Coaching Manual for Transferable Skills in SET Disciplines

Training the mindSET –
Improving and Internationalizing Skills Trainings for Doctoral Candidates

Contents

List of figures

I. Introduction

High quality supervision and coaching are instrumental for PhD candidates to be successful on their path to a doctoral degree. They rely strongly on competent and experienced colleagues and support staff to achieve the required academic level of their work to qualify for their degree. However, the evaluation of existing further education courses for doctoral candidates provides evidence that even high-qualitative and fully satisfying research training needs to be complemented by individual personal support and coaching in order to fully prepare the PhD candidates for their future work life, whether in academia, or in the private or the public sectors. While there is ample support for doctoral candidates with respect to the development of disciplinary knowledge and research competence, the same cannot be said about many crucial transferable skills.

The aim of the "Training the mindSET" initiative is to develop a common European core curriculum for transferable skills designed specifically for the SET (Science, Engineering, and technology) disciplines, covering such competencies as entrepreneurial thinking, leadership, communication, and organizational skills, including education in research ethics and good scientific practice. The mindSET project aims at establishing a template for such training. Eight training modules were chosen, and the four contributing universities have designed courses and run pilot testing. Each module is comprehensively described in the European core curriculum, and all are intended to be offered in support of existing PhD programmes, providing a firm grounding for different professional aspects of the PhD.

This manual on coaching PhD candidates in the SET disciplines is part of the handbook "Training the mindSET – Improving and Internationalizing Skills Trainings for Doctoral Candidates", presenting a curriculum in transferrable skills developed by the international mindSET project team. The manual is intended as a train-the-trainer-resource that discusses aspects of how to design and implement the different courses and modules. Some general guidelines are presented and discussed together with some reflections on what is meant by 'transferable skills', how adults learn, the characteristics of teaching, coaching, mentoring, and supervision and what distinguishes them from each other. Some practical general recommendations on teaching-learning activities for the modules are presented, based on the experiences from the pilot testing.

The target audience for the manual is any faculty and university staff that may function as a teacher or coach in the modules, such as subject teachers, coaches from the university's training centers, PhD supervisors, or peer doctoral candidates. The manual should work as an introduction to those who will contribute to the professionalization of the PhD education.

It should be noted that neither knowledge nor skills alone is sufficient to meet the challenges of real life. To be able to meet new challenges, or old challenges in new contexts, competence is required, and competence is based on the ability to apply knowledge and skills in contexts together with other core professional competencies, such as communication, collaboration, negotiation and management. It also requires the ability to put problems into contexts and reflect on possible consequences. It is these core professional competencies that "Training the mindSET – Improving and Internationalizing Skills Trainings for Doctoral Candidates" aims at supporting.

Finally, there are two aspects of the recommendations in this manual that should be kept firmly in mind. The first is that it is likely that much of what is said here may be self-evident to anybody trusted with running one of the modules, and the second is that nothing presented here should be considered as anything else than advice, which can be heeded or ignored according to the mindset of those responsible for the design and running of the modules. Hopefully, though, the manual may function as a mental checklist for what can be done, and for forming a basis for asking questions about how to

further develop the transferable skills of our future PhDs. Good advice is characterized as something that is worth reflecting upon in order to inspire changes of one's own.

II. About the Modules

Transferable skills.

As noted above, the mindSET project was initiated in order to contribute to the professionalization of the PhD, beyond an education and training for research. The format was chosen to be self-contained modules consisting of short courses focusing on specific desired skills, that would be easily combined and taken by the doctoral students during their PhD training. Transferable skills are often literally understood to be those skills that can be applied in a wide spectrum of circumstances and include problem solving skills (including analytical and critical reasoning, attention to both detail and wider context, as well as creative and lateral thinking), communication skills (including presenting and writing both for academic and general audiences, active listening, and applying for funding), and teamwork, management and leadership. Such skill sets should provide a valuable complement to doctoral competencies regardless of specialization, in academia as well as in the private or public sectors.

It should be pointed out that although a skill may have generic and transferable characteristics, all skills benefit from being learnt and mastered in a specific context before being practiced in a wider context. The challenge of so-called domain transfer of learning has its origins in that what is learnt in one context is often surprisingly difficult to apply in another context.

Also, skills training without anchoring in some appropriate theoretical framework runs the *risk* of so-called blind practice, where you know what to do and how, but lack the background framework to know why, making it harder to make decisions about *when* to apply the skills. So, the challenge is to strike a fruitful balance between theoretical scaffolding and practical exercises.

The modules were chosen to address feedback from stakeholders from the private and public sector on desired skill sets and competencies for the doctoral candidates and should effectively support the employability of doctoral candidates in SET disciplines. The stakeholder feedback covered such aspects as:

- Complex problem-solving and analytical skills, individually and in teams.
- Adaptability, ability to change and flexibility
- Relational and social skills – being a team player or working in teams
- Digital skills, both specific and general
- Autonomy, effective self-organization, and communication skills,
- Trans- and interdisciplinary thinking
- Leadership potential – motivation and commitment
- Negotiation skills

In order to address the stakeholder feedback, the following modules were chosen. Each module consists of one or more courses and addresses different aspects of the stakeholder feedback.

Nr.	Modules / Courses	Number of courses	ECTS points (recommended)
0	Research Methods and Career Planning	2	2
I	Research Ethics and Good Scientific Practice	5	10
II	Acquiring Third-party Funds and Projects	4	5
III	Project Management	6	7
IV	Cooperation, Communication and Presentation	4	4
V	Leadership and Management	6	10
VI	Publication and Promotion	4	4,5
VII	Innovation and Entrepreneurial Thinking	5	7,5
VIII	Teaching Methods	5	8
Total		50	58

Fig. 1. The task of developing the modules and run pilot versions of the courses was shared between the four collaborating universities. Modules II and VIII were developed at TU Berlin; modules I and V at Politecnico Milan; modules VI and VII at NTNU; and modules III and IV at WUT.

In addition to a basic module on Research Methods and Career Planning, there are eight modules in total, designed to address different aspects of professionally relevant training in transferable skills for PhD students. It should be noted that the transferable skills discussed here are relevant skills not only for career choices in the public or private sectors but are also in support of doctoral education itself. It is likely that not all PhD students have a need or desire to follow all eight modules, and even if they would want to there is hardly time within the tight timeframe of the doctoral education. The design of the modules is extensively described in the European core curriculum of Training the mindSET – here we offer a short description of the modules, based on the pilot courses offered so far. A short motivation, an outline of activities, and some samples of learning outcomes is presented here. It should be noted that neither modules nor courses are definitive, but rather a basis for further development. The reader should consult the Training manual for a more comprehensive description of the courses, including the learning outcome descriptions, teaching-learning designs, and assessment tasks.

1. Research Ethics and Good Scientific Practice

Motivation for a module on Research Ethics and Good Scientific Practice

PhD candidates need to be aware of and apply central principles of good scientific practice. They must also be able to recognize, analyze, and assess potential ethical and social aspects and issues inherent in everyday research, as well as in the development and the consequences of the use of technology.

The module uses case studies as a basis for discussions to illustrate different aspects of ethical issues, such as responsibility in technological development, and good scientific practice. Good scientific practice, academic misconduct, conducts in the ethics of research, informed consent, and ethics commissions and committees are all discussed using examples and case studies. Also, the major ethical frameworks are presented and discussed, providing the basis for introducing ethical reasoning and the most widespread fallacies in ethical reasoning in general, and in scientific and technological reasoning in particular. Finally, the issue of social responsibility of researchers and research institutions is raised.

Does your research activity lead to a better world? Are individual researchers or research institutions bound by a social contract to contribute to the common good?

Learning outcomes include

After the finished module, the student will be able to discuss and reflect on

- basic values and rules for conducting responsible science,
- good scientific practice, publication ethics, and academic misconduct,
- responsibility in design and implementation of research,
- the social impact of research, development and the consequences of the use of technology.

2. Acquiring Third-party Funds and Projects

Motivation for a module on Acquiring Third-party Funds and Projects

While third-party funding is essential for financing many projects, both in industry and in research, a good project idea does not necessarily result in a successful project proposal. There are many aspects of the proposal submission process that determine whether a project proposal will be funded or rejected. The better these aspects can be addressed in an application, the better are the prospects to attract attention among competing proposals, and the more likely it is that the project will be funded.

The module aims at providing an understanding of available public and private research and development funding, the criteria and expectations of the funding authorities, and how to meet these in writing applications, contributing to the development of the students' evaluative judgement in writing funding applications.

Learning Outcomes include

After the finished module, the student will be able to

- find and identify suitable funding opportunities for their research projects,
- write a funding proposal for a research project based on an overview and understanding of both public and private research funding for research and development projects,
- meet the criteria for a high-quality proposal and the formal requirements and expectations of the funding authority, considering marketing aspects and how to write a persuasive project summary,
- draw up a budget plan.

3. Project Management

Motivation for a module on Project management:

Developing competency in time and project management is essential to the future of PhD students, whatever career path they choose. Time, self- and project management are major challenges in any PhD research project. The PhD thesis is the end product of a research project that can be improved by learning how to manage and organize the project work, and when to ask for assistance and collaboration.

In the pilot, two courses have been given in this module: "Self- and Time Management", and "Project Management Fundamentals". These courses aim at developing management competency in support both of research project quality and the learning outcomes for PhD students.

The management of research and development requires much more than the short-term planning of activities such as performing experiments or studies and analyzing them. Project management skills are highly useful in anticipating, avoiding and handling the impact of any organizational challenges that may occur during a PhD research project. The application of project management tools in PhD research

dramatically increases its efficiency and is also a desired competency for a post-doctoral career in academia or business.

The courses are directly applied to the PhD research project, making them immediately relevant and serve as a very valuable contribution to the doctoral studies.

Learning outcomes include
After the finished courses, the student will be able to

- apply methods for self- and time management, relevant for academia, and the public and private sectors,
- develop strategies for interactions with others,
- apply project management tools to their own research project, such as identifying stakeholders, creating a budget, rate risks and opportunities, and how to use open software to organize a research project.

4. Cooperation, Communication and Presentation

Motivation for a module on Cooperation, Communication and Presentation:

Cooperation, communication, and presentation skills are core competencies expected from all PhDs, regardless of whether they leave academia or whether they pursue an academic career. Present day research and development projects are highly dependent at all stages on high quality cooperation, communication and presentation skills. Such skills need to be honed at every stage during the doctorate studies, up to and including the final exams and the thesis defense.

In the pilot, two courses have been given in this module: "Communication and Presentation - in Business Settings", and "Group Dynamics and Conflict Management". The first one aims at developing and practicing the communication and presentation skills in business settings – presenting ideas, or products, services, or technological solutions in a comprehensible and attractive manner to different types of audience. The course on "Group Dynamics and Conflict Management" places an emphasis on leadership issues in group processes, and deals with the basis and origins of conflicts, conflict models and types of conflicts, escalation, mediation, and conflict resolution.

Learning Outcomes include
After the finished module, the student will be able to

- deliver a message in specific circumstances to specific stakeholders or group of stakeholders,
- identify and analyze factors driving group dynamics, based on understanding of the importance of roles, norms and structure in groups,
- identify sources of conflicts and address how to solve conflicts constructively.

5. Leadership and Management

Motivation for a module on Leadership and Management

It is highly likely that PhD students will be working in a leading position in their future careers, whether they work in academia or business. The leading position does not have to be formal to benefit from an understanding of the nature of leadership and management.

The module is intended to provide a basis for understanding different leadership approaches and styles. Leadership is a complex topic investigated from many different perspectives. Traditional and innovative leadership styles (e.g., democratic, autocratic, transformational) are discussed, and

transactional and transformational leadership models are contrasted. The importance of trust in teamwork activities is presented and discussed, and feedback as a tool for building trust is practiced.

Learning outcomes include
After the finished module, the student will be able to

- reflect on traits and skills of a good leader and leadership processes,
- reflect on leadership culture, ethical standards and personal values,
- discuss the practical implications of successful leadership in different professional contexts and situations
- use feedback to build trust.

6. Publication and Promotion

Motivation for the module Publication and Promotion

At the heart of all scientific endeavor lies the reporting of research problems, their study, outcome, analysis and conclusion in the context of the findings of others. In the pilot, two courses have been given in this module: "Academic and Scientific Research Writing", and "Pitching Your Research to Key Audiences".

In Academic and Scientific Research Writing, insights into the writing process are offered, covering general principles and individual preferences. Writing is a dynamic and complex process, and very individual. Typical features of clear, logically structured, coherent academic writing, and the structure and style of relevant genres (abstract, one-liner, scientific research paper) are discussed.

"Pitching your Research to Key Audiences" is an introduction to the communication of research to different audiences, and to help prepare a pitch of one's own research. The course covers the strategic planning of successful pitches, deciding on the topic and core message, identifying the target group(s) and how to connect with the audience. The structure, content and reasoning of the core message is discussed together with some design and rhetorical elements.

Learning Outcomes include
After finishing the two courses described above, the student will be able to

- produce a clear, coherent and well-structured academic text in English,
- apply a knowledge of structure, style and language of Scientific Research Writing in English
- give and receive effective feedback

7. Innovation and Entrepreneurial Thinking (NTNU)

Motivation for a module on Innovation and Entrepreneurial Thinking

This module aims at developing the entrepreneurial mindset of the PhD student. How can research findings be leveraged beyond publication? Translating research outcomes to practice requires an entrepreneurial mindset. The entrepreneurial mindset revolves around sensing opportunities, acting through several developing alternative ideas or solutions, and mobilizing resources to develop these ideas or solutions to viable enterprises. These enterprises may be business ideas, research opportunities, or initiatives for the public good.

The module focuses on research-based entrepreneurship, and presents the academic cornerstones of entrepreneurship, together with the skills and tools needed to implement an innovation.

Learning outcomes include

After the finished module, the student will be able to

- communicate research results to non-researchers, such as investors, partners, managers, and policy makers – by focusing on possible practitioner advantages from the results,
- discuss opportunities and pitfalls of Intellectual Property (IP) from research results, and how different Intellectual Property Rights (IPR) can be secured and developed,
- present a pitch for an enterprise venture,
- reflect on the business mindset, based on an initial understanding of important aspects of a business model.

8. Teaching Methods

Motivation for a module on Teaching Methods

The module aims at providing a foundation for university pedagogics. In conventional lectures, the didactic content of a course is often presented to students in a classroom or auditorium. The format is far from optimal for learning as it struggles with limited attention spans and retention rates. For some time, other approaches to the design of teaching-learning activities have been tried, tested and found to be more conducive to learning. These approaches have in common that they are student centered and encourage students to be active at all stages, enhancing their learning processes. In addition, the use of digital media of different kinds opens up possibilities both for providing access to the learning material and allowing the students to master the use of digital tools.

Learning Outcomes include

After the finished module, the student will be able to

- explain features of some common in-use pedagogical models and frameworks, such as Intended Learning Outcomes, Constructive alignment, the Bloom and SOLO Knowledge taxonomies, as well as cognitive load theory,
- apply some student active learning designs in their teaching activities, explain the benefits of using such approaches to their students in turn and be aware of any limitations the approaches may have,
- produce podcasts and videos for use as learning materials or as presentation tools,
- reflect upon the challenges and efficacies of their own teaching activities.

III. General practical recommendations

The modules have been designed and implemented using different student-centered learning activities, to varying degrees. All the modules consist of short courses and aim at developing transferable skills that support practical and analytical competencies. Theoretical background is necessary for framing the practices, but it is the practical application of principles and methods as well as the use of tools that form the basis of reflection and learning.

Common for all aspects of doctoral education are some basic features of how adults learn most efficiently. In fact, these aspects are true also for undergraduate students but are often seen as personnel intensive and costly. Nevertheless, the teaching-learning design of university education needs to increasingly reflect the way adults learn. Education should be designed to foster self-regulation, evaluative judgment, and self-motivation as early as possible, and should start when the students enter higher education.

Adults learn most effectively when they are involved in the planning, implementation, assessment and evaluation of their own learning. They also need to become self-regulated in their learning and be fully aware of what their goals are. It is also highly desirable for them to apply learning as immediately as possible, in contexts where there are concrete and specific needs to know. The contexts should be real life, and the analysis of whatever outcome there is benefits from being discussed, in feedback sessions between students, and in reflection discussions with teachers, coaches or mentors. All of the above contributes to establishing self-motivation which may well be the single most important driver for learning among adults.

Each module will continue to evolve over time, as experience is shared and modules are woven into a coherent system, where the modules support each other and the doctoral education.

Learning outcomes
What are the concrete practical skills and competencies that the doctoral students should develop in the module?

The first issue is deciding on the intended learning outcomes for the module. For each module and course within the module, there are specific skills that are targeted.

These should be formulated as practical skills acquired by the participants as a result of taking part in the course. The modules are not intended as introduction to theoretical frameworks, but as contributions to the skill sets that support the application of the desired knowledge and competence in real situations.

One of the most important learning outcomes is that students will be able to make evaluative judgments, particularly about what they have mastered so far, and what they still need to learn more about. To be able to make evaluative judgments about the quality of one's learning requires ample opportunities to discuss and apply criteria for different levels and types of quality. Such exercises also need to be accompanied by opportunities to both give and receive feedback, both between students, and between students and teachers (or coaches, or mentors).

Overall design
Considering that the modules are short – well short of 100 hours of total work – and focus on skills training, it is advantageous if the students are given preparatory tasks to deliver before the first meeting in order to start the learning process as soon as possible. The tasks may be short essays, finding the answers to a more or less challenging set of questions, or anything else that is appropriate for the course at hand. They may be given texts to read, reflections to write, or even tasks to solve before the first meeting. With only limited time at hand the better prepared the participants are, the more they will be able to benefit from the training. If preparatory work is appropriate, what it entails needs to be decided for each unit and needs to be at the discretion of the responsible staff, based on the intended learning outcomes, and any previous experience of similar courses.

It is recommended that the modules should be characterized by some of the following design features. Not all features are equally desirable in all modules, and some course units within the modules are too short to incorporate more than a few. There is also ample room for adapting and modifying these features to suit the desired learning outcomes. The final decision on design choices needs to rest with those responsible for running the course or module.

- Preparatory work
  - Considering the short duration and specific skills to learn it is desirable that the students come prepared. The preparation may consist of reading up on theoretical background or the context where the skills in question are used, as suggested above.
- Introductory session
  - Start meeting the students, letting them meet each other, discuss the learning outcomes and the learning activities, present appropriate theoretical models or frameworks.
- Student centered learning activities, such as for example
  - *Short* introductory presentations interweaved with think-pair-share exercises and group discussions. The group discussions in turn are brought back to discussions in plenum with summarizing comments by the teachers. This helps in establishing a shared understanding of frameworks and contexts and in high-lighting challenges or unforeseen consequences.
  - Use of peer-feedback can help in developing evaluative judgment. An introductory discussion of criteria for what characterizes good work is often appropriate. Feedback exercises where the students critique each other constructively according to the agreed upon criteria, coupled with instructor feedback on the quality and character of the participants' peer-feedback help to establish an ability to judge the quality of the work. This is a necessary aspect of continued life-long learning.
  - There is a rich repertoire of student-centered learning activities that can be used, such as problem-oriented small group learning, task-based activities, test-teach-test procedures, and Socratic questioning, to name a few. For further inspiration, the reader is referred to IO1 section IV.3 Teaching Methods, where a list of teaching-learning activities is presented.
- Using examples, real world case-studies, and the participants' own experiences for discussions and analysis based on the presented theory frameworks help to anchor the application of the desired skills in context.
- Concluding session where the outcome of the students' work during the course is presented and discussed. The outcome can be a group or individual effort, such as a written report or an oral presentation, possibly both.

It is good practice and advice to use varied approaches for the different courses in a module, and for different modules. To this end, it is recommended that those responsible for the courses and modules meet, present and discuss their designs and experiences with each other and the supervisors involved in the PhD-students doctoral education.

Assessment

It is recommended that the assessment for these activities includes a tangible deliverable, e.g., a presentation, an essay, a report, and that it is presented and discussed between students and coaches. In addition, a short individual reflection essay, where the students write about what they have learnt and what challenges they face, will help the students to retain what they have experienced and learnt and reflect on how to make good use of their newly acquired skills. The concluding session should mark the end of the course and module, except for a possible reflection essay. Avoid post-meeting group tasks as they make students dependent on each other for completion of the module or course unit.

The experiences from the pilots are encouraging. There is clearly an interest among doctoral students for training in the transferable skills chosen for the modules. Also, the modules have been run with a clear objective towards practical skills training, and not merely information and learning about theory and frameworks within the subject areas. Still, the modules and the courses can be further developed and should be adapted to the local needs of those trainers and institutions who wish to apply the curriculum in their own organization.

III.1 On-line vs. On-site teaching-learning activities

Due to the onset of the Covid-19 pandemic, the mindSET project plans for arranging the courses had to be adapted to on-line learning environments on short notice. Circumstances forced the project team to explore the possibilities of on-line learning to an extent that was unlikely to have taken place otherwise.

On-line teaching has some advantages over on-site teaching, most obviously in that there is no travel time, and very small carbon footprints. There is a strong argument to be made that we need to increase the use of on-line meetings and work-forms in the future for those very reasons. The challenges we all have met during the pandemic arise partly from abandoning the familiar in favour of something new. In the on-line formats, planning activities are more demanding. For instance, it is harder to discreetly observe from afar if somebody struggles with a task, or when to interrupt a session to address all. Consequently, all usual teaching-learning activities benefit from thinking through to arrive at new protocols in place of what we are accustomed to.

On-site teaching-learning activities benefit relations building, communication, small talk, and networking, mostly because we are used to work and socialize face to face, side by side. Also, spending time away from home, as was planned for the pilots, increases overall interactions beyond the teaching-learning sessions. This allows for getting to know each other informally, immersing the participants in small talk and discussions of topics outside of the core scope of the course and exploring new ideas. But a course that is held exclusively on-site with participants that travel far will also be limited in terms of what can be achieved in a short time. On-site, concentrated courses, also lead to much stronger commitment from the participants to finish the course.

It is recommended that when implementing the modules, these are designed in such a way that they can be organized both on-site and on-line, and that the teaching-learning activities can be run irrespective of mode, albeit with some modifications.

IV. About teaching, coaching, mentoring, and supervising

There are important distinctions between teaching, coaching, mentoring, and supervising, even though these are vague and the actions clearly overlapping. There are quite a few definitions to be found in the literature, made necessary by a desire to characterize and analyze these activities. A short reflection on the subject is presented here.

Definitions of teaching, coaching and mentoring are many and overlapping. At first glance, teaching and coaching are concerned about the student's learning, while mentoring is about initiating or driving change in other persons by being a role model, and supervision a responsibility for supervisor, PhD student and institution alike, which often includes different aspects of teaching, coaching, and mentoring.

Teaching is most often used to support the learning of theory, theoretical frameworks and models. When designed as a student-centered learning activity, it is likely to engage students in applying theoretical frameworks and models to measurement, calculation or computation, in order to analyze data and make judgments about the results.

Higher education teaching at the graduate level, as at the undergraduate level, is much more about learning the features of complex theoretical frameworks, and how theory can be applied in analysis and discussion of studied phenomena.
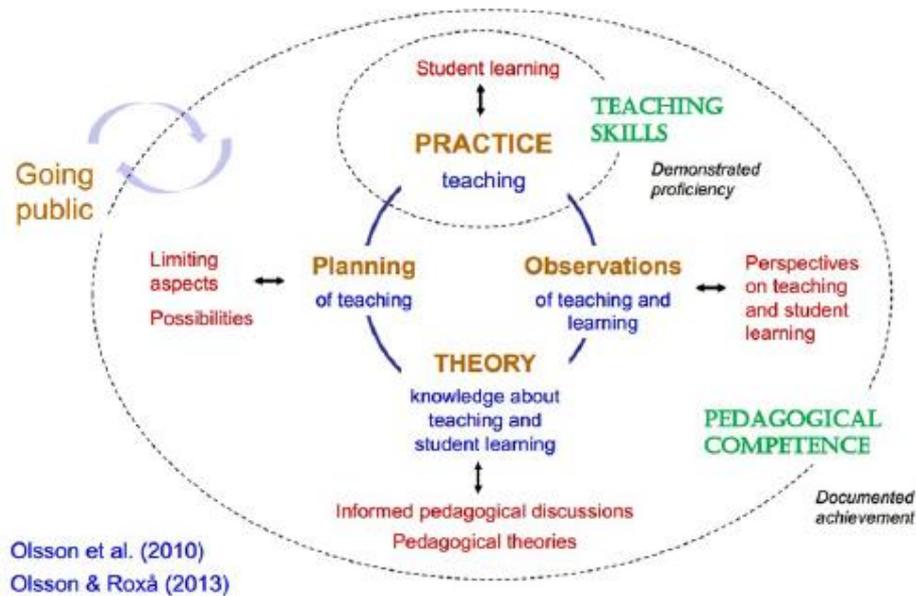
Fig. 2. A model for the dual development cycles of student-learning (practice) and the practitioner's pedagogical competence. *(From Pedagogical Competence – A development perspective from Lund University. / Olsson, Thomas; Mårtensson, Katarina; Roxå, Torgny. A Swedish Perspective on Pedagogical Competence. ed. / Åsa Ryegård; Thomas Olsson; Karin Apelgren. Division for Development of Teaching and Learning, Uppsala University, 2010. p. 121-132.)*

A highly useful model for the development of pedagogical competence was developed by Olsson, Mårtensson, and Roxå [Fig. 2]. They offer a model for the continuing development of the teacher's pedagogical competence – the blue central circle of the figure. At the top, we find the teacher's practice where the students engage in learning. Here, teaching skills evolve over time, and the proficiency of the teacher can be demonstrated. To the right is illustrated that the teacher observes effect and consequences of the teaching practice and put this in the perspective of what is known about student learning and teaching. At the bottom is shown that the teacher puts experiences and observations from the practice into the perspective of pedagogical theories and frameworks and engages in informed pedagogical discussions. Finally, to the left, the model shows the planning of the next iteration of practice, considering the limitations and possibilities at hand. All of the above describe a teacher's pedagogical competence as something far more than solely the practical aspect of teaching classes. The model is based on the idea of Scholarship of Teaching and Learning and offers a useful model for discussing the context of teaching. At the heart lies the idea that the development of teaching-learning activities aimed at strengthening learning requires that the teacher also learns in the process.

Coaching has its origins in sports in the first half of the 20th century and has been increasingly applied to any activity where practical skills need to be acquired and mastered over the past half century. It has evolved from its origins in sports to a structured and highly interactive coaching dialogue between coach and coachee. Since the beginning of the 90s, it has become increasingly important in business and organization. The central task of the coach is to help and support the coachee to develop the skills or competencies they are aiming for. Presently, the understanding and practice of coaching has evolved to a deeply engaged dialogue format, where coach and coachee engage a continuing and transformative dialogue between themselves where they reflect upon the process and the progress.

One definition states that coaching aims at unlocking people's potential to maximize their own performance. It is about helping people to learn rather than teaching them. Coaching deals to a large extent with stimulating the coachee's self-reflection capacity, which is the primary goal for the

coaching dialogue. The coaching process identifies strengths and shortcomings, offers solutions for overcoming problems and developing new strategies for handling different situations. The coach is someone who acts as a facilitator for the coachee's development.

The coach does not have to be an expert in the particular field, and stands slightly aside of the task at hand, while simultaneously engaging in the learning and development of the coachee. The focus of the coach is the learning of the coachee, and in many ways it is a much closer relationship than that of teacher and student.

To be a **mentor** is mostly understood to be a role model. While the coach provides guidance to the coachee about performances, mentors share their knowledge, skills and experience, and invite the mentee to take part in their reasoning, in order to support the mentee to develop and grow. Also, coaching is mostly non-directive and performance driven, while mentoring tends to be development driven. While the coach need not be an expert in the precise field, that is desired of the mentor. The mentor's expertise needs to be sufficiently close to the field the mentee is developing skills and competence in. Mentoring is also often less structured than coaching.

Clearly, the differences between teaching, coaching and mentoring are vague, and there is considerable overlap between what characterizes them. It is rare that there is full agreement between different people as to what the differences and similarities are. What is important though is that there is a shared understanding between the student and the person who is doing the teaching, coaching, or mentoring with respect to expectations, process, and goals.

Supervision, finally, borrow characteristics from all three - teaching, coaching and mentoring - depending on the circumstances, such as which phase the doctoral student happens to be in. Supervising doctoral candidates is a challenging and complex task that covers many different teaching-learning activities, that may include both coaching and mentoring at different stages and not always by the main supervisor. Initially, a supervisor may, to some degree, instruct and evaluate the work in a way that has more to do with work supervision than with any teaching-learning scenario, but throughout the doctoral project the character of the supervision needs to change and evolve, allowing for the PhD-students' development and growth.

The transferable skills modules in the mindSET project offer support to the PhD students already during their doctoral projects. As the skills modules co-exist and interact with the supervision, it is recommended to bring in aspects of the doctoral project into the teaching-learning activities of the modules. Considering the importance of supervision for the PhD student, it may therefore be worthwhile to provide an additional framework for discussing PhD supervision.

V. A model for thinking about PhD supervision

As the modern doctorate training in SET disciplines to a large extent has changed from the apprenticeship model to a structured graduate school model, the modern doctorate is no longer exclusively a training to become a researcher. Post-graduate education has evolved to become a professional education where a broader set of competencies is desired by all stakeholders. The stakeholders can be seen to be future employers, the PhD students themselves, universities and research institutes, as well as society at large. For PhD students to be able to employ acquired skills and knowledge, they need to develop competencies that go beyond traditional post-graduate education. This transformation of the aim and scope of doctoral studies has evolved in parallel with changes in the approaches to supervision and coaching.

We have chosen the framework developed by Dr. Anne Lee to describe our recommended supervision techniques. Lee's framework articulates different aspects of PhD education and suggests five complementary approaches to PhD supervision. The eight modules developed in the mindSET project can all be understood to belong to different aspects of this framework, and the modules can be mapped against Lee's framework providing an understanding of which aspects of the PhD education the modules address.

The five approaches to supervision are categorized as Functional, Enculturation, Critical Thinking, Emancipation, and Relationship Development and describe to what extent and level of detail the supervisor takes control of the process and what capabilities of the candidate they strive to cultivate (see Fig. 3). The questions as to what the most suitable approaches are will change over the course of the education process as well as depend on the maturity and personal skills of the candidate. The individual supervisors also tend to prefer some approaches over others, thus building awareness and knowledge about the different supervision techniques and their function areas is essential in a train-the-trainers manual.

	Functional	**Encultura-tion**	**Critical thinking**	**Emancipation**	**Relationship Development**
Supervisor's activity	Rational progression through tasks Negotiated order	Gatekeeping Master to apprentice	Evaluation Challenge	Mentoring, supporting, constructivism	Supervising by experience, developing a relationship
Supervisor's knowledge & skills	Directing, Project management	Diagnosis of deficiencies, coaching	Argument Analysis	Facilitation Reflection	Managing conflict Emotional Intelligence
Possible student reaction	Organised Obedience Negotiation skills	Role modelling Apprentice-ship	Constant inquiry, fight or flight	Personal growth, reframing	A good team member Emotional intelligence

Fig. 3. After Anne Lee, ("How are doctoral students supervised? Concepts of doctoral research supervision." (Anne Lee, Studies in Higher Education, Vol. 33, No. 3, June 2008, 267-281).

While it can be difficult to separate the approaches in terms of supervisor activities themselves, the primary difference between the approaches can be found in the intention of the activities, as in what skills you are aiming at developing by the approach.

- The Functional approach is when the supervisor takes control of the process and tasks to be completed, sets clear and strict deadlines towards reaching a goal or submission, setting up milestone meetings and is very explicit on expectations. The student will do as told and reaching the goal is very likely. It is mechanical, rational and goal oriented.
- In the Enculturation approach, the idea is to cultivate the student to become a member of the academic society, to teach the students to think like a specialist in the specific academic discipline and to grow their network among their peers.
- Critical thinking is a fundamental skill for academics, and this approach aims at training students in asking fundamental questions like "What," "Why" and "How," training them in reflecting reasoning, developing argumentation skills, debating a topic. This is critical in training the students to become independent researchers trusting their own expertise.
- Emancipation refers to the process of maturing and becoming an adult. The eye is not on the target, but rather on the process. The students must learn to acknowledge and express why they

want to take a PhD, accepting the terms and the hard work, accepting the responsibility by finding their inner motivation.

- The final approach to supervision is Relationship development. This approach is about developing the emotional intelligence of the candidate. By supervisors taking more personal interest in the candidate and sharing their own experience, giving pastoral support, the candidates will develop empathy and relational skills vital for becoming a good and supporting team member, managing conflicts and building a healthy work environment.

Each of these approaches is useful in teaching the students specific skills and competencies, but to build a complete researcher we anticipate that all of them should be applied at some point over the course of the doctoral training. When used with flexibility, this framework can be a problem-solving tool, it can be a basis for discussion with co-supervisors to apply blended approaches or other colleagues to share best practices and assess your own practice and performance as a supervisor. It is also a helpful mechanism to understand the expectations of the student and what the students' needs are during the course of the training.

Further to Dr. Anne Lee's framework for supervision, we have cross referenced the five approaches to what kinds of skills the different modules of the MindSET curriculum are aiming at.

	Functional	Enculturation	Critical thinking	Emancipation	Relationship development
Research Ethics and Good Scientific Practice	–	STRONG	STRONG	–	–
Acquiring Third-party Funds and Projects	STRONG	STRONG	–	–	weak
Project Management	STRONG	–	–	–	STRONG
Cooperation, communication and presentation	weak	STRONG	STRONG	–	STRONG
Leadership and Management	STRONG	–	–	–	STRONG
Publication and Promotion	–	weak	STRONG	weak	–
Innovation and Entrepreneurial Mindset	weak	STRONG	STRONG	STRONG	STRONG
Teaching Methods	–	STRONG	STRONG	–	weak

Fig. 4. Mapping the modules against the dimensions in Lee's framework, indicating how well the different modules couple with the aspects in Anne Lee's framework. Dark green color couples strongly. It is recommended that those involved perform their own analysis of how the modules and aspects couple.

VI. Concluding remarks

The intention of the coaching manual for transferable skills modules for the SET disciplines is to point to the fact that even high-qualitative and fully satisfying training is not sufficient without the complementation by individual personal support and coaching. The manual can be used by all European universities and beyond providing SET disciplines without or with little adaptation to frame conditions. Which design and guidelines to be followed are to be chosen depending on the desired learning outcomes, the chosen activities, and choices made by the institutions and teachers responsible for the courses.

This train-the-trainer-resource has discussed aspects of how to design and implement the different modules and courses. General guidelines are presented and discussed together with some reflections on what is meant by "transferable skills", how adults learn, the characteristics of teaching, coaching, mentoring, and supervision and what distinguishes them from each other. It is important that there is a shared understanding between the student and the person who is doing the teaching, coaching or mentoring with respect to expectations, process, and goals.

All the Transferable skills modules consist of shorter courses and aim at developing transferable skills that support practical and analytical competencies. It is important that course descriptions have concrete and concise learning outcomes. It is vital that the coach invites the candidate to reflect on the motivation for taking the course.

Theoretical background is necessary for framing the practices, but it is the practical application of principles, methods and the use of tools that forms the basis of reflection and learning. It is recommended that learning outcomes are formulated as practical skills acquired by the participants as a result of taking part in the course. In order to achieve this, it is essential that students apply their own research projects as the basis for the assignments given in the courses.

Assessments typically focus on PhD students' experience related to learning objectives, motivation, and benefit of learning objects. It is recommended to challenge the students' reflection of learning and self-evaluation that put a focus on learning, acquiring competence and the development of new skills.

The development and practical testing of these Learning-Training-Teaching events shows to be relevant for the introduction of Transferable Skills in doctoral education. It has been tested In-Real-Life format and as digital courses. We may conclude that international collaboration, the students' and coaches' learning environment, works well in both forms.

Since Covid-19 stroke in March 2020, universities all over the world have gained vast experience in running online training courses. Students alike have experienced many online sessions of very diverse quality. The academic world has faced a game-changer in how training is offered in the future. New digital tools will be applied, and courses will be prepared for hybrid participation.

The activities in this project may enhance learning inside and outside academia and create further skills necessary for improved doctoral education and benefit for other stakeholders. All for the development and utilisation of science and technology, for the benefit of society.

Links to on-line resources

All outputs like tutorials, European training manual, European core curriculum, and the competence self-assessment tool can be found on our project platform.

For the tutorials, please go to: http://www.mindset-project.eu/results/webinars/
For the European training manual for transferable skills in SET disciplines, go to: http://www.mindset-project.eu/results/training-material/
The competence self-assessment tool can be retrieved here: http://www.mindset-project.eu/results/self-assessment/
The European core curriculum is available at: http://www.mindset-project.eu/results/curriculum/

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