to develop their confidence. Ideally, it would be great if the workshop could be delivered twice in advance of the showcase day so the teachers could get additional feedback. As teachers' time was limited and they were focused on the multiplier event, IBL activities were not provided on the day. If more time was available the workshop would have commenced with an IBL activity.

**What design principles for future workshops would you recommend based on your experience.**

Allowing teachers to present their posters in the room where the multiplier event would be hosted eased their concerns and gave them more confidence.

### Overall reflections

This workshop is an important element of the 3DIPhE course. It helped the teachers to clarify their thinking on their inquiry in terms of their question, data and inferences. It gave them the necessary confidence to present their work to a wider audience.

## Participant Reflections on Course

All of the teachers completed their practitioner inquiry on an aspect of teaching physics. Three of these focused on teaching at lower secondary level, one related to the transition year in Ireland between lower and upper secondary and the final inquiry examined the teaching of vectors at upper secondary level using guided inquiry worksheets. The lower secondary inquiries explored a range of topics including electricity, measurement and earth science and all investigated these in the context of IBL approaches. The transition year project explored the uptake of physics at upper secondary level and designed a short course to promote interest and study of physics. Having completed

the project, the teachers note that they understand IBL and they feel that it is an effective strategy to motivate students' interest in physics. The majority indicated that they use IBL approaches more often as a result of the project. The teachers agree that students learn both content knowledge and skills through IBL lessons although one teacher agreed more strongly to the statements for skills compared with her response to development of content knowledge. Interestingly at the end of the project the teachers are more positive towards the use of student designed experiments, students data analysis and students drawing conclusions as a way to motivate students. Similar responses to the baseline survey were found regarding teachers' professional learning; they were all very eager to develop and enhance their practice but they had limited opportunities in their employment to do so. At the end of the project, all of the teachers indicated a positive disposition towards the use of practitioner inquiry. They all intended to use PI beyond the lifecycle of the project and would recommend it to their colleagues. While all agreed they had the ability to generate questions and collect data their level of agreement to these statements was mixed with some ranking their response as "1" and others as "3" on a scale of "-1 to 3". Very positively, the teachers provided a response of 2 and 3 to the statement that they know how to adapt their practice based on evidence generated from practitioner inquiry. This is very encouraging as at the heart of the 3DIPhE project was the aim to support teachers to make evidence informed decisions on their practice to enhance the learning of their students. In the final responses the teachers were also very positive towards the use of PLC as a mode of professional development. The more experienced teachers in terms of teaching years also indicated a desire to lead PLCs in their own schools and outside of their schools in the future.

The feedback from the teachers in the post survey reflect and support the facilitator observations noted in this case study. When asked "*which activities in the course were most beneficial in preparing you to carry out a practitioner inquiry?*", the teachers highlighted a mix of PI, IBL and PLC activities. They specifically mentioned:

- Previous examples of PI from previous years
- Practical activities that could be used in the classroom
- Simple explanations of PI
- Use of passions and motivations
- Refining questions and planning
- Initial team building activities and collaboration (with like minded people)
- Posters and presentations

The teachers were also asked if they had made any changes to their general approach to teaching physics science their involvement in the project. Once again their responses were positive and encouraging. One teacher noted that she was "*more motivated to improve how I teach physics*", another noted that they are going to be more confident in their teaching as IBL challenges you to be more prepared and one noted that they had fallen out of using IBL but the project had pushed them back into using it. Another teacher indicated that they would now "*Constantly reviewing lesson plans, making them more student centred, actively looking for student feedback, building IBL into my SOWs in a continuous incremental process*". It is very clear from the teacher feedback that they were motivated to take learnings from all aspects of the project into their everyday practice.

## Reflections on Multiplier Event

The DCU local multiplier event (ME4) took place over two days in February 2020. There were 23 participants. This included 15 national attendees, two international teachers from Poland and Slovenia, the three DCU partners and three of the project partners from Slovenia, Poland and Belgium. Additional national participants had registered but unfortunately due to a national weather warning many could not travel.

The Local Multiplier Event was a wonderful opportunity for 3DIPhE teachers to share their inquiries and engage with international teachers and partners as well as some local interested teachers. The two day event was inspiring and motivating for all who attended. On the first day, the attendees were introduced to the work and aims of the 3DIPhE project by the partners. This was followed by a short presentation by each teacher (national and international) who described their inquiries. Over the course of the two days, small group poster sessions were arranged where the teachers had an opportunity to share and learn in detail about each other's work. A roundtable discussion was held on the first day which sought to unearth shared learnings from the project. This was organised where small groups discussed prompt questions before a plenary discussion. The prompt questions included:

- What is the impact of doing PI for a teacher?
- What is the impact of doing a PI for student learning?
- How does a PLC support a teacher doing a PI?
- What advice would you give to a teacher starting a PI for the first time?

In the table below a 'snapshot' of the responses from the day are presented. It is very clear that the teachers who engaged in the project found that there were many benefits to using Practitioner Inquiry to systematically analyse and inform their practice.

<p><b>What is the impact of doing PI for a teacher?</b></p> <ul style="list-style-type: none"> <li>• Better planning</li> <li>• Considering how to teach, reflect</li> <li>• Allow to stand back and look at yourself and makes you evaluate yourself as a teacher</li> <li>• Evaluate student learning</li> <li>• Give you a mechanism to improve</li> <li>• Gives you confidence to try new things (and fail sometimes)</li> <li>• Ability to communicate and present to other teachers</li> <li>• Value of collaboration, use others ideas</li> <li>• To inform future practice</li> </ul>
<p><b>What is the impact of doing a PI for student learning?</b></p> <ul style="list-style-type: none"> <li>• Students develop problem solving skills</li> <li>• Gives them a chance to achieve a goal - this can encourage them</li> <li>• Different strategies for different students (I know this now!)</li> <li>• Allows students to engage with each other, peer feedback</li> <li>• Hopefully help link theory and practice</li> <li>• Student voice is heard - engaged more, becomes stakeholder</li> <li>• Students feel the teachers engagement</li> </ul>
<p><b>How does a PLC support a teacher doing a PI?</b></p> <ul style="list-style-type: none"> <li>• Communicate with others</li> <li>• Refreshing</li> <li>• No longer have to talk to myself</li> <li>• Get to know different people, learn something new from them</li> <li>• Grow and Glow (last years PI) was shared and worked</li> <li>• Keeps a teacher on track</li> <li>• A sounding board for ideas</li> <li>• A new point of view on the problem</li> <li>• Inspiration, sharing ideas</li> </ul>

### What advice would you give to a teacher starting a PI for the first time?

- Do not be afraid
- Be ready to make mistakes
- Keep it simple
- Do not think that your inquiry is not big or important enough
- Choose a good question, be engaged! Take time for having a good question
- Topic must be a passion
- Start small, don't be too broad
- Ask why something is not working
- Keep an open mind
- Sit with being lost - it's okay, you will find your direction
- Stay positive
- Be brave

The first day concluded with a presentation of certificates to the teacher. The second day included more poster sessions as previously described and workshops as well as an input on Education Design Research. In particular the IBL workshops were very well received by the participants. These workshops were delivered by the international partners and they gave new approaches to using IBL. It was good for the native teachers to learn about the work in other countries. Overall it was felt that the LME was a great success. The feedback from the attendees was positive, in the post event survey one noted that it was a *“great event, well organised and very beneficial to me as a teacher”* and another said that *“It was enlightening and inspiring to hear the enthusiastic honest experiences of the showcase teachers. I hope that I can incorporate more practitioner inquiry into my own work”*. Indeed the all of the attendees agreed to the majority of statements regarding their motivation to engage in practitioner inquiry and professional learning communities and that they would encourage the use of these within their own organisation and at a national level.

### Key Learning and Recommendations for Design Principles:

1. Link in with other participants of previous iterations
2. Leaned on facilitators in context of PI more than IBL
3. Learned a lot from PLC teachers regarding sharing of practice, school contexts etc.
4. There is a need to be flexible and to adapt to your changing environment such as changing participant numbers, time teachers want to share informal experiences etc. However, when making changes it is essential that the facilitators are fully aware of their learning goals and that the adaptations consider how the intended learning is still achieved or deferred for a later point. Hence, the planning of the course needs to be completed in advance and not session by session.
5. It is important to allow teachers opportunities to share their passions, personal background and experiences. Knowledge of each other's perspectives and experiences better helps to develop understanding of each other which helps in the creation of the PLC.
6. Using examples of previous project practitioner inquiries is a helpful approach to demonstrate the expectations of PI.
7. Links between clarifying questions, IBL activities and PI need to be modelled but also made explicit by the facilitators to help make the link and demonstrate the transferability of the skill of questioning.

8. Teachers in the courses should be given a voice so they can input and inform how the course is delivered, this gives a sense of responsibility, value and ownership which also supports the construction of the PLC.
9. Even though some activities are going really well a facilitator needs to be conscious of the entire day's schedule and may have to cut things short. In doing so they should reflect on whether the intended learning has happened and if it's appropriate to do so.
10. Less is more! It's important not to overplan workshops. It's better to have more quality over quantity. This can be difficult when there is so much you want to expose teachers too especially when you have them for a short period of time.
11. Instructions need to be very clear. Don't give out too many instructions at once, break the tasks into smaller chunks and give instructions as needed.
12. In addition to peer feedback, teachers need individualised feedback on their plans. The use of google drive
13. PLCs need to be owned by all members. Using protocols such as the attributes of a learning community and the comment function is an effective way for the facilitator to provide timely feedback. where the teachers co-create and discuss values and obligations are very helpful to get commitment to creating a sustainable community.
14. Teachers need both individualised and peer feedback. Sometimes when working in a PLC there can be a focus on only using peer activities. It's important to provide individual attention too. It was found that the google drive comment option allowed for the provision of individual feedback in a group setting.
15. Start teachers as early as possible doing a PI. A shared or prescribed PI could be used before they commence their own PI.
16. It is important to provide teachers with individualised support when analyzing their data and making inferences. This is a critical stage in the process that requires facilitation.
17. Allowing teachers to present their posters in the room where the multiplier event would be hosted eased their concerns and gave them more confidence.



# University of Ljubljana Slovenia Case Study

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## Introduction

This case study reports on the implementation of a professional development course for second level science teachers facilitated by partners from the Faculty of Education at the University of Ljubljana (UL) Slovenia. The course, which is part of the second iteration of the Three Dimensions of Inquiry in Physics Education (3DIPhE) Erasmus+ programme was designed to develop teachers competencies and understanding of Practitioner Inquiry (PI) and Inquiry Based Learning (IBL) through engagement in a Professional Learning Community (PLC).

## Context and background

In the second cycle, two professional learning communities of teachers (PLCTs) were formed in Ljubljana and both were coached by coaches from UL and Zavod Republike Slovenije za šolstvo (NEI - National Education Institute Slovenia), with coaches from UL having the leading role. The first group was smaller and continued from the first cycle, named PLCTI2e (experienced). The second PLCT, called PLCTI2n, consisted partly of teachers that joined the local multiplier event in March 2019 in Ljubljana. There were about 50 attendees including 9 presenting teachers from PLCT1 from the 1st cycle. Many of them signed the list for receiving information in future and some of them expressed interest in joining the new group in the project 3DIPhE. The second group of teachers, which joined, were teachers motivated by members of the first group. They were co-workers of participants of PLCT1 or other colleagues.

The structure of the PLCTI2 was quite different from the PLCTI1 cohort. In the first PLCT iteration two groups of teachers joined - 3 teachers from Ptuj and 4 teachers from Vojnik. The Vojnik group was interesting, because they joined with a purpose. Their school planned to organize the vertical of teaching science from the primary (grade 4-5) to lower secondary Science (grade 6-7) and physics (grade 8-9). Their plan was to discuss their actions and to learn new approaches etc. The Ptuj group consisted of three teachers, one of physics, one of science and a primary school teacher. When other attendees realised that working in the group in the school would be nice, they asked for permission to bring colleagues. Practically from every school, teachers come with active colleagues, or they have an active colleague in the PLCTI2e group to share experience and work with.

The second difference was geographical. In the second iteration, teachers came from distances over 100 km from the meeting place in Ljubljana, therefore we redesigned the structure of meetings. The meetings of the PLCTI2s were longer than in the first iteration, typically 4 hours and met every second month. In this regard, we were able to compare both types of workshops across the two iterations - shorter and more frequent, longer and less frequent.

The PLCTI2e group consisted of 7 teachers of physics and math or science (grade 6-7), 6 primary school teachers (grades 4 and 5), three secondary school teachers responsible for teaching physics, mathematics and electronics. The presurvey data clearly shows that all the teachers valued experimental work of students positively, however they mostly severely guided experimental work with instructions and rarely with questions and hints. Almost all teachers assessed their own skills on carrying active experimentation during lessons positively but not highly positive, they were mostly motivated to improve their skills in guiding or supervising active learning of their students using the IBL methodology. Although teachers were only vaguely familiar with PI, they expressed a strong interest in being able to inquire their own practice and provide evidence as a support for their claims. They mostly believed that they could use this method to persuade a headmaster or colleague on some changes. In general, the whole was highly motivated and it turned out that they very actively searched for a collaborating group in their schools and they brought colleagues to the next meeting which resulted in a very large, sometimes almost difficult to manage PLCT.

The PLCTI2n group had finally 16 members counting only those who persisted and presented at the multiplier event in March in Ljubljana. One teacher of the PLCTI2n group presented her inquiry at the multiplier event in Dublin.

Teachers appreciated the combination of different levels of teacher, from primary to high school, debates were richer and aspects were different. Training aims were focused on IBL but instructed by learnings from the first cycle, inquiry of effects of the new method was immediately added. We developed a few protocols that were used to distinguish an inquiry at the level of students and inquiry at the level of a teacher. This difference was very confusing for the group in the first cycle. They all prepared a report for the national multiplier event and most of them also for the final international conference. Only a few decided not to contribute due to the language issues.



The training aims were the same as for the community in the first cycle

- To establish an active professional learning community with an air of confidence, sharing of ideas, and helping each other in any of respects.
- To train the teachers in Inquiry based learning.
- To introduce the methods of practitioner's inquiry and to implement them in their inquiries focused in IBL.

But there was another goal as situation permitted also

- To collaborate with and learn from the experience of the expert group.

The organization of the work was different. As it quickly turned out the novice community needs longer and less frequent meetings due to the distance from Ljubljana, the plan for the work was different. We intentionally included experiments to each workshop, but longer time for the workshop allowed us to include both perspectives, new experiments, development of IBL units and planning the PI on them.

Additionally, as we wanted to encourage the two communities to collaborate, we intentionally organized two thirds of the workshops for the novice group PLCT2n alone and one half for the expert group PLCT2e alone, but in the final part, for the break and for activities after the break they merged and worked together. This organization was proven effective, but it had a serious drawback - running two workshops in parallel, coaches were accompanying two different groups and it was later difficult/impossible to reflect, evaluate and compare the activities in both groups.

During the work we focused on the following indicators. On partner's and coaches' level we aimed to upgrade and improve the experience and learning from the 1st cycle, on teachers' and pupils' level the group consisted of newcomers therefore we focused on acquiring new expertise and knowledge regarding IBL and PI.

## Overview of Course

The PLCTI2 courses were led by four coaches from 3DIPhE project, in parallel with PLCTI2e, which continued their work in the 2nd cycle. PLCT1e was the second group of teachers that these coaches facilitated in PI and development of PLCs. All four coaches had participated in the C1 course in PI for coaches provided within the 3DIPhE project. All teachers participated in the meetings, held traditionally on the first Monday evening in the month, voluntarily.

The course started with ice breakers and building the safe environment in the community. At the beginning we focused on IBL skills, and each workshop included also one IBL activity, from structured to open. After gaining a basic experience with IBL, the program moved to reshaping teachers' existing experimental work toward more IBL transferring more responsibility of the work to students, At the same time PI was introduced in order to systematically collect evidence on implementation of reshaped activities. A special emphasis and also tools were developed to differentiate between the two inquiries, of students inquiry based learning and teacher's practitioner inquiry. Unfortunately, the plan did not allow for more inquiries that were implemented in the school within the cycle, so the last two meetings were focused on preparation of teachers reports during multiplier events.

In general, each workshop included at least one ice-breaker and one experimental activity except the workshops focused on preparation of presentations.

Workshop Details	IBL	PI	PLC
<p><b>WS1: Duration 2 hours and 10 minutes (13 participants and 4 coaches)</b></p> <ol style="list-style-type: none"> <li>1. Introduction of the coaches and the project 3DIPhE</li> <li>2. Protocol: <i>Different cultures/getting to know each other</i></li> <li>3. Baseline survey</li> <li>4. Coffee break with the task of introducing themselves to three people they do not know yet</li> <li>5. Guided IBL unit: Melting point of chocolate (teachers were invited to repeat the unit in the class)</li> <li>6. Protocol: <i>Farming vs Gardening</i> (introduction of PI)</li> <li>7. SWOT (on paper) and the “Take away message”</li> </ol>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>
<p><b>WS2: Duration 2 hours 10 minutes (11 participants and 4 coaches)</b></p> <ol style="list-style-type: none"> <li>1. Meeting of both groups, playing with the tubes</li> <li>2. IBL2 - guided IBL unit with tubes</li> <li>3. <a href="#">Tool 00B - IBL my plan</a> (the selected part of the tool, to see the less/more IBL step - developed into the worksheet that connects and differentiate between IBL and PI)</li> <li>4. Protocol: <a href="#">Passion- for IBL (00A tool)</a></li> <li>5. IBL: Asking questions – Plasma ball</li> <li>6. Discussion <ol style="list-style-type: none"> <li>a. Which subjects would you like to turn into IBL?</li> <li>b. Discussion on future organization of meetings (less of meetings, but longer)</li> </ol> </li> <li>7. SWOT online in Take away message</li> </ol>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>
<p><b>WS3: Duration 4 hours (16 participants and 4 coaches)</b></p> <ol style="list-style-type: none"> <li>1. <a href="#">Tool B: My IBL plan</a></li> <li>2. Example of PI inquiry (objects on a weighing scale submerged under water, draw sketches of the experiment) - <a href="#">developed to a tool</a> - alternative forms of data</li> <li>3. Tool: Inquiry question - Work on teachers PIs</li> <li>4. Work on their PI – data collection and rough design of the PI plan: <ul style="list-style-type: none"> <li>• Protocol: <i>Easy ways to collect data-</i> presentation of data collection options</li> <li>• <a href="#">Tool: Inquiry plan</a>: Teachers to complete a rough PI plan accompanied by the poster which combines PI and IBL</li> </ul> </li> <li>5. IBL: Liquid nitrogen experiments: sinking and floating of helium and air balloons</li> <li>6. Coffee Break and the common part (both groups together in P006):</li> <li>7. Funny experiments with »pudding« and non-linear liquids</li> <li>8. Liquid nitrogen ice cream and socializing (end of the year)</li> <li>9. SWOT online</li> </ol>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>

<p><b>WS4: Duration 4 hours (14 participants + 4 coaches)</b></p> <ol style="list-style-type: none"> <li>Teachers presented as short 5-7 minutes talks about their IBL plans.</li> <li>Complete a GoogleDrive document (individually): IBL Accompaniment for a teacher</li> <li>Each member presents at which phase their PI is at and why (In 3 groups)</li> <li>Presentation of all deadline related to conferences, invitation to apply for LME</li> <li>About collecting and presenting data. Posters of last year's LME.</li> <li>Protocol: <i>Compass</i></li> <li>COFFEE BREAK (both groups)</li> <li>IBL - double shadows (Both PLCT groups together)</li> <li>SWOT online (Both PLCT group together)</li> </ol>	<p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>
<p><b>WS5: Duration 2 hours 10 minutes (14 participants + 3 coaches)</b> Both <b>PLCTI2n</b> and <b>PLCTI2e</b> groups together</p> <ol style="list-style-type: none"> <li>Information on the continuation of the group meetings and ME</li> <li>Presentation of those, who did not presented their PI yet (each 5 min maximum)</li> <li>Individual work on posters</li> <li>Coffee Break</li> <li>Individual work on posters</li> <li>SWOT online</li> </ol>	<p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p>
<p><b>WS6: Duration 1 hour (18 participants from both communities and 3 coaches)</b> Zoom meeting due to COVID quarantine. Both <b>PLCTI2n</b> and <b>PLCTI2e</b> groups together</p> <p>Final meetings were held online because of quarantine, however this one finished the Cycle 2. We continued to meet, but we did not prepare the program, because teachers were very busy; Nevertheless, they welcomed the idea to meet for a shorter period. Those meetings were also an extensive source of information regarding COVID and the teaching problems.</p> <ol style="list-style-type: none"> <li>Feedback from LME</li> <li>Difficulties of virtual teaching</li> <li>Exchanging knowledge and experiences</li> <li>Discussing a possible help from UL students</li> </ol>	<p>●</p>	<p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p>

For further details on the protocols referred to in the workshops please refer to Appendix B.

## Analysis and Reflections on Training Delivery

Discussion in continuation is based on immediate after meeting reflections of coaches that were present.

### Workshop 1

#### Description of activities

Here the set of activities was standard, introduction of coaches, ice-breaker for introduction of activities, baseline survey to establish the state of art, and a continuation of get to know each other through the coffee break with a requirement that every person has to introduce him/herself to three people he/she does not know, followed by IBL activity (Fig.1, find more about the activitie with melting chocolate in [Volume 1.](#)) and an introduction to PI through the *Farming vs Gardening* protocol focusing on the large variety of problems in a small community of a class. SWOT had to be filled in at the spot.

#### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

Introductory part was devoted to presentation of the working plan and aims of the project. The Protocol *Different cultures/getting to know each other* other was used to establish connections between both PCT expert and novice groups and gathering data for the aims of the project. The second part illustrated the nature of PI with a Farmer vs. Gardener protocol. We emphasized that (our) academic research is far from simplicity as modelled by farmer's focus and that also we usually inquire about small scale problems similar to them. As already learned from the community from the first cycle, who valued experimental activities very much, the structured IBL on melting temperature of a chocolate was carried out in continuation of the second part. It proved our learning from the first cycle, as it was well accepted by participants and highly valued in their SWOT analysis later.

#### **Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

The coffee break should be longer to enable bonding between the participants, introductions and discussions. The rule of strict timing was obeyed, however it was forgotten to explain why. This should have not been omitted. Nevertheless, we had to hurry in the second part, so conservative measures of generous time spans for activities should be planned. The timing is always a problem during implementation as no test in advance is possible for the first time execution. On the other hand, the timing probably comes with experience.

#### **What design principles for future workshops would you recommend based on your experience.**

For the first meeting a longer coffee break should be provided and less planned content, with generous time spans for activities. With less content, some reserve scenarios for additional activities might be prepared. Overall reflections. As written in the introduction, the novice PLCT consists of a large variety of people, from machine engineers to elementary teachers, and physics teachers. The group is large (13 people), and they all come from quite distant regions of Slovenia. Luckily, they mostly drive together, therefore there are better chances that they will persist.

The use of the first protocol, *Different cultures/getting to know each other* other was extended to the coffee break with a requirement that teachers make three new acquaintances, which they, seemingly, successfully accomplished. Also coaches introduced themselves and this was well appreciated. The learning from this part was that coaches should become a part of the group at the same level as participants as soon as possible. The group was successfully formed.

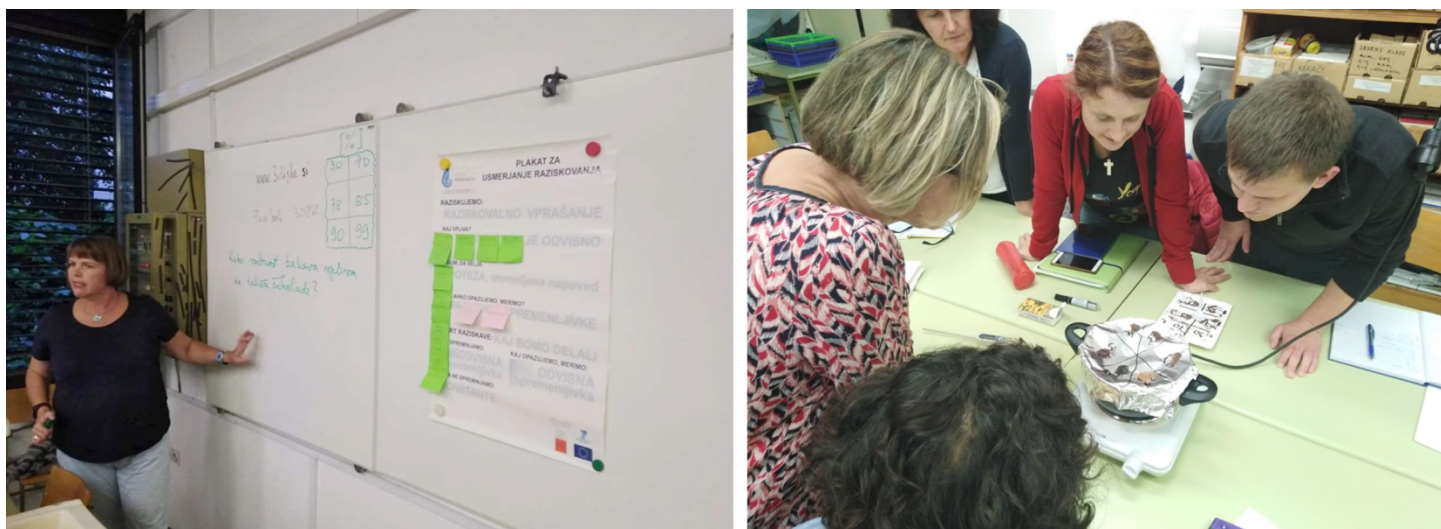


Figure 1 Left: Structured inquiry - what influences the melting of chocolate, determination of independent and dependent variables with a help of the IBL poster. Right: Carrying out the experiment - heating the small pieces of chocolates with different content of cocoa above the boiling water.

## Workshop 2

### Description of activities

#### *Activity 1 Meeting of both groups and playing with the tubes*

As workshops ran in parallel, the first meeting was used not only by the teachers from the PLCT2n to get to know each other, but also to meet the members of the PLCT2e group. Playing with tubes is a simple activity, where each person gets a tube of the length that corresponds to one key. The tubes were taken from an activity that is regularly used in the pre-service program. Different keys are coded with different colours, and participants play a song following a coloured chart under guidance of the “conductor”.

#### *Activity 2 IBL2 - guided IBL unit with tubes*

They continue with an activity, which inquires the properties of tubes that influence the height of the tone and can be used to define the key in advance. Tubes differed in cross section, material and length.

#### *Activity 3 Tool - [IBL my plan](#) (the selected part of the tool, to see the less/more IBL step - developed into the worksheet that connects and differentiate between IBL and PI)*

The tool has three parts: In the first part a teacher chooses a topic he usually teaches with experiments or that he/she wants to include experiments, and describes his usual unit. In the second part he reflects his activities with the adapted FIBONACCI questionnaire More this/ Less this that allows the teacher to become aware of slight changes that would change the activity to more IBL. In the third part the teacher uses the hints from the questionnaire and adapts the plan for the activity. In this way the plan for the unit is already under preparation.

#### *Activity 4 Protocol: [Passion- for IBL](#)*

This protocol is an adaptation of the passion protocol, however it focuses on experimental work and what are teacher’s beliefs regarding benefits of experimental work.

#### *Activity 5 IBL: Asking questions – Plasma ball*

The activity from exploratorium also provides a material, which can later be used as data collection for an introduction of PI (Fig. 2 left).

### Activity 6 Discussion

- Which topics would you like to turn into IBL (Fig. 2, middle and right)?  
Review of topics in school to be considered for potential IBLization.
- Discussion on future organization of meetings (less of meetings, but longer)

### Activity 7 SWOT online in Take away message - at the spot

#### Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?

The aims of this workshop were to continue the training of participants in IBL, to inform participants about PI and encourage them to think about potential inquiries and to further develop personal relations and collaborativeness in the PLCT. Based on experience during the previous iteration (PLCT11) our plan was leading the novice group PLCT12n to focus on topics, in which they will carry out IBL as a part of their PI, as soon as possible. We stimulated them to focus on units, where they carry out experiments already, and to implement subtle shifts towards IBL, and conduct a PI related to them. Developing IBL skills was done during the activity with simple tubes which produce sounds with different frequencies; the IBL was about finding which property of the tube determines its pitch. It was started as an open inquiry to enable playing with participants' ideas and finished as structured to cover the broader spectrum of IBL skills. Introducing members of PLCT to PI was done during the activity with a plasma ball; the focus was on asking questions.

#### Which elements of the workshop would you change if you were to repeat the workshop?

Keeping up with the schedule seemed to be in focus of the coaches, but still needed improvement; however, it meant that we hurried between the activities and through reading. Individual prints might help with reading instead of projection on the board.

#### What design principles for future workshops would you recommend based on your experience.

The group's focus seems to be on IBL, as it is something teachers can use directly in their classrooms. We should look for a way to promote working on PI and use of protocols to build PLCT. Introducing a separate time slot to make a short and clear conclusion and potential take away message for every activity also seems a good idea.

#### Overall reflections

Meeting was very energetic and effective; members were very focused and eager, interested also in a KA1 project. We have to prepare a clear instruction on how to join a KA1 project and a short questionnaire regarding their needs for professional development. Five members of the PLCT were missing, however.

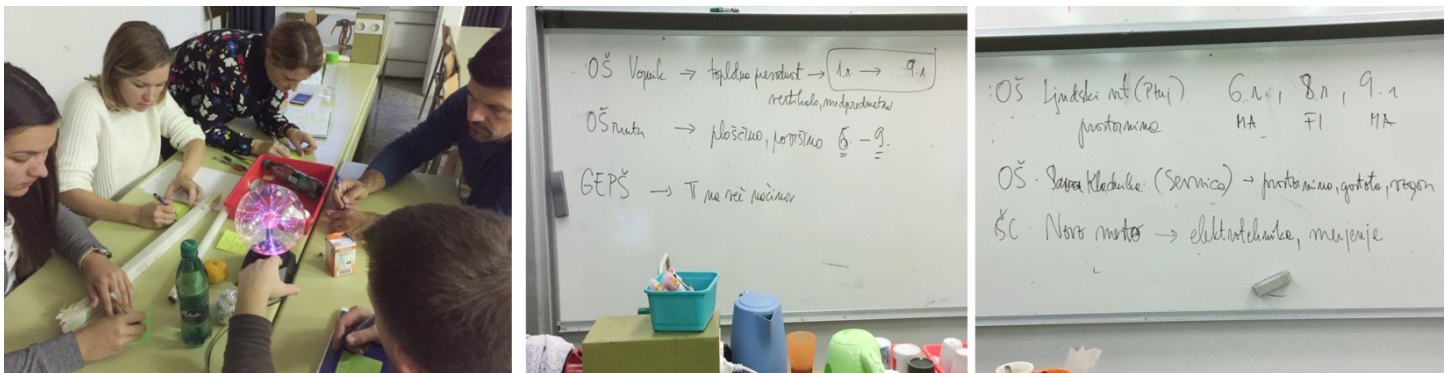


Figure 2: Left - Which question can be transformed to an inquiry based learning? Center and right: A review of plans for IBLs suggested by different participants.

## Workshop 3

### Description of activities

#### *Activity 1 Tool: My IBL plan*

Planning an IBL activity for the classroom using the [worksheet for students](#). As a help, the teachers used the poster IBL guide, which was also transformed to a worksheet that helps students to record their findings.

#### *Activity 2 Example of PI inquiry*

The activity should demonstrate how collection of data does not require much effort and what type of data can be an evidence. Two objects that differ in material, size and mass are hung on a lever type balance in different distance from the pivot that the lever is horizontal. Next, both objects still on the lever are submerged under water and the lever is not horizontal anymore. Participants are required to sketch the experiment before and after the objects are submerged in water, then inspect the sketches of the whole group and consider the potential PI questions that these collection of data is an evidence for finding the answer. We planned to develop this activity to a [tool - alternative forms of data](#) - but the tool needs additional tests and fine tuning in future.

#### *Activity 3 Work on teachers PI – inquiry question using the tool - PI plan*

Teachers focused on preparation of their PIs they plan to carry out and later present in local multiplier event. The coaches developed a tool that combines the PI plan with other tools.

#### *Ad 4 Work on teachers PI continuation – data collection and rough design of the PI plan:*

- o Protocol: Easy ways to collect data - presentation of data collection options
- o Tool PI plan: complete a rough PI plan accompanied by the poster which combines PI and IBL

The PI plan was accompanied with two posters referenced in appendices. The first poster is the IBL guide, which was also used earlier for preparation of IBL. The second poster is a PI guide. Both posters have a very similar cycle, but the IBL poster is placed as a focus of PI. Both posters together support differentiation between the two inquiries.

#### *Activity 5 IBL: Liquid nitrogen experiments: sinking and floating of helium and air balloons in the air*

A surprising experiment. To the helium balloon the air balloon is connected as a weight. If the helium balloon is filled enough, the air balloon is lifted from the ground and hangs as a light weight. However, if the balloon with air is submerged to the liquid nitrogen, it pulls down the helium balloon and falls to the ground. The same is true if a helium balloon is submerged in liquid nitrogen. Inquiry is open and should test ideas, why this happens.

#### *Activity 6 Coffee Break and the common part (both groups together in the classroom P006):*

#### *Activity 7 Funny experiments with »pudding« and non-linear liquids*

#### *Activity 8 Liquid nitrogen ice cream and socializing (end of the year)*

Activities in the second part were for fun as that was the last meeting in the year 2019 (Fig.3). Nobody knew at that time what awaited us in 2020 at that time.

#### *Activity 9 SWOT online*

## Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?

The purpose of the workshop was to choose the IBL activity, the PI question and make the PI plan. As a PLCT the purpose was to motivate the members to work in the group and on the project. The workshop was very efficient, because all of the members already had a subject on which they were working (started at the previous meeting), they had steps written (so they did not forget what they already did) and worksheet B was completed by everyone - between the previous and this meeting. This might also contribute to the continuation of the process. Preparation from the previous meeting and the work done between the meetings provided enough input for moving one step further in planning their IBLs and PIs in this meeting.

## Which elements of the workshop would you change if you were to repeat the workshop?

The work on teachers' planning was interrupted several times with non-related examples on different stages of PI. Input is necessary, but it was unfortunately placed. One of the (non-related) examples was also too time consuming and the consequence was that the time was short to work on PI questions. It could be omitted or done in less time.

## What design principles for future workshops would you recommend based on your experience.

It is really not enough time for working on the IBL and the PI in just one meeting. Separating work on their projects from furthering the skills, necessary to work is also necessary. The participants also appreciated getting feedback (but not criticizing) from coaches and colleagues, and their colleagues accepting critics - all very important for each teacher's personal development.

## Overall reflections

The group is very motivated to work and it seems that some of their work will be really good. However, some members of the group demonstrated a serious lack of scientific knowledge, which could undermine the whole work on their project. "Gossiping" from more knowledgeable members of the group helped, but perhaps this is an additional issue.



Figure 3: Final entertaining part of the 3rd workshop, PLCTI2n and PLCTI2e together investigating influence of a charged balloon on a non-Newtonian liquid.



## Workshop 4

### Description of activities

*Activity 1 Teachers presented as short 5-7 minutes talks about their IBL plans.*

Here teachers already came with results of their inquiries with plans for presentations during the local multiplier event.

*Activity 2 Complete a GoogleDrive document (individually) - the Tool: Teachers accompaniment of IBL class*

Teachers systematically recorded their observations of IBL in the classroom.

*Activity 3 Each member presents at which phase their PI is at and why (In 3 groups).*

Each member that did not present the finished inquiry presented the status of his/her PI

*Activity 4 Discussion about all deadlines related to conferences, invitation to register for LME*

*Activity 5 About collecting and presenting data. Posters of last year's LME.*

*Activity 6 Protocol: Compass Points (Fig. 4 left).*

*Activity 7 COFFEE BREAK (both groups)*

*Activity 9 IBL - Double shadows (Both PLCT groups together) Fig. 4 right.*

Find more about the activitie in [Volume 1](#).

*Activity 10 SWOT online (Both PLCT group together)*

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

Final information about LME and presentation of PIs were the main purposes of the workshop. Presenting new interesting IBLs to the group and encouraging collaborativeness in the group were also done. As this was the final meeting before the LME, members received necessary information about the event and precise feedback to their projects and presentations, which they greatly appreciated. As usual, useful IBL activity for the classroom was warmly welcomed.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

It would be beneficial to provide guidelines for presentations, as they were too long and often without a focus. Teachers also asked for them. Some time for analysis of the double shadows activity (regarding IBL component) would be beneficial. More support (and time devoted to this) regarding their PI would also be beneficial.

### **What design principles for future workshops would you recommend based on your experience.**

Clear guidance for preparation of presentations would help improve them. Teachers also have to have the opportunity to get training in presenting their inquiries, evidence and conclusions and to practice it. Discussions, encouragement and hints for their PI would be beneficial; some teachers also need more ideas how to guide pupils through IBL. Some teachers left pupils alone with the question, design and conclusions, which frustrated pupils instead of motivating them.

### **Overall reflections**

The group will have a lot of examples of PI on IBL. As work with this group focused more on IBL and the teachers are really trying to do IBL, they don't think about PI enough. More activities with focus and practice on PI should be implemented.

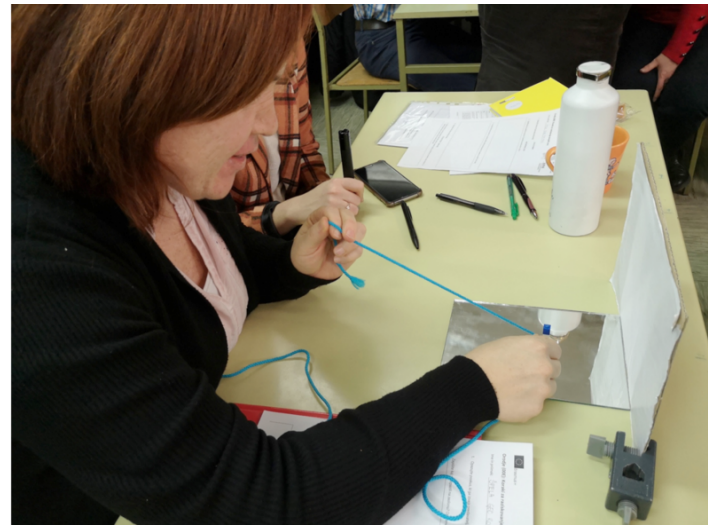
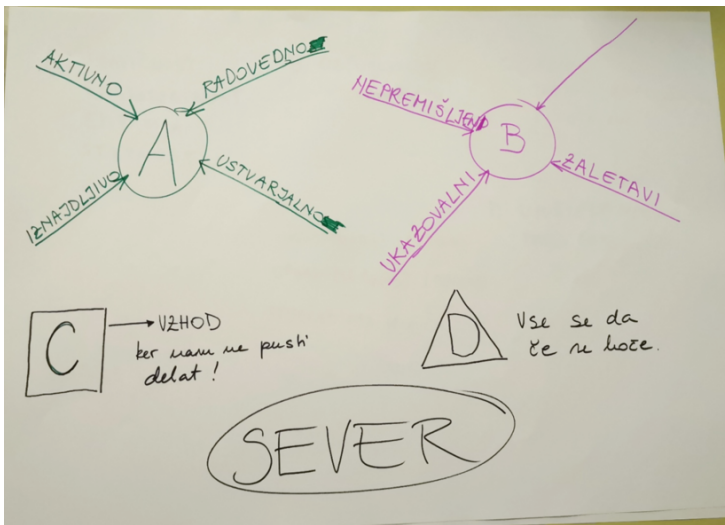


Figure 4 (Left) Results of compass protocol. (Right) IBL on double shadows.

## Workshop 5

### Description of activities

The last meeting was focused on preparation of presentations and posters for the local multiplier event.

### Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?

The participants worked individually on their presentation while being supported by coaches, when they needed help. This suited them very well. "Tool\_Accompanying Form" was sent to participants in advance via e-mails with information about their PI and IBL and was appreciated - they have said that it helped them to make the presentation. So this also contributed to improving their presentations.

The process also provided coaches with a learning opportunity: The questions and troubles which the participants had were also very informative for us - we were able to diagnose the weak points of our work through their weaknesses.

### Which elements of the workshop would you change if you were to repeat the workshop?

The meeting should start earlier, as the participants arrived before the scheduled time and started working by themselves.

### What design principles for future workshops would you recommend based on your experience.

Preparing presentations as a concluding activity of one year cycle is an excellent opportunity for overview of inquiries, sharing ideas, ideas for future work and a good training for the real event. Individual support during preparations for the presentations helps boost their confidence; it also contributed to the success of the SME.

### Overall reflections

The group was enthusiastic and many very interesting ideas were presented. They have done a great job. Some of the PIs were positively surprising.

## Workshop 6

### Description of activities

No specific activities were planned but teachers were happy to see each other and discuss various methods how they cope with COVID remote teaching and learning. We also discussed potential supervising of PEF students during COVID.

### Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?

This last meeting was held on-line due to the Covid-19 pandemics. It was planned as a PLCT building and strengthening event. It was a short, non-structured opportunity to meet, discuss and support each other in those unique circumstances. This gave the participants support and lessened the feelings of being alone in the totally new situation.

### Which elements of the workshop would you change if you were to repeat the workshop?

As it was the first online meeting, we did not prepared any activities and we have not realized that online meetings would become a practice in future.

### What design principles for future workshops would you recommend based on your experience.

At that time we were still hoping that the quarantine would not take long and that we would be able to return to a usual mode of action. However, in retrospective, it was a beginning of online activities that for the project 3DIPhE ended with an entirely remote Final conference. Also in retrospective, virtual meetings have to planned in the same way as meetings in vivo, with activities, supervised discussions, plans for actions in the period before the next meeting etc.

### Overall reflections

Almost all participants of both PLCTs in the 2nd iteration joined and discussed their new lives, remote teaching tips and tricks, problems etc. The meeting was shorter as usual but regarding the fact that no activities were prepared, it lasted a bit more than an hour. Teachers explicitly expressed an expectation that they want to continue with online meetings and also a new date was set.

## Participant Reflections on Course

The focus group consisted of two elementary school teachers, two lower secondary school teachers and two high school teachers. They were asked two simple questions: What did they appreciate during the course? And, what would they suggest for improvement? Participants reported, consistently with coaches observation, the most interesting part of workshops were new experiments that could be used in school and the training in guiding/supervising IBL. They also suggested the experimental part should be expanded. They also appreciated the PI although they plainly admitted that they will not be as thorough as they were for preparation of presentations for the multiplier event. However, they appreciated a different perspective on the school work. Finally, two points were very stressed in addition, a very friendly and collaborative atmosphere in the PLCT that stimulated work and enable discussions on various problems, which is usually not possible, when limited to the own school, and a possibility to present their inquiries during the local and the final event including the support and help of coaches for preparation of presentations.

## Reflections on Multiplier Events

All members that persisted to 2020 presented their inquiries during the local multiplier event in March. The language used in reports was Slovene but almost half of reports were in English, as there were also foreign participants. Of all members only two did not decide to present at the Final conference due to the language issue.

Participants reported that hearing peers speaking in a non perfect English was a great stimulus to try as well. Reports of members of PLCTs were highly positive because the event allowed them to review their work and they realized the extent of the work that was done. In addition, they stressed the quality of workshops. Few teachers that joined the events of 3DIPhE for the first time, expressed explicit interest to join the group.

The high interest for presenting might have been stimulated also buy Slovenina rules that such activities are needed for professional promotion.

## Key Learning and Recommendations

1. Physics teachers are the most motivated by ideas of new experiments they can directly use in school. This means, to keep motivation high, each workshop has to include at least one practical experimental, if possible IBL, activity that can later be used in school.
2. Although teachers liked the idea of active approach and they mostly join to PLCT to improve in this respect, they mostly believed that they allow for an active and independent learning of students. It turned out that they were actually not experienced IBL users. This was valid even for teachers that used a lot of experiments during their teaching. With this respect, they welcomed the methodological support offered by developed worksheets and guides for IBL and examples introduced during the meetings. They were always the most welcome part of the meeting. Again, as a learning, IBL is very difficult for a teacher used to standard teaching approach but also to teachers who believe that they use active approaches in their teaching, and elements of training, which support the change toward more independent work of students, have to form an essential part of workshops.
3. It turned out that differentiation between inquiry based learning and the practitioner inquiry is extremely difficult. The support offered by posters protocols developed by UL was a great help. So, we concluded that one workshop with an emphasis on differences and similarities of the two different inquiries supported by tools designed for this purpose have to be included in a training program.
4. The process of introducing a regular practitioner's inquiry as a regular practice is long. Motivation, like presentations at the events, publications etc., which in Slovenia enable promotions in employment stimulated members of a novice PLCT, but continuation of training on PI could have a very positive effect. Our opinion based on this recognition is that the life of a PLCT with coaches involved in some meetings at least has to span over more years, at least two, and even after, the collaboration with coaches should be fostered. With this respect, the fast one week course is probably too short and it would be welcome that teachers return to refreshment courses or that a way to stay in contact with coaches of the course aslo after their participation in the short professional training.
5. Finally, the PLCT became a good, friendly and hardworking group during the training. It would be very good for them to continue and to form similar communities with their colleagues.



# Artevelde University of Applied Sciences Belgium Case Study

**Jan De Lange**

## **Introduction**

This case study reports on the implementation of a professional development course for second level science teachers facilitated by partners from Artevelde University of Applied Sciences (AHS) Belgium. The course, which is part of the second iteration of the Three Dimensions of Inquiry in Physics Education (3DIPhE) Erasmus+ programme was designed to develop teacher's competencies and understanding of Practitioner Inquiry (PI) and Inquiry Based Learning (IBL) through engagement in a Professional Learning Community (PLC).

## Context and background

This case study describes a PLCT course on practitioner inquiry for second level teachers that was facilitated in a school in Oedelem, Belgium, where four teachers worked together as part of a professional learning community for the duration of the course. The structure of the course allowed the four teachers to develop as a professional learning community, learn about practitioner inquiry, learn about inquiry based learning and finally conduct and present a practitioner inquiry on their own practice.

In the spring of 2019 a digital flyer was distributed by an email newsletter to a University network of schools in Flanders. Several individuals responded and site visits were carried out in several schools to provide more specific information about the course and discuss the expectations of the schools and teachers. In contrast to other schools (where communication went via the heads of the school), the response from the school in Oedelem was from a science teacher who represented several science teachers in that school. The ownership and motivation of this group of teachers to participate in this course was very evident from the beginning, and eventually the other schools that were visited did not participate in the course. This kind of bottom-up approach (starting from the motivation of teachers) rather than a top-down approach (incentive from the head of school) was important for the success of the course. For most other schools the high workload deterred teachers from participating. The experience of the coaches from the first iteration was that motivation and ownership are essential elements of a successful PLC. The first group of teachers the coaches worked with eventually did not complete the course. Hence the coaches were excited to work with Oedelem as the initiative came from the teacher level.

All four of the participating teachers were teaching in the same school in Oedelem (even to the same students). The school was relatively small (about 300-400 students) and is a typical school for applied technical sciences in agriculture, horticulture (gardening) and environment (nature). The course started with 6 teachers but one of the teachers was pregnant and absent during the following school year. Another teacher eventually decided not to participate because of other priorities and the amount of workload that was expected. The participating teachers were all teaching science, mostly biology and chemistry, except one who taught project-based learning in entrepreneurship, with students between 15-18 years of age. She participated because she liked working with the other science teachers. It is important to note that science curricula in this school are as much as possible applied to the themes of biotechniques and agriculture.

This group of teachers had a lot of experience and expertise in teaching. They reported that they usually start a lesson with a revision of the previous lesson, deliver new content using traditional approaches and then support students in applying this new content in new activities (individual & group work). During practical work they use active learning approaches (like IBL), which is not surprising, given that the science curriculum includes a number of mandatory experiments. Depending on the topic, sometimes during practical work students have to learn the content themselves (inductive approach) but other practical work starts after certain scientific concepts have been taught (deductive approach). Practical work is mostly guided (semi-guided). Teachers use a fixed method but students are asked to adapt and change certain steps or the teacher provides opportunities where students can make suggestions.

Differentiation and student motivation are some of the challenges identified by the teachers. How to differentiate student ability in class, both for the stronger students as well as for students that have difficulties with the science content, organisation and planning of practical, work, etc? How to motivate students to work more independently and more actively? It is quite challenging in big groups to have an overview of all students. Is everyone working actively? Students ask a lot of questions and it is difficult for teachers to facilitate everyone.

The four teachers all teach different subjects but according to them IBL is important in each of these subjects (even in entrepreneurship). The teachers do believe in the importance of IBL and felt that practical work increases the motivation of students. However, they experience difficulties guiding practical work in an effective and efficient way. Not knowing the answer or conclusions during inquiry work of their students is uncomfortable for them and so they do not give much ownership to their students during IBL activities. At the beginning of the PLCT course, teachers indicated they were motivated to improve their practice and they find it difficult to identify what doesn't work. They are not used to working in a PLCT and giving feedback to colleagues as this practice does not happen a lot in schools.

In this case study a detailed overview of the course and facilitator reflections will be presented. It will also provide a rationale for some of the course activities which will be supported by learnings from the first iteration of the 3DIPhE project.

This case study provides an overview of the aims of the course, along with providing details of the workshop content. Following this, the content of each daily workshop is described in detail, and analysis of each of the daily workshops is provided. This analysis will focus on what we learned from each of the activities, along with evidence of the teachers' work from each of the days.

## Overview of Course

The 3DIPhE course for PLCTI2n ran from June 2019 for 10 months and a total of 30 hours was spent with the PLCT group (this included the local multiplier event). This PLCT was led by a new coach to 3DIPhE, but was developed based on the experiences and learning from the first 3DIPhE iteration with the previous coach and also with the other 3DIPhE partners). The new coach had extensive experience coaching teachers and professional development courses on IBL.

All of the teachers participated in the workshops voluntarily, mostly after school hours at the school. They preferred shorter workshops of maximum 2.5 hours because they usually had spent several hours of the day teaching. The teachers remarked that they found the workshops very time-consuming and also very demanding.

Workshop Details	IBL	PI	PLC
<p><b>Pre - Workshops meetings</b>            Discussions with 6 possible candidates. Duration of talk: 30 min per participant.            Goals:            1) Gathering information from the teachers            2) Delivering information about the course &amp; project.            3) Practical questions and issues</p>			

Workshop Details	IBL	PI	PLC
<p><b>WS1: Duration 3 hours (6 participants)</b></p> <p>Introduction and problem exploration</p> <ol style="list-style-type: none"> <li>1) IBL activity on black boxes as an ice-breaker with a discussion on what is IBL</li> <li>2) Goal and working principles of this course</li> <li>3) Planning and practicalities</li> <li>4) Protocol: <i>Passions</i></li> </ol> <p>Homework:</p> <ul style="list-style-type: none"> <li>- Observe each other, find a critical friend,</li> <li>- baseline test</li> </ul>	<p>●</p> <p>●</p> <p></p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p></p> <p>●</p>	<p></p> <p>●</p> <p></p> <p>●</p>
<p><b>WS2: Duration 3 hours (6 participants)</b></p> <p>From problem exploration to a first inquiry question</p> <ol style="list-style-type: none"> <li>1) PLC bonding. Protocol: <i>Forming ground rules</i></li> <li>2) Planning and practicalities</li> <li>3) Different exercises about raising &amp; refining research questions <ul style="list-style-type: none"> <li>- exchange experiences of classroom visits</li> <li>- Starting from results from baseline questionnaire</li> <li>- Results from passion protocol</li> <li>- The Fibonacci self assessment tool about IBL.</li> </ul> </li> <li>4) IBL activity: raising questions with plasma spheres</li> <li>5) Choosing the inquiry questions</li> </ol> <p>Homework: Discuss inquiry question with Critical Friend</p>	<p></p> <p></p> <p></p> <p>●</p> <p></p>	<p></p> <p></p> <p>●</p> <p></p> <p>●</p> <p>●</p>	<p>●</p> <p></p> <p></p> <p></p> <p></p>
<p><b>WS3: Duration 3 hours (4 participants)</b></p> <p>Orientation &amp; refinement of inquiry question</p> <ol style="list-style-type: none"> <li>1. IBL activity Subtle Shifts</li> <li>2. What is PI? using Protocol: <i>Farming vs Gardening</i>, PI vs Academic research</li> <li>3. Refinement of the inquiry question <ul style="list-style-type: none"> <li>- Individual orientation on problem through 5W + 1H method</li> <li>- Presentation of chosen problem in group &amp; peer feedback</li> </ul> </li> <li>4. Homework: Use template (with inquiry question &amp; subquestions) to synthesize &amp; specify your inquiry.</li> </ol>	<p>●</p> <p></p> <p></p> <p></p>	<p></p> <p>●</p> <p>●</p> <p></p> <p>●</p>	<p></p> <p></p> <p></p> <p></p>
<p><b>WS4: Duration 6 hours (6 participants)</b></p> <p>Refinement of inquiry question, data Collection for better understanding</p> <ol style="list-style-type: none"> <li>1. IBL activity: Argument Driven Inquiry (ADI)</li> <li>2. Individual reflection on inquiry questions (Protocol: <i>Litmus Test</i>)</li> <li>3. Group discussion: Refining your inquiry question (Protocol: <i>What? So what? Now what?</i>)</li> <li>4. Data collection for practitioner inquiry (Protocol: <i>Easy ways to collect data</i>)</li> <li>5. Homework: none</li> </ol>	<p>●</p> <p></p> <p></p> <p></p>	<p></p> <p>●</p> <p>●</p> <p>●</p>	<p></p> <p></p> <p></p> <p></p>



Workshop Details	IBL	PI	PLC
<p><b>WS5: Duration 3 hours (4 participants)</b></p> <p>Design of inquiry plan</p> <ol style="list-style-type: none"> <li>1. Data collection for practitioner inquiry (Protocol: <i>Easy ways to collect data</i>)</li> <li>2. Developing an inquiry plan (start during session)</li> <li>3. Homework: developing inquiry plan using template (Protocol: <i>My Inquiry Brief</i>)</li> </ol>		<p>●</p> <p>●</p> <p>●</p>	
<p>In between WS 5 &amp; WS 6 Individual coaching was carried out with each teacher to help them develop their inquiry plan.</p>		<p>●</p>	
<p><b>WS6: Duration 3 hours (4 participants)</b></p> <p>Feedback on inquiry plan and start analyzing data</p> <ol style="list-style-type: none"> <li>1. Peer Review of Inquiry/Implementation Plans (Protocols: <i>Zones of comfort</i> and <i>Inquiry brief peer feedback</i>)</li> <li>2. Data analysis (first steps)</li> <li>3. Preparations for LME 02 and 03 March in Diest</li> <li>4. Homework: making draft posters.</li> </ol>		<p>●</p> <p>●</p> <p>●</p>	<p>●</p>
<p>Local Multiplier Event: Duration 1,5 days (20 participants)</p> <p>Poster presentation</p>		<p>●</p>	
<p><b>WS7: Duration 1 hours (4 participants)</b></p> <ol style="list-style-type: none"> <li>1. Data analysis and make conclusions (Protocol: <i>Data Driven Dialogue</i>)</li> <li>2. Building awareness of the need of looking back at your data without bias and the possible pitfalls by using a step by step guidance (Protocol: <i>Data Driven Dialogue</i>)</li> <li>3. Homework: Teacher completes this exercise at home.</li> </ol>		<p>●</p>	

For further details on the protocols referred to in the workshops please refer to Appendix B.

### Workshop 1

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

#### *Activity 1: Black box (water making machine)*

Since this was the first meeting with the teachers, the coach started with a short icebreaker activity and at the same time discussed IBL. It started with a small activity, called black box. This activity is not a unit, but rather a short exercise on specific IBL skills, such as developing models. This was seen as a starter activity and did not have the intention of being used to describe or define IBL for the participating teachers. It was found to be an interesting activity to find out the teachers' ideas on IBL. The coaches participated in this activity as equal members of the PLC. There were no correct answers in this activity, only opinions and it was essential that every teacher had the feeling that their voice mattered (and others listen to it). This approach emphasized there was no hierarchy in the group and every member had an important role to play.

The coaches felt that this activity lasted too long in comparison with the other activities of this first workshop. It didn't bring a change in opinion to the group and was more or less restating opinions they already had.

#### *Activity 2: Clarify the goals and 'rules' of this course*

This activity was more lecture-based and there was not much interaction. Maybe this could be done in a more interactive way but on the other hand the PLCT would lose too much time. The coach wanted to discuss teachers' expectations about professional development and creating a safe environment to collaborate in a constructive way. The coaches felt that providing clear goals and expectations were very important for the teachers. Teachers indicated they have never worked in this kind of professional learning environment before. They already knew each other for a long time but didn't actually talk about their practice in a formal way. Therefore pointing out the differences between a teachers' staff room (more informal) and this PLCT (more formal, but still safe environment) made this very clear to them.

The coaches felt that this activity went okay and it is something that must be presented very clearly during every course.

#### *Activity 3: Passion protocol*

This protocol started by showing some of the coach' own inquiries as an inspiration for the teachers (again, this indicated that coaches also have a lot of inquiries). The teachers discussed and decided what they are passionate about. The goal at the end of this activity was that teachers could identify their own inquiry question.

This protocol possibly focussed too much on teacher's needs and passions. Part 2 of this protocol focussed more on the learners and their needs. Though this workshop started with an IBL activity as an icebreaker, there were no specific questions related to IBL. The passions of the teachers were more focussed on pedagogical issues, such as, students' motivation, differentiation, bringing passion for the science subject to their students and working on metacognitive skills, e.g. perseverance and planning. This 'absence of link with IBL' in the inquiry may not be seen as problematic. On the contrary, it was important that while conducting a PI, teachers work on their passions and not on something that was imposed. This 'ownership' of the inquiry was present with all teachers and they were highly motivated to continue the PI course.

This protocol was very useful for getting the participants to think about why they love teaching and to explore new ideas. Because of this broad perspective the inquiries were often quite general and needed some further refinement.

#### *Activity 4: Elaborating on the 'homework'*

At the end of this first workshop, teachers were asked to do a 'mini observation' with each other. This helped them to consider a more specific inquiry and refine their own inquiry questions. The teachers were very motivated to do this, because they never had done such an activity and it was very new to them. Teachers were asked to complete the online pre-questionnaire as homework. The results of these were discussed in the next workshop.

### **What design principles for future workshops would you recommend based on your experience. Overall reflections**

- Make very clear that every member of the PLC is equal. There is no hierarchy (not even between the coach and teachers). Everyone is learning in a PLC.
- Use protocols to steer wonderings towards IBL by using for example the Fibonacci assessment tool (Carulla S.B. et al, 2012).
- Certainly in the first workshops activities are needed where goals from the 3 dimensions (IBL-PI-PLC) are present. This creates an initial mindset for the participating teachers about the course. This workshop used an icebreaker (PLC) – IBL activity but this did not fully include these dimensions and the teachers did not use their reflections in the other activities of this workshop.
- All activities from this workshop were relevant and had an added value. A coach must rely on many examples of exercises on IBL, PI & PLC. However, make sure you do not try to do too much in a workshop. The design principle 'less is more' is very important. Be very clear on what you want to achieve, then choose only a few activities/protocols and stick to them. For example, there were very positive reactions on the lesson study proposal as homework, but together with the passion protocol it was too much.
- Some protocols like the passion protocol are very clearly described with fixed timeline and instructions. However, during the workshop the coach often deviates from the instructions and timeline (because interesting discussion opened). It is difficult to strike a balance between following the schedule and being flexible. Some protocols are powerful because of their fixed instructions and timeline. It is important to have a timekeeper.

## **Workshop 2**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

During this workshop several activities were planned (see overview of the course). However, while delivering the workshop, it was impossible to complete the agenda. Only half (or maybe less) was actually done. One of the reasons (but not the only reason) for this lack of time was that the group of science teachers had an inspection for the science curricula at the beginning of the school year. The results were not bad but also not 'very good'. There were some remarks and teachers needed to vent their frustrations and concerns. This was an external factor so the group definitely had to take some time talking about it. This flexible approach is positive but on the other hand influenced the agenda and time schedule.

#### *Activity 1: Raising questions*

The objective here was to obtain a lot of questions from the teachers. The focus was quantity (divergent thinking) and not refinement of specific questions. They were several discussions, each time starting from a different perspective:

- a. From the results of the pre-questionnaire.

This resulted in a lot of questions about the different topics from the questionnaires: teaching approach, challenges teachers cope with, practical work & professional development of teachers. These questions gave a good overview what teacher 'problems' were and what they were struggling with. Teachers mentioned that it was good to use the insights from the questionnaire. In this way they had the feeling it was useful to fill in the questionnaire (and it was not something above their heads).

- b. Using an exchange activity to discuss the mini-observation lesson study.

Though a protocol for doing classroom observations had been introduced only one "mini-observation" was completed. This was unfortunate. But on the other hand, it led to a lot of questions. Teachers acknowledged the added value of having an observer in class (looking at it from a different perspective gave some new information) but it also influenced their teaching practice. The teachers were not used to observing each other. To summarize, after these activities, lots of questions were raised.

The group felt an urgency to focus because they were not advancing in the PI process.

The IBL activity on plasma spheres was cancelled. Because not everything was done as planned, the group needed to change the planned homework a little bit.

*Homework:*

1. In order to focus more on IBL in their PI, teachers had to use the Fibonacci self-assessment tool. This tool helped teachers to reflect on IBL and think about their strengths and weaknesses.
2. Every teacher must pick out the 2 questions they felt as most relevant to them. These 2 questions were the starting point for the next workshop.

### **What design principles for future workshops would you recommend based on your experience. Overall reflections**

- The gap between the first workshop (June) and the second workshop (October) was too big. Workshops at the beginning of the course should be organized closer to each other.
- It is good to start to think divergently and raise many questions about their practice, but this should be limited in time! There must also be time to converge and choose 1 or 2 questions.
- Same recommendation as from the 1st workshop: 'less is more'! Discussing the results from questionnaire, exchange protocol about lesson study & filling in the Fibonacci self-assessment tool is too much! Choose only one or two activities/protocols and stick with them.
- Same recommendation as from the 1st workshop: Do not deviate too much from the instructions and timeline.
- An IBL activity, even if it's a short one, is a must! It ensures some variation in the workshop and it creates a nice pace.

## **Workshop 3**

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

*Activity 1: IBL activity 'Subtle Shifts'*

IBL activity subtle shifts was very powerful. Because of the 'small changes' that teachers can make to enhance IBL, it is very accessible for the teachers. They all mentioned that they wanted to make small changes in their own lessons. Apparently (this was noticed only a few months after this activity) they all have made some small changes during

practical lab work of their students, but they didn't incorporate this in their inquiries of the PI. They thought a PI should be about something bigger than just making some small changes.

Find more about the activities in [Volume 1](#).

### *Activity 2: What is PI? (PI vs Academic research)*

Using the metaphor 'gardening versus farming' differences between PI and academic research were discussed. This was done very short but it was very clear to the teachers. It was a good exercise and it didn't take too much time. It had a nice pace.

### *Activity 3: Refinement of the inquiry question*

1. Individual focus on problem through *Why, Who, When, What, Where + How (5W + 1H)* protocol. The Orientation activity went well. It was good that teachers individually had to work in silence through specific questions (5W + 1H) about their problem.
2. Presentation of chosen question in group & peer feedback  
Teachers found the peer feedback to be very valuable. Several times (also at other moments of peer feedback) there were comments like '*We should do this more often! Not only during these workshops... It should be part of the school culture.*'

The most difficult part in PI is defining a good achievable inquiry question that is not too broad or too specific, not too difficult but still is relevant to them. The most important criterion is that their inquiries must have impact on their personal professional level. However, you cannot perpetually spend time on refining and refining. At a sudden point, they have to act, they have to do something. Further on in the process, the questions will still be refined. Teachers have to be aware that their choice of inquiry question at this moment is not definite, that it can change over time.

*Homework:* Use template (with inquiry question & subquestions) to synthesize & specify your inquiry. Teachers were asked to fill in a template and send it a week before the next workshop to the coach. This stressed them a little bit, but they acknowledged we needed to set up deadlines. They still felt a little bit insecure about their inquiry questions (and subquestions).

*Homework for the coach:* Support participants for searching for literature about their questions. Not all teachers have confidence in finding 'good' (=relevant) literature.

*General feeling:* Teachers acknowledge that we are getting somewhere during the PI process. It is becoming more and more specific, but very slowly.

## **What design principles for future workshops would you recommend based on your experience.**

### **Overall reflections**

- When the workshops should be organized? The previous workshop (October 8th) was held in the evening after the teachers had been giving class for the whole day. The coach noticed difficulties to stay focused (because of tiredness at the end of the day). This second workshop was held on a Wednesday afternoon and there was a better 'work attitude'. In the future, workshops should not be organized after a whole day of teaching.
- Timing and following a script (protocols) remain very important.
- Metaphor on gardening versus farming is a very good exercise. Because in a short time you can discuss differences between PI and academic research without going too much into detail.
- Take some time in each workshop to work in silence and individually. Teachers have difficulties working at home so the workshops should also provide time for a working space (not only talking and discussing).

- The protocol on orientation (5W+1H) is very good and should be available for every partner.
- Peer feedback is very powerful, but be aware: ‘Act, don't just think and talk’
- Help teachers finding ‘good’ literature is important!

## Workshop 4

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

#### *Activity 1: IBL activity Argument Driven Inquiry (ADI)*

The IBL activity (adapted from resources produced by NSTA on Argument Driven Inquiry) was very powerful and very well appreciated by participants. Though this activity would not directly be connected to the PI's, they mentioned that these kinds of exercises were very inspirational. They were constantly taking notes and making plans on how to implement ADI into their practice. In this way, this is a kind of small PI on its own.

#### *Activity 2: Individual reflection on inquiry questions (Litmus Test)*

After the IBL activity, teachers had to think individually using the guiding questions from the litmus test. It was a good exercise to focus. It was strictly limited in time.

#### *Activity 3: Group discussion: Refining your inquiry question (What? So what? Now what?)*

Using the protocol What, so what, now what? teachers gave peer feedback to their inquiry question and subquestions. While doing this, the coach projected the online document at a screen and immediately added the feedback. This was very efficient and teachers (finally) got the feeling it was getting more and more specific.

#### *Activity 4: Data collection for practitioner inquiry (Protocol: Easy ways to collect data)*

Because a lot of time was spent on activity 3, the teachers rapidly looked at the different ways of data collection. The teachers agreed that during the next workshop (which was planned already a week later) we would not spend time on IBL activities but only at their PI's.

*Homework: /*

### **Which elements of the workshop would you change if you were to repeat the workshop? What design principles for future workshops would you recommend based on your experience.**

#### **Overall reflections**

- Use online google documents for each teacher to make inquiry plans. In this way in group we can all work together at the same time in the same document and afterwards these documents can easily be shared so the coach, other teachers and external critical friends (& experts) can give feedback.
- Shared the inquiry questions and subquestions with some external experts .
- During protocols of peer feedback (like ‘What, so what, now what?’) a strict time schedule and time keeper is necessary! Otherwise you don't have enough time to discuss every participants' inquiry.
- Take some time at the end of the workshop to discuss what we are going to do in the next workshop. We decided to drop the IBL activity to have sufficient time on the PI. IBL activities in combination with PI are very powerful, but not easy to find an appropriate balance.

## Workshop 5

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

*Activity 0: Wrapping up the refinement of inquiry questions.*

Before the activity on data collection the coach summarized every PI using the online Google document. For the first time all teachers used laptops and worked together on Google doc's (inquiry questions of each participant). The coach took most of the notes immediately in the online document so it was clear and accessible for everyone. The group could easily agree on the essence for each inquiry question and move on to the next one. The refinement of the inquiry questions was finally finished. Again, this illustrates that the PI process, certainly the first stages, proceeds rather slowly.

*Activity 1: Data collection for practitioner inquiry (Protocol: Easy ways to collect data)*

This tool was a good way to illustrate that inquiry is about gathering data and data can be very different. Some of the teachers already interviewed or questioned some of their students and they noticed how interesting this was. A quote from a teacher: *“It is so powerful to present your inquiry question to your students. It is surprising how much information you will get. Students give very interesting feedback and suggestions. We always think we have to find solutions at our professional challenges ourselves, but in many cases the answer lies in the hands of your students.”* Looking at the different data, teachers were feeling more and more confident about collecting data. It doesn't have to be big or academic, but it is important to collect various types of evidence.

*Activity 2: Developing an inquiry plan (started during session)*

Starting from their inquiry questions and data collection tools, teachers had to think about a plan. Some guiding questions were given like:

- How are you going to answer your questions?
- What kind of data should you collect?
- How this data will lead to an answer to your questions?

The group openly discussed some of the questions, so they are inspired to work at home on their inquiry brief. At the end of the workshop, the coach proposed some individual coaching on each plan. They all agreed on that, so between workshop 5 & 6d one-hour individual meetings were scheduled by the coach with each teacher.

*Homework: developing inquiry plan using template (inquiry brief), draft version*

**What design principles for future workshops would you recommend based on your experience.**  
**Overall reflections**

- This workshop followed only six days after the workshop 4. Teachers acknowledged the benefit of planning several workshops in a short period of time. In this way they had the feeling the PI process was more 'alive' and they were proceeding faster in their inquiries.
- Using laptops and online Google docs are powerful to summarize, to agree on essence and to make it visual for everyone.
- Always use specific examples of data when explaining the data collection tool (Tom's data folder is an example of fictional data made by partner DCU from Ireland for experiencing this data collection tool). It would be nice if we had a good example from the second iteration of PLCTs.
- Same recommendation as previous workshop: at the end, agree together with whole group on the planning and goals of the next workshop.

## **In between workshop 5 & 6**

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

By coaching each teacher individually the coach wanted to help teachers develop an inquiry plan. During a PLC meeting the coach doesn't have enough time to support in depth the inquiry plans of each teacher. This individual coaching moment really helped teachers. There was one individual coaching session where also an external expert was invited to bring in expertise about entrepreneurship. All teachers were very happy with this extra coaching. There were no specific protocols prepared. Only a draft version of the inquiry plan (inquiry brief) was needed. It was amazing what was done in one hour.

**What design principles for future workshops would you recommend based on your experience. Overall reflections**

- If it is manageable for a coach of a PLC (in time), organize an extra individual coaching meeting.

## **Workshop 6**

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

### *Activity 1: Peer Review of Inquiry/Implementation Plans*

After the individual coaching sessions every teacher now had a more specific plan. Beforehand these plans were also shared with some external critical friends, so teachers had already got some feedback. The peer feedback went very well! The power of working in a group is present! The group directly worked on laptops like the previous meeting. Every inquiry plan was adapted immediately while discussing it, and everyone could follow all changes made in the online document. Peer feedback in every step of the PI is good, but it takes time. Again, it is balancing between spending time and being efficient.

Another difficulty at this moment was that some of the teachers were already collecting data, while others didn't start yet. This different pace of each PI makes it difficult to find appropriate protocols that fit the whole group. The coach has to be flexible at this moment.

Because everyone appreciated the peer feedback very much and not everyone had already collected data. We decided during the workshop to postpone the data analysis exercise.

### *Activity 2: Preparations for LME on 2nd and 3rd of March in Diest*

Two teachers were delegated to go to the Local Multiplier Event in Diest. It was very difficult to plan this and make sure teachers could be replaced at school. They also needed to provide tasks for their students during their time of absence. Teachers stressed out that this is problematic at their school. They are willing to go but they have to do this on top of everything else. To support them, the coach decided to make a draft poster for them (based on their inquiry plans).

*Homework:* Making draft posters.



## **What design principles for future workshops would you recommend based on your experience.**

### **Overall reflections**

- Peer feedback is powerful! Use it as much as you can, but make sure you diversify with individual working time.
- In this workshop, an IBL activity was not included and that was ok! IBL activities are more powerful in the beginning of a PLCT. At the end they have less added value.

## **Workshop 7**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Which elements of the workshop would you change if you were to repeat the workshop?**

This workshop was planned at the beginning of April 2020. Because of the Covid-19 pandemic this could not take place face-to-face. Therefore an online session (panopto recording) was made and provided to the teachers. This was a more theoretical approach. The PLC component was of course not present.

The goal of this session was building awareness of the need to look back at your data without bias and the possible pitfalls by using a step by step guidance (Protocol: *Data Driven Dialogue*). These steps were:

- Recall inquiry question & plan
- Overview of the data collected
- Predictions
- Make your data visual
- Observe patterns (don't conclude yet, only describe...)
- Interpretations & conclusions
- Validation of results

At home, teachers would have to do this exercise themselves with the data they have collected. Unfortunately the Covid-19 pandemic also interfered with their PI and teachers were not able to test all activities & collect all data they have planned. Some teachers had already some information and made provisional conclusions. At this time the teachers also had other priorities so it was difficult for them to do this exercise on data analysis and making conclusions. Therefore, they are no reflections about what contributed most effectively to the purpose of this workshop

## **What design principles for future workshops would you recommend based on your experience.**

### **Overall reflections**

This workshop used a mixture of different protocols. It is good to provide several protocols to the coaches, so they can easily fall back on a range of possibilities. Then it is the responsibility for the coach to prepare workshops with clear goals and activities. It's necessary to make sure a coach has a wide range of possible instructions (protocols) at hand that are related to the specific goals of IBL, PI or PLC.

## Participant Reflections on Course

Comparing the results from the pre and post survey, some small changes were noted in the responses from teachers. Those changes were more evident on the theme of professional learning than on IBL. Before the course, the teachers already had a quite positive attitude towards IBL and practical work, and they felt comfortable using IBL in class. After the course their attitude and feeling comfortable about using IBL was still present and was even slightly better. Teachers indicated that they will use IBL more often in class as a result of this course. As a result of this course the teachers valued the importance of professional learning. More specifically they appraised very much giving feedback to peers, reflecting on their own practice and working in a PLC with colleagues. However, they do not believe that their efforts will have an impact on the schools' policy or even have influence at a national level.

The same trend and results came out of the open questions of the post survey and the focus group interview after the course. In general, teachers really appreciated the course and help they've got during the course. Teachers reflected on the three pillars of the course: IBL-PI-PLC. They have learned new methods about IBL and science education. They were inspired by specific examples of IBL and they have used this to adapt their own class practice. For example, they learned more how to guide an IBL activity and give more ownership during the activity to their students. One teacher inquired about the value of giving feedback, not only feedback from the teacher but also give feedback to each other.

Conducting a Practitioner Inquiry was very new for the teachers. For them PI is taking time to think about a problem in their teaching practice. The teachers made a commitment/engagement, they were 'obligated' to spend time on their challenges. They weren't used to taking time to tackle pedagogical problems in their professional career. Participating in this course kind of obligated them to actual work on those problems. Every teacher took time to stand still and reflect on what works and what doesn't work in class. Turning the problem into a specific inquiry question was perceived as a difficult but also as very valuable and good exercise. Taking into account that you must collect data and think how to collect data about your practice, was another difficult but very powerful thing while inquiring about your practice. Reading literature about educational problems and teaching methods was also very new to them. They noticed it is important to spend time reading literature. At the end of the course, they all agreed they were much more critical towards their own teaching practice as they did before.

The third pillar of the course, working together as a group of colleagues in a PLC, was also perceived very well: conversations with colleagues, to have contact with colleagues in a more formal manner (not just small talk in teachers' room) to exchange ideas, receiving feedback from coach and colleagues. They all indicated the importance of involving other colleagues (from other subjects) by the practitioner inquiry.

Though the course was evaluated positively, there were also some remarks and recommendations. For instance, about the workload. The course was pretty time consuming and it is important to be as efficient as possible. During the first three workshops, it took some time (too much time) to come to a specific inquiry question. A workshop every two months during that period was not so efficient. Therefore, workshops coming in a quicker succession would be better, certainly at the start of the PI process (from passion to inquiry question and inquiry plan).

Some interesting quotes from the teachers:

- *'I am not satisfied with the results of my own PI. I got stuck because it was too difficult and challenging, but that is not so bad at all! Although my personal inquiry was not so successful, I still learned a lot!'*

- *‘Thanks to this course I’ve learned how important it is to involve my students in finding solutions about challenges I face within my teaching, but also students face while doing tasks. I was surprised to notice how many useful tips students can give. So every time I will face a problem in class or students face a problem (for example in planning practical work), I will first ask my students’ opinion about it, instead of looking at the answer myself. It is an important attitude every teacher should have.’*
- *It was interesting to learn from each other’s inquiries. Some results (like giving feedback about practical work with an online logbook or design thinking) will be applied in several other subject by other teachers.*
- *‘Although I was doubtful at the beginning, I was surprised to see the positive effect of my intervention (using context as a start for chemical calculation). I will use this approach more often in the future.’*
- *‘It is surprising to see how small changes in my teaching approach already have some positive effect.’*
- *‘The LME was certainly an added value for me! It was interesting to see other teachers’ practitioner inquiries.’*
- *‘It’s a pity that our managing board (heads) and other colleagues who were not part of our PLCT were not so involved. We must have a forum to communicate about interesting professional development to other teachers. Broadening in our school what we have learned is important.’*
- *‘We must rethink the way we work together as colleagues in our school. Now meetings are more about administration, purchase of material, organization of excursion, etcetera but we must have time to work on actual problems and challenges we face as teachers.’*
- *‘Take time to try something else! That’s important!’*

## Reflections on Multiplier Event

Two teachers participated one day at the local ME. As a coach you don’t know what to expect and how these teachers would present and react at this event. It is important to know that none of the teachers finished their PI’s in advance of the LME. They have presented provisional results of their inquiries and it was interesting to get feedback from other peers.

Afterwards, both teachers were very positive they have participated. It was certainly an added value for them. They felt really proud about the work they presented and they were also very pleased by positive and constructive feedback but what they most valued was the interactions with other colleagues. At that moment they had seen that there were not the only ones doing a PI (and spending so much time on it). It really opened up their horizons. They felt sorry for the other 2 teachers that they could not participate.

## Key Learning and Recommendations for Design Principles:

- The coach should have a wide range of possible instructions/protocols but should apply the ‘less is more’ principle! Set clear goals, choose and select the appropriate protocol, but don’t overload your workshop.
- While facilitating the workshop, be aware of time! You must be strict so everyone can be heard, but also be flexible so you can work on actual and relevant challenges from your PLCT group.
- The combination of protocols PI – IBL really worked! Often the IBL activities are not related to the PI

inquiries, but that's not a problem. Anyway teachers are inspired and will be using some of those inspirations (but not in their PI's).

- Ownership remains essential! Do not steer them too much towards topics you prefer.
- There is no hierarchy! Let your teachers know we are all at the same level... Helping each other is crucial.
- Help teachers make notes during workshops. You can point out a responsibility for taking notes.
- If possible, provide some time for individual coaching moments. In this way you can support each individual more in depth.
- Make an agenda and set goals for the next workshop together with your PLCT members. Be flexible in the total structure of the course.
- About the duration and structure of the workshops:
  - 3 hours is a maximum to stay focused! It is pretty intense.
  - At the beginning should be organised in a quicker succession (every 1 or 2 weeks, starting with 3 or 4 workshops). When the inquiry plan is almost finished, teachers should have time to start collecting data. After a break of 2 months, again a series of several workshops (about data analyzing, presenting results and validating) should follow each other again a bit faster.



# University College Leuven-Limburg Belgium Case Study

**Katrien Vyvey,  
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## Introduction

This case study reports on the implementation of a professional development course for second level science teachers facilitated by partners from University College Leuven-Limburg (UCLL) Belgium. The course, which is part of the second iteration of the Three Dimensions of Inquiry in Physics Education (3DIPhE) Erasmus+ programme was designed to develop teacher's competencies and understanding of Practitioner Inquiry (PI) and Inquiry Based Learning (IBL) through engagement in a Professional Learning Community (PLC).

## Context and background

The coaching took place in a school where they chose to completely reorganise the courses of natural sciences, geography and technology for the students in the first grade of the secondary school (age 12-14 years). So far, these subject matters were offered in separate courses, but since this school year a STEM-course was built in which the 3 subject matters are taught in an integrated way.

In order to develop the STEM-materials a PLC was established in the school. The teachers of the PLC were looking for support on their STEM-materials: i.e. ways to improve their materials as well as their teaching. They were trying to figure out best practices (e.g. more guided or more open approach). The school provided time during working hours for the teachers to develop the STEM-materials and take part into the course. Classes of the participating teachers were taken over by colleagues during the moments of the course.

First versions of the STEM-materials were already made before the start of the course. Teachers wanted to finalize and improve them. Therefore, the course took the first versions of the STEM-materials as a starting point and focused on PI to improve those materials. For one of the themes, i.e. 'Bicycle', the coaches also had an input in the development of the STEM-materials. For three STEM-themes, (Bicycle, Energy and Fruits), the coaches showed the teachers the usefulness of practitioner inquiry to test and improve the STEM-materials and the teaching of them. Inquiry based learning took a central place in all themes.

The course started with 16 teachers, eight of whom finished the entire program. The other eight teachers were frequently present at the course moments, but nevertheless missed some essential parts of the course. E.g. they did not fill in the surveys, did not complete the homework, they did not contribute to the development of the STEM-materials and did not complete a practitioner inquiry.

The group of teachers was young. From the eight teachers that finished the whole program three of them had between 3-10 years of experience. The other five teachers had less than three years' experience. For all of them it was the first time that they participated in a UCLL course on IBL/PI. The teachers had a background in all STEM-components, i.e. they were teaching mathematics/physics/technology/geography/biology/chemistry or a combination of two or three of these subject matters.

Before the start of the course it was striking that the teachers reported that they found it difficult to facilitate students doing practical work, especially when the answer of the investigation was unknown for the teachers. Apart from that, the teachers felt rather confident about their abilities to use inquiry-based learning. They all had a positive attitude towards inquiry-based learning and collaborative learning. They were convinced of the positive effects for their students concerning skills and competences, content knowledge and motivation.

Teachers also indicated at the start of the course that they were motivated to reflect on their teaching and enhance their teaching. However, they felt rather uncomfortable about inquiring into their own practice. Though they reported there was a dialogue between peers about their teaching, they felt there was room for improvement.. Apart from interacting with their peers, teachers did not interact much with other stakeholders about the effectiveness of their teaching (i.e. students, other teachers, direction, and national level). Teachers expressed that they viewed inquiring into their own practice as a means to enhance their own practice, not as a means to support other stakeholders.

## Overview of Course

The course ran for 4 months from December 2019 and provided support on developing new IBL STEM-materials and on carrying out a PI for improving the use of STEM-materials in classroom practice. The development and improvement of new STEM-materials that use IBL was the starting point of this course. To achieve this goal, teachers collaborated in a PLC.

Workshop Details	IBL	PI	PLC
<p><b>WS1: Duration 3 hours (16+2 participants)</b></p> <ol style="list-style-type: none"> <li>Exchange of ideas and concerns about the new developed STEM materials Protocol: <i>Critical Friend</i> where the teachers and coaches were critical friends for each other.</li> <li>break</li> <li>How to perform a PI? Protocol: <i>Farming vs Gardening</i> Share examples of PI Short brainstorm on finding a good question using a short version of Protocol: <i>Choosing the right question</i>.</li> <li>Practicalities, homework, deadlines and agenda</li> <li>Homework: Refine your research question Think about data collection methods</li> </ol>	●	● ● ● ●	●
<p><b>WS2: Duration 1.5 hours (6+2 participants)</b></p> <ol style="list-style-type: none"> <li>Separate coaching with 6 participants</li> </ol>	●		
<p><b>WS3: Duration 3 hours (16+2 participants)</b></p> <ol style="list-style-type: none"> <li>Presentation of new STEM-materials, including IBL using Protocol: <i>World Café</i></li> <li>Presentation of the PI homework Optimisation of the PI research questions with the aid of the Protocol: <i>Litmus Test</i> and Protocol: <i>Critical Friend</i></li> <li>Protocol: <i>Easy ways to collect data</i></li> </ol>	●	● ● ●	●
<p><b>WS4: Duration 3 hours (16+2 participants)</b></p> <ol style="list-style-type: none"> <li>Exchange of experiences of the first lessons with the STEM-materials, including IBL</li> <li>PI: data collection Exchange of ideas for data collection and problems encountered during the data collection</li> </ol>	●	● ●	● ●
<p><b>WS5: Duration 1 hour online (8 participants)</b></p> <p>Physical meeting, cancelled due to corona health crisis. Though the physical meeting was cancelled, some teachers were individually further coached online. The focus of this workshop was to exchange conclusions about the new STEM-materials and the PI-cycle and discuss the critical analysis of the gathered data.</p> <ol style="list-style-type: none"> <li>Adjustments to the PI-cycle. Since the lessons in schools were only online some changes to the data collections methods were made. Support was given on alternative data collection methods, so that some of the data collection could be performed online.</li> <li>Online support on data analysis and drawing conclusions.</li> <li>Support was also given on how to create a poster.</li> </ol>	●	● ● ●	
<p><b>WS6: Cancelled due to the corona health crisis.</b></p> <p>The focus was to organise a 6th workshop so teachers could present final results and receive feedback from coaches. Despite of the cancellation we received 1 poster with PI-results</p>		●	●

For further details on the protocols referred to in the workshops please refer to Appendix B.

## Analysis and Reflections on Training Delivery

Below you find an overview of the different workshops, their strengths and what can be improved in the future.

### Workshop 1

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The exchange of ideas and concerns about the STEM-materials which were in development, including IBL was a good start to create a positive mindset for PI. The teachers learned a lot from their critical friends. The input of the different STEM-backgrounds (mathematics, sciences, technology) gave an extra dimension to the discussion and was an asset for the PLC. The PLC had a shared goal and vision which helped to support the motivation of the teachers. Quickly an atmosphere of trust and openness was present in the discussions, contributing to the firmness of the PLC.

The farmer versus gardener protocol was useful to overcome the fear of the teachers who taught at first we were talking about a big academic research. The connection of PI with deeper learning helped the thinking of the teachers about a good PI research question. Nevertheless, the teachers had difficulties inferring a good research question out of the initial discussion. They needed support of the coaches to do so. Often the teachers were simply stuck. Without the help of the coaches they were not able to reformulate their wonderings into a question allowing an inquiry of their practice. Therefore, teachers were asked to think about a good PI research question as homework.

*Homework:* the teachers were asked to think about a good PI research question.

In order to reduce the workload for the teachers and make the homework clear to them an online template was foreseen by the coaches in which the teachers only had to fill in one or two sentences, as shown in this example:

**Title of project: Bicycle**

**What is your PI research question?**

**Version 1:** What is the influence of the open or closed version as a working method for the time it takes to complete the project for students?

**Version 2:** What is the influence of the open or closed version as a working method on the learning gains of students?

The PI poster presentation can be found here ([this is not a link to a poster presentation???](#)).

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

Somehow the teachers did not make the transfer from the farmer versus gardener protocol to their own practice. It might be a good idea to spend more time on the farming versus gardening protocol in a next workshop. It might be useful to explore the following questions: What questions would a gardener ask himself? What questions would a farmer ask? What approach is useful for you as a teacher: the one of the gardener or the one of the farmer? In our case we do not have a garden but a classroom. What question can you, as a teacher, ask yourself?



## **What design principles for future workshops would you recommend based on your experience.**

The exchange of ideas and concerns about the STEM-materials that are in development was a good start to create a positive mindset for PI. The teachers learned a lot from their critical friends. The different STEM-backgrounds were an asset here. The farmer versus gardener protocol was useful to overcome the fear of the teachers who taught at first we were talking about a big academic research. However, enough attention should be given to the transfer from the farmer versus gardener protocol to their own teaching practice. The connection of PI with deeper learning helped the thinking of the teachers about a good PI research question. Nevertheless, finding a good PI research question is difficult for the teachers. Support from the coaches is important!

## **Workshop 2**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

Some of the teachers asked for extra support to be prepared for workshop 3, in which they would present the STEM-materials to each other and also other interested teachers. Therefore, in workshop 2 individual coaching was foreseen for the teachers who were interested. Note that at this point the STEM-materials were not tested out yet in the classroom. Feedback on both the STEM-materials and the presentations was given from the coaches. Also some extra information was given on how the implementation of the STEM-materials in the classroom could be inquired and improved by the means of PI later on. A lot of teachers were concerned about the amount of IBL in the STEM-materials. They were not sure about the amount of classical scaffolding they should provide later on. Especially on the theme Bicycle a lot of input was given by the coaches.

### **Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

It was an informal discussion in a good atmosphere.

## **What design principles for future workshops would you recommend based on your experience.**

It was an informal discussion in a good atmosphere. It is helpful for both the coaches and the teachers to provide individual coaching since it allows teachers to ask specific questions from which also the coaches can learn (e.g. the concern about the amount of classical scaffolding, or overcoming the fear of giving presentations).

The teachers were focused on the STEM-materials and quickly saw the added value of performing a PI later on to improve the quality of the (teaching of the) STEM-materials. The results of this session came clear in workshop 3 where teachers were enthusiastic and nice presentations were given.

## **Workshop 3**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The teachers presented their IBL-material to each other using the protocol World Café. The teachers were focused and interested in each other's work. The presentations went well and all teachers were very enthusiastic. This world café format also helped to further establish a good atmosphere in the PLC.

Time was also spent on how to inquire and improve the implementation of the STEM-materials in the classroom by means of PI. The teachers really spent time on their PI-homework. The homework therefore was a very good starting point for further elaborating on PI. The coaches noticed that despite the efforts of the first session the PI research questions were often not specific enough. The Litmus test (P10) and the critical friends (P96) were very helpful here. E.g. A typical PI research question was: Is it better to teach the STEM-materials in an open or closed way? However, teachers did not specify whether they were focusing on the motivation, learning outcomes, of the students nor did they specify the type of students (e.g. strong in sciences or not), etc.

Table 1 shows a part of a Litmus test. The black text concerns the first version of the PI research question. After finishing the Litmus Test the research question was adapted and the Litmus test was filled in a second time in red.

**Table 1: Partial example of a Litmus test**

Litmus Test: Complete this test for your research question		
Black: research question 1		
Yellow: research question 2		
Nr.	Criteria	Enter below
0.	Start: My current research question is:	What is the influence of the open-middle-closed version as a working method on the time it takes for students to complete the project? <b>What is the influence of the open-middle-closed version as a teaching method on the learning gains of the students?</b>
1.	Does it match your interests why?	Yes, if we discover that an open version takes less time to, we can work more efficiently in the future. <b>Yes, I have never given 1 project in 3 different ways and I am curious about what students learn the most from.</b>
2.	Does it improve the learning of the students? Explain.	Not necessarily... <b>It's better to investigate the variable "results" instead of time.</b>
3.	Is it a question whose answer you don't yet know?	Yes. We suspect that a closed form goes faster because there's more control. However, it is also possible that an open version is faster because students are able to work at their own pace and therefore will only be slowed down by their own questions and not that of every student. <b>Yes. We've never done it before and the results could go both ways.</b>

Next, methods to collect data (P33) were discussed. The teachers obviously were not used to using qualitative tools such as observation with field notes, external observator, discussion with the students, ... It took some effort to convince them that these results are indeed only usable on a small scale, i.e. in their own classes in those specific STEM-lessons, but that to improve a specific lesson for a specific group of students those qualitative tools are often better than the big questionnaires. Therefore, we asked the teachers as a homework to think about at least three different data collection tools for performing a PI. Also here an online template was foreseen by the coaches in order to reduce the workload for the teachers and make the homework clear to them. Teachers only had to fill in a few key words.

*Homework:* List at least three different data collection tools for performing a PI. An example of a response from a teacher was:

1. *Survey at the end of all sessions*
2. *Interview after the presentations*
3. *Comparison of the examination results (of the different versions)*

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

Teachers immediately think about questionnaires to perform their PI. From the beginning (WS 1) it should be stressed that there exist a lot of simple tools to collect data, that may be as relevant or even more relevant than questionnaires to draw conclusions from their PI-cycle.

Although we started with the gardener versus farmer protocol in workshop 1, obviously the teachers did not make the transfer to their own data collection methods in workshop 3. Therefore, it might be useful to repeat the gardener versus farmer protocol and focus on the following questions to make the transfer from the protocol to the classroom easier: How does a gardener collect data? How does a farmer collect data? What would you do in your classroom: collect data as a gardener or collect data as a farmer? What is important in the data of the gardener? Can you make the transfer to your own classroom: what data collection tools would be interesting there?

We did show an example of a PI-cycle from the first 3DiPhE iteration in which qualitative data collection tools were used. However, also here the teachers of the second 3DiPhE course were nodding 'yes' but did not make the transfer to their own classroom easily. Probably, more good PI-examples should be given and it might be useful to foresee a discussion about the benefits of a particular (qualitative) data collection method that was used.

**What design principles for future workshops would you recommend based on your experience.**

The teachers were enthusiastic about sharing their STEM-materials. A world café to do so is an added value for the atmosphere in a PLC. The teachers were motivated to make their homework from the 1st session and this was really a good starting point for the second session. It is probably useful to repeat the gardener versus farmer protocol and focus on the transfer from the data collection tools of the gardener to the possible data collection tools in the classroom. It is useful to give good PI-examples and discuss the benefits of the different (qualitative) data collection tools in those PI-examples.

## **Workshop: 4**

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The teachers were enthusiastic in sharing their first experiences on the implementation of the new STEM-materials. The world café (P31) went well and further established a good atmosphere in the PLC. Sometimes the implementation of the STEM-materials in the classroom was done by co-teaching, which is another interesting way of collaborating. Teachers indicated that they were not used to co-teaching and that somehow they were unsure about doing this in an optimal way. Nevertheless, it helps to make the PLC-members trust each other. It was useful to discuss with the teachers their homework on how to collect data and to adjust the data collection tools chosen by some teachers. Now, the teachers felt ready to perform the PI in the classroom.

*Homework:* Perform the PI with the selected data collection tools and draw conclusions from it.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

In the second part we got a lot of questions on how to collect PI data. Teachers were still convinced that questionnaires are the only valid tools and that one should be able to compare different classes in exactly the same setting. It was hard to convince them that one can also learn a lot from classroom talks, observations with field

notes, critical friends and external observers. In future workshops we would show more successful PI-cycles using other data collection methods than questionnaires and discuss the benefits of qualitative data collection tools. It might also be useful to refer back to the gardener versus farmer protocol and make once more the explicit transfer from the protocol to the classroom.

**What design principles for future workshops would you recommend based on your experience.**

It's nice for the atmosphere in the PLC to give teachers the opportunity of exchanging experiences on ongoing projects.

## **Workshop 5: 30/03/2020**

Cancelled due to the Corona health crisis.

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop? Please support your answer with relevant evidence from the workshop**

The idea was to exchange conclusions about the new STEM-materials and the PI-cycle and discuss the critical analysis of the gathered data. There was some limited online coaching of the teachers. Since the final lessons in schools were only online some changes to the PI data collections methods were made. Support was given on alternative data collection methods, so that some of the data collection could be performed online (e.g. a small questionnaire). The teachers also learned that they had more information on the lessons from the beginning of the course, i.e. lessons that were given in the classroom, than they thought. Also here, it had to be stressed that small qualitative data collections methods, e.g. remarks from students or external observations, are valuable information for the PI inquiry. Online support was given on how to analyse the data and how to draw conclusions from them. Support was also given on how to create a poster.

**Which elements of the workshop would you change if you were to repeat the workshop? Please support your answer with relevant evidence from the workshop and indicate changes you would make.**

Collegial interaction and reflection was mostly missed in this final stage: the individual coaching was the minimum we could do but it could not really replace a physical meeting about 'What did we all learn?'

**What design principles for future workshops would you recommend based on your experience.**

Online coaching can never replace a real physical meeting. However, it can be an addition to physical meetings in cases of necessity.

Nevertheless, we as coaches learned that the teachers have more valuable information on their teaching than they think. Teachers should be encouraged to pick up all kinds of small data to improve their teaching.

## **Workshop 6:**

Cancelled due to the Corona health crisis.

The idea was to organise a 6th workshop to present the final results with the feedback and input from the previous workshops. Despite the cancellation we received one [poster](#) with PI-results as shown in Figure 1.

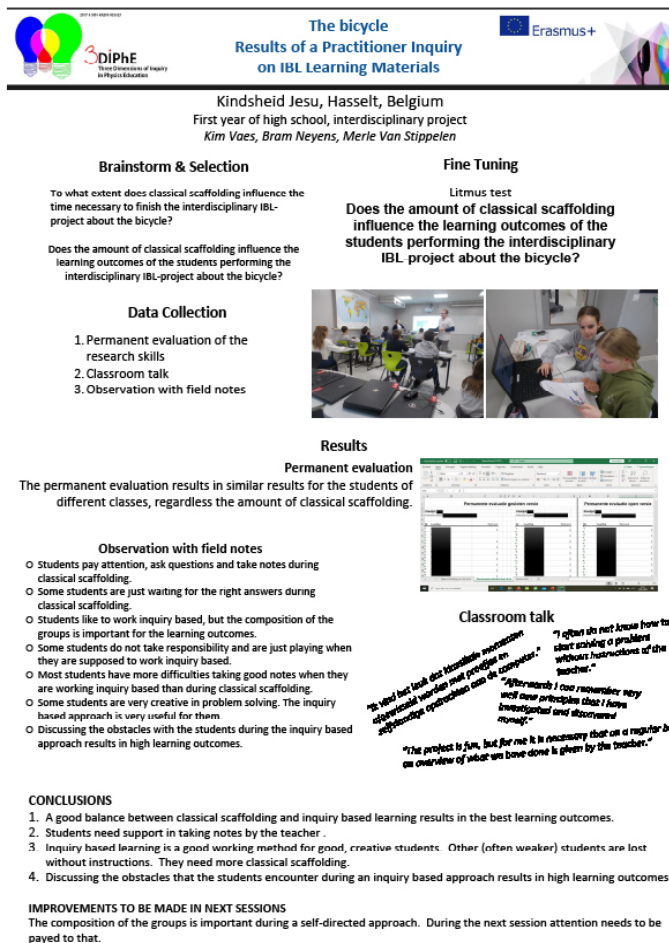


Figure 1. PI Poster from Belgian teacher.

## Reflections on Course

Following conclusions can be made from the participants reflections and surveys:

### *Inquiry based learning (IBL)*

Before following the course, teachers were convinced that they knew what inquiry-based learning is. By following the course they realized that inquiry-based learning is more complicated and broader than they thought. Although the score from the post-survey is still good, this results in a lower score for 'I understand what is meant by the phrase inquiry-based learning'. Possibly they were too positive about their knowledge before starting the course. They also realized that inquiry-based learning is more than just doing practical work.

After following the 3DIPhE course, teachers feel more comfortable about teaching practical work. Nevertheless, they still feel quite unsure when the answer to an investigation is unknown to them, although also this improved after following the course. Teachers indicate that they have applied inquiry-based learning more frequently in their classroom as a result of being involved in the course. A quote of one of the teachers: "We were sceptical about IBL and giving too much liberty to the students. However, very soon the students found some interesting working approaches to the problem. Discussing these different approaches in the class resulted in high learning outcomes for the students."

### *Practitioner inquiry (PI)*

The post survey shows that after following the course the teachers were very positive about practitioner inquiry. The course absolutely reached its goal here! The teachers know after following the course what practitioner inquiry is and find it a valuable tool to examine and improve their practice! They feel confident about the different steps of practitioner inquiry. As a result they are much more confident about inquiring about their own practice and identifying ineffective teaching approaches. They are convinced that the inquiries into their own practice can inform and support other teachers. By following the course they have more access to knowledge that will improve their teaching. Teachers also want to apply practitioner inquiry to different teaching approaches, not only to inquiry-based learning.

Following results on a scale from -3 (disagree) to 3 (agree) were striking in the surveys that were filled in by 8 teachers, a baseline survey before starting the course and a post survey after finishing the course:

	<b>BASELINE SURVEY</b>	<b>POST SURVEY</b>
I am confident I can effectively inquire into my own teaching practice.	1,3	2,0
I am able to identify ineffective teaching approaches.	0,6	1,7
I regularly challenge my assumptions about my own teaching.	0,9	1,7

The results show that the course has motivated the participating teachers on inquiring into their own practice.

Time constraints are the main restriction for the implementation of practitioner inquiry in the classroom. If more time would be given to the teachers they all would apply practitioner inquiry to improve their teaching a lot more since they are convinced of the value of it!

### *Professional Learning Community (PLC)*

Teachers feel confident about collaborating in a group and think that this helps to learn about their teaching. They however feel reluctant about leading a PLC themselves. Especially for developing interdisciplinary STEM-materials, collaborating in a PLC is a real asset. It allows input from different STEM-backgrounds, resulting in better STEM-materials. The teachers also collaborated for a few STEM-lessons by co-teaching. This was new for them but helped to make them trust each other and intensify the collaboration. Allowing teachers to share their experiences helps to create a good atmosphere in the PLC.

A comment from one of the teachers was:

*“We find it difficult to teach as a team in the classroom. We have never collaborated during our teaching practice and we really needed to adapt to that. The second time assisting each other was already a lot easier.”*

The surveys indicate that it is important that the schools explicitly provide time to the teachers for collaborating and engaging in dialogue. At the beginning of the course teachers were given time by their school to collaborate on developing STEM learning materials while at the end of the course the teachers were teaching. Therefore there was less time for dialogue amongst them at the end of the course. This results in fluctuating survey results on going into dialogue with each other and giving feedback to each other. Nevertheless, the teachers indicate that they give and receive feedback from each other and that they value that. After following the course they also ask more regularly their students for feedback on their teaching.

## Reflections on Multiplier Event

The multiplier event focused on interaction and interchanging teachers' PI, via posters and was carried out jointly with partner CEF. A total of 14 posters were presented. Each member presented their PI to peers and several external attendees. This was done in rounds in such a way that almost all participants could listen to each presentation of a poster, and ask questions about it. Some quotes from the interviews afterwards express the appreciation for this way of working:

*Teacher X: It is ok to keep trying, to keep improving, Teacher Y: a kind of satisfaction that we are all doing our best. I always think there are huge results*

Making the poster was a challenge for some, at the same time it made teachers learn better what a PI is like, and how to do it; also really reflecting on it was needed before the poster could be made. During meetings teachers had some doubts on the added value of a multiplier event, it is to say, a more general meeting to exchange all PI's. The crucial issues are: firstly did they really note their learnings, or was this a kind of learning of "nice to have been here" and nothing else. Secondly: the learning will only be useful if they would be determined to proceed with another PI. Only then the learning will be put into practice, and only then this upward spiral can start. In Belgium we did not have teachers as external participants, so the hope for inspiration for next generation PLCT was lost. The attendance of several pedagogic coaches and tutors at university colleges gave some hope for dissemination.

## Key Learning and Recommendations for Design Principles:

1. Teachers are often interested in learning materials. These offer a gateway for introducing PI. Teachers start joining the workshops because they want support on their learning materials. By showing the teachers that PI is an interesting tool to test the learning materials by themselves, they start to become interested in PI.
2. A well-functioning PLC is a real asset for the teachers, especially when they are supposed to collaborate on integrated subject matters, each teacher from his/her specific expertise and background. From that point of view moments where teachers can exchange concerns and ideas are an added value to a workshop.
3. A lot of teachers only think about questionnaires as a way to collect data. They need coaching to understand that a lot of other data collection methods exist and that, as a matter of fact, they already have a lot of data in a natural way that only needs some structuring. An explicit transfer from the gardener to farmer protocol to the classroom might be helpful here. Also, giving examples of other PI-cycles and discussing the benefits of the different (qualitative) data collection methods might be an added value to the course.
4. If possible, provide additional individual coaching moments. In this way you can provide support more into depth.
5. In order to get good results from the PI-cycle it really helps to provide after every workshop a specific task in the form of a homework and discuss the homework together during the workshop afterwards. In order to reduce the workload for the teachers and lower the threshold to make the homework it helps to provide an easy accessible template in which the teachers only have to fill in 1 or 2 sentences or a few key words.
6. Teachers find it quite time consuming to go through the whole course, make homework, etc. Some teachers/ PLCs quit because of that. Those who finish the cycle usually end up being satisfied.
7. Online coaching can never replace a real physical meeting. The atmosphere of a PLC is missing in online coaching. However, it can be an addition to physical meetings in cases of necessity (like the corona health crisis).



# Catholic Education Flanders Belgium Case Study

**Wim Peeters**

## Introduction

This case study reports on the implementation of a professional development course for second level science teachers facilitated by partners from Catholic University of Leuven (CEF) Belgium. The course, which is part of the second iteration of the Three Dimensions of Inquiry in Physics Education (3DIPhE) Erasmus+ programme was designed to develop teacher's competencies and understanding of Practitioner Inquiry (PI) and Inquiry Based Learning (IBL) through engagement in a Professional Learning Community (PLC).



## Context and background

This 3DIPhE course had three teachers who completed it fully and was delivered during the period of June 2019 to March 2020. It involved 34 workshop hours. All teachers of the PLCT were from the same school. This school traditionally was not focused on science or STEM education, but parents asked for more opportunities in this sector for their children. At this time a curriculum reform was taking place in Flanders, and combining both trends, the head of the school decided to start up a work group to address both challenges: the parent's wishes and the curriculum reform. This PLCT group engaged in building and developing a totally new course on STEM. This means that science, technics, engineering and mathematics (but also ICT) are integrated in so called STEM modules, topics that incorporate the different disciplines. The course starts in the first year of secondary (12 year old pupils) with a 3 period course on science experiments and 1 period of ICT, and in the second year it expands to 5 periods per week integrated STEM-science. The curriculum of the latter was very much aimed at IBL. The teachers felt that they have a lack of content knowledge and skills of IBL. When the teachers heard about 3DIPhE they expressed their wish to take part. This PLCT was a group of initially six teachers, three carrying out the STEM PI and three supporting them. However, soon one by one the three supporting teachers abandoned the sessions. Three teachers completed the course and the only support they got was from the facilitator. The teachers carried out several small PIs the previous school year, which were considered as warm up activities and to develop understanding of how teacher learning can take place.

This case study is about a PLCT that carried out a so-called shared PI: they shared basically the following inquiry question: "In which ways do we need to adapt our future STEM course in order to make it more inquiry based?" The three teachers (one female, two male) carried out their PI in two rounds of inquiry. All three were developing a STEM course, consisting of different modules, which they wanted to become really inquiry based. Their academic source was the book [Inquiry in Science Education](#) (Harlen 2012) which was an outcome of the Fibonacci project. The indicators for IBL were drawn from the self-assessment tool (Harlen, 2012 p. 41-43). The facilitator reshaped it into a new activity Cloud of goals of the Fibonacci project (find more in [Volume 2](#)). Each round they focused on two or three different items of the cloud, considering how to implement this aspect or element of IBL in their lessons expressed in the preliminary versions of a STEM module. They separately gathered data and provided feedback to their two peers. The idea was to implement the lessons learned in all modules, making them more inquiry based.

As the start of the course the pre-knowledge of the teachers and their motivation was analysed. This was done using a baseline questionnaire. The analysis of this questionnaire influenced the development of the whole course. The analysis of the questionnaire led to the following conclusions:

- the teachers were willing to learn more about IBL, especially the lab work, they recognise this is a weakness, but at the same time they feel strong enough to take this challenge.
- the teachers' interpretation of skills and competences reflected only the practical work and lab sessions. Asking questions, formulating questions and several other skills inherent to the IBL approach were not taken into account. Teachers' perceptions on the meaning of IBL need broadening.

From all questions of the survey, we took the 5 highest ranked positive answers and this shows a willingness for deep learning on their own practice, mainly through reflection, a deep consciousness on understanding the basics of their jobs. At the same time, the bottom 5 show an enormous reluctance to share these insights, it seems that they were very uncertain when it comes to critical thinking with external people.

The findings of the baseline questionnaire, indicated that the facilitator should expect a highly motivated team, willing and motivated to learn. At the same time the learning should aim at broadening their view on what IBL really is. The teachers should learn by themselves, based on experiences and evidence they collect during their

inquiry. A good framework is needed that encompasses all aspects of IBL. Therefore the initial workshop activities focussed on using IBL techniques in a realistic setting, and putting forward the Fibonacci insights of IBL in a shape that is digestible (Fibonacci Cloud of Goals, find more in [Volume 2](#)).

This PLCT met seven times during the school year 2019-2020. In each workshop the goals and agenda (without timing) were discussed. The facilitator reflections and teacher's reflections were collected through a survey that had a mix of multiple choice questions and some more open questions on the workshop. Some comments were also collected on the process being used, at the general level. During each workshop examples of aspects of IBL were given. The feedback on these examples from teachers was positive. However, the teachers found it extremely difficult to implement IBL in their own lessons. They also reported that maintaining and transferring learning across several modules was difficult. Transfer of knowledge from one setting (module) to another was not self-evident. Not all aspects of IBL were implemented at the same time during their lesson series, but even focusing on only one or two IBL characteristics they found difficult. During the seventh workshop, a multiplier event, the members of the PLCT were asked to fill out a post-survey and to take part in a focus group interview. These data are also analysed towards the end of this case study.

In this case study a detailed overview of the course and coach reflections will be presented. It will also provide a rationale for some of the course activities which will be supported by learnings from the first iteration of the 3DIPhE project.

## Overview of Course

The PLCTI2n course was led by one very experienced coach from the 3DIPhE project. The findings of the baseline questionnaire, indicated that the coach should expect a highly motivated team, willing and motivated to learn. At the same time the learning should aim at broadening their view on what IBL really is. The teachers should learn by themselves, based on experiences and evidence they collect during their inquiry. A good framework is needed that encompasses all aspects of IBL. Therefore the initial workshop activities focussed on using IBL techniques in a realistic setting, and putting forward the Fibonacci insights of IBL in a shape that is digestible (cloud of goals).

Workshop Details	IBL	PI	PLC
<p><b>WS1: Duration 6 hours (6 participants)</b></p> <p>Demonstrations on inquiry-based learning</p> <ol style="list-style-type: none"> <li>1. The hourglass</li> <li>2. Fruit in water</li> <li>3. Discuss the topic of inquiry based learning</li> <li>4. Characteristics of inquiry-based learning</li> </ol>	<p>●</p> <p>●</p> <p>●</p>		
<p><b>WS2: Duration 4 hours (5 participants)</b></p> <ol style="list-style-type: none"> <li>1. Outline the context of an Erasmus+ European project, in particular 3DIPhE, and the cloud of goals of Fibonacci</li> <li>2. Briefly explain the terms PLC and Practitioners Inquiry, in connection to the above.</li> <li>3. The plasma ball as a theme for learning to ask questions</li> <li>4. Discuss the topic of inquiry based learning</li> <li>5. How to achieve goals through a PLC that conducts Practitioners Inquiry</li> <li>6. Apply IBL goals in the prepared material for the first year</li> </ol>	<p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p> <p>●</p>	<p>●</p> <p>●</p> <p>●</p>

Workshop Details	IBL	PI	PLC
<p><b>WS3: Duration 3.5 hours (5 participants)</b></p> <ol style="list-style-type: none"> <li>1. Discuss the theme of inquiry-based learning in the ongoing module: hypothesis plus examples with sand</li> <li>2. How to reach the goal of the research through a PLC doing practical research, i.e. how does the group work as a PLC, how do we hold on to what we have learned? (e.g.: overview of findings last year)</li> <li>3. Apply the research question in the prepared material for the first year: were the agreements made last time complied with?</li> <li>4. What's okay? What are working points?</li> </ol>	●	●	●
<p><b>WS4: Duration 3.5 hours (4 participants)</b></p> <ol style="list-style-type: none"> <li>1. Use the collected data (student notes), ICT questions from the learners to analyse own notes and then draw conclusions in order to be able to answer the following research questions: How do writing your own notes and asking questions contribute to a better understanding of what STEM is in class STEM1 by Teacher 1? ... in class STEM 2 by Teacher 2 ... in Teacher 3's STEM 3 class.</li> <li>2. Prepare a report on the subject in the form of a poster</li> <li>3. Choosing an analogue research question for the next module, based on the 8 core aspects identified by Harlen (2012).</li> <li>4. Identify actions that lead to the answer of the new research question in the second module.</li> </ol>		●	
<p><b>WS5: Duration 3.5 hours (4 participants)</b></p> <ol style="list-style-type: none"> <li>1. Reflect and discuss learning from the previous report.</li> <li>2. Analyse the collected data (student notes) around the hypothesis in order to draw conclusions in order to answer the next research question:</li> <li>3. How can we improve the ability to formulate hypotheses in ... class STEM 1 by Teacher 1 ... in class STEM 2 by Teacher 2 ... in Teacher 3's STEM 3 class.</li> <li>4. How can we improve our ability to discover our own strengths and weaknesses in ... class STEM 1 by Teacher 1 ... in class STEM 2 by Teacher 2 ... in Teacher 3's STEM 3 class.</li> <li>5. Preparing a report on the subject in the form of a poster.</li> <li>6. Choose an analog research question for the next module, based on the 8 core aspects identified by Harlen (2012 )</li> <li>7. Identify actions that lead to the answer of the new research question in the third module.</li> </ol>		●	●

Workshop Details	IBL	PI	PLC
<b>WS6: Duration 3.5 hours (3 participants)</b> 1. Explore the state of affairs, especially with regard to dates. Transforming analysis and conclusions into a report 2. Design of the poster as a presentation. 3. Decide what needs to be done in the next month. 4. Discuss what inquiry-based learning is - how to pick up as a teacher?		<input type="radio"/>  <input type="radio"/>  <input type="radio"/>	<input type="radio"/>
<b>WS7: Duration 10 hours (3 participants)</b>  During multiplier event: 1. Present and discuss results of PI with peers 2. Provide feedback to peers on their PI 3. Reflect on the process of PLC and PI	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>

For further details on the protocols referred to in the workshops please refer to Appendix B.

## Analysis and Reflections on Training Delivery by the facilitator

### Workshop 1

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

The workshop aimed at engaging teachers in the real process of an IBL lesson, to make them feel it. This was successful, since the facilitator could observe they were really discussing which experiments they would set up to check their hypothesis, they really were discussing the observations done, which were relevant or not.

**Which elements of the workshop would you change if you were to repeat the workshop?**

The fruit activity was perceived as a bit too childish. This workshop was meant to engage in buoyancy law using daily materials, like fruits and vegetables. Sadly, in a feedback discussion 2 months later, they claim that they learned nothing. So the theme was not really motivating for them. Since there are many others, the facilitator would choose another example in the future. At the same time it was clear by observation that teachers had big difficulties in finding adequate variables, finding methods for fair testing, and methods for measuring quantities. Especially since this was a context that was new to them. Rather than seeing this as a weakness they have which needed improvement, they rejected the approach and the subject as “inappropriate”. Being confronted with a new learning method, essential to IBL, it must be concluded that the experience was “hard”. It was clear that this experience was well out of their comfort zone.

**What design principles for future workshops would you recommend based on your experience.**

To have a document, alongside with the steps in the process, that indicate what is happening, and **why** the facilitator is doing what he is doing. And what the learning was, in connection to IBL.

## Overall reflections

The facilitator learned almost two months later, when he asked teachers present at workshop one what they remembered. They only remembered their opinion, only a little of the strategies used, and also only a little on the aims of the goals. Teachers perceived this activity as “not too much learning”. As facilitator It is important to indicate, separately and explicitly, what the purpose of the activities is, what he was doing and why, and how he implemented the learning goals (for the teachers in this case) them. **The general level must be explained well. Teachers cannot reach this level by themselves.**

## Workshop 2

**Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

The plasma ball activity as it demonstrated once again that asking questions can lead to inquiries.

**Which elements of the workshop would you change if you were to repeat the workshop?**

Pay more attention to the changes they need to make in the modules: the teachers were learning about IBL in view of developing their own modules. Implementing the learnings immediately would show the gain of the learnings. The learning of the facilitator is: as soon as teachers learn something, give them an exercise to implement this learning in another lesson, to transfer the learning to another situation (other subject, other class, other year, maybe even other discipline). Such exercise should also be part of the course for coaches of PLCs, one of the outputs of 3DIPhE. Another element of attention would be to go back several times to the inquiry question teachers posed themselves. Immediate needs sometimes prevail over the long term planning.

**What design principles for future workshops would you recommend based on your experience.**

To bring order in people’s minds: focus on the PI, do not let daily concern interfere with the process of this inquiry. This group is so much focused on the daily teaching that they have difficulties reflecting on the PI itself. One needs time for reflection, and also to take it into account in the future. Note: perhaps in this case it was a disadvantage to meet the group in their own school, which made them sensitive for “other” school matters, and which led to situations in which they “needed to solve quickly something”, a distraction that was not welcome for the facilitator.

## Overall reflections

The teachers selected two goals to include in the STEM module they wanted to develop to enhance IBL in school. These were taken from the cloud of goals of the Fibonacci self- assessment tool. Taking two goals is not that easy to collect data on, and not that easy to pay attention to all the time in the STEM module lessons. The teachers however did not feel uneasy about it, not realising that they were tackling these aims in a shallow way, not in depth (gathering data, impact on the learning of the students, observations of students’ skills, etc.), they took the goals too much for granted. The facilitator feels the need to stress that part of the PI again. Maybe two goals, two aspects is too much to implement at the same time. Another issue is that earlier learnings - however small- were not taken into account explicitly . A major remark is that the facilitator did not ask the participants to the workshop what they expected from it, giving away a chance to set the focus right. After reading the teachers’ feedback he concluded: The above feedback, together with the high rate of “Agree” and “Completely agree” to questions on “how did it go” was reason for satisfaction. However, some feedback pointed out the need for really practical work, less than the learning of the teacher via their PI.

## Workshop 3

### Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?

The two examples of IBL with sand were appreciated a lot. Since one of the teachers focused on formulating hypothesis, the facilitator elaborated two small activities with sand to illustrate how it works: how to formulate a hypothesis, how to organise a discussion, then to perform the experiment ( very small one in this case), how to reflect on the observations in relation to the hypothesis, and then to adapt hypothesis. The facilitator showed how he adapted his coaching to enhance the learning of the teachers, activities were much more focused on their needs, with respect to the STEM module they are implementing at that moment. The facilitator followed feedback comments of the previous WS such as “Helps us well with the preparation of our new STEM project”; “Preparation exam of STEM module + support for progress in STEM module “marble track””. This approach was highly appreciated, so the facilitator bounced this back stressing that he needs their reflection to improve the coaching; indeed, this had a positive effect: all 4 of the teachers filled out the online teacher reflection tool at the end of the session.

### Which elements of the workshop would you change if you were to repeat the workshop?

To plan the location better. It was not really reserved (responsibility of the teacher group), and the PLC needed to move half way. This is a loss of time, but also of focus. It's important that all teachers are fully engaged and not distracted by external aspects. The facilitator could discuss the norms agreed by the teachers at the start of sessions to help focus everyone's attention.

### What design principles for future workshops would you recommend based on your experience.

The facilitator would actively connect the participants' reflections to the agenda of next time, and also tell them how he adapted the programme based on the feedback. This can build trust but also give rise to a lot better learning of the participants.

### Overall reflections

One teacher used photos in the class to illustrate to the learners how they were behaving. So in this way he really used data to give immediate feedback to the learners and to improve their learning in a very direct way. One teacher provided feedback: “Facilitator, I think you've prepared this session well. Certainly I thought it was good that you listened to our feedback!” One advice for facilitators is to **really organise the feedback tool to keep connected with the PLCT**. Based on the responses to the online feedback tool, a lot of learning was reported by the teachers. Also a lot of goodwill and appreciation was noticeable.

## Workshop 4

### Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?

This workshop aimed at data handling. The analysis of data exercise was done based on data teachers provided (at the end of the previous workshop it was announced that data was needed for the next exercise). The ownership of this data was unquestionable. However, in regards to raising questions: no data at all were provided. In regards to taking notes individually: only a few data, despite that hints were given on how to collect this data. Note: this data was provided by a different teacher to the one who had taken “formulating hypothesis” as focus for his PI.

So, we needed to take a set of data that were not at all in line with the inquiry questions initially posed . The facilitator needed to find a way to still give them the impression that learning took place, so the PLC looked at the data provided, which were much more about the learners' opinions on the module than on the inquiry questions. This data gathering took place via a Google form, and this was in view of ICT lessons. Connecting disciplines was in this way a splendid idea, as such! The key goal was to learn to analyse data and draw conclusions from them. Based on 24 answers (1 whole class), a few conclusions: only one-in-eight of the learners were aware of the IBL goals during an experiment, only one-in-ten was aware that working in groups was an added value. Half of the learners liked doing experiments. Half of them did not suggest any new topic or interest. Teachers experienced difficulties in understanding how this analysis should affect their future lessons. Conclusion of the facilitator: analysis of data was done, conclusions were drawn in a guided way. The data provided were not usable in any PI, which was a pity. The results also confused the teachers, taking away the focus from their PI. This led to mixed success in the PI.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

The planned approach was ok, but the quality of the work was questionable. The group of teachers made the same mistake as any beginner: the data does not link to the question and is aimed at teaching, not at learning. The goals of the STEM module were not assessed. Data were not usable in any PI. The questions were posed at hoc, without any discussion in the PLC.

### **What design principles for future workshops would you recommend based on your experience.**

It is clear that the gain would have been larger if the PLC would develop the survey together, the questions would relate to one or more PIs, or at least to the learning that was previewed in the STEM module, in relation to the PIs (like formulating hypothesis, asking questions, taking notes). Checking on an intermediate moment whether the data collected are ok ( in all aspects) would have solved this. Despite the way it went was not ideal, still the use of data from teachers to exercise the analysis-conclusions phase is recommended. Even in this case the motivation and engagement was very high, because data were connected directly to their daily job.

### **Overall reflections**

After reading the opinions of the teachers the facilitator saw that the comments seemed very positive. The teachers had a good feeling. However, no data on their own PI were gathered. The idea was to see what progress was made on “asking questions”, on “writing down feedback of the teachers by the learners” and on “writing down own notes”. To analyse and to draw conclusions. The focus was not on their own learning, hand in hand with that of the students, but the focus was only on the students.

The facilitator took it for granted that data were connected to the inquiry question. However, he needed to explain a lot better what the aim of the inquiry is, that the question and data need to be aligned, that conclusions need to relate to data gathered. Facilitators should bear in mind that teachers are not used to doing inquiries, they have no experience, it is an important element in their own learning. A lot of time is needed to build up this learning and moreover, that learning is also a key attitude of the teacher himself. Note (see previous workshop). Without reminder, the reflection was again given by only one teacher! The learning of WS3 was lost again in WS4, despite the PLC WS being so positively assessed by the teachers.

## Workshop 5

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

Teachers wanted to make an exam on the STEM module. They had a draft set of questions, all focusing purely on the content, aimed at memorising knowledge. Their questions needed to be put in line with the goals they set themselves in the beginning of the module. They were surprised that this needed to be the main focus. This discussion led to “better” questions. In this way the summative evaluation at least evolved more towards the IBL goals set before.

Apart from that it was good that the facilitator was able to direct them again towards their own PI, related to the learning of the learners. He suggested a few questions that aim at “formulating hypotheses”, “asking questions”, etc. This was totally new to the teachers.

As for each WS, minutes, notes were taken, and shared on line. The idea was to write down learnings, practicalities, hints, and all other ideas that could be useful. Until this workshop only the facilitator had written in that document, as part his own PI. Only very rarely teachers had a look at it. But, for the first time, during this workshop, one of the teachers helped take notes for the online report on the activities during the WS. All suggestions about the exam were gathered there. This should be a strategy of the facilitator. It can be the history of the learning of the PLC, useful for all members at least. Note: it should be stressed that exactly during the session of asking summative questions, one of the teachers was motivated to write everything down.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

This workshop was dominated by the pre-exam stress of the teachers, who needed to develop a new set of questions based on a module they have only given once, and which reflected in many aspects a different kind of teaching/learning. The quality of the WS was not top as such (in view of the learning line 3D set for a PLC doing a PI), but there was no other option here. Looking at it in a positive way, the outcome was that teachers got a better insight on how to make a summative evaluation on IBL lessons. So next time this could be a subject on its own.

### **What design principles for future workshops would you recommend based on your experience.**

Shared reporting of meetings, preferably online, is a strong advice. On top of that, make sure the minutes of the WS are made in a collaborative way. This way the teachers can add their opinion and learnings too; even materials and links can be shared this way; it is another way of connecting to teachers better, and to gather data as a facilitator. If summative evaluation is a must: launch the topic “how to evaluate IBL goals with exams”, but also, and in particular, how to use the exam to gather data that fit in the PI.

### **Overall reflections**

It is advisable to stress more the minutes of the meeting as a shared responsibility. Also, to repeat over and over again what the goals of the PI and PLC are. Teachers tend to go back to the initial state of mind very easily (old school exams as draft). Teachers find it still difficult to relate what they do in view of PI and teaching to the real learning of students. For this PLCT the order of priorities is 1. teaching, 2. doing IBL, 3. teaching in an IBL way as prepared; The issue of this December issue was the exam. Of course new teaching methods require a new vision on exams, if at all exams are necessary. Own learning and data gathering was not their focus. Practical issues took over again. Meanwhile the data gathering had taken place in a somewhat changed version. The exam was not considered as a way to collect data on what they had been trying to make the pupils learn. Exams can only test knowledge. Leaving old thinking behind caused a lot of stress. Pushing the poster idea brought them back on track of their PI. Taking IBL as an attitude and taking all opportunities to make the activities more inquiry based seems to be again another difficult step. It is not self-evident at all, and it is realistic to realise that teachers, without further support will return to their previous way of teaching.



## Workshop 6

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

To take the task of producing a poster (a little bit enforced) as a guide for overviewing the work done by the teachers and the tasks still to do. It also shows the efforts done so far, and it also gave the participants the idea that the work was useful.

### **Which elements of the workshop would you change if you were to repeat the workshop?**

Ideally teachers prepare a meeting like they expect their students to prepare for class. . But this seems to be difficult. Despite what I asked them, only a few things were really ready to put on the poster. The only solution the facilitator could come up with was to work in a very practical way, solving all issues as they arose, one by one, starting with the logo of the school. It worked. But it took more time, so, when it came to more important issues, when time was up, the work was not finished.

### **What design principles for future workshops would you recommend based on your experience.**

Best is to point out in the beginning what the final product would look like, for example a good poster of a PI. This would make more clear what is expected. It was communicated, but teachers do not realise what it means and do not think deeply on the task. They carry out what is expected, step by step, but not looking ahead a few steps. They are not always aware that they should take more initiative, also in view of the final product. A poster-guide would help I think, with examples, possible templates, and hints how to present tables, how to use a photo in a targeted way (not just as a “light” design element), and so on.

### **Overall reflections**

It is hard to have teachers work for this project. They consider the day to day practicalities still more important than deep learning. Learning is hard for them. It is hard not to approach them like students. The facilitator supposed that teachers would understand that the poster is a kind of summary of all their learnings, and also a way to orden thinking and reflect on the strategy used for the PI. It was disappointing to read in one of the feedback forms “*Very much about the poster. Nothing we can apply in our practice*”. Making the poster, sharing their learning was considered loss of time. The exam and teaching materials for next year was more important. Still, after this long time, one of the teachers was not aware that this course was about her learning, to be used afterwards to develop STEM modules in an IBL way for the next year. Looking back at all written comments, only a few address directly the PI element of the course. Again, this shows that every idea, every step needs a lot of explanation on why this activity is done, and how it relates to the learning of the teacher.

## **Workshop 7: this was the 2 day dissemination event.**

### **Which elements of the workshop do you believe contributed most effectively to the purpose of the workshop?**

Looking at others’ posters with a professional eye for details and depth is a skill not too many teachers have. Presenting their own inquiry to others forced teachers to explain clearly what they were up to, what they planned, how they came to certain conclusions.

## **Which elements of the workshop would you change if you were to repeat the workshop?**

Teachers carried out two small inquiries and presented only one, because one was not elaborated enough. This information/learning was lost, and there was no time to have teachers include this in their presentation.

## **What design principles for future workshops would you recommend based on your experience.**

Start making posters a lot earlier. This way the facilitator has more evidence of data and materials available, also, the status of the poster can be seen as a monitoring tool, both for the facilitator as for the teacher. Even the initial layout with title (Inquiry question), logo of school, small presentation of the teacher himself, etc, has a value.

## **Overall reflections**

Spreading the news, empowering outreach is very difficult. During this sharing event some external friends were present, but the more general, unknown public was not there. Also nobody from the government, though we have good relationships with them.

## **Participant Reflections on Course**

Participants' final reflections, as expressed in the post-survey. Conclusions drawn are question per question (often with many subdivisions), but focused on certain key elements of the project. The difference in answers between pre- and post-survey are taken as lead for following conclusions:

On the topic of teaching the IBL way: Also in the focus group interview it was clear that they realised a sustainable impact giving them a lot of confidence, especially in IBL. Some background can explain this success: the 3 teachers were chosen for developing a new STEM course for the second year of secondary, consisting of several STEM modules (themes). They were rather engaged. The structure given was clear to them, especially on IBL (Fibonacci self-assessment tool- cloud of goals). They worked on it for 2 years, the first a warming up phase with very small inquiries (given that there was no time in the weekly schedule to try out the new STEM course) and the second year (still no periods for testing foreseen) with more elaborated PIs. So, all in all we consider the presurvey two years prior to the post survey, which is an advantage for showing progress. The raise of 0,57 is real, but not that high improvement however. Teacher feedback files and focus interviews reveal that the PLCT had expectations not totally in line with the goals of the project, namely developing a course for STE M, consisting of several STEM modules. The project could offer strategies for developing a good course, IBL based, but not the course itself. They admit though that they have learned a lot.

On the topic of student learning: The group of 3 teachers have a good feeling of their initiative as far as the students are concerned. They feel that the introduction of IBL in the STEM modules is positive for their students. Especially they recognize a lot more than before how demonstrations can be an added value for IBL. The conclusion of the facilitator is that after this second year ( of which the first year was more like tasting what IBL is, and what PI is) the rather traditional way of thinking of this group of teachers has changed positively towards more modern methods of teaching, the IBL way. Their open mind is a big advantage for their learning, probably convinced by their own observations: the teachers communicated on "What key elements did students learn?" as follows: " The use the investigative method; Pupils receive more focused feedback on their research; The investigative method fine tune for the students; Pupils learn to do a research; Hopefully in time to use the rubrics; Evaluating themselves and each other; The students will learn to collect data and analyse them themselves.; The pupils are allowed to bring their own material and test it out. ; The pupils will evaluate themselves and look at the strengths and weaknesses of themselves and others. Warm them up for the future of STEM." Of course this is not a complete list, but the

teachers noticed a big progress in attitude and skills of students, which is as important as the content of the lessons. This is a major shift of mind.

From the point of view of the facilitator there is always a doubt whether this will prove to be sustainable. With intense coaching by the facilitator, and with a sharp goal in their heads (developing STEM modules in an IBL way) things went well. The issue of transferring the knowledge to other modules and - why not? -to other courses, remains an open question.

On the topic of collaboration in a PLC: This group in general enjoyed a lot the project and the coaching of the development of their STEM modules. In particular they are open to changes, think positively about IBL and are even in for spreading this idea wider. Although they agree that they have learned a lot, and that they like collaborating, still they didn't like the group meetings too much. Taking leadership over a PLC is not that negative because one of the teachers "agreed" with this idea, so she would be a candidate. The facilitator agrees that the group is a good group to work with: they learn, and are eager to learn too. They reflect on their learning and they feel happy about having learned. Despite some minor frictions within the group, they are professional enough to continue on this path of change. Getting in touch with colleagues outside the school remains very difficult, actually putting a limit to their learning capacity. Reflecting on the opinions of teachers two were really remarkable: to the question " Which activities in the course were most beneficial in preparing you to carry out a practitioner inquiry?" one answer was: " the examples of ppt of PI", and another "Input of other colleagues to give you another perspective", key elements of collaboration in a PLC.

On the PI they carried out: This group of 3 persons had difficulties in understanding the general level of their learning. They considered this most of the time interesting, but did not value a lot the impact on their practice. They wanted more first line help, writing courses. (" How do we draw up the exam of Scientific Experiment?", Elaboration of the following module; Discussing the exam now and possibly already the next course of our colleague." : these are only 3 of the comments received). At least they are convinced that their courses will be better in the future, but they are left behind with the work to be done, namely to write the courses themselves.

## Reflections on Multiplier Event

The multiplier event focused on interaction between all PLCTs and sharing teachers' PI, via posters. 14 posters were presented. Each member presented their PI to peers and several external attendees. This was done in rounds in such a way that almost all participants could listen to each presentation of a poster, and ask questions about it.

Some quotes from the interviews afterwards express the appreciation for this way of working:

*Teacher X: It is ok to keep trying, to keep improving.*

*Teacher Y: A kind of satisfaction that we are all doing our best. I always think there are huge results.*

Making the poster was a burden for some, at the same time it made teachers learn better what a PI is like, and how to do it; also really reflecting on it was needed before the poster could be made. During meetings teachers had some doubts on the added value of a multiplier event, it is to say, a more general meeting to exchange all PI's. The crucial issues are: firstly did they really note their learnings, or was this a kind of learning of "nice to have been here" and nothing else. Secondly: the learning will only be useful if they would be determined to proceed with another PI. Only then the learning will be put into practice, and only then this upward spiral can start. During the focus group interview it felt like:" A kind of satisfaction that we are all doing our best. I always think there are huge results".

In Belgium we did not have local teachers as external participants, so the hope for inspiration for next generation PLCT was lost. The attendance of several pedagogic facilitators and tutors at university colleges gave some opportunity for dissemination.

## Key Learning and Recommendations for Design Principles:

1. There is a difference between teachers that learn about IBL and PI and the way they use this learning. One would regard this as logic, but my experience is that the learning of teachers is not always visible in the way they tackle their teaching challenges. They experience difficulties in transferring what they learned in situation A (here a certain STEM module) to changes in a STEM module B. This is why it might be very important to aim and point out the general level, and also to pay attention in the course on how certain learnings can be implemented in different contexts. If the learning is too specific or too much aimed at this or that situation/content, it is not usable elsewhere. So aiming at a general level might give the teachers insight that aspects are usable everywhere, in all classes and all schools and all subjects. For example: the facilitator follows a certain protocol on the sand experiment, training the formulation of a hypothesis. The idea is to give the teachers a teaching method to do this. But in practice, they did not follow the protocol, but did it in a very traditional way, with paper and pencil, and no group discussions. The facilitator did not explicitly tell them they also should teach it in the way they- the teachers- experienced it during the protocol. This implicit logic is hard to be recognized by teachers, hence the facilitator should explain it - the general level. The next step should be to apply the same method in other situations, in another STEM module maybe, and not for hypothesis, but for analysing data for example. This general level can be very powerful, if clearly understood.
2. To have a shared online document, alongside with the steps in the process, that indicate what is happening, and why the facilitator is doing what he is doing. (The [Volume 2](#) of the e-book explains this from the point of view of the doing a PI on IBL, and [Volume 3](#) of the e-book looks at all processes in the PLC from the point of view of the facilitator). This document can also be used as minutes, as a list of learnings, ideas, advice, hints, as agreements on practicalities.
3. Make sure this of the WS is made in a collaborative way. This way the teachers can add their opinion and learnings too; even materials and links can be shared this way; it is another way of connecting to teachers better, and to gather data as a facilitator.
4. To do the exercise to put all learnings in place, to implement them in different lessons immediately. To train teachers to implement the learnings in other contexts, settings, lessons, groups.
5. This should also be present in the PI course: an exercise, in which an aspect of IBL that was studied in a given context (subject, chapter) is transferred to another part of the course or other teaching materials
6. Have the IBL materials ready to show examples of questions, hypothesis, grouping, all aspects of IBL. Maybe even let the teachers explore these examples. Also other ideas might draw their attention. Both for their PI and for their IBL lessons.
7. Ideally the PLCT should get some follow up sessions to make their learnings more sustainable. Taking IBL as an attitude and taking all opportunities to make the activities more inquiry based is a difficult step. It is not self-evident at all, and it is realistic to realise that teachers, without further support will go back to their previous way of teaching.

# PART C: APPENDIX

## APPENDIX A

## APPENDIX B - protocols:

Atlas

Attributes of a learning community

Choosing the right question

Compass

Consensogram

Consensogram (Irish Version)

Critical Friend

Data Driven Dialogue

Developing IBL skills - part 1 : Brainstorming

Developing IBL skills - part 2: Formulating a research question

Developing IBL skills - part 3: Designing an IBL experiment

Developing IBL skills - part 4: Evaluation at the IBL

Different cultures/getting to know each other

Easy ways to collect data

Farming vs Gardening

Forming ground rules (creating norms and values)

Inquiry brief peer feedback

Litmus Test

Manual for an Inquiry Brief

My Inquiry Brief

Passions

Silent Chalk talk

What are clarifying and probing questions?

What? So what? Now what?

Why, Who, When, What, Where + How

World Cafe

Zones of comfort

# Appendix A

The appendices are in .docx format and will be downloaded.

[A.1 DCP9 3D IO1 PLCT Baseline Questionnaire 310118 DCU](#)

[A.2 DCP11 3D IO1 PLC Workshop Reflection Diary 010218 DCU](#)

[A.3 DCP14 PLCTI2 \(novice group\) Post Questionnaire \(DCP13\)](#)

[A.4 DCP14 PLCTI2 \(novice group\) Focus Group Questions \(DCP13\)](#)

[A.5 DCP15 E4-E7 Attendee Questionnaire DCP15](#)

[A.6 DCP18 Final Conference Attendee Questionnaire](#)

[A.7 DCP18 3DIPhE Final Partner Reflection Tool](#)

# Appendix B

## Overview of Protocols reported in Case Studies.

Protocol	UJ	DCU	UL	AHS	UCLL	CEF
Atlas						WS4
Attributes of a learning community		WS3				
Choosing the right question	WS2	WS1		WS3		
Compass	WS2	WS2	WS4			
Consensogram	WS3					
Consensogram (Irish Version)		WS1				
Critical Friend					WS1/3	
Data Driven Dialogue	WS5	WS2/4				
Developing IBL skills - part 1 : Brainstorming	WS3					
Developing IBL skills - part 2: Formulating a research question	WS4					
Developing IBL skills - part 3: Designing an IBL experiment	WS4					
Developing IBL skills - part 4: Evaluation at the IBL	WS5					
Different cultures/getting to know each other		WS1	WS1			
Easy ways to collect data	WS4		WS3	WS4/5	WS2	WS2
Farming vS Gardening	WS1	WS1	WS1	WS3	WS1	
Forming ground rules (creating norms and values)				WS2		WS2
Inquiry brief peer feedback				WS6		
Litmus Test	WS3	WS2		WS4	WS2	
Manual for an Inquiry Brief		WS3				
My Inquiry Brief				WS5		
Passions	WS1	WS1	WS2	WS1		
Silent Chalk talk		WS1				
What are clarifying and probing questions?						WS3
What? So what? Now what?	WS4	WS2		WS4		
Why, Who, When, What, Where + How				WS3		
World Café					WS2/3	
Zones of comfort		WS3		WS6		

# Atlas

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

National School Reform Faculty ([www.nsrffharmony.org](http://www.nsrffharmony.org))

## Purpose of the protocol

The main goal is to develop in the participants the ability to reflect on the research data.

Since in the Linpilcare project teachers are educated to work more evidence-informed, it is clear that evidence should be extracted from data, by drawing conclusions. However, this is a very difficult part, since teachers are not really experts in this. The Atlas protocol helps them to train their own skills, and to learn from how other members of the PLC do it.

Selecting data to share is the centrepiece of the group discussion. The following guidelines can help selecting data or artefacts that will promote the most interesting and productive PLC discussions. Data or artefacts that do not lead to a single conclusion generally lead to rich conversations. For example: answers to rather open questions. Sharing and discussing data of different kinds sometimes make people feel “on the spot” or exposed, either for themselves, for their students or for their profession. Trust is needed in the group, and in addition, the use of a structured dialogue format provides an effective technique for managing the discussion and maintaining its focus.

## Materials

No external materials, the participants materials/data serve as centerpiece.

## Time

60 minutes

## Roles

Facilitator - reminds the group of the norms. Is also timekeeper

Presenter - providing the data set, gives a very brief statement of the data and avoids explaining what he/she concludes about the data.

## Process

### 1. Getting Started

- The facilitator reminds the group of the norms. Note: (Each of the next four steps should be about 10 minutes in length. It is sometimes helpful for the facilitator to take notes.)
- The educator providing the data set gives a very brief statement of the data and avoids explaining what s/he concludes about the data if the data belong to the group rather than to the presenter.

### 2. Describing the Data (10 Minutes)

- The facilitator asks: “What do you see?”



- During this period the group gathers as much information as possible from the data.
- Group members describe what they see in data, avoiding judgments about quality or interpretations. It is helpful to identify where the observation is being made e.g., “On page one in the second column, third row . . . “
- If judgments or interpretations do arise, the facilitator should ask the person to describe the evidence on which they are based.
- It may be useful to list the group’s observations on chart paper. If interpretations come up, they can be listed in another column for later discussion during Step 3.

### 3. **Interpreting the Data (10 Minutes)**

- The facilitator asks:
  - “What do the data suggest?”
  - Second question: “What are the assumptions we make about students and their learning?”
- During this period, the group tries to make sense of what the data say and why. The group should try to find as many different interpretations as possible and evaluate them against the kind and quality of evidence.
- From the evidence gathered in the preceding section, try to infer: what is being worked on and why?
- Think broadly and creatively. Assume that the data, no matter how confusing, makes sense to some people; your job is to see what they may see.
- As you listen to each other’s interpretations, ask questions that help you better understand each other’s perspectives.

### 4. **Implications for Classroom Practice (10 Minutes)**

- The facilitator asks:
  - “What are the implications of this work for teaching and assessment?” - This question may be modified, depending on the data.
- Based on the group’s observations and interpretations, discuss any implications this work might have for teaching and assessment in the classroom. In particular, consider the following questions:
  - What steps could be taken next?
  - What strategies might be most effective?
  - What else would you like to see happen? What kinds of assignments or assessments could provide this information?
  - What does this conversation make you think about in terms of your own practice? About teaching and learning in general?
  - What are the implications for equity?

### 5. **Reflecting on the ATLAS-Looking at Data (10 Minutes)**

#### Presenter Reflection:

- What did you learn from listening to your colleagues that was interesting or surprising?
- What new perspectives did your colleagues provide?
- How can you make use of your colleagues’ perspectives?

#### Group Reflection:

- What questions about teaching and assessment did looking at the data raise for you?
- Did questions of equity arise?
- How can you pursue these questions further?
- Are there things you would like to try in your classroom/context as a result of looking at this data?

# Attributes of a learning community

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources:

Inspired by SRI (<http://www.schoolreforminitiative.org/>) and adapted to the European context by Catholic Education Flanders

## Purpose of the protocol:

Teams can use this tool at the start of a professional learning community. By using this tool, teams start from their prior knowledge on 'what a place of positive learning is.' The participants themselves establish basic attributes of good learning communities through their own & real experiences. The attributes become the basic goals/guidelines for establishing a professional learning community and later on for checking on progress as their new professional learning community develops.

## Materials:

A sheet of paper

## Time:

45 min.

## Roles:

Group leader to introduce the protocol;  
To work in small groups: facilitator, time keeper, presenter, participants

## Process:

1. Participants write about a personal experience in a learning community that they know was a place of positive learning for them. It can be an experience in a club, a group, a school, a course... any group that was a positive learning experience. Their writing should include:
  - a. the reason for the group's existence;
  - b. how the group was structured;
  - c. what they learned;
  - d. how they learned;
  - e. what made it a positive learning place. (8 min.)
2. The participants form groups of 4 and appoint a facilitator, a time keeper, a presenter.(2 min.)
3. Every participant gets 3 minutes to share his/her story. If the participant needs less than 3 minutes to share, the rest of the time is silent time to reflect on what the participant shared. (3 min. each participant = 12 min.)
4. As each story is told, the group picks out the attributes that made that learning community productive and satisfying (e.g. everyone listened to each other, we worked cooperatively to get things done, there was a lot of respect for different opinions...).(8 min.)

5. Each group makes a list of the 4 or 5 attributes that seem to stand out for them. Sometimes they will be attributes that show up in all the stories, sometimes it will be an attribute that only appears in one story but seems really important to the group. (5 min.)
6. Each group names one attribute in turn while the group leader records on a general list. Any repeated attributes get noted with stars (\*). (5 min.)
7. When the list is complete (the facilitator can reword for a succinct list), the group leader asks the group if this list seems like a good list of attributes to guide the group as it forms its own community of learners. Additions can be made at this time. If anything on the list seems hard to do, or inappropriate to the group, a note to that effect is written next to that attribute. (5 min.)
8. At different points during the seminar/workshop, the 'Attributes of a Learning Community' are checked for development and progress.

# Choosing the right question

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Developed by Project Zero, Harvard University (Evidence Project, 2000).  
You can find all information about Project Zero at <http://www.pz.harvard.edu> and all information on the evidence project at <http://www.pz.harvard.edu/projects/the-evidence-project>

## Purpose of the protocol

This protocol helps clarify the process for choosing a question to focus on evidence informed work. As teachers identify questions about their practice that feel important to them, they are asked to consider the four questions below. During this protocol each participant is asked to address the four questions.

1. Why is this question personally important to you?
2. How is it relevant to teaching and learning in your classroom?
3. What direct connections to student learning can we identify?
4. Does this question feel too specific or too broad?

## Time

50 minutes:  
5 minutes individual preparation  
4 times 10 minutes presentation of a question = 40 minutes  
5 minutes to debrief

## Roles

There is an overall presentation of the protocol. Then groups of 4 participants, prepare the presentation of their question, present their question and dig deeper into the question.  
In the groups of 4 these are the roles: Time keeper, presenter and facilitator

## Process

1. Make groups of 4 participants;
2. Appoint a facilitator, a time keeper and the facilitator informs that every participant will be a presenter;
3. Each participant prepares individual his/her question about his/her practice and addresses these four questions: (5 min)
  - Why is this question personally important to me?
  - How is this question relevant to teaching and learning in my classroom?
  - What direct connections to student learning can I identify?
  - Does the question feel too specific or too broad?
4. The presenter presents his/her question and explains why this question is important to him/her, how it is relevant to teaching and learning, what direct connections the question has to student learning and if the question feels too specific or too broad. (3 min.)
5. The group members ask clarifying questions, the presenter answers (2 min.)
6. The group members ask probing questions, the presenter is silent (2 min.)
7. The group discuss on what they heard and reflect on the 4 questions, the presenter is silent. (2 min.)
8. The presenter reflects on what he/she heard and decides on what he/she does with his/her question. (1 min.)
9. Repeat the process with another presenter

## Exemplification

### Clarifying questions:

Are simple questions of fact. They clarify the dilemma and provide the nuts and bolts so that the participants can ask later on good probing questions and provide useful feedback.

### Examples of clarifying questions:

- Is this what you said...?
- What resources were used for the project?
- Did I hear you say...?
- Did I understand you when you said...?
- What criteria did you use to...?
- What's another way you might...?
- Did I hear you correctly when you said...?
- Did I paraphrase what you said correctly?

### Probing questions:

Probing questions are powerful, open questions that are intended to help the presenter think more deeply about the issue at hand. If a probing question doesn't have that effect, it is either a clarifying question or a recommendation.

### Examples of probing questions:

- Why do you think this is the case?
- What would have to change in order for...?
- What do you feel is right?
- What's another way you might...?
- How is...different from...?
- What sort of an impact do you think...?
- When have you done/experienced something like this before? What does this remind you of?
- How did you decide/determine/conclude...?
- What is your hunch about...?
- What was your intention when...?
- What do you assume to be true about...?
- What is the connection between...and...?
- What is the opposite were true? Then what?
- How might your assumptions about...have influenced how you are thinking about...?
- What surprises you about...? Why are you surprised?
- What is the best thing that could happen?
- What do you need to ask to better understand?
- How do you feel when...? What might this tell you about...?
- What is the one thing you won't compromise?
- What criteria do you use...?
- Do you think the problem is X, Y or something else?
- What evidence exists...?
- If you were X, how would you see this situation?
- If time, money were not an issue...?

# Compass

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Sue Horan, June, 2007, School Reform Initiative website:  
[http://schoolreforminitiative.org/doc/compass\\_points.pdf](http://schoolreforminitiative.org/doc/compass_points.pdf)

## Purpose of the protocol

This is a group building activity, not to be done at the first time that a group meets each other but still rather in the beginning of the group forming process.

Similar to the Myers-Briggs Personality Inventory, this exercise uses a set of preferences which relate not to individual but to group behaviours, helping us to understand how preferences affect our group work.

The protocol also stimulates mutual understanding of people's learning process and attitude in given circumstances.

## Materials

Prepare 4 chart board (or equivalent) cards with written N, E, S, W put in the different directions N, E, S and W; please try to do that adequately – look at the position of the sun at a given moment.

## Time

25-50 min, depending on to what extend the facilitator organizes the discussions.

## Roles

Facilitator, whole group, then 4 groups

## Process

The room is set up with 4 signs on each wall — North, South, East, and West.

If the group is small, then it might be necessary to rearrange the protocol in such a way that still all different behaviours can be explained to one another.

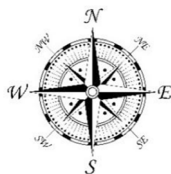
1. The facilitator gives an overall introduction of the protocol:
  - What are the goals;
  - What is the process.
2. The facilitator briefly characterises the 4 directions, as follows: (he has additional information here below - see below: 'Compass Points Explanations Expanded');

### North

Acting — “Let’s do it”;  
likes to act, try things, plunge  
in

### West

Paying attention to detail —  
likes to know the who, what,  
when,  
where and why before acting



### East

Speculating — likes to look  
at the big picture and the  
possibilities before acting

### South

Caring — likes to know that  
everyone’s feelings have been taken  
into consideration and that their  
voices have been heard before acting

- Participants are invited to go to the direction that corresponds best to their personal style. No one is only one direction, but everyone can choose one as their predominant one;
- The groups get 15 min. so that each group can answer the following questions:
  - What are the strengths of your style? (4 adjectives) (write that in ‘your box’)
  - What are the limitations of your style? (4 adjectives) (write that in ‘your box’)
  - What style do you find most difficult to work with and why? (write that in ‘the corresponding box’)
  - What do people from each of the other directions or styles need to know about you so you can work together effectively? (write that in ‘the corresponding boxes’)
  - What do you value about the other 3 styles? (write that in ‘the corresponding boxes’) When complete, each group will report back to the whole group.

*Optional 1: In smaller groups the answers to 1-5 could be given individually in the boxes on paper (see last page) after which an exchange of the papers can take place. Discussion and feedback are also possible in that way.*

*Optional 2: The facilitator can hand out the more extended information below on a separate sheet.*

- The facilitator organises a plenary by raising the following issues:
  - Short round of answers given by each group;
  - Note the distribution among the directions: what might it mean?
  - What is the best combination for a group to have? Does it matter?
  - How can one avoid being driven crazy by another direction?
  - How might one use this exercise with others? In the class? With students?
- The facilitator gives feedback at the very end of the protocol, by reflecting on the different personal styles that can be present in a group, and how to approach it as an added value.

## References

[http://schoolreforminitiative.org/doc/compass\\_points.pdf](http://schoolreforminitiative.org/doc/compass_points.pdf)

## Exemplification

By the use of this protocol:

- This is usable in many situations, and many time settings;
- It is advisable to have at least a group of 10 persons to make it really active, else it becomes more an abstract discussion on virtual people;
- People react very positive on this protocol: it makes sense and is very recognizable. The obligatory choice for ONLY ONE direction always provokes discussions;
- Maybe it is possible to position people in intermediate places to indicate more precisely where they find they belong.

If going deeper into discussion it can take more time, but discussions can be very clarifying to one another. (in a team of people that know each other already)

Teachers found this protocol very interesting because it allows to recognize the way of working of each community and how we interact with other with different ways of working.

Participants also recognized the importance of working with the added value, shared experiences and the potential of each one, according to their style.

## Compass Points explanation expanded (developed by Sue Horan, June 2007)

### North

- You take charge.
- You run the daily operation.
- You have lists of things to do and you need to get started and get them done.
- You get assignments in early.
- You don't have to ask questions to begin your work or assignment.
- You drive the work and get it done.
- You teach our children a complete curriculum.
- You will stitch the mosaic together and do the work.

### East

- You have the big picture, the frame that needs to be filled in.
- You need to see the final product and will work with the end in mind.
- You believe in working backwards, understanding by design.
- You don't get a project started until you are clear about the final product.
- You teach our children the big concepts.
- You know what the mosaic looks like in the end.

### West

- You ask the hard questions.
- You live by inquiry.
- You challenge us to identify the details.
- You don't start a project until you are clear about the details.
- You make our picture more complete.
- You lead by inquiry and engage in thoughtful discourse.
- You make us think and teach detailed concepts to our children.
- You fill in the details of the mosaic.

### South

- You take in the information, slow us down, and make sure everyone has voice and is heard.
- You include everyone, and make sure the human side is nurtured.
- You take care of us and bring up our affective domain.
- You make sure the emotional side of our work is heard.
- You make sure we are all included.
- You teach our children with strong relationships and care.
- You add beauty to the mosaic, make sure everyone participates in the creation, and keep us all.



# Consensogram

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

School Reform Initiative: Mrs. Gene Thompson – Groove learned the consortium to know consensogram during a professional learning activity. Catholic Education Flanders made a protocol from this.

## Purpose of the protocol

What is a consensogram:

This way of questioning helps to map the prior knowledge, skills & needs of participants. The facilitator asks 8 questions. The participant answers each question with ++ = I strongly agree, + = I agree, - = I disagree, - - = I strongly disagree. As soon as the participants have answered the questions, the results are visualized.

The facilitator writes each question on a large sheet. Under each question an XY axis is designed. The X axis is labelled ++ + - and - -. The Y axis is labelled with numbers. Each participant has 8 post-it notes. For each question they stick a post-it note above ++ , + , - , or - on the X axis.

Next, the group notes what they see (\*), they discuss and analyse the produced data, they interpret the data and they draw conclusions.

When can a consensogram be used:

A consensogram can be used to determine the opinion of the participants about an issue and to structure discussions. A consensogram helps to get a better understanding, to formulate the opinion of the participants and to share their opinions. A consensogram gives the facilitator immediate information and data to work on. A consensogram makes sure that all participants are involved in the issue and that their prior knowledge is taken into consideration.

## Materials

Questionnaire, 8 large sheets - one for each question – with an XY axis, 8 post-it notes for each participant.

## Time

20 minutes to realise the consensogram, 40 minutes to have a professional discussion/conversation on the results (depending on the number of questions and the number of participants).

## Roles

Facilitator who leads the process, participants

## Process

**Preparation:**

- Prepare 8 questions, note each question on a large sheet (of paper);
- Draw 2 axes on each sheet:
  - X = horizontally: the opinion ++ + - - -
  - Y = vertically: the number of answers
- Stick the sheets on the wall;
- Ensure that each participant has as many post-it notes of the same size as you have questions (mostly 8);

**process:** realising the consensogram

- Presentation of the questions; (2 min.)
- Participants answer the questions ++ + - --; (8 min.)
- Participants note their response to each question on post-it notes (e.g. question 1, ++); (5 min.)
- Participants stick their post-it notes on the 8 sheets (of paper); (5 min.)

**Process:** professional discussion/conversation based on the consensogram

- The facilitator asks the participants **to look** at the charts and to note what they see. (the facilitator makes sure that the participants don't interpret yet); (8 min.)
  - The participants deliberate in groups of 4 on what they **see**. The groups share their findings. (the facilitator makes sure that the participants don't interpret yet); (8 min.)
  - The facilitator asks each participant to **analyse** individually what they see on the graphs.(8 min.)
  - The participants deliberate in groups of 4 on their **analysis**. The groups share their analysis. (8 min.)
- The facilitator asks each group to draw **conclusions** based on the results of their analysis. The groups share their conclusions. (5 min.)

**Addendum: Examples of questions:**

When you ask the questions, inform the participants that these questions should be considered within the context of their own practice. Refer for instance to their practice during the past week, month – their practice with a specific group of students...

Nr.		++	+	-	--
1	Practitioner inquiry is an integral part of the job of teachers (of: a teacher's job)				
2	The many years of experience of teachers have turned them into experts.				
3	Effective teachers set their own learning goals and monitor their own learning progress				
4	for a teacher it's not enough to know if something works, he/she also needs to know why something works				
5	The extent to which teachers constantly search how to optimize their practice determines their expertise				
6	It's better for teachers to follow textbooks because they have been written by experts				
7	Inquiring your own practice is a continuous professional learning strategy				
8	Data collection is an essential part of a teacher's job.				

# Consensogram (Irish Version)

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

**Please complete in the context of your school**

## Part 1 Reflective Dialogue

1.a Staff members talk with each other about their teaching and the specific challenges they face

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

1.b Teachers share, observe, and discuss each other's' teaching methods and philosophies.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

1.c Teachers assume that all students can learn at reasonably high levels and that teachers can help them.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

1.d Teachers not only work together to develop shared understandings of students, curriculum and instructional policy, but also produce materials and activities that improve instruction, curriculum and assessment.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

## Part 2 Inquiry Based Learning

2.a I understand what is meant by the phrase inquiry-based learning.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

2.b I regularly use inquiry-based learning when teaching

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

2.c I am confident using inquiry-based approaches when teaching.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

2.d I am motivated to try different approaches when teaching

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

### Part 3. Practitioner Inquiry

3.a I am keen to understand how to enhance my teaching.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

3.b I regularly self-reflect on my practice.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

3.c I am confident I can effectively inquire into my own teaching practice.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

3.d I am able to identify ineffective teaching approaches.

Not at all	Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5

# Critical Friend

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Bambino, D. (2002). Critical Friends. *Redesigning Professional Development*, 59 (6), 25-27.  
Costa, A & Kallick, B. (1993). Through the Lens of a Critical Friend. *Educational Leadership*, 51 (2), 49-51.  
Network leadership in action: What does a critical friend do? NCSL [www.ncsl.org.uk](http://www.ncsl.org.uk)

## Purpose of the material

In given material roles of critical friend in building and supporting a network (PLC) are described.

## Material

A critical friend can be defined as a trusted person who asks provocative questions, provides data to be examined through another lens, and offers critiques of a person's work as a friend.

A critical friend takes the time to fully understand the context of the work presented and the outcomes that the person or group is working toward. The friend is an advocate for the success of that work.

A critical friend is typically a **colleague** or other **educational professional** who is committed to helping an educator or school improve. A critical friend is someone who is encouraging and supportive, but who also provides honest and often frank feedback that may be uncomfortable or difficult to hear. In short, a critical friend is someone who agrees to speak truthfully, but constructively, about weaknesses, problems, and emotionally charged issues.

### Critical friend – to whom, when and why?

Every student—and educator, too—needs a trusted person who will ask provocative questions and offer helpful critiques. We need another person to change our focus continually, pushing us to look through multiple lenses. Although we, the “ultimate owner of the glasses” decide on what “just right” fits for us.

We must increasingly ask the right questions and collect the appropriate evidence; we are constantly refocusing our work. No one perspective on student learning will be sufficient to assess a student's capabilities and performances. Assessment requires someone who will provide new lenses through which learners can refocus on their work. A critical friend provides such feedback to an individual — a student, a teacher, or an administrator — or to a group.

Critical friends are useful in various educational situations: in classrooms, in staff development meetings, and between administrators.

*In the classroom.* Students use the critical friend's process in the classroom for feedback on their writing, project work, and oral presentations. The process provides a formal way for students to interact about the substantive quality of their work.

*In staff development.* Teachers use critical friends to plan and reflect on their own professional development. The critical friend's process allows teachers to understand one another's work at a deeper level.

*Between administrators.* Administrators often find themselves too busy to reflect on their practices. In addition, they are isolated from one another. To counteract these tendencies, some administrators have designed critical friendships into their working relationships, calling upon colleagues for critique.

### **Critique as part of evaluation *versus* judgment**

The art of criticism is often overlooked in school life. Because the concept of critique often carries negative baggage, a critical friendship requires trust and a formal process. Many people equate *critique* with *judgment*, and when someone offers criticism, they brace themselves for negative comments. Critical friendships, therefore, must begin through building **trust**. The person or group needs to feel that the friend will:

- be clear about the nature of the relationship, and not use it for evaluation or judgment;
- listen well: clarifying ideas, encouraging specificity, and taking time to fully understand what is being presented;
- offer value judgments only upon request from the learner;
- respond to the learner's work with integrity;
- be an advocate for the success of the work.

### **Critical friends group – collaboration of peers**

By providing structures for effective feedback and strong support, Critical Friends Groups help teachers improve instruction and student learning. Critical friends:

- give feedback
- collaborate
- find new solutions
- create community

### **How you can use this material in your practice**

This material helps to reflect on the roles of critical friend and build critical friendship in your PLC.

**Sample critical friends group**

***Deborah Bambino's experience***

*By providing structures for effective feedback and strong support, Critical Friends Groups help teachers improve instruction and student learning.*

*On Monday mornings, my students used to count on my trying out some new strategy that I had picked up at a teacher workshop the previous Saturday morning. Like Mary Poppins with her carpetbag of tricks, I often had a new warm-up or lesson at the start of each week. I spent part of many weekends at workshops in search of the perfect teaching technique that would motivate the unmotivated and awaken the curiosity of even my coolest-of-the-cool middle school students.*

*I don't regret the time that I spent in those sessions. I picked up a repertoire of activities and deepened my own curiosity about learning. What I regret is that my quest for the curricular cure-all was solitary and unconnected with my colleagues at school.*

*After eight years of this whirlwind, I signed up for something different—not a recipe-for-success workshop, but a coaches' training program for building collaboration and reflection among colleagues—a Critical Friends Group. Organized by the National School Reform Faculty, which is coordinated by the Harmony School Education Center in Bloomington, Indiana, Critical Friends Groups help people involved with schools to work collaboratively in democratic, reflective communities. The training focused on building the trust needed to engage in direct, honest, and productive conversations with colleagues about the complex art of teaching. Unwilling to blame the students' abilities or home environments for a lack of school success, we learned several protocols for collectively examining and discussing how to improve both the students' work and the teachers' approach. My initial training lasted just a week, but the lessons have changed my life.*

*The Critical Friends Group process acknowledges the complexity of teaching and provides structures for teachers to improve their teaching by giving and receiving feedback. Working together to improve the day-to-day learning of all students is crucial to the success of Critical Friends Groups.*

*When the members of our training group returned to our schools, we joined colleagues in forming Critical Friends Groups, each group with up to a dozen educators who were willing to meet monthly to examine both student work and the teacher work that prompted it.*

*For me, this process meant looking more deeply at both my assignments and my students' responses to them. I could no longer blame the weather, the full moon, or my students' hormones when a lesson failed to produce its intended results. Instead, I took the work to my Critical Friends Group and asked my colleagues what they saw, what they questioned, and, most important, what they saw missing in my teaching approach.*

*After sharing my work with my Critical Friends Group colleagues, I realized that I could share these feedback protocols with my students. Who better, if I really wanted to hear why a lesson wasn't working? Using my Critical Friends Group experience, I started designing rubrics and assignments with my students, watching as their motivation and grasp of the material grew.*

# Data Driven Dialogue

Adapted from School Reform Initiative

## Sources

Developed by the Teacher Development Group, 2002. ([www.schoolreforminitiative.org](http://www.schoolreforminitiative.org))  
Based on work presented by Nancy Love, author of “Using Data/Getting Results,” 2002.

“Dialogue comes from the Greek word dialogos. Logos means ‘the word,’ or in our case we would think of the ‘meaning of the word.’ And dia means ‘through’ – it doesn’t mean two. A dialogue can be among any number of people, not just two. Even one person can have a sense of dialogue within himself, if the spirit of dialogue is present. The picture or image that this derivation suggests is of a stream of meaning flowing among and through us and between us. This will make possible a flow of meaning in the whole group, out of which will emerge some new understanding. It’s something new, which may not have been in the starting point at all. It’s something creative. And this *shared meaning* is the ‘glue’ or ‘cement’ that holds people and societies together,” (Bohm, D., 1990).

This protocol builds awareness and understanding of the participant’s viewpoints, beliefs, and assumptions about data while suspending judgments. All participants have equal voice. The 3 phases of data-driven dialogue assist groups in making shared meaning of data. We encourage you to use this tool with your entire school staff and/or with your school leadership team at a special meeting on data. The dialogue tool helps to replace hunches and feelings with data-based facts, examine patterns and trends of performance indicators, and generate “root-cause” discussions that move from identifying symptoms to possible causes of student performance. In order to effectively use this tool, participants will need to have grade level, school, or district data reports.

- **Phase I Predictions**  
Surfacing perspectives, beliefs, assumptions, predictions, possibilities, questions, and expectations.
- **Phase II Go Visual**  
Re-create the data visually.
- **Phase III Observations**  
Analyzing the data for patterns, trends, surprises, and new questions that “jump” out.
- **Phase IV Inferences**  
Generating hypotheses, inferring, explaining, and drawing conclusions. Defining new actions and interactions and the data needed to guide their implementation. Building ownership for decisions.

For protocol and facilitation, see *Data Driven Dialogue Protocol Facilitation Plan*.



# Data Driven Dialogue Protocol Facilitation Plan

**Time** (60-90 minutes)

1. **Review Protocol** (3 minutes)
2. **Presentation** (5 minutes)  
“Owner” of the data provides overview of the context and focus
3. **Clarifying Questions** (4 minutes)
4. **Phase I: Predictions**
  - a. Group fills out predictions sheet (3 minutes)
  - b. Round-robin report-out of predictions (one item each person, one round only — 3 minutes) May be charted by the facilitator or other member of the group
5. **Distribution and Examination of Data** (7 minutes)
6. **Additional Clarifying Questions**, if necessary (3 minutes)
7. **Phase II: Go Visual** (10-30 minutes)  
Participants mark up and re-organize the data to better understand it.  
May be done individually, in pairs, or in small groups depending on group size and amount of data.  
Highlighters, chart paper, and calculators are helpful to have on hand.
8. **Phase III: Observations**
  - a. Group fills out observations sheet (5 minutes)
  - b. Round-robin report-out of observations may (one item each person, continue rounds until new ideas are spent — 5 minutes)
9. **Check in with Presenter** (2 minutes)  
Do we need to refocus our attention?
10. **Phase IV: Inferences**
  - a. Group fills out inferences sheet (5 minutes)
  - b. Round-robin report-out of inferences. May be charted (one item each person, continue rounds until new ideas are spent — 5 minutes).
11. **Response from the Presenter** — What new thoughts are you having about the data now? What are your next steps? (5 minutes)
12. **Implications** for teaching and learning (10 minutes)
13. **Debrief** the protocol (3 minutes)

*Note: This protocol can be done in 2 sessions if desired, stopping after Step 8 between sessions. Participants can fill out the inferences sheet between meetings to allow for a fuller discussion of the results in the next session.*

## Data Driven Dialogue Phase I Predictions

Phase I Predictions dialogue takes place before you see the data. During this time, you activate prior knowledge, surface assumptions, and make predictions, thus creating readiness to examine and discuss the data. You hear and honor all assumptions and ideas as “building blocks for new learning.”

### Private Think Time

Before beginning your Phase I Predictions dialogue, please reflect privately and record several of your preliminary thoughts about the data. One or more of the following thought-starters may be helpful.

- I assume...
- I predict...
- I wonder...
- My questions/expectations are influenced by...
- Some possibilities for learning that this data may present...

## Data Driven Dialogue Phase II Go Visual

During Phase II Go Visual you re-create the data visually, on large sheets of paper, on a data wall, etc. Participants mark up the data so they better understand it (i.e., highlight trend lines in different colors, do math calculations and chart those, color code parts of the data that relate to each other). Participants might create visuals individually or in pairs or triads. Depending upon the amount of data, it might be helpful to divide it into subsets and identify who in the group will work with different subsets.

## Data Driven Dialogue Phase III Observations

During Phase III Observations dialogue, you engage with the actual data and note only the facts that you can observe in the data. Conjectures, explanations, conclusions, and inferences are off-limits. You make statements about quantities (e.g., Over half the students...), the presence of certain specific information and/or numerical relationships between ideas (e.g., Over 90% of the students achieved below standard in Problem Solving; Compared to last year's data, the percentage of students performing at the advanced and on-standard levels in Skills increased by 8%...).

### Private Think Time

Before beginning Phase III Observations dialogue, please study the data privately and record several of your observations.

### Remember:

Just the facts! If you catch yourself using the following words, then stop.

~~Because...~~

~~Therefore...~~

~~It seems...~~

~~However...~~

- I observe that...
- Some patterns/trends that I notice...
- I can count...
- I'm surprised that I see...

## Data Driven Dialogue Phase IV Inferences

During Phase IV Inferences dialogue, you (a) generate multiple explanations for your Phase III Observations; (b) identify additional data that may be needed to confirm/contradict your explanations; (c) propose solutions/responses; and (d) identify data needed to monitor implementation of your solutions/ responses.

### Private Think Time

Before beginning Phase IV Inferences dialogue with your colleagues, please reflect privately, using one or more of the following thought starters to prompt your thinking:

- I believe the data suggests... because...
- Additional data that would help me verify/confirm my explanations is...
- I think the following are appropriate solutions/responses that address the needs implied in the data...
- Additional data that would help guide implementation of the solutions/responses and determine if they are working...

# Developing skills to create an IBL module

## Part 1: Generating ideas

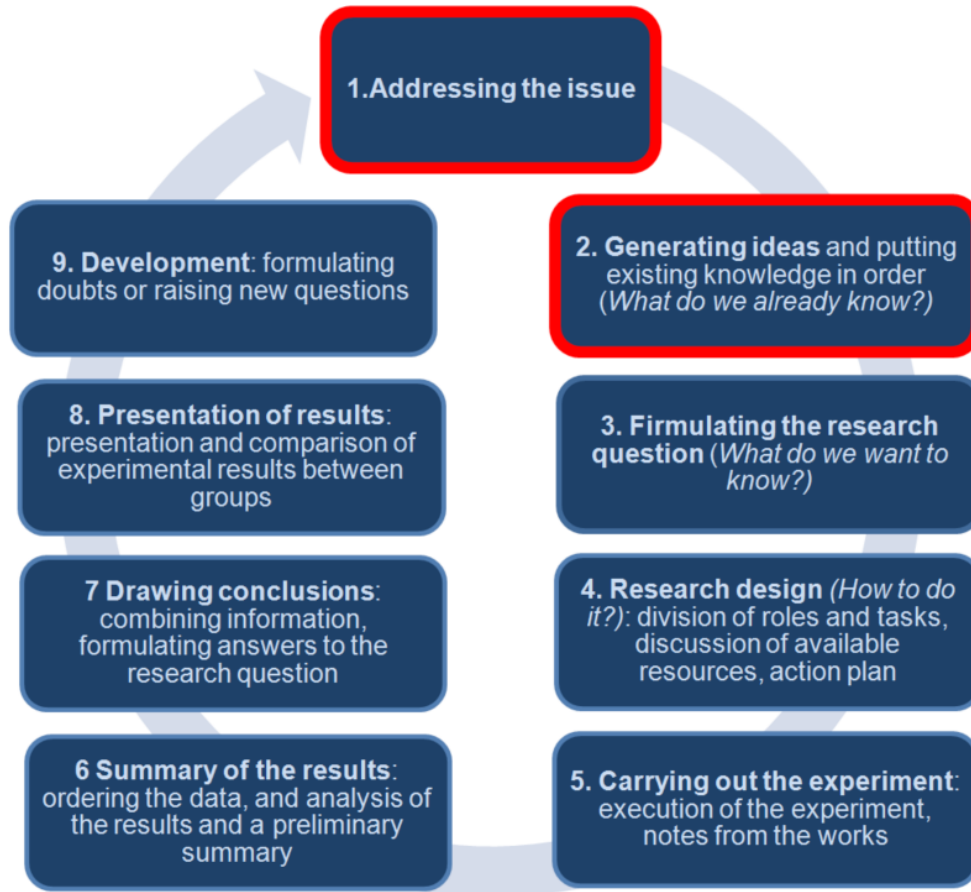


Figure 1 IBL cycle

### Features and conditions of implementation in class. Generating ideas (brainstorming)

1. Method: brainstorming, group discussion
2. Based on students' daily experience or previous school experiences (recall situations, images, events)
3. Necessity of moderating the discussion (students may have a discussion in an unexpected direction)
4. Conducting element in class management.
5. The art of returning to the subject you set yourself.

## IBL protocol 1. Generating ideas

<b>Groups</b>	<b>N</b> groups of 2-4 persons	
<b>Duration</b>	$(15 + 10 \cdot N)$ min	
<b>Course</b>	15-20 min <b>in groups</b>	Establishing in groups an introductory storyline to the issue, including examples and questions to students (including a number of paths to which students can direct the discussion and ways to return from these paths to the topic set by the teacher)
	8 - 10 min <b>for each group</b>	Take over the role of teacher by the group and lead the <b>Generation of Ideas</b> , by moderating discussions with all the other participants who come into the classroom as students
<b>Additional remarks</b>	Depending on how advanced the groups are: <ul style="list-style-type: none"> <li>• all groups should be asked a predetermined issue (e.g. friction, gravity, etc.) - <b>preferred in case of 1. iteration</b></li> <li>• allow groups to choose the issue - <b>preferred in the 2nd iteration</b></li> </ul>	

# Developing skills to create an IBL module

## Part 2: Formulating the research question

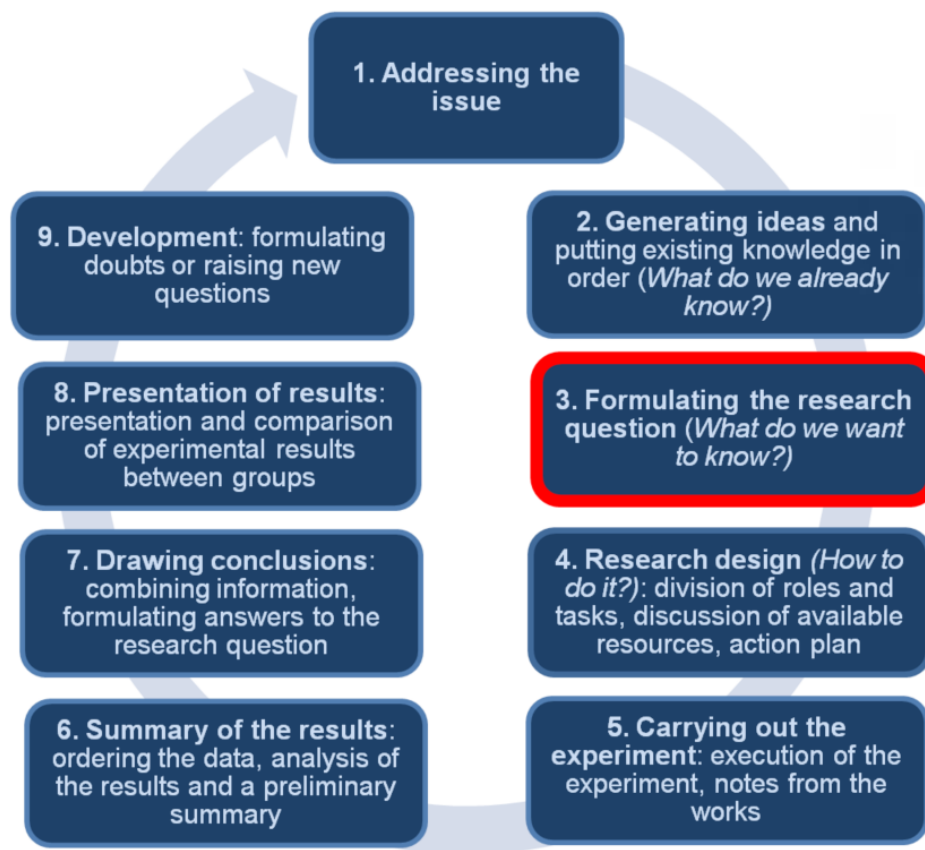


Figure 1 IBL cycle

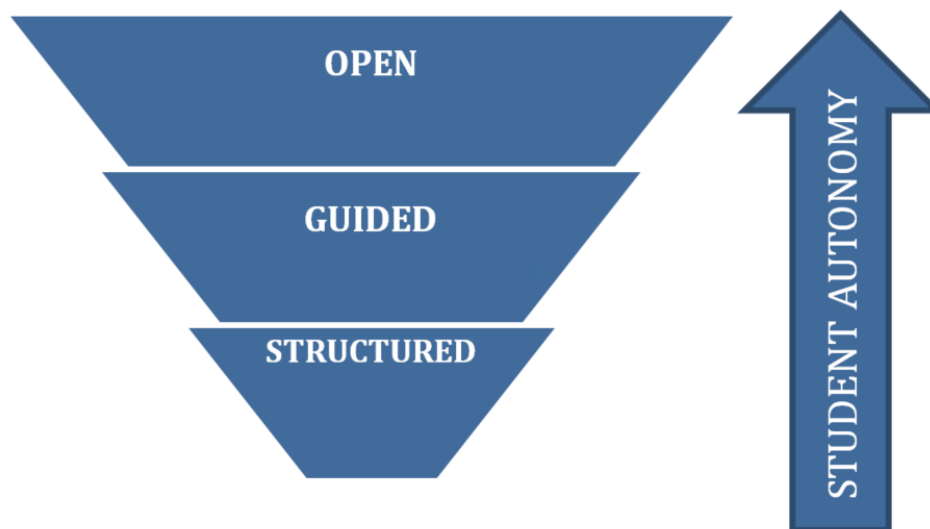


Fig. 2 Levels of inquiry

## Features and conditions of realization in class. Formulation of the research question

1. The teacher's determination of the level of advancement of students and selection of the IBL level to the level of advancement of students (structured, targeted, open).
2. Method: whole-class discussion (low level of student independence) or individual work and group discussion (higher level of student independence)
3. Objective: to determine what we want to know?
4. Necessary conditions: to be determined: What resources do we have? How much time do we need?
5. Features of the research question:
  - No simple answer possible: YES/NO to the question asked
  - The possibility of conducting a classroom study, the results of which will lead to conclusions allowing to answer this question
  - Ensuring implementation through a test or cycle of tests in which the control of variables will be ensured (in one test only one variable can be changed at a time, the others must be controlled, the so-called *fair test*)

### IBL protocol 2. formulation of the research question

<b>Groups</b>	N groups of 2-4 persons	
<b>Duration</b>	(15 + 5* N) min	
<b>Course</b>	1 min <b>in groups</b>	Identify the issue to which research questions will be asked (general issue, e.g. friction, gravity).
	7 min <b>individually</b>	Individual work on research questions with an outline of module implementation on three different levels.
	7 min <b>in groups</b>	Establishing three common research questions, one for each of the three levels.
	4 - 5 min <b>for each group</b>	Presentation of your three research questions together with an outline of your students' idea of implementation.
<b>Additional remarks</b>	Depending on how advanced the groups are: <ul style="list-style-type: none"> <li>• all groups should be asked a predetermined issue (e.g. friction, gravity, etc.) - <b>preferred in case of 1. iteration</b></li> <li>• allow groups to choose the issue - <b>preferred in the 2nd iteration</b></li> </ul>	



# Developing skills to create an IBL module

## Part 3: Design of the IBL experiment

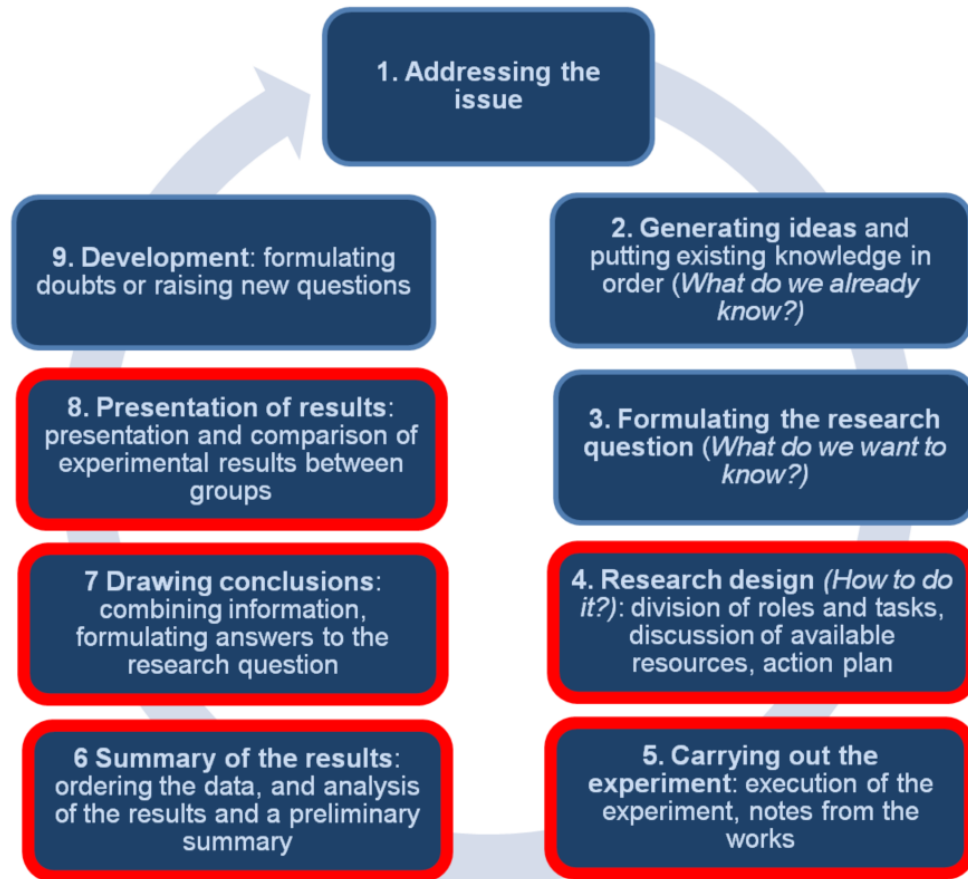


Figure 1 IBL cycle

### Features and conditions of realization in class. Design of the IBL experiment

1. Determination of resources, time, spatial possibilities, number and number of groups, how to divide into groups
2. Establish the IBL level at which students will work.
3. Identify the issue and research question.
4. Establishing the skeleton of the vision of module implementation.

### IBL protocol 3. design of the IBL experiment

<b>Groups</b>	N groups of 2-4 persons	
<b>Duration</b>	95 min	
<b>Course</b>	5 min <b>in groups</b>	Establishing the level of the IBL module in groups and selecting the research topic and question.
	15 min <b>in groups</b>	Designing the implementation of the experiment in class: ORGANISATION: <ul style="list-style-type: none"> <li>• Number of groups</li> <li>• Number of people in the group</li> <li>• Breakdown into groups</li> <li>• Space arrangement</li> <li>• Time frame</li> </ul> MODULE: <ul style="list-style-type: none"> <li>• Availability of materials (self-selection or sets)</li> <li>• Number and type of hypotheses</li> <li>• Number and types of experiments</li> <li>• Planning process</li> <li>• Data collection and recording process</li> <li>• Data analysis process</li> <li>• Presentation of results</li> </ul>
	20 min <b>in groups</b>	Graphic project of module implementation.
	8 - 10 min <b>for each group</b>	Presentation of the project to another group.
	2 × 10 min <b>in pairs</b>	Exchange of projects between groups. Critical assessment of the project ( <i>critical friends</i> ) of another group using notes ( <i>stickers</i> ) and oral comments (the group being assessed listens to the analysis).
	15 min <b>in groups</b>	Reflection on comments from another group and revision of the module.
<b>Additional remarks</b>	Depending on how advanced the groups are: <ul style="list-style-type: none"> <li>• all groups should be asked a predetermined issue (e.g. friction, gravity, etc.) - <b>preferred in case of 1. iteration</b></li> <li>• allow groups to choose the issue - <b>preferred in the 2nd iteration</b></li> </ul>	

# Developing skills to create an IBL module

## Part 4: Evaluation at the IBL

### Features and conditions of implementation in class. Evaluation in the IBL

1. Shaping assessment:
  - Activity table
  - The sections
  - Self-assessment and peer review
2. Summative evaluation:
  - Tests with IBL elements: planning, hypothesis, experience design, data analysis, inference.
  - Scientific reasoning tests (Lawson type)

### Features and conditions of implementation in class. Activity table

- Who are we judging?
- What are we evaluating?
- When do we judge?
- How to carry out evaluation effectively?
- To what extent will the assessment in the table affect
  - for the whole evaluation of participation in the module classes?

### Features and conditions of implementation in class. Self-assessment and peer review table

- What is to be assessed?
- Rules for student assessment
- Rule of assessment on the basis of both tables
- To what extent will the assessment on the tables affect the entire assessment of participation in the module classes?

### Features and conditions of implementation in class. The sections

- Breakdown into levels (minimum 3)
- General rule for level
- Selection of aspects (skills) to be assessed
- Description of each skill at each level
  - Each subsequent level assumes that the criteria of the previous level are met
  - Clear, single criterion separating two adjacent levels

## IBL protocol 4. Assessment methods in the IBL

<b>Groups</b>	<b>N</b> groups of 2-4 persons ( <b>K</b> ) persons	
<b>Duration</b>	$(55 + 7 * N + 10 * K)$ min	
<b>Course</b>	7 min <b>in groups</b>	Working on the strategy and feasibility of assessing using the activity table.
	8 min <b>in groups</b>	Preparation of activity table proposals.
	3 min <b>for each group</b>	Presentation of the strategy and activity table in the forum.
	15 min <b>in groups</b>	Identify 4-8 questions for self-evaluation and peer review and evaluation strategies using this tool.
	4 min <b>for each group</b>	Presentation of the strategy and the self-assessment and peer review table in the Forum.
	5 min <b>in groups</b>	Establish in the group the IBL module for which boxes will be prepared and the division of the module into sections for evaluation by individual group members.
	5 min <b>individually</b>	Preparing a box for one part of the IBL module.
	<b>K</b> × 10 min <b>in groups</b>	Critical analysis of the boxes of one group member by the other members of the group.
<b>Additional remarks</b>	Depending on how advanced the groups are: <ul style="list-style-type: none"> <li>all groups should be asked a predetermined issue (e.g. friction, gravity, etc.) - <b>preferred in case of 1. iteration</b></li> <li>allow groups to choose the issue - <b>preferred in the 2nd iteration</b></li> </ul>	

# Different cultures/getting to know each other

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Lesničar, B. (2017), Different cultures. Ljubljana: Zavod RS za šolstvo

## Purpose of the protocol

Connections/ice-breaking activity/getting to know each other/talking about different countries and cultures. It is best to use it at the beginning of a session or at the first PLC meeting. This activity enables the participants to get to know each other a little bit better. If they are from the same cultural background/school, the topic could be hobbies or special interests. They can also discuss what challenges/issues confront teachers in their subject/schools etc.

## Materials

Pictures, photos of their own country/hobbies/special interests (landscape, symbols, cultural sights, culinary tradition..)

## Time

10 min.

## Roles

- Facilitator
- Participant/student
- PLC

## Process

Steps:

1. The facilitators invites the participants to find and talk to somebody they don't know or don't have the habit to cooperate with on the regular basis.
2. The group of the participants mingle and everybody talks to somebody they didn't know before or didn't cooperate before. With the help of the item brought to the session they tell the partner something about themselves, then they switch roles.

## References

Lesničar, B. (2017), Different cultures. Ljubljana: Zavod RS za šolstvo

# Easy ways to collect data

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Inspired by: Dana, N.F., & Yendol-Hoppey, D. (2008) *The reflective educator's guide to professional Development: coaching Inquiry-Oriented Learning Communities*. Thousand Oaks, CA: Corwin press

## Purpose of the protocol

To discover different ways of data collection

- This material has been developed to support teachers in collecting data during their practitioner inquiry. When teachers decide to do practitioner inquiry, they start with formulating a question about their practice. Once their question is clear and concise, they can collect data.
- This material gives an overview of the different kinds of data that teachers can collect. The material gives also suggestions on how to work with the material in school teams.

After the collection of data, teacher - inquirers analyse the data, decide on what they will do based on the analyse of the data and share their findings with colleagues.

## How you can use this material in your practice

Two possibilities:

1. Cut out the twelve different ways of data collection and put them on several tables in the meeting room;
  - a. Make twelve groups (f.i. 24 participants = 12 groups of 2);
  - b. Each group go from table to table and read the different ways of data collection;
  - c. After having read a way of data collection, they discuss on how they can use this way of data collection in their practitioner inquiry.
2. Cut out several times the twelve ways of data collection and put them in stacks of 4 (f.i. 1 – 4, 5 – 8, 9 – 12)
  - a. Make groups of 3 participants;
  - b. Each participant of each group reads a stack of 4 ways of data collection (f.i. cards 1 – 4) and he/she gets the task to explain the content of what he/she has read to the other 2 colleagues;

Participants tell to the other participants of each group what they have read.

<p><b>Data collection 1: Field notes</b></p> <p>To capture action in the classroom, many teacher researchers take field notes as they observe. Field notes can come in many shapes, forms, and varieties. Some of these include scripting dialog and conversation, diagramming the classroom or a particular part of the classroom, noting what a student or group of students are doing at particular time intervals (e.g. every two minutes), and recording every question that a teacher asks. Field notes are not interpretations but rather focus on capturing what is occurring without commenting as to why the action might be occurring or how one judges a particular act. The forms that your field notes take depend on your wondering.</p>	<p><b>Data collection 2: Documents/artifacts/student work</b></p> <p>Field notes capture actions as data on paper. However even without field notes, schools and classrooms naturally generate a tremendous paper trail that captures much of the daily classroom activity. The paper trail includes student work, curriculum guides, textbooks, teacher manuals, children’s literature, individualized education plans, community memos, parent newsletters, progress reports, teacher plan books, written lesson plans, and correspondence to and from parents, the principal, and specialists. The amount of paperwork that crosses a teacher’s desk can make any teacher bleary eyed. Often the papers teachers view do not hold significant meaning when read in isolation or when quickly in order to be able to hand them back in the morning. Teachers need to ‘get through’ paperwork in order to keep up with their work. Yet, when teaching and inquiry are intertwined with one another, the papers become data and take on new meaning. When teacher-inquirers select and collect the papers that are related to their research wonderings, we call these papers documents and artifacts. Systematically collecting papers provides you with the opportunity to look within and across these documents to analyze them in new and different ways.</p>
<p><b>Data collection 3: Interviews</b></p> <p>Teacher talk is important! As talk is crucial to the life of a teacher, capturing talk can be an important form of data collection. Field notes are one way to capture talk that occurs naturally in the classroom. Some teachers-inquirers go a step further than naturally occurring classroom talk by interviewing as well. Interviewing can be informal and spontaneous or more thoughtfully and planned.</p>	<p><b>Data collection 4: Focus groups</b></p> <p>Focus groups offer teachers another vehicle for collecting the talk and thoughts of children in the classroom. In many ways, focus groups occur daily in the form of whole-class or small-group discussion. The focus-group discussion can serve as a tool for understanding students’ perceptions. For example, a focus group can provide insight into how students experience a new instructional strategy.</p>

<p><b>Data collection 5: Digital pictures</b></p> <p>Interviews and focus groups can capture words as data. A very old proverb you are likely familiar with is ‘a picture is worth a thousand words.’ Another wonderful way to capture action that occurs in the classroom as data is through digital photography</p>	<p><b>Data collection 6: Video as data</b></p> <p>Digital pictures capture a single snippet of action in the classroom at one point in time. Video as a form of data collection takes digital pictures one step further by capturing an entire segment of action in the classroom over a set time period. Given that teachers often collect their best data by seeing and listening to the activities within their classroom, video becomes a powerful form of data collection for the teacher researcher. Teacher researchers have found that using video can help them collect descriptive information, better understand an unfolding behavior, capture the process used, study the learning situation, and make visible products or outcomes. More specifically, through observing video of one’s own teaching, teachers can observe attitudes, skill and knowledge levels, nature of interactions, nonverbal behavior, instructional clarity, and the influence of physical surroundings.</p>
<p><b>Data collection 7: Reflective journals</b></p> <p>Strategy 1 to 6 are ways to make data collection a part of your teaching by capturing what naturally occurs in your teaching day – action in the classroom through field notes, digital pictures, and video; student progress in your classroom through document analysis; and talk in the classroom through interviews and focus groups. One of the ways that interviewing and focus groups serve as powerful data collection strategies is through the talk of interviewing, because a teacher-inquirer gains access into the thinking of the child or adult being interviewed.</p> <p>Capturing “thinking” is a challenge for any researcher. One way a teacher researcher captures the thinking that occurs in the school and classroom within his or her own mind is through journaling. Journals provide teachers a tool for reflecting on their own thought processes and can also serve as a tool for students to record their thinking related to the project at hand.</p>	<p><b>Data collection 8: Weblogs</b></p> <p>Similar to a journal, weblogs are another excellent way teacher researchers can capture their thinking as an inquiry unfolds. Weblogs are easily created, easily updateable web sites that allows an author (or authors) to publish instantly to the Internet from any Internet connection. As blogs consist of a series of entries arranged in reverse chronological order, they can serve as a sort of “online diary” where teacher researchers can post commentary or news about the research they are currently engaged in. Unlike the journal as a form of data collection, the teacher researcher who blogs can combine text, images, and links to other blogs as well as post comments in an interactive format. The comment feature of blogs provides the opportunity for teacher researchers to receive feedback from anyone in the world (in an open blog community) or teacher researchers (in a closed community).</p>



<p><b>Data collection 9: Surveys</b></p> <p>Some teacher-inquirers employ more formal mechanisms (such as sociograms and surveys) to capture the action, talk, thinking, and productivity that are a part of each and every school day. The most common formal mechanism we have observed in our work with teacher-inquirers is surveys. Surveys can give students a space to share their thoughts and opinions about a teaching technique or strategy, a unit, or their knowledge about particular subject matter;</p>	<p><b>Data collection 10: Quantitative measures of student achievement</b></p> <p>In this area of high-stakes testing and accountability, numerous quantitative measure of student performance abound, and these measures can be valuable sources of data for the teacher-researcher.</p>
<p><b>Data collection 11: Critical friend group feedback</b></p> <p>Using multiple sources of data is important. An additional way of data collecting is through critical friend group feedback. Critical friend groups are one version of professional learning communities. A professional learning community is consisting of educators who come together voluntarily at least once a month for some hours. Group members are committed to improving their practice through collaborative learning.</p>	<p><b>Data collection 12: Literature as data</b></p> <p>Although we often do not think of literature as data, literature offers an opportunity to think about how your work as a teacher-inquirer is informed by, and connect to the work of others. No one teaches or inquires in a vacuum. When we engage in the act of teaching, we are situated within a context (our particular classroom, grade level, school, ...), and our context mediates much of what we do and understand as teachers. Similarly, when teachers inquire, their work is situated within a large , rich, preexisting knowledge base that is captured in such things as books, journal articles, newspaper articles, conference papers and Web sites. Looking at this preexisting knowledge base on teaching informs your study. All you need to figure out is which pieces of literature connect to your wonderings and will give you insights as your study is unfolding. Teacher-inquirers generally collect literature at two different times.</p> <ul style="list-style-type: none"> <li>- When they define or are in the process of defining a wondering and</li> <li>- As their studies lead them to new findings and new wonderings.</li> </ul> <p>In these cases, teachers use the literature to become well informed on what current knowledge exists in the field on their topic. Literature is an essential form of data that every teacher-inquirer should use so as to be connected to, informed by, and a contributor to the larger conversation about educational practice.</p>

# Farming versus Gardening

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Dana, F.N, (2013), *Digging deeper into action research*. London: Sage publications

(p.54): “Lawrence Stenhouse uses the comparison of an agriculturalist and a gardener: the traditional researcher is an agriculturalist, while a teacher is a gardener who creates and tells his or her research story through engagement in summative data analysis ...”

Earl, L. and Katz, S. (2006), *Leading schools in a data-rich world, harnessing data for school improvement*. California: Corwin Press

## Purpose of the protocol

People usually interpret research as an activity carried out by university researchers, following high standard procedures. Inquiry is an activity done by teachers, gathering evidence to give direction on how to improve their practice. To make clear that both activities do not conflict, but that each has its role a discussion can help. A metaphor helps to visualize both activities. This protocol provokes discussion to clarify each activity and to put both in the correct perspective.

- How rich PI can be and how it adds value to the profession of education
- the difference between academic research and practitioners inquiry

## Materials

Photo like the one in addendum. Any picture is ok, preferably even own made.

Second photo in addendum is also just as an example. (Lorna Earl used a painting: “The garden” of Giverny–Monet ).

(Post-its).

## Time

15 minutes

## Roles

Facilitator and participants

## Process

The facilitator gives the following information

( SHOW THE FIRST PICTURE, OR BEAM IT)

Data gathering is like this garden....

Diverse plants, different kinds, some colourful, other colourless, all together they make an equilibrated picture. The diversity makes it beautiful and meaningful. The data and inquiries can differ a lot. That makes the dinner tasty. The garden of data will improve the health of the inhabitants of the house!

( SHOW THE SECOND PICTURE, OR BEAM IT)

Academic research is like this photo: it is massive, gives a lot of data, is reliable but on the other hand a bit focused on one issue only.

Explain. ( if necessary)

Of course the facilitator can allow discussions after presenting this point of view

## References

Dana, FN, (2013), Digging deeper into action research. London: Sage publications

Earl, L. and Katz, S. (2006), Leading schools in a data-rich world, harnessing data for school improvement. California: Corwin Press

## Exemplification

During the Linpilcare course it was used as follows:

- both pictures were shown, while only the theme ( PI versus Ac. Research) was launched. The participants were invited to write key ideas/words on post-its and to stich them underneath the picture the ideas/words link to. (5 minutes). The participants then were invited to formulate conclusions.

The discussion gives rise to looking at “Thinking through practice” , section 3.3.1

### Addendum:

**One can find or take his own pictures. The ones below only illustrate it.**



**COMPARED to**



OR



# Forming ground rules (creating norms and values)

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

SRI, resource and protocol book (<http://schoolreforminitiative.org>)

## Purpose of the protocol

Gaining agreement around ground rules, or norms & values, is important for a group that intends to work together on difficult issues, or who will be working together over time. They may be added to, or condensed, as the group progresses. Starting with basic Ground Rules builds trust, clarifies group expectations of one another, and establishes points of “reflection” to see how the group is doing regarding process.

## Materials

Chart paper

## Time

Approximately 30 minutes

## Roles

Facilitator, participants

## Process

1. Ask every participant to write down what each participant needs in order to work productively in a group, giving an example of one thing the facilitator needs, i.e. “to have all voices heard,” or “to start and end our meetings when we say we will.” (this is to help people focus on process rather than product)
2. Each participant names one thing from her/his written list, going around in a circle, with no repeats, and as many circuits as necessary to have all the ground rules listed.
3. Ask for any clarifications needed. One person may not understand what another person has listed, or may interpret the language differently.
4. If the list is VERY long — more than 10 Ground Rules — ask the group if some of them can be combined to make the list more manageable. Sometimes the subtle differences are important to people, so it is more important that everyone feel their needs have been honored than it is to have a short list.
5. Ask if everyone can abide by the listed ground rules. If anyone dislikes or doesn't want to comply with one of them, that ground rule should be discussed and a decision should be made to keep it on the list with a notation of objection, to remove it, or to try it for a specified amount of time and check it again.
6. Ask if any one of the ground rules might be hard for the group to follow. If there is one or more, those ground rules should be highlighted and given attention. With time it will become clear if it should be dropped, or needs significant work. Sometimes what might appear to be a difficult rule turns out not to be hard at all. “Everyone has a turn to speak,” is sometimes debated for example, with the argument that not everyone likes to talk every time an issue is raised, and others think aloud and only process well if they have the space to do that. Frequently, a system of checking in with everyone, without requiring everyone to speak, becomes a more effective ground rule.
7. While work is in progress, refer to the ground rules whenever they would help group process. If one person is dominating, for example, it is easier to refer to a ground rule that says, “take care with how often and how long you speak,” than to ask someone directly to stop dominating the group.
8. Check in on the ground rules when reflection is done on the group work. Note any that were not followed particularly well for attention in the next work session. Being sure they are followed, refining them, and adding or subtracting ground rules is important, as it makes for smoother work and more.

# Inquiry brief peer feedback

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Dana, N. F., & Yendol-Hoppey, D. (2008). *The Reflective Educator's Guide to Professional Development: Coaching Inquiry-Oriented Learning Communities*. Thousand Oaks, CA: Corwin press, p. 105.

## Purpose of the protocol

To discover how an inquiry brief can be structured and to stimulate participants to write their own inquiry brief.

## Materials

Sample inquiry brief – if possible use your own inquiry brief.  
Format for writing an inquiry brief.

## Time

15 – 20 minutes per group member

## Roles

Suggested group size: 4  
1 timekeeper  
1 presenter that - or present her/his own inquiry brief – or present the sample inquiry brief proposed in this document. The presenter knows the content of the inquiry brief.

## Process

1. Select a timekeeper.
2. Presenter hands out a hard copy of the inquiry brief to each member of the group.
3. Group members *silently* read the inquiry brief, making notes of issues/questions they might like to raise in discussion with presenter (4 minutes). As group members read the brief, the presenter engages in a writing activity to complete the following sentences:
  - Something I would like help with on my inquiry brief is . . .
  - One thing this group needs to know about my proposed inquiry to better prepare them to assist me is. . .
4. At the end of the reading of the inquiry brief (or when it is clear that every member of the group has completed reading and taking notes on the inquiry brief, and the presenter has finished his/her response to the writing activity), the timekeeper invites the presenter to read his/her sentence completion activity out-loud. (No more than one minute).

5. Participants talk to each other as if the presenter was not in the room, while the presenter remains silent and takes notes. (10 Minutes)

Participants focus on **each** of the following:

- Provide “warm feedback” on the inquiry brief. This is feedback that is positive in nature and identifies areas of strength. (1 – 2 minutes)
- Address the area the presenter would like help on and discuss the following questions (8 – 10 minutes):
  - A. What match seems to exist (or not exist) between the proposed data collection plan and inquiry question?
  - B. Are there additional types of data that would give the participants insights into his/her question?
  - C. Rate the “do-ability” of this plan for inquiry. In what ways is the participant’s plan meshed with the everyday work of a teacher?
  - D. In what ways does the participant’s proposed time line for study align with each step in the action research process?
  - E. What possible disconnects and problems do you see?

Time keeper asks presenter to summarize the key points made during discussion that he/she wishes to consider in refining his/her plan for inquiry. (1 Minute)

# Litmus Test

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

- Training course N. Dana, Lisbon, Portugal

## Purpose of the protocol

to improve the inquiry question in a guided way, reflecting on 7 criteria for good inquiry questions, in the context of practitioners inquiry

## Materials

Mindmap and work sheet, both in addenda below

## Time

From 15 minutes to 30 minutes, depending on how much time the facilitator spends explaining each of the criteria.

## Roles

- Facilitator: explaining each criterium, going through all 7; timekeeper  
- Participants, each with their own wondering/question

## Process

After each criterium, the participants rewrite or adapt their version of the question. At the end it is almost sure changes have been made.



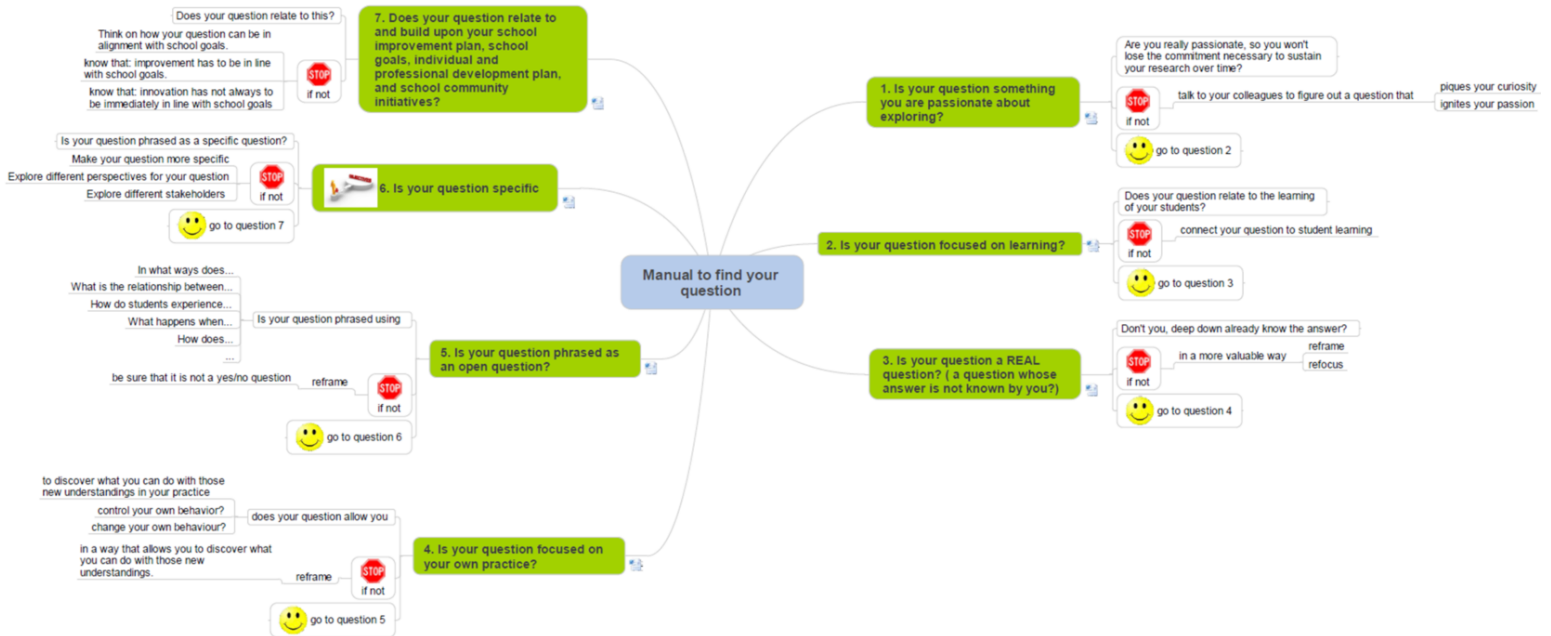
**Addendum: work sheet: please copy the following in two pages/ landscape for each participant**

Phase	Theme	Question, improvement, answer or criterion, hint, reflection> Indicate or write the change if necessary
0.	Start: my present Q. is....	...
1.	Passion	
2.	Focus on learning?	
3.	A real question?	
4.	Own practice?	
5.	Is your question an open question?	
6.	Specific?	
7.	Related to context?	
Conclusion	Write the updated version of your question here:	

# Manual for an Inquiry Brief

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

Addendum: mindmap: please copy the picture below to another document and print it in A3 format for the user's convenience. The original pdf version is also available on the Linpilcare website.



# My Inquiry Brief

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

Name:.....

Organisation: .....

## My inquiry brief

This brief needs to be read by other persons, later on. Take that into account as you build it up. Make sure you write everything in English. Please write slowly and clearly.

<p>1. My passion is:</p> <p>.....</p> <p>2. What is your wondering about?/Purpose/context/why? :</p>	<p>7. How to analyse the selected sets of data (after the ATLAS protocol)</p>
<p>3. My personal first version of wondering/question is</p>	<p>8. Data Collection: how many students, in which classes, etc: the reality of your context</p>
<p>4. During the litmus test my wondering/question changes into:</p>	<p>9. Calendar: when/what? Deadlines</p>
<p>5. Question/wondering after Choosing the right question protocol</p>	<p>As part of T004 please fill in: I need help with. . .</p>
<p>6. Data selection: 2 or 3 kinds from Easy ways of gathering data (or other)</p>	<p>As part of T004 please fill in: Some thing(s) this group needs to know about my proposed inquiry to be able to help me (background information) . .</p>

**T004: Write down the summary of the remarks you got via the post-its.  
This will define the latest version of this Inquiry Brief**

# Passions

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

Dana, N., Yendol-Hoppey, D. (2009), *The reflective educator's guide to classroom research. Learning to teach and teaching to learn through practitioner inquiry*, California, Corwin press

## Purpose of the protocol

Participants discover their passion in education and delve deeper into their passion to come to a 'wondering' about their practice. The 'wondering' is the first step towards a researchable question for the practitioner inquiry of the participant.

## Materials

Print the addendum pages here below, recto verso. Cut the frames. Make stacks of the 8 passions. Ensure that every participant has a stack with the 8 passions.

## Time

60 minutes or even more if needed

## Roles

Facilitator, participants

## Process

Option 1 (bigger groups):

- group people with the same passion and make them exchange ideas on the same passion and the corresponding exercise;
- If you choose this option, you need an extra round to share your experiences with the chosen passion.

Option 2: (smaller groups – less than 10):

group people with different passions and also invite them to explain and exchange ideas about each other's passion. In this case, no extra round is needed.

1. Give each participant a stack with the 8 passions. (see addendum below)
2. Let each participant read the passion profiles and identify the passion that most accurately describes who he/she is as an educator. If several fit (this will be true for many participants), the participant choose the one that affects him/her the most, or the one that seems most significant as he/she reflects on his/her practice over time. (5 minutes)

3. (with bigger groups) Without using the number of the passion profile, participants ask colleagues questions and find the people who choose the same profile. (5 minutes)  
or
  4. (with small groups) Make groups of 4 and share your passion. (5 minutes)
  5. In your groups of colleagues with profiles, choose a facilitator, a timekeeper and a recorder/reporter. (2 minutes)
  6. Check to see if you all really share the chosen passion. Then talk about your school experiences together. What is it like to have this passion – What is it like to be this kind of educator? Each person in the group should have an opportunity to talk, uninterrupted, for 2 minutes. (10 minutes)
  7. Next, each person in the group identifies an actual student, by name, who has been affected by the group's profile. Write (in your journal) (5 minutes)
    - a. What have I done with this student?
    - b. What has worked? What hasn't?
    - c. What else could I do?
    - d. What questions does this raise for me?
  8. Talk as a group about the questions that teachers who share this passion are likely to have about their practice. List as many of these questions as you can. (15 minutes)
    - a. Recorder/reporter should write on a chart and should be ready to report out to the large group. Be sure to put your passion profile at the top of the chart.
  9. Read the exercise on the back of the passion. Think on how you will do this in your practice and share with the group. (10 minutes)
    - a. Recorder/reporter should write on a chart and should be ready to report out to the large group. Be sure to put your passion profile at the top of the chart.
  10. Whole group debrief:
    - a. What strikes you as you listen to the passions of your colleagues?
    - b. Which of the questions generated intrigues you the most? Why?
    - c. How might you go about exploring this question with colleagues?
- What would you do first? (15 minutes)

**Addendum below:**



<p><b>Exercise 2:</b></p> <p>Browse (virtually) your manuals, your curricula and your old diaries. As you browse through those documents, you draw up a list of things that you taught but where you didn't feel good and what you want to optimize in the future. In addition to each topic in your list, describe in a few words why you were not satisfied with this section and how you could optimize it. Finally, choose one topic from your list that you want to focus on with future research. Brainstorm questions related to teaching on this topic.</p>	<p><b>Exercise 1:</b></p> <p>Make a list of all the students in your class or make a list of all the students you teach in a certain period. As you make the list, note what makes each student unique. Focus on characteristics that the student shows and that you observe. Avoid judging or criticizing students. Write one question next to each student's name. That question is about something that can give you insight into how that student learns.</p>
<p><b>Exercise 4:</b></p> <p>Brainstorm a list of educational strategies that you want to try. In addition to each item on your list, you should briefly state why you want to try this strategy. Write down a question that is related to the strategy you want to try and why you want to try it out. Brainstorm about a list of the most frequent educational strategies that you apply in your practice. Then place an asterisk next to the strategy that intrigues you the most. Write here in a few sentences why this strategy intrigues you the most. Then formulate a question that is related to the educational strategy and why it intrigues you.</p>	<p><b>Exercise 3:</b></p> <p>Make a list of things that you do in your practice and that you think promote the student's learning. Circle what you think can still be improved. Make an evaluation of the materials you use to teach (eg within one subject / learning area). Do these materials ensure that you pay sufficient attention to the diversity and different backgrounds of your students? For which students are these materials insufficient? What's missing? .</p>



<p><b>5: relationship between yourself and your colleagues</b></p> <p>You are essentially a <b>team player</b> , so you do your job the way you do. You like to measure yourself with colleagues, discuss approaches with them and listen to ideas and techniques that they apply. Because you only really learn when you can discuss it with them.</p> <p>Teaching is a <b>challenge</b> that you all <b>tackle as a group</b>. You only win if everyone wins.</p> <p>When you try something new in class that is very successful, one of the first things you think is “I have to tell X”.</p>	<p><b>6: the intersection between your personal and professional identities</b></p> <p>You came <b>from a different job</b> in education and you often have the feeling that your previous professional identity conflicts with your new identity as an educator. You do not feel efficient and are frustrated when your students or colleagues do not tackle a certain task in the same way as you, based on an approach that is considered second nature to you, arising from your previous identity as a writer, actor, artist, researcher ... What keeps you awake at night is how you can use the knowledge, <b>skills and experiences that you have brought from your previous professional life</b> to come to powerful forms of teaching and learning in your class and / or school.</p>
<p><b>7: Challenges of the future</b></p> <p>You became a teacher <b>to change / help the world to create a more just, fair, democratic and peaceful world</b>. You know that the world of the <b>future will be full of challenges</b> and move faster than the world you have always known. You constantly think of ways to integrate things like ‘race, class, disability, power ...’ into your practice. You wonder <b>what skills the students of the future need to have</b> to function in that world, and you want to do everything to sharpen those skills.</p>	<p><b>8: School as a quality indicator</b></p> <p>What keeps you awake at night is how your students <b>can maintain a high level</b>, despite the many distractions they experience every day in your class / school.</p> <p>It seems that the <b>school context</b> is conspiring against everything you know about effective teaching and learning.</p> <p>You worry about <b>exam results</b> and things like <b>pisa scores</b>.</p> <p>Is it not the task of an education to aim high and go for good evaluations? And how do you actually, <b>effectively and efficiently evaluate it ?</b></p>

<p><b>Exercise 6:</b></p> <p>Write your biography concisely. Discuss the development of your interests and passions. Finally, discuss why you chose to become a teacher. Draw a timeline of your career where you indicate how you grew as a teacher. Start with your date of birth and note dates and dates in which crucial issues occurred in your life and career. Make a coat of arms of yourself as a teacher. For example, you can place a mythical image in one part that describes how you want to be as a teacher. In another part you can place a symbol that indicates how you want to be as a teacher. In another part you choose the colors that best suit who you want to be as a teacher. In another part you can depict a characteristic of what you want to be as a teacher. Finally, you can choose a word or spell that matches how you want to be as a teacher.</p>	<p><b>Exercise 5:</b></p> <p>Remember the last time you were impressed by a colleague. What did he / she do that impressed you?</p> <p>Was there anything you wanted to do about it? Why did that have such an effect on you?</p> <p>In what way does that colleague differ from you?</p> <p>Are there things that could be beneficial if you took over something from him / her?</p>
<p><b>Exercise 7:</b></p> <p>When you think of the world that your students end up in, what do you think of?</p> <p>Which skills and characteristics are important in that world of the future?</p> <p>If you think of the educational reform of 2040 or 2050, what do you think will be circled in red at the top of the agenda?</p> <p>Can we already learn something from this insight? Can you make that concrete for your own lesson?</p>	<p><b>Exercise 8:</b></p> <p>Why do you think it is important to strive for a high level and good results?</p> <p>Is it more important that they reach their very highest level with the highest potential, or is it more important that the general level is as high as possible?</p> <p>What exactly does a high level mean to you? How can you measure that? Can you see that?</p> <p>Does the way you measure influence the way your system works? What kind of conclusion do you draw for your own lesson?</p>

# Silent Chalk talk

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

*Originally developed as Chalk Talk by Hilton Smith, Foxfire Fund; adapted for the NSRF by Marylyn Wentworth.*

## Purpose of the protocol

Chalk Talk is a silent way to do reflection, generate ideas, check on learning, develop projects or solve problems. It can be used productively with any group—students, faculty, workshop participants, committees. Because it is done completely in silence, it gives groups a change of pace and encourages thoughtful contemplation. It can be an unforgettable experience. Middle Level students absolutely love it—it's the quietest they'll ever be!

## Materials

Chalk board and chalk or paper roll on the wall and markers. Or  
A variant with regular pencils and paper format A4 that was set on the desks was performed with our small PLC of psychology teachers. Comments were later typed and included in the meeting resource, so that the participants could download it from Moodle and in that way have the evidence of their learning.

## Time

Varies according to need; can be from 5 minutes to an hour.

## Roles

Facilitator; participants

## Process

1. The facilitator explains very briefly that Chalk Talk is a silent activity. No one may talk at all and anyone may add to the Chalk talk as s/he please. You can comment on other people's ideas simply by drawing a connecting line to the comment. It can also be very effective to say nothing at all except to put finger to lips in a gesture of silence and simply begin with #2.
2. The facilitator writes a relevant question in a circle on the board. Sample questions:
  - What did you learn today?
  - So What? or Now What?
  - What do you think about social responsibility and schooling?
  - How can we involve the community in the school?
  - How can we teach evidence informed?
  - What do you want to tell the school leaders?
  - What do you know about Slovenia?
  - Which protocols can you use for better organizing your teaching?
3. The facilitator either hands a piece of chalk to everyone, or places many pieces of chalk at the board and hands several pieces to people at random.
4. People write, as they feel moved. There are likely to be long silences—that is natural, so allow plenty of wait time before deciding it is over.

## References

National School Reform initiative

# What are clarifying and probing questions?

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

SRI, resource and protocol book, <http://www.schoolreforminitiative.org/>  
National School Reform Faculty Harmony Education Center [www.nsrffharmony.org](http://www.nsrffharmony.org)

## Purpose of the material

Participants:

- discover the difference between clarifying questions and probing questions;
- discover more about what probing questions are;
- get guidelines & suggestions to formulate probing questions;
- get a list of examples with probing questions.

## Material

### What are clarifying questions:

They are simple questions of fact. They clarify the dilemma and provide the nuts and bolts so that the participants can ask good probing questions and provide useful feedback.

#### Examples of clarifying questions:

- Is this what you said...?
- What resources were used for the project?
- Did I hear you say...?
- Did I understand you when you said...?
- What criteria did you use to...?
- Did I hear you correctly when you said...?
- Did I paraphrase what you said correctly?

### What are probing questions:

Probing questions are powerful, open questions that are intended to help the presenter think more deeply about the issue at hand. If a probing question doesn't have that effect, it is either a clarifying question or a recommendation.

#### A good probing question:

- Allows for multiple responses;
- Avoids yes/no responses;
- Empowers the person being asked the question to solve the problem or manage the dilemma (rather than deferring to someone with greater or different expertise)
- Stimulates reflective thinking by moving thinking from reaction to reflection;
- Encourages perspective taking;
- Challenges assumptions;
- Channels inquiry;
- Promises insights;
- Touches a deeper meaning;
- Creates a paradigm shift;
- Evokes more questions;
- Is concise;
- Prompts slow response.

**Suggestions:**

Since effective probing questions can be difficult to frame, we offer the following suggestions:

- Check to see if you have a ‘right’ answer in mind. If so, delete the judgment from the question, or don’t ask it;
- Refer to the presenter’s original question/focus point. What did he/she ask for your help with? Check your probing questions for relevance;
- Check to see if you are asserting your own agenda. If so, return to the presenter’s agenda;
- Sometimes a simple ‘why...?’ asked as an advocate for the presenter’s success can be very effective, as can several questions asked in a row;
- Try using verbs: ‘What do you fear? Want? Get? Assume? Expect?’
- Think about the concentric circles of comfort, risk and danger. Use these as a barometer. Don’t avoid risk, but don’t push the presenter into the ‘danger zone.’
- Think of probing questions as being on a continuum, from ‘recommendation’ to ‘most effective probing questions’ as a way to distinguish between suggestions, advice giving, and probing questions. Consider these questions from a consultancy, during which a teacher presented a dilemma about increasing students’ commitment to quality work:
  - Could you have the students use a rubric to assess their work?  
(recommendation re-stated as a question)
  - What would happen if students assessed the quality of their work themselves?  
(recommendation re-stated as a question)
  - Why should students be invested in doing quality work?  
(probing question)
  - What would have to change for students to work more for themselves and less for you?  
(more effective probing question)

**Possible probing questions:**

- Why do you think this is the case?
- What would have to change in order for...?
- What do you feel is right?
- What’s another way you might...?
- How is...different from...?
- What sort of an impact do you think...?
- When have you done/experienced something like this before? What does this remind you of?
- How did you decide/determine/conclude...?
- What is your hunch about...?
- What was your intention when...?
- How might your assumptions about...have influenced how you are thinking about...?
- What surprises you about...? Why are you surprised?
- What is the best thing that could happen?
- What do you need to ask to better understand?
- What do you assume to be true about...?
- What is the connection between...and...?
- What is the opposite were true? Then what?
- How do you feel when...? What might this tell you about...?
- What is the one thing you won’t compromise?
- What criteria do you use...?
- Do you think the problem is X, Y or something else?
- What evidence exists...?
- If you were X, how would you see this situation?
- If time, money were not an issue...?

# What? So what? Now what?

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

The School Reform Initiative website: <http://schoolreforminitiative.org>  
Developed by Gene Thompson-Grove, 2014; revised version 2012

## Purpose of the protocol

This protocol allows participants to connect to one another and to each other's work, while at the same time allowing all group members to get useful feedback. After establishing a preliminary version of an inquiry question or wondering for a practitioners inquiry, and the first personal check via the litmus test protocol that leads to a draft version, the protocol seeks to provide feedback on this question by the members of the PLC, leading to a "final" version.

## Materials

The materials come from the participants contribution: their particular inquiry question, in the draft version

## Time

40-45 minutes

## Roles

Facilitator/timekeeper (who also can participate); participants

## Process

1. Introduction: There is an overall introduction of the protocol goals and steps. The group is divided into groups of 4. All participants take a turn facilitating, and all participants present. The facilitator also gives feedback. 3 min for organising and explaining this.
2. Participants individually outline a current inquiry question of their PI: 3 min  
They answer 2 questions:
  - What question/challenge do I have?
  - So what, why is this important for me?

3. In rounds of 12 min:

- The first presenter explains their question/challenge, ending with a focus question. Participants in the group take notes, write questions. 2min
  - Group asks clarifying questions. 2 min
  - Individuals in the group talk amongst themselves, while the presenter listens into the conversation, taking notes and considering new insights and possible next steps. The presenter is silent during this step. The group takes up each of the following questions in some way, along with any other focused discussion the presenter has asked the group to have.
    - ‘What I heard the presenter say was...’
    - ‘Why this seems important to the presenter is...’
    - ‘What I wonder is...’ or ‘The questions this raises for me are...’
    - ‘What this means to me is...’
    - ‘What I might suggest is...’
- 5 min
- Reflection by the presenter to the group – Now what? This means, after this discussion, what are the final options and adaptations the presenter will do to his inquiry question or wondering. 3 min

Repeat for each participant in the group. (approximately 12 minutes per person)

## References

The School Reform Initiative website: <http://schoolreforminitiative.org>

# Why, Who, When, What, Where + How (5W+1H)

## **Problem space**

Describe your problem as thoroughly as possible with the method 5xW + 1H (what, who, when, why, where & how).

## **What is the problem?**

*Give a clear description of the problem:*

- *Is something going wrong?*
- *Is there something undesirable or unacceptable?*
- *Is something missing?*
- *Could anything be improved?*
- *Is there anything very successful and should be more widely implemented?*

## **Who is facing the problem?**

*Try to identify who is involved in the problem:*

- *Who are the stakeholders, the 'users'?*
- *How these stakeholders are related to the problem?*
- *How do these stakeholders experience the problem? What differences do they have?*

## **When does the problem occur?**

*Clearly indicate when the problem occurs.*

- *How often does the problem occurs?*
- *At what time does this problem arise?*



**Why is it a problem?**

*Make it clear why this problem should be solved.*

- *Are there certain standards or priorities that must be met?*
- *Why is the problem perceived as a problem?*
- *What is the use of solving the problem?*

**Where does the problem occur?**

*With this question you provide insight into the locations and situations where the problem occurs.*

- *In which rooms does the problem occur?*
- *In what situations does the problem occur?*

**How did the problem arise?**

*Indicate how the problem arose over time.*

- *What was the cause of the problem?*
- *What preceded the problem?*

**Capture benefits**

What do you hope the inquiry will deliver? When will you be happy/satisfied?

**Notes from discussion with your critical friends (group of peers in your PLC)**

**Now try to synthesize your problem in one question:**

# World Cafe

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

## Sources

<http://www.theworldcafe.com/> (22.4. 2016)  
pre-prepared questions used to direct discussions

## Purpose of the protocol

Efficient conversation is the core process that drives personal and professional life, the World Café is a method, a process, or technique which helps the PLCs to share the experience, learn from each other and also makes sure that everybody's voice is heard.

## Materials

Questions/issues/dilemmas the PLC deals with (prepared in advance)

## Time

60 min

## Roles

Facilitator and Participants

## Process

Steps:

1. The participants form the groups of five and sit at the tables. Each table is equipped with some pencils and paper and the question/dilemma the group will discuss.
2. Welcome and Introduction: The facilitator/ host begins with a warm welcome and an introduction to the World Café process, setting the context, explaining the rules of this protocol.
3. Small Group Rounds: The process begins with the first of three or more twenty minute rounds of conversation for the small group seated around a table. At the end of the twenty minutes, each member of the group moves to a different new table. They may or may not choose to leave one person as the "table host" for the next round, who welcomes the next group and briefly informs them in on what happened in the previous round. If there is no host, the previous group can leave the post-it notes with their opinion written on them.
4. Questions: each round is presented with a question specially designed for the specific context and desired purpose of the World Café. The same questions can be used for more than one round, or they can be built upon each other to focus the conversation or guide its direction.
5. Harvest: After the small groups (and/or in between rounds, as needed), individuals are invited to share insights or other results from their conversations with the rest of the large group.

# Zones of comfort

Adapted from LINPILCARE 2014-1-BE02-KA201-00432

A **comfort zone** is a psychological state in which things feel familiar to a person and they are at ease and in control of their environment, experiencing low levels of anxiety and stress. In this zone, a steady level of performance is possible ( Alasdair, 2009)

## Purpose of the protocol

To make people feel more comfortable in a given situation where they are challenged. To give them insight in their own and others' reactions in situations which are not always very familiar. To establish a wondering. To have a guideline for setting up rules for a professional learning group.

Each can determine his own zones. Communicating them is **a way to build trust among the group** members.

The protocol should be used in a compact way, i.e.

## Materials

Hint: if graphics are needed, many shapes are available on the internet.

## Time

15 - 20 MINUTES all together. If the goal is to establish a wondering or rules for the PLC, then more time is needed.

## Roles

Facilitator, pairs, whole group

### Facilitation:

There is an overall introduction of the protocol goals and steps. The facilitator also gives feedback at the very end of the protocol. The protocol should be used not too soon.

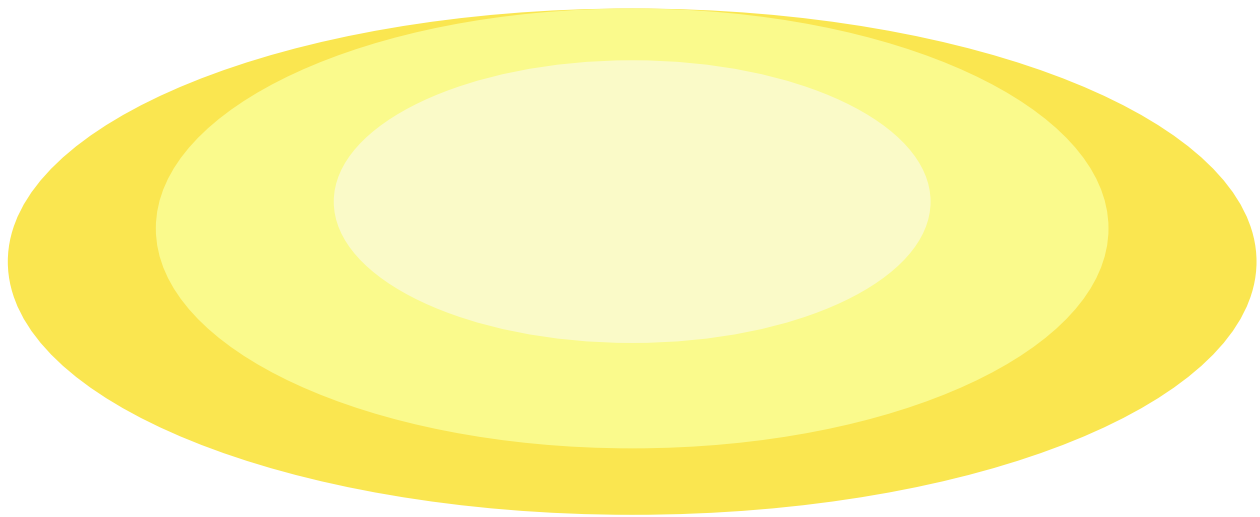
If the group of people know each other already (being colleagues for years already) then still it is a useful activity in view of building trust among the group members.

Whole group participates, group building activity. First phase is individual, after that sharing is done, and if the group is very large, some minor exchange is also needed. Do not force people in their Danger Zone!

## Process

The facilitator asks the participants:

1. Draw a diagram of concentric circles in the following manner: ( 6 min)
  - a. The middle circle is comfort, the second is risk, and the third is danger.
  - b. Consider the various aspects of your work. Think about the aspects that feel really comfortable to you, those that feel like there is some risk involved, but generally positive, and those aspects that you know get your hackles up, make you feel defensive, cloud your judgment, or make you want to retreat.
  - c. Decide on the size of each zone based on your consideration. Do you work a lot in your comfort zone, your risk zone? Do you work only a little in your danger zone? Make the size of the zones reflect the quantity (%) of time you work there.
  - d. Working in a PLC, in what zone would you situate this? Why?
  - e. Carrying out a practitioners' inquiry, in what zone would you situate this? Why?



2. ( 3 min) Think about the tasks, people and places that make up your professional life. Write each of these into the zone that best represents your sense of relative comfort, risk or danger.
3. ( 3 min ) Look at the tasks/people/places you put in the danger zone. Write a question for each of these beginning with, "How do I...?" These dilemmas can later be explored.
4. ( 5 min )Discuss among the group the answers each one of you gave.

## References

Alasdair A., K. White: "*From Comfort Zone to Performance Management*" [1]  
<https://www.nsrharmony.org/free-resources>, in particular  
[https://www.nsrharmony.org/system/files/protocols/zones\\_of\\_comfort\\_0.pdf](https://www.nsrharmony.org/system/files/protocols/zones_of_comfort_0.pdf)

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