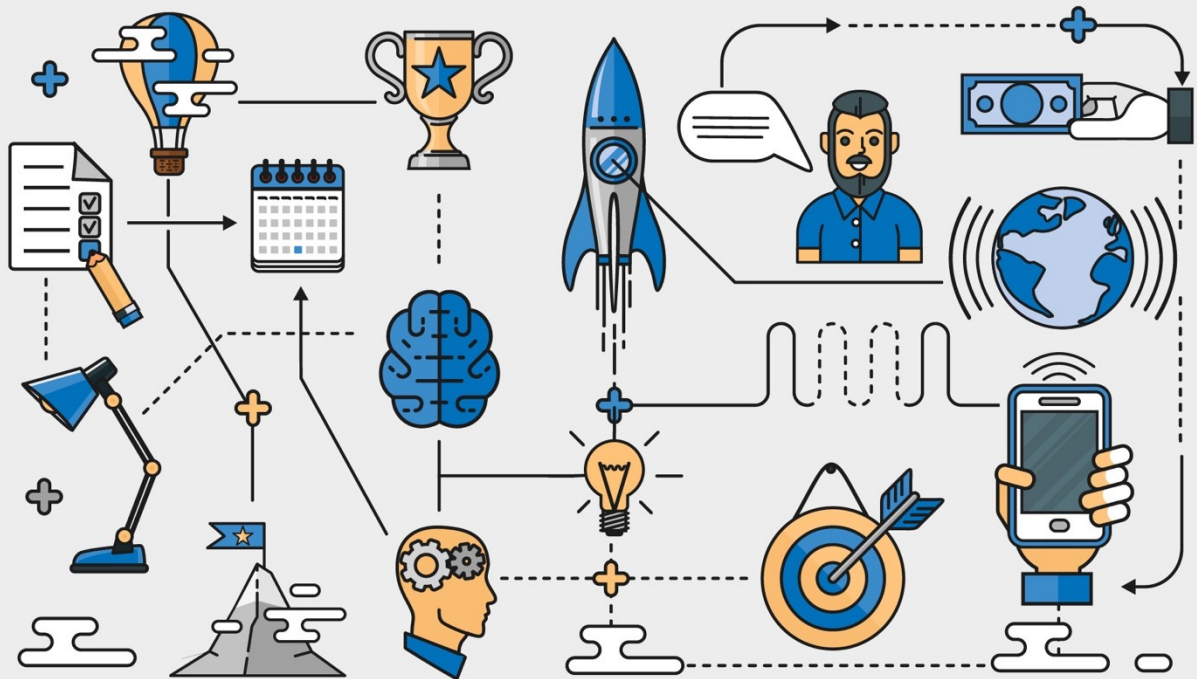




InnovatiVET

INTELLECTUAL OUTPUT 3 - TOOLKIT CREATIVE PROBLEM SOLVING AND DESIGN THINKING



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CONTENTS

What is it about?	5
1. CHAPTER 1 - CPS and Design Thinking in Education across Europe.....	6
1.1. THE IMPORTANCE OF PROBLEM SOLVING IN THE EDUCATIONAL SYSTEM	6
1.2. CREATIVE PROBLEM SOLVING AND DESIGN THINKING - EUROPEAN COMMISSION.....	6
1.3. CONTEXTS AND CASES IN PROJECT PARTNERS' COUNTRIES	7
1.3.1. Creative Problem Solving and Design Thinking in Finland	7
1.3.2. Creative Problem Solving and Design Thinking in Denmark.....	10
1.3.3. Creative Problem Solving and Design Thinking in Italy.....	14
1.3.4. Creative Problem Solving and Design Thinking in United Kingdom	16
1.3.5. Creative Problem Solving and Design Thinking in Slovenia.....	18
CASE: Project "GS1 Slovenia and open curriculum"	19
CASE: VET system for professional qualification at School Center Velenje	20
COMPETENCES.....	21
2. CHAPTER 2 - CPS METHODOLOGY and PEDAGOGY FOR VET.....	23
2.1. What is CPS methodology?.....	23
2.2. A CPS framework.....	24
2.3. Convergent and divergent thinking - a pedagogical approach for classrooms	25
2.4. The importance of the creativity in VET.....	26
2.5. A real challenge: implement creativity in vocational education and training	27
2.6. Experiments:	28
3. CHAPTER 3: Design Thinking METHODOLOGY and PEDAGOGY FOR VET	29
3.1. What is Design Thinking?	29
3.2. The importance of Design Thinking in VET	30
3.3. Design Thinking Frameworks.....	30
3.4. Challenges of implementing Design Thinking in the classroom.....	31
3.5. Experiments	32
4. CHAPTER 4 - CPS and Design Thinking IMPLEMENTATION.....	33

4.1.	Creative methods and models for VET with practical solutions and Tips.....	33
4.2.	APPROACH: Lateral Thinking	34
4.2.1.	OVERVIEW:.....	34
4.2.2.	DESCRIPTION	34
4.2.3.	HOW TO.....	35
4.2.4.	IMPLEMENTATION IN VET – TIPS AND EXERCISE	35
4.3.	UNDERSTANDING TOOL: 5WH (WHO? WHAT? WHERE? WHEN? WHY? HOW?).....	37
4.3.1.	OVERVIEW:.....	37
4.3.2.	DESCRIPTION	38
4.3.3.	HOW TO.....	39
4.3.4.	IMPLEMENTATION IN VET – TIPS AND EXERCISE	39
4.4.	GENERATING TOOLS: Brainstorming and trigger method.....	40
4.4.1.	OVERVIEW:.....	40
4.4.2.	DESCRIPTION	40
4.4.3.	HOW TO.....	41
4.4.4.	IMPLEMENTATION IN VET – TIPS AND EXERCISE	42
4.5.	THE DOUBLE-DIAMOND MODEL	43
4.5.1.	OVERVIEW	43
4.5.2.	DESCRIPTION & HOW TO.....	44
4.5.3.	IMPLEMENTATION IN VET – TIPS.....	61
	References.....	62

WHAT IS IT ABOUT?

A toolkit for teachers, educators, mentors, trainers in the VET sector on how to implement the creative approaches in their teaching and thereby implementing an innovative practice.

The toolkit contains a full description of the methodology, pedagogical approach to be used, guidance and counselling implementation and a large section about the practical tips and description in which situations the tools will be useful in.

The toolkit promotes the development, testing and implementation of innovative practices and methodology in the VET sector.

4 chapters:

1. CPS and Design Thinking in Education across Europe
2. CPS METHODOLOGY and PEDAGOGY FOR VET
3. Design Thinking METHODOLOGY and PEDAGOGY FOR VET
4. CPS and Design Thinking IMPLEMENTATION: creative methods and models for VET with practical solutions and Tips

APPROACH:

- Research from the partner countries coming from the Evidence-Gathering report (IO1)
- Full methodology description including relevant bibliography and links
- Pedagogical approach to be used in order to be more effective in VET
- Practical training schemes and tips for an effective implementation
- Special focus on implementation within WBL and integration activities
- Pilot the contents thanks to the involvement of a group composed by associated partners and other stakeholders via surveys and feedbacks

The experiments carried out by the project partners are published in the section “documents” on our project website: www.innovativet.eu

1.1. THE IMPORTANCE OF PROBLEM SOLVING IN THE EDUCATIONAL SYSTEM

An interesting book published by the Organisation for Economic Cooperation and Development (OECD) is focused on the development and assessment of problem-solving in 21st century school (Csapó & Funke, 2017):

“The skills considered most essential in our modern societies are often called 21st-century skills. Problem solving is clearly one of them. Students will be expected to work in novel environments, face problems they have never seen and apply domain-general reasoning skills that are not tied to specific contexts.”

Problem solving is one of the skills OECD researched about in last years, especially in connection with the ways different educational methods are able to stimulate its enhancement. In 2012 OECD’s Programme for International Students Assessment (PISA) compared the relative performances in problem solving in 43 different countries (OECD, 2014).

The mean score is compared with the OECD average score (500 points) – the European countries differ notably – following the average score of some countries, including the ones from InnovatiVET consortium:

- Singapore – 562 points (1st mean score in the ranking)
- Finland – 523 points (1st European country in the ranking – 10th in the global ranking)
- England (United Kingdom) – 517 points (11th in the global ranking)
- Italy - 510 points (15th in the global ranking)
- Demark: 497 points (23rd in the global ranking)
- Slovenia: 476 points (30th in the global ranking)

1.2. CREATIVE PROBLEM SOLVING AND DESIGN THINKING - EUROPEAN COMMISSION

European Commission since 2009 has proposed, in the strategic framework for European cooperation in education and training (known as ‘ET 2020’¹), four strategic objectives.

The fourth objective listed is about the **enhancement of creativity and innovation**, including entrepreneurship, **at all levels of education and training**.

The objective stated in the document ET2020 is:

“As well as engendering personal fulfilment, creativity constitutes a prime source of innovation, which in turn is acknowledged as one of the key drivers of sustainable economic development. Creativity and innovation are crucial to enterprise development and to Europe’s ability to compete internationally. A first challenge is to promote the acquisition by all citizens of transversal key competences such as digital

¹ Council conclusions of 12 May 2009 on a strategic framework for European cooperation in education and training (‘ET 2020’) - details available at http://ec.europa.eu/education/policy/strategic-framework_en

competence, learning to learn, a sense of initiative and entrepreneurship, and cultural awareness. A second challenge is to ensure a fully functioning knowledge triangle of education-research-innovation. Partnership between the world of enterprise and different levels and sectors of education, training and research can help to ensure a better focus on the skills and competences required in the labour market and on fostering innovation and entrepreneurship in all forms of learning. Broader learning communities, involving representatives of civil society and other stakeholders, should be promoted with a view to creating a climate conducive to creativity and better reconciling professional and social needs, as well as individual well-being.”

ET2020 framework is based on a lifelong learning approach and it is currently addressing the Erasmus+ programme - the EU's programme to support education, training, youth and sport in Europe². The budget of €14.7 billion is providing opportunities for over four million Europeans to study, train, and gain experience abroad. In May 2018, the Commission adopted its proposal for the next Erasmus programme, with a doubling of the budget to 30 billion euros for the period 2021-2027 with expected learning and mobilities opportunities for 12 million Europeans.

1.3. CONTEXTS AND CASES IN PROJECT PARTNERS' COUNTRIES

The context in all National Countries of InnovatiVET consortium are presented together with some practical cases and an evaluation matrix used to highlight some important elements of the cases analysed.

1.3.1. CREATIVE PROBLEM SOLVING AND DESIGN THINKING IN FINLAND

NATIONAL POLICIES AND CONTEXT

In Finland, the reform in Vocational Education and Training (VET) has changed the way how students can create their personal study path and structure their education. Instead of specialization to specific occupational tasks, the students are encouraged to study more general, multidisciplinary subjects as part of their qualification. This rhetoric comes from the view on future work and future working life, where routine tasks are taken over by automation and robotics, and human workforce is needed for expert thinking and complex interaction.

In this scenario high order social and mathematical competences are required from the graduates, as they need to be mobile and able to shift between different occupational contexts. Key skills for navigating one's career in the changing landscape of work are communication skills, ability to use information and communication technologies, digital literacy, critical thinking, creativity and problem solving skills.

VET training has, however, a balancing act of training students to existing needs of the labour market and the need to equip the graduates with skills for lifelong and continuous learning. When looking closer to desired graduate attributes, students are expected to have strong cognitive skills and social

² more info at <http://ec.europa.eu/programmes/erasmus-plus/>

skills. In addition, skills for self-understanding and self-regulation have become more and more important, because they are linked to motivation, time and resource management and self-assessment.

According to national reports in education, several studies indicate that social skills, creativity and problem solving skills will become ever more important in the working life. In Finland, graduates in higher education are reported to have good capacity in the mentioned skills in general, with the exception of graduates in technology. In VET, the skills mismatch of graduates entering the labour market is more severe when compared to workers with higher education. The expectations for VET graduates calls for a better command of management and leadership skills, customer service, sales skills and innovation in order to better collaborate with the graduates from higher education at the workplace.

Researchers provoke the question on how vocational education and training is able answer to the needs of the labour market. The reform on VET has given the colleges more freedom to organize the training to meet the local needs – qualitative aspects of education, but has put more emphasis on quantitative indicators such as amount of degrees and parts of degrees achieved in the institution as well as graduate employability and enrolment to further education.

Based on research in work-oriented and project-based learning in VET, creative problem solving and design thinking is best achieved when students' skills improve in the social interaction when engaged in cooperative learning in projects. Students feel shared responsibility for completion of the scheduled project and during the process, they develop and use creative problem solving in making decisions on how to manage the different stages of project work. Therefore, a sense of community and an experiential feeling of security facilitates creative problem solving and forms a fertile ground for design thinking processes. In the following, an example of project learning is described where students' socio-emotional skills, such as working in a group, self-regulation and emotional skills are developed in both work-related and open contexts.

CASE: THE EPIC PROGRAM

In the Epic Program student teams develop new, innovative solutions to practical challenges by using tools and methods of team-based production development adopted from NASA, the National Aeronautics and Space Administration of the USA. The usability of the solutions and concepts are tested, evaluated and further developed with various methods and using experimentation and prototyping. The origins of the program are based on a collaboration between a Finnish company and the NASA for creating a learning platform for the space administration.

The Program is a collaboration between the Riveria College, North Carelia Education Consortium, University of Eastern Finland, Karelia University of Applied Sciences, the Teacher Training School in Joensuu and the NASA. Cooperation between different educational institutions secures a smooth flow from one educational sector from the other. Local companies are involved in the Program to provide the students practical challenges and to sponsor the activities. Internationality is present in the Program not only through the international collaboration, but also via the student body as the challenge attracts also international students.

For the students the Epic Program gives an opportunity to develop new concepts and prototypes and for the winning team, even to travel to Houston, the headquarters of NASA. For teachers, the program offers upskilling on methods for design thinking and innovation. The companies in the region benefit from new concepts and solutions when developing their business models. For the general public, the

Program opens up importance of attracting and retaining students in STEM disciplines (Science, Technology, Engineering and Mathematics) in order to ensure competent work force for the future economy. In the larger scale, the Epic Program gives an opportunity to discuss the role of space exploration in advancing science, engineering, technology, education, and the economy.

The practical challenges for creative problem solving and design thinking have included e.g. use of an empty space in a housing building for student entrepreneurship and entrepreneurship among international students. The teams are facilitated by local experts and the companies in the region. After a training, the innovation processes rely on self-directed teams and collaborative learning. Student teams report their solutions and prototypes in Showrooms at the end of the semester.

The Program was given a reward in 2018 by the Federation of Finnish Enterprises for an accomplishment in developing new models for entrepreneurship education and finding solutions for global challenges.

Table 1. CPS and DT in Finland

Criteria	CPS	DT	Yes, how	No, how
Contributes to a VET teacher's continuing professional development plan	x	x	Techniques of open innovation, project-based and problem-based learning are applicable to VET. Multi-disciplinary approach benefits to teacher collaboration cross boundaries in the curricula.	
Is supporting development of divergent thinking skills	x		The challenges range from very open-ended problems to very practical, working-life oriented and organization-specific problems.	
Is supporting development of lateral thinking skills	x		Students are encouraged for self-regulated learning, both individually and in teams. The methods used structure learning and thinking skills.	
Is supporting development of creative skills	x	x	The nature of the challenge is designed for creative problem solving and thinking out-of-the box. Space exploration widens the horizon of problem solving and helps to loosen rigid barriers of what is possible and what is needed.	
Is supporting employability of students	x	x	Students are encouraged for self-employment. The Epic Challenge is embedded to the studies in entrepreneurship in all the participating educational institutions.	
Is supporting development of DT toolkits for teachers	x	x	Teachers in the educational institutions participating in the program receive further training in innovation methods, design thinking and creative problem solving.	
Is developing industrial currency of teachers and working-life relevancy of education	x	x	Collaboration with industries is vital, because program is based on a sponsoring model.	

Has an element of innovation relevant to teachers	x	x	National curricula encourages teachers to engage with innovation and development, and they are able to integrate the projects in the curricula through entrepreneurship course modules.	
Has proof of teacher & employer co-design	x	x	The challenges come from the local businesses and work organizations, and the stakeholders are involved in the Showrooms when students report their new concepts and solutions.	

1.3.2. CREATIVE PROBLEM SOLVING AND DESIGN THINKING IN DENMARK

NATIONAL POLICIES AND CONTEXT

Since 2010 Innovation & entrepreneurship education has been a mandatory part of Vocational education and training regulated by the Ministry of Education in Denmark (RETSINFORMATION, 2010). As a consequence, it has been taught as a course subject across VET-Schools in recommended syllabuses developed by the national Foundation for Entrepreneurship in Education. (FFE, 2017). A part of this course applies creative problem solving as an idea generation methodology. In November 2018, entrepreneurship has reached even further prioritization and emphasis with the newest policy for Vet-schools in Denmark called “From primary school to skilled worker - Vocational education for the future” (EMU, 2019). In this new policy, it is stated that teaching of entrepreneurship must be strengthened so that young people are also supported in the desire to establish their own business (UVM, 2018). Hence, creative problem-solving is one of the course methodologies within the entrepreneurship education and has an increased attention in Denmark’s VET-schools.

With the upper secondary school reform, as of November 2018, it is maintained as a course within upper secondary school education (UVM, 2019). With the latest reform, it is stated that it is mandatory that all courses taught have an element of innovation across subjects. Furthermore, innovation and entrepreneurship is also seen as an independent elective that relates to courses taught either in social sciences or business economy. Creative problem is a subject taught within the curriculum of innovation and entrepreneurship.

Creative problem solving has been taught as a methodology ever since 2010 within the course of entrepreneurship (Retsinformation., 2010, UVM, 2019), FFE, 2011). Design thinking however, is only taught in tertiary education as an official course. It is therefore not a part of formal education in VET industry as course or methodology.

Nonformal is a different story however, since it is often part of the syllabus within the course of innovation, as a process that leads to innovation primarily inspired by the success of IDEO. IDEO is an internationally recognized design company who in 1999 appeared in ABC Nightline with their design process (IDEO., 1999).

As a consequence, teachers have seen the benefit of applying design thinking within their syllabuses as detected in an example from Tønder Commercial high school which was applied in upper secondary education (TCC., 2017). In VET schools though, it is not part of the syllabus of innovation, as seen in the syllabus that the foundation for entrepreneurship supplies for teachers in VET industry (FFE., 2011).

Both above mentioned cases are nonformal examples. That means that Design thinking is applied in nonformal education but on the incentive of the individual teachers.

CASE: THE EDUCATIONAL LABORATORY

From 2012-2014, 14 institutions (10 educational and 4 research and development organisations) in the capital region of Copenhagen conducted a series of educational experiments, referred to as the Educational Laboratory (“Uddannelseslaboratorium”) (UDDX, 2015c). The purpose of this project was to experiment with new methods to transform practice in order to improve educational organisations. More specifically, a series of educational experiments (120) were conducted in order to “develop innovative solutions for the demands and challenges currently faced by business and professional educations” (UDDX, 2015, p.5).

The national challenges and demands (from the professional educational side) were identified as following (Sørensen, 2015) :

- Dropout rate is increasing (despite massive efforts to reduce it)
- Lack of approximately 10.000 apprenticeships
- VET has a low status amongst youth: only one out of five proceeds directly from “ground school” to VET
- Increasing problems with absence and lack of motivation among students
- Unemployment amongst graduates is increasing
- Increasing number of students with psychological and/or social issues (most frequent cause for dropping out)
- Challenge of ‘outdated’ skills not corresponding with actual needs

The output was a tried-and-tested toolkit (known as *Vocational Educational Lab*), which could then further aid other educational programmes to conduct their own experiments in order to foster a more innovative program. Ultimately geared towards benefitting the students – for example strengthening 21st century skills, or strengthening their transfer process from educational institute to their field of practice – the toolkit focused on teachers and students *jointly* addressing development. More specifically, the educational institute could continuously deliver self-improvement by nurturing a culture of change by using the vocational educational lab.

As a result of these experiments, over 500 members of staff and over 800 students have participated (UDDX, 2015a, 2015b), as well as contracting 53 agreements with companies (UDDX, 2015b). Some highlighted findings are as following (Sørensen, Jensen, & Hutter, 2014; UDDX, 2015a, 2015b):

- Experiments can result in positive developments in educational practices which support and strengthen teacher and student innovation competences
- Increased commitment by students by being included in the planning process of the educational programmes – experiments can serve as a foundation for shared organizational processes of learning (i.e., a user-driven education)
- Increasing transfer of knowledge from the educational institutions to the companies who offer internships, thus resulting in a more coherent educational program which would reflect the needs of the industries aiming to recruit graduates
- Inclusion of industry-relevant problems and challenges in classroom teaching would increase student reflective skills, which could then promote innovative practices between educational institution and company.

As a main conclusion, this project determined that “authentic educational challenges can be met by an experimental setting, where educational experiments provide a way for a renewed and improved practice” (Sørensen, Jensen, & Hutter, 2014, p. 63).

Table 2. CPS and DT in Denmark

Criteria	CPS	DT	Yes, how	No, how
Contributes to a VET teacher’s continuing professional development plan	X	X	Indirectly. The experimental cycle used in the educational lab allows teachers (and their institutions) to instigate change to ensure relevant knowledge, practices and challenges stay up-to-date in the classrooms. Although not tailored to a personal professional development plan, competences required to teach a certain course/program become much more apparent.	
Is supporting development of divergent thinking skills	X		Directly. The experimental cycle promotes a thought process, which can help facilitate creative ideas by exploring a multitude of possible solutions.	
Is supporting development of lateral thinking skills	X		Directly. The experimental cycle’s requirement that each experiment must be for instigating change, signifies that it is a tool which helps to generate ideas “which break free from your current thinking patterns and their usual pathways” (de Bono, 2019). In other words, ideas are generated based on change and current ways of thinking.	
Is supporting development of creative skills	X	X		Indirectly. The experimental cycle does provide a platform which could foster creative ideas due to the establishment of an experimental zone, yet its primary function is to identify a challenge and instigate change. There is no guarantee that the cycle will provide originality or be task appropriate – two key elements in defining creativity (Kaufman, Beghetto, & Dilley, 2016)

Is supporting employability of students	X	X	Directly. The experimental cycle demonstrated that experiments co-created with students and teachers resulted in students gaining 21 st century skills, as well as defining a more user-driven education.	
Is supporting development of DT toolkits for teachers		X	Directly. The experimental cycle has elements derived from DT concepts and ensures that participants must imagine the challenge from multiple perspectives (collaboration), using integrative thinking as well as experimentalism.	
Is developing industrial currency of teachers and working-life relevancy of education	X	X	Directly. The working-life relevancy of the education is strengthened by proposing relevant challenges to be faced in the experimental cycle.	When the education is up-to-date to industry standards (working-life relevancy), it is then intuitive that this necessitates teachers to map the necessary development of their industrial currency in order to be able to teach the relevant courses. This does not ascertain that the industrial currency is actually developed.
Has an element of innovation relevant to teachers	X	X	Directly. One of the requirements for the experiments in the cycle is that it must be of innovative nature.	
Has proof of teacher & employer co-design	X	X		The experimental cycle has been utilized in this context only between teachers and students. A clear research gap exists here in that company/industry professionals were not involved, especially considering that one of the issues was challenging outdated needs that did not meet industry demands. Future experiments are necessary which involve teacher & employer co-design.

1.3.3. CREATIVE PROBLEM SOLVING AND DESIGN THINKING IN ITALY

NATIONAL POLICIES AND CONTEXT

In Italy, there is a poor evidence of practical examples of the use of the creativity in the learning process, especially in the Vocational Education and Training.

A relevant example³ is Porta Futuro – a centre for guidance, training and employment active in Lazio region.

The centre is focusing its activity on creativity, soft skills, innovation and as a driver for development.

About soft skills, the creativity is one of the main training activities delivered via workshops lasting three hours for maximum 10 participants. During the workshop, the trainees are pushed to adapt their attitudes and creative approaches in different social, working and professional contexts⁴.

The training about soft skills is included in the training programmes for two categories:

- Youth – 18-29 years old
- Adults – 30-45 years old

CASE: DESIGN THINKING IN ITALY – THE PROJECT "INNOVATIVE DESIGN OF SCHOOL EDUCATIONAL PROCESS "



Source: 20/08/2018 from <http://www.innovazioneinclassa.it/index.php>

The project "Innovative Design of School Educational Process" aims to respond to the pressing request for a better and updated methodological and didactic innovation for the teaching staff. This training is necessary to increase the effectiveness of teaching / learning processes, promote the development of high skills in pupils, enhance individual talents and encourage training success by using technology.

The project, thanks to a collaborative environment, created for all Italian teachers, gives a possibility for teachers to build their teaching and learning methods "among peers", through a shared and visible path in each phase.

Through the web-portal, it is possible to see all the phases of conception and realization of the new teaching models and new teaching materials and it will be possible to participate in the development of new ways of sharing information and knowledge.

The teachers involved in the project are actively engaged on several fronts:

- participation in training workshops in five cities along Italy;

³ CEDEFOP, BRIEFING NOTE Innovation and training: partners in change, November 2015, No 2 - <https://www.cedefop.europa.eu/en/publications-and-resources/publications/9103>

⁴ The full list of seminars and workshops are available at: <https://www.portafuturo.it/>

- collaboration through the web portal to the creative and innovative process;
- experimentation of the new methods with the pupils in their classes.

The process is shared and made visible to all Italian teachers and to all those interested in innovative approaches in the school.

The project started with 100 innovative teachers and the partners of this project are:

- ANP (Associazione Nazionale Dirigenti e Alte Professionalità della Scuola): national association of School directors present at national level in each Region.
- FTI (Fondazione Telecom Italia): foundation funded by the first national telecommunication firm (Telecom Italia) with the aim to improve the quality of life of Italian residents.

The project produced a series of Tutorials about the Service Design Thinking, tools and guides useful for the improvement of the educational approach in the class.

Table 3. CPS and DT in Italy

Criteria	CPS	DT	Yes, how	No, how
Contributes to a VET teacher's continuing professional development plan	x	x	By providing methodologies, collaborative environment, workshops and experimental approaches	
Is supporting development of divergent thinking skills	x		Thanks to the experiment carried out and the monitoring phase collecting data and benchmarking of the projects	
Is supporting development of lateral thinking skills	x		In some projects that was the main focus on lateral thinking skills to be introduced in the classrooms	
Is supporting development of creative skills	x		In some projects that was the main focus on lateral thinking skills to be introduced in the classrooms	
Is supporting employability of students	x		The overall goal is to prepare the student to develop competences and skills in line with the job market demands	
Is supporting development of DT toolkits for teachers		x	It is providing didactical and methodological tools for the teachers with a Design Thinking approach applied to the educational offer	
Is developing industrial currency of teachers and working-life relevancy of education				This aspect is not applicable to this case

Has an element of innovation relevant to teachers	x	x	It is based on a better and updated methodological and didactic innovation for the teaching staff	
Has proof of teacher & employer co-design				It is still in development

1.3.4. CREATIVE PROBLEM SOLVING AND DESIGN THINKING IN UNITED KINGDOM

NATIONAL POLICIES AND CONTEXT

The UK department of education aims to provide “a broad and balanced curriculum which will prepare [students] for life in modern Britain”. However, the Government makes no explicit mention of creativity or creative problem solving in specifying the curriculum (for example, there is no requirement to “demonstrate creative approaches” to a problem). There is also no clear mention of creativity as being a transferable skill with applications beyond the arts. This is in line with the Government’s stated policy to create a ‘knowledge-based’ (as opposed to ‘skill-based’) curriculum, and to avoid proscribing or privileging any one pedagogical method over another. Creative problem solving and design thinking are viewed as ‘methods’ and the government therefore leaves it to individual schools to implement creative problem solving, if they wish. Because of this, certain organisations that have sufficient resources, both within the school system and outside it, are world-leading in their teaching of creative problem solving. However, after successive years of tight funding in the public sector, the majority of UK schools are very unlikely to experiment with these innovative techniques.

When it comes to Government initiatives and organisations, there are very few that support creative problem solving explicitly. Initiatives that support creativity are also unlikely to operate for the education of disciplines that are not explicitly related to the arts. However, with most education and apprenticeship policies being devolved in the UK, the governments of Wales, Scotland and Northern Ireland have opportunities to set their own priorities in this area.

In 2013 Scotland launched its Creative Learning Plan, a major policy which included an increased emphasis on creative problem-solving and creative thinking at all points in the school curriculum. As part of the Plan, the government organisation Creative Scotland worked with Education Scotland to develop the school and college curriculums to improve outcomes for employability, for example:

- 1.1.1. Skills for Learning, Life and Work (SfLLW) were developed across school subjects along with case studies showing this in practice. More flexible assessment methods were also developed to encourage creativity in learning and teaching. Skills for Work Courses are available in a range of vocational areas. They promote creative delivery through partnership working and creative thinking in learners by developing employability skills.
- 1.1.2. ‘Certificate of Work Readiness’ (CWR): a new award aimed at 16-19 year olds who need support to move into their first job or further study. CWR builds employers’ capacity and expertise to support young people via work experience, by focusing upon employer endorsement. The award was developed in collaboration with stakeholders and is assessed by employers.

OUTLINE OF NON-FORMAL EDUCATION AND APPROACHES

Outside the formal education system in the UK there are now several organisations that teach students creative problem solving approaches outside the national school system. Typically, these organisations provide classes or courses outside regular school hours, and are funded privately (i.e. through fees from parents or occasionally paid for by charities, rather than by government funds). As such their expansion is limited to students with the funds to pay, or with access to support. However, because they have the resources and the freedom to pursue educational objectives without the requirement to teach to national exam results, they are free to experiment with innovative content and methods which do not yet appear on national school syllabus.

CASE: FIRE TECH CAMP

One example is Fire Tech Camp, an organisation which teaches technology and problem-solving skills through day classes and week-long 'camps' in London and other locations in the UK. The classes cover topics from coding and robotics, to VR, graphics and game design, and are targeted at students aged 9 to 17. Alongside the knowledge-based content of the course, there is also a clearly defined soft skills syllabus, tailored to the age group and topic at hand, covering specific skills such as teamworking and collaboration, creative confidence, critical thinking, emotional awareness and so on.

A key part of the teaching methodology of Fire Tech Camp (FTC) is project-based learning, an established pedagogical approach which bases the students' journey around a challenge they must complete, without specifying in detail how they should do so. Certain basic elements may be taught beforehand, but key decisions about how those elements are to be combined to achieve the overarching goal are left to the students. This approach prompts students to engage with the content in a more active way, since the student decides for themselves what they are going to do. As a result, students are often highly motivated.

When a student working on a project at FTC encounters an unexpected problem, they are encouraged to first try solving it for themselves or consulting a classmate, before turning to a teacher for help.

The open-ended nature of the project-based approach may introduce unpredictability and the possibility that a student's project will fail – however, at Fire Tech Camp, as with other modern providers of the project-based approach, failure is celebrated as a sign of ambition and creativity. This creative confidence, alongside other desired soft skills such as peer-to-peer learning and effective teamworking, are celebrated and reinforced at FTC through a system of badges and reflection exercises. For example, at the end of each day of a camp project, there is a session of 'stand-ups' in which students describe what they tried, what worked, what didn't work, and how they were helped by each other. Younger students are encouraged to give each other constructive feedback through the mnemonic 'two stars and a wish' – two pieces of positive feedback, and one thing to improve.

It is clear that many of the techniques used within FTC are transferrable to other parts of the VET sector. In fact, some schools (such as the LDE UTC, described in Intellectual Output 2) already work closely with companies to establish industry-relevant project-based briefs.

Table 4. CPS and DT in the United Kingdom

Criteria	CPS	DT	Yes, how	No, how
Contributes to a VET teacher's continuing professional development plan	x		Techniques of project-based learning are applicable to VET, and can be added to a set of effective teaching strategies.	
Is supporting development of divergent thinking skills	x		The open-ended nature of the approach gives rise to a wide array of creative outcomes, through which students still achieve the desired learning objectives.	
Is supporting development of lateral thinking skills	x		Students are encouraged to find their own solutions to problems encountered, which engages creative and lateral thinking faculties	
Is supporting development of creative skills	x		Students are encouraged to find their own solutions to problems encountered, which engages creative and lateral thinking faculties	
Is supporting employability of students	x		While Fire Tech Camp students are mostly below typical working age, the skills nurtured through the classes are those sought by employers. Therefore the classes raise employability.	
Is supporting development of DT toolkits for teachers		x		FTC does not directly develop DT toolkits for teachers.
Is developing industrial currency of teachers and working-life relevancy of education		x		FTC does work with employers but not closely, as its students are generally young.
Has an element of innovation relevant to teachers	x		Project-based learning and its implementation – particularly 'gamifying' the attainment of other social and soft skills	
Has proof of teacher & employer co-design		x		Employer-teacher co-design is not a major part of how FTC works

1.3.5. CREATIVE PROBLEM SOLVING AND DESIGN THINKING IN SLOVENIA

NATIONAL POLICIES AND CONTEXT

The open curriculum in vocational and professional education programs has been introduced through new and renewed educational programs since 2004. Since the beginning, many questions and dilemmas appeared that were solved by schools in various ways. Namely, openness means freedom for schools, which was difficult to unify, especially since the expert public was not able to completely unify the views on the situation. More uniform views are now gradually shaped based on a common search for solutions, the implementation of examples of good practice and the exchange of experience.

The legal basis of an open curriculum is found in the **Vocational Education Act**, which deals with the open curriculum in articles 13 and 18. Both articles speak of the involvement of schools and social partners in determining of open curriculum:

- Article 13: " part of the education program is set up by schools together with the social partners"
- Article 18: "Social partners ... in the performance of their duties in VET, cooperate with schools in ... the establishment of an open curriculum. " In preparing an open curriculum, the school director must work with the social partners.

Also article 68 speak about involvement of social partners: "The educational work is carried out according to the annual work plan, which includes: ... part of the educational program the school determines in cooperation with the social partners ..."

In lower VET programs there are 448 hours of the open curriculum, in secondary VET programs there are from 578 to 704 hours of open curriculum in secondary technical programs 574 to 670 hours and in vocational technical programs 242 to 288 hours.

Open curriculum is an integral part of the annual work plan and is confirmed by the school council. Since open curricula is part of a public educational program, all elements must be publicly announced, with other program units of the educational program.

Creation of an open curriculum begins with needs analysis of the employers and the local environment, taking into account the school's personnel, material and organizational potential. Furthermore, the open curriculum is a challenge or a development opportunity for the school, especially for additional cooperation with companies, continuous curricular planning, introduction of new forms and methods of teaching, implementation of individualized lessons, connections between various educational programs and rapid integration of new professions into programs, and also a competitive advantage. **Experience shows that an open curriculum is used for development of innovation and creativity in many cases.**

From all ideas that the school acquires, from the analysis needs and also ideas from students, parents and teachers, the working group at the school chooses the most appropriate and sets goals and competences that are the basis for the creation of open curriculum modules.

CASE: PROJECT "GS1 SLOVENIA AND OPEN CURRICULUM"

GS1 Slovenia is an independent and non-profit organization in the field of international standards of GS1 for identification, capture and electronic data exchange. The national representations of the international organization GS1 operate in more than 110 countries around the world, while GS1 standards are present in more than 150 countries. The GS1 organization has more than a million members - from international companies to small, local businesses.

In 2012 and up to now, GS1 Slovenia has, in a systematic way, initiated the preparation of the bases for the realization of the project "GS1 Slovenia and Open Curriculum".

Within the framework of the transparency of acquired professional competences, three levels of certification in secondary and tertiary education were identified.

Level 2 about using GS1 standards is about:

- comparing different standards for the identification, capture and exchange of data of sales units, services, locations, transport units, returnable packaging, documents
- knowing the difference between different standards for the identification, capture and exchange of data of sales units, services, locations, transport units, returnable packaging, documents
- distinguishing and describing the factors that influence the useful value of the GS1 system
- knowing consequences of using GS1
- analysing possibilities of using the GS1 system
- suggesting possibilities of implementing the GS1 system
- evaluating effectiveness of the global system of supply chain standards GS1

Level 2 and especially level 3 promotes and encourages creativity and problem solving.

CASE: VET SYSTEM FOR PROFESSIONAL QUALIFICATION AT SCHOOL CENTER VELENJE

Qualification structure – meaning knowledge and competences of human resources – is one of the significant organizational characteristics. Human resources with adequate qualifications and competences will be able to optimally use their knowledge and skills and will achieve better results, higher quality, will be inventive and innovative, in short, to achieve the added value that enables a good position of the organization on the market.

Professional Qualifications are developed in close cooperation with employers. Professional Qualifications System is complementary to the formal education system and national vocational qualification system and enables significantly faster reaction to the needs of employers for skills and competences. Professional Qualifications are designed specifically for combination of tasks or work, recognized by employers as important and necessary to carry out entrusted work or task or to achieve specific business result, contract or order. Combination with preliminary analysis opens new opportunities in knowledge management and fast reaction to developments in technology, work processes and market requirements.



Within the framework of the European project, School Center Velenje recognized the need for organized professional training for installers in the field of renewable energy sources. In cooperation with the Energy Industry Chamber, catalogues for four professional qualifications have been designed:

- Installer of thermo solar systems,
- Installer of Photovoltaic systems,
- Heat Pump Installer, for professional qualifications
- Installer of wood biomass heating systems.

Following the procedure described above, experts developed catalogues, followed by professional training and certification. Training and certification were organised on the principle of recognition of lifelong learning. They invited former students of the school centre and providers of installation services in the field of renewable energy sources.

The catalogues included European directives and regulations in the field of energy industry. Quality, efficiency and reliability of renewable energy sources system, their essential elements of training and later basic criteria for assessment of qualifications. The certificate holders could therefore work with certificates anywhere in the EU.

COMPETENCES

The four professional qualification above mentioned have all a common structure that includes advising about the possibilities of using energy from renewable sources, how to design a plan for the use of renewable energy, competencies about installation and quality management. A relevant part of the training is connected with the development of skills of problem solving, innovation and creativity of ideas in designing solutions.

Table 5. CPS and DT in Slovenia

Criteria	CPS	DT	Yes, how	No, how
Contributes to a VET teacher's continuing professional development plan	x	x	Monitoring labor market, its developments and trends, close cooperation with employers and their experts contribute to continuous professional development of a VET teacher.	
Is supporting development of divergent thinking skills	x	x	CPS and DT support also (beside others) development of divergent thinking skills.	
Is supporting development of lateral thinking skills			CPS and DT support also (beside others) development of lateral thinking skills.	
Is supporting development of creative skills	x	x	CPS and DT support also development of creative skills.	
Is supporting employability of students	x	x	Both give additional knowledge and skills that is actually result of labour market needs.	

Is supporting development of DT toolkits for teachers	x	x	It actually depends on the teacher, though open curricula as well as professional qualifications encourage DT.	
Is developing industrial currency of teachers and working-life relevancy of education	x	x	Monitoring labour market, developments and trends, close cooperation with employers and their experts helps teachers maintain their industry currency.	
Has an element of innovation relevant to teachers	x	x	Have to think of new ways of delivering knowledge and skills. After monitoring labour market, they act as initiators and co-developers of new competences.	
Has proof of teacher & employer co-design	x	x	They cooperate in development of open curriculum and of professional qualifications.	

2.1. WHAT IS CPS METHODOLOGY?

Creative Problem Solving is a methodology for approaching a problem in creative and innovative ways in order to solve it.

For a better understanding (Noller, 1979), it is possible to analyse the three words separately:

By **CREATIVE** it means: having an element of novelty and being relevant at least to the one that is looking for a solution. It is about the creativity of ideas and not the one related to arts.



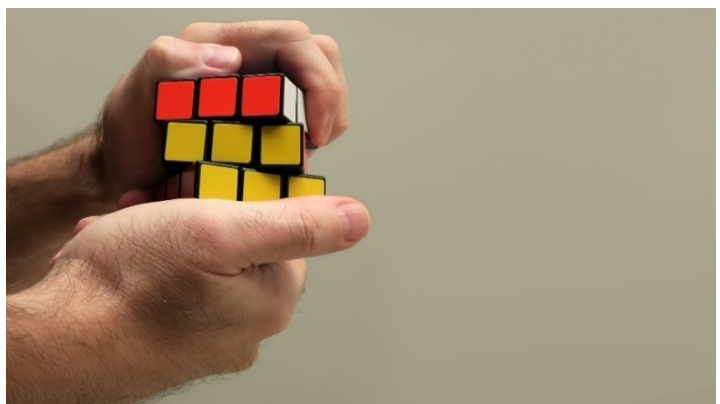
Source 06/07/2019: image by [Colin Behrens](#) from [Pixabay](#)

By **PROBLEM** it means: a situation that is a concern, a difficulty and it needs an action – it is possible to define it, in a more positive way – a challenge that could offer some opportunities if we are able to remove the problem.



Source 06/07/2019: Image by [www.slom.pics](#) from [Pixabay](#)

By **SOLVING** it means: conceive different ways to change, adapt or transform the problematic situation into an opportunity environment.



Source 06/07/2019: Image by [rubylia](#) from [Pixabay](#)

2.2. A CPS FRAMEWORK

The Creative Problem Solving approach can be divided in four different components - three of them are process ones plus a management one (Isaksen, Dorval, & Treffinger, 2011):

- Understanding the challenge
- Generating ideas
- Preparing for actions
- Planning your approach (management)

Understanding the challenge

It is essential to start by understanding clearly the problem to transform it in a challenge. It could consist in different stages such as:

- Consider the possible challenges and opportunities and select the most promising ones
- Explore available data from different sources and point of views
- Frame the problem by generating a variety of problem statements and then select or invent a specific problem statement



Source 06/07/2019: Image by [Sasin Tipchai](#) from [Pixabay](#)

Generating ideas

During this stage it is important to generate as many, different, various, unusual and weird ways to face the problem. About the ways to generate ideas and unlock creativity, please refer to next chapter and to chapter 4.1 (ref. lateral thinking).



Source 06/07/2019: Image by [Gerd Altmann](#) from [Pixabay](#)

Preparing for action

It is about the time to transform interesting and promising ideas into actions aimed to find solutions. It is composed as a development of



solutions (analysis of possible solutions, definition and adaptation) and also by building acceptance (useful to consider tools such as follow-through, commitment, resistance and, at the end, formulation of specific plan of actions).

Planning your approach

This the management component of the CPS framework. It is the driver of all the actions during the application of CPS methodology. It is composed of two stages:

- Appraising tasks: during this phase it is decided if the solutions are the right ones by keeping track of people involved, resistance, blocks and constraints, environment and results.
- Designing process: it is the plan about how to use the CPS elements and solution available. The customisation of approaches and actions are implemented there. About effective and creative ways and methods to design the process, please refer to next chapter 3 about Design Thinking.



Source 06/07/2019:Image by [Free-Photos](#) from [Pixabay](#)

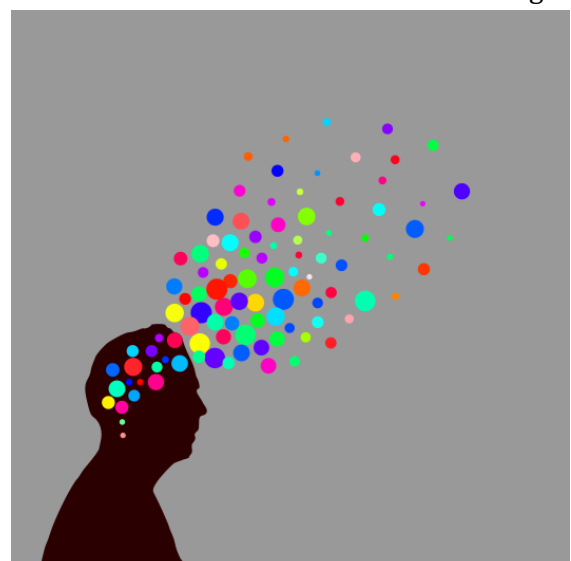
2.3. CONVERGENT AND DIVERGENT THINKING - A PEDAGOGICAL APPROACH FOR CLASSROOMS

When someone is trying to solve a problem, there are two basic ways to think about the possible solutions. These two types of thinking are: convergent and divergent thinking – coined by the American psychologist Joy Paul Guilford.

Convergent thinking is the ability to provide the “correct” solution to meet the criteria that is sought. It is the single answer to a problem, the one the students are used to give during most tasks and tests.

Its opposite is the **divergent thinking**, that is related to the creativity. It is about the type of thinking used to solve a new problem that could have many possible answers or solutions. In other words, divergent thinking involves a broad search for decision options with respect to a problem for which there is no unique solution.

Several studies confirmed that children have a high divergence capability and that it decreases dramatically



as they become adults. Divergent thinking is discouraged in classrooms where the common culture penalises students for being wrong or for their non-normative behaviours.

Source 06/07/2019: wikimedia.org © Nevit Dilmen

In order to implement divergent thinking to work in harmony with convergent thinking in the classrooms it is possible to use different strategies – useful in vocational training but also in other formal and non-formal learning contexts:

- Problem-based learning: it is based on a series of questions created by the students in order to solve a problem that they have created and usually related to a specific subject – the added value is related to the possibility to not learn on the basis of questions to which there is a correct answer.
- Collaborative learning: the students are pushed to work together in group to solve a problem, carry out some activities or create a product/service. The power of peer learning is large, and this methodology could produce relevant benefits such as: development of higher-level thinking, communication, self-management, leadership skills, interaction, self-esteem, and responsibility.
- Lateral Thinking: Edward de Bono (1991) introduced in his book the lateral thinking as a possible way to unlock the creativity thanks to a series of techniques in groups or alone. Those techniques are based on the concept that it is possible to use a provocative and deliberate thinking in a not-obvious way. A full description of lateral thinking is described in chapter 4.1

2.4. THE IMPORTANCE OF THE CREATIVITY IN VET



In Vocational Education and Training, the activities are usually related to practical and manual activities carried out usually on a work-based learning environment.

The ongoing technological and social changes are compelling VET sector to better prepare learners for work situations that are unpredictable and frequently requires the creativity that is immanent in design and innovation.

Because creativity is a concept that requires to be understood at political, educational and societal levels, it is extremely important to address the need for a cultural shift in VET sector that involves all the staff.

European Commission has declared the creativity, together with the innovation, as one of the main common EU objectives for European Policy cooperation 'ET 2020' – it is the strategic framework for European cooperation in education and training.

2.5. A REAL CHALLENGE: IMPLEMENT CREATIVITY IN VOCATIONAL EDUCATION AND TRAINING

German Erasmus+ National Agency BiBB published a study about innovation and creativity for Vocational Educational and Training (Weiß, 2009). It emerges that creativity and innovation flourish best where there is space for the students to act in a discretionary way and where the learning contexts have not been regulated and set in stone in advance.

What conception of the phenomenon of creativity is best suited to the field of vocational education?

VET (Vocational Education and Training) aims to prepare people for employment in craft and industry, where there is an ever-growing requirement for creativity and innovation.



Following prof. Tangaard (2017) :

“It is my concern that an understanding of creativity be developed with vocational education and training in mind. It is not enough to import models from other areas, where the distinction between ideas and production or creativity and execution is often relatively hazy and therefore not well suited for VET comprising production, handcraft and industry. In Europe, vocational education schemes are considered the solid base on which almost all kinds of industry and craft depend. If Europe is to retain its innovative capacity, then vocational education, especially the capacity of VET courses to nurture the creative potential of students, must play a key role. Both service-oriented and productive industries need employees who are capable of recognising new opportunities and inventing new products and undertakings. Moreover, the rapid rise of technology in the global economy has highlighted the need for our human capacity to adapt to these technological changes and continue creating and developing.”

However, can we say that, in our various countries, we are on our way to a more creative educational system and more creative teaching that will assure the preconditions for innovation at all levels of the system, including vocational education? The answer seems to be “yes and no.” On the one hand, we know quite a lot about what is needed. On the other hand, there is not much evidence to suggest that educational systems around the world are able to address the challenge”

2.6. EXPERIMENTS:

InnovatiVET project consortium has carried an experiment aimed to introduce the creativity in a Vocational Education and Training context.

The experiment by EURO-NET was about the use of LEGO©bricks for vocational orientation and career advisory – the full report of the training experiment is published on InnovatiVET website under the section “documents”.

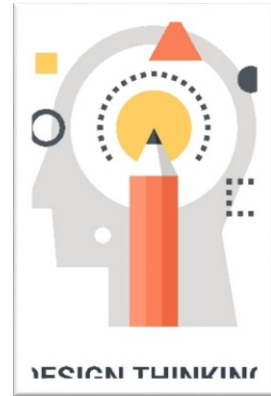
www.innovativet.eu

3.1. WHAT IS DESIGN THINKING?

Design Thinking (DT), in its modern format, can be described as a “methodology that imbues the full spectrum of innovation activities with a human-centred design ethos” (Brown, 2008, p.86). Traditionally, DT has been utilized as an approach by designers of commercial products, processes and environments (Elsbach & Stigliani, 2018; Kimbell, 2011). Due to its apparent capabilities of fostering innovation and solving complex problems (Brown, 2009; Dorst, 2011), DT evolved from merely the realms of designers, to the field of management, where it could be used to solve managerial problems (Elsbach & Stigliani, 2018). Notably, DT’s ability to positive influence business performance, such as growth and profitability (e.g., Chiva & Alegre, 2009; Gemser & Leenders, 2001), and innovation capabilities (e.g. , Filippetti, 2011; Menguc, Auh, & Yannopoulos, 2014), is well documented.

This has understandably led to a greater industry demand to DT not only being a managerial skill, but an integrated manner of the way people work – right at the heart of a company culture (Kolto, 2015).

Rather than identifying as a technology- or organization-centred approach to problem solving , DT practitioners associate themselves as a human-centred approach to problem solving (Kimbell, 2011), corroborating with Brown’s emphasis on DT having a human-design centred ethos (2008). That is to say, that by focusing on users’ experiences - especially emotional ones (Kolto, 2015), companies and their employees can see the world through their customers’ eyes and hearts, generate products and services that improve their lives - a necessary component to survive and succeed in today’s complex world (Stigliani, 2018).



Source 12-08-2019 from [Colourbox](#)

Jeanne Liedtka, Professor at the Darden School of Business, explains in the following table why design thinking works (Liedtka, 2018, p.74):

Table 6: Design Thinking in brief

The Problem:	The Cause:	The Solution:
While we know a lot about what practices stimulate new ideas and creative solutions, most (innovation) teams struggle to realize their benefits.	People’s intrinsic biases and behavioural habits inhibit the exercise of the imagination and protect unspoken assumptions about what will or will not work.	DT provides a structured process that helps innovators break free of counterproductive tendencies that thwart innovation. Like Total Quality Management, it is a social technology that blends practical tools with insights into human nature.

3.2. THE IMPORTANCE OF DESIGN THINKING IN VET

Due to DT's increasingly important role in industries, DT's role in education has also accordingly grown in importance, not only for students, but for teachers as well, due to the expected link between school, workplace and employee (Helms Jørgensen, 2004). The teaching profession necessitates continuous learning and development, as they deal directly with human capital (Harris & Jones, 2010). More specifically, teachers are expected to continuously update information, knowledge, practices and methods, to guarantee improvements of students' abilities and aptitudes (Lieberman, 2000). Therefore, "a school is not only a place for students to learn new knowledge and skills but also a workplace where teachers can learn and improve their profession - essentially, they need to frequently update their profession's knowledge" (Phusavat, Hidayanto, Kess, & Kantola, 2018, p.737). This signifies that DT can serve as a bridge to not only the workplace and school, but also within the school and amongst the teachers.

DT in a setting of Vocational Education and Training is a collaborative process involving diverse participating stakeholders as exemplified by UDDX (2015c), where innovative solutions to improve educational practices were derived for the benefit of students and teachers alike. In addition, the structure of Design thinking creates a natural flow from research to rollout (Liedtka, 2018), thus facilitating a process for innovation and change. It is a structured process that through its methodology guides you through the process of effective problem solving from beginning to end solution by applying different types of tools and exercises (Design Council, 2019b).

3.3. DESIGN THINKING FRAMEWORKS

An exhaustive list of DT methodologies and frameworks have been developed over the previous decades (see: Elsbach & Stigliani, 2018). For the purpose of this toolkit, integrated models from UDDX's toolkit (UDDX, 2015c) with the Double-Diamond Model (Design Council, 2019b) will be used to explain how to achieve innovative solutions with DT in VET. This framework is explained in greater detail in chapter 4.5.

InnovatiVET wishes to apply DT in the VET sector by seeing it as a medium for co-creation (Kambil, Ginsberg, & Bloch, 1996; Prahalad & Ramaswamy, 2004) of education amongst stakeholders whom in InnovatiVET are defined as **teachers, students, and companies/industries**. This will aid in better preparing VET institutions delivering graduates who have the necessary 21st century skills for the future workplace. While DT has in many instances been used internally in organizations and institutions, the inherent advantage of including an external partner is an increased motivation and will to succeed from all parties (Lystbæk & Harboe, 2018).

3.4. CHALLENGES OF IMPLEMENTING DESIGN THINKING IN THE CLASSROOM

While the benefits of DT and education are apparent due to its relation to developing and harnessing vital 21st century skills (Lor, 2017), implementing it into the classroom is another matter entirely. There are several issues that need addressing if you are to implement DT in your classroom:

Craft skills vs. the human-centred approach

VET is traditionally focused on craft skills and not centred on a deeper understanding of design principles (i.e., a human-centred approach), which involves human psychology, technology and society. While craft skills are still very important and relevant, it should be ubiquitous to pair these traditional skills with the human-centred design ethos (Brown, 2008) of DT. This will require quite a shift in mentality from the traditional teaching methodologies in VET, which leads to the second issue:

Teacher training & support for DT

In order for teaching staff to adequately implement DT into their curriculum, it is important for educational institutions to allocate time, space, financial and material resources, teacher support and training in DT-teaching and learning in order to increase expertise, as well as confidence (Kwek, 2011; Lor, 2017). In addition, it is also advisable to implement a mentorship model (Carroll, 2014) to not only help teachers in DT, but also students. Carroll (2014) further argues with teachers and students learning DT side-by-side under the council of a mentor, teachers will learn a good benchmark on how to teach it in the future.



Source 13-08-2019 from [Colourbox](#)

Lastly, Zupan, Stritar & Nabergoj's (2005) research encouraged the use of teaching teams instead of single teachers per class as this would lead to a focus on engagement rather than mastering theory.

Assessing student work and progression

When traditional numeric, grade-base systems are in place for assessing quality and progression of a student, DT can prove difficult to quantify, especially in terms of a student's capabilities. More specifically, "due to the nature of the process, learning outcomes may not be evident at the outset, which can be uncomfortable" (Collins, 2019) for the teachers. A solution for teachers could be to construct pacing guides to show how long each phase in the DT process should take and tie this into the student outcomes in order to keep the process on track.

Overcoming the fear of failure

Failure is a necessary part of the DT fabric. Failure spells disaster for many, but it should be (for both student and teacher) taught as integral part of the process. It permits the student and teacher to regroup, reassess and refine their issues and solutions! Adding small assessment tasks into the design process can aid alleviate the fear of failure (Collins, 2019).

3.5. EXPERIMENTS

The InnovatiVET project consortium has carried out two experiments aimed at introducing design thinking in a Vocational Education and Training context.

The full report of the training experiments conducted by FabLab London and EASV can be found on InnovatiVET's website www.innovativet.eu.

4.1. CREATIVE METHODS AND MODELS FOR VET WITH PRACTICAL SOLUTIONS AND TIPS

In this chapter there are some creative methods and models for VET with practical solutions and tips such as:

- APPROACH: Lateral Thinking
- UNDERSTANDING TOOL: 5WH + how (WHO? WHAT? WHERE? WHEN? WHY? HOW?)
- GENERATING TOOLS: Brainstorming and trigger method (tool)
- DESIGN THINKING: The Double-Diamond Model

The layout used is the following:

1. 1 page as **OVERVIEW** to understand the method/model by replying to the following questions:
 - a. What is it?
 - b. Why is it useful in VET?
 - c. What are the multidisciplinary details?
 - d. Links
2. **DESCRIPTION** pages: it consists in further in-depth analysis of the approach and of the tool. There is also space for the description and links to some cases –helping foster an effective implementation for relevant stakeholders.
3. **HOW TO** use the method/model/approach with practical details
4. **IMPLEMENTATION IN VET – TIPS** for an effective implementation and some practical **EXERCISES** ready-to-be used in the classroom.

4.2. APPROACH: LATERAL THINKING

4.2.1. OVERVIEW:

1. *What is it?*

Lateral thinking is not just a technique, it is a manner of solving problems using an indirect and creative approach via reasoning that is not immediately obvious. It involves ideas that may not be obtainable using only traditional step-by-step logic.

2. *Why is it useful in VET?*

Because this approach is useful to understand and better define some real problem that a worker could face in daily job activities where the availability of more alternatives could give more chance to solve the problems.

3. *What are the multidisciplinary details?*

Psychology, Management, Behavioural sciences

4. *Links*

<https://www.edwddebono.com/lateral-thinking>

<http://www.debonothinkingsystems.com/tools/lateral.htm>



Source: www.inkmedia.eu - 20/06/2019: available at <https://www.flickr.com>

4.2.2. DESCRIPTION

Edward de Bono is a Maltese physician, psychologist, philosopher, author, inventor and consultant. He originated the term lateral thinking.

Edward de Bono also links lateral thinking with humour, arguing there is a switch-over from a familiar pattern to a new, unexpected one. It is this moment of surprise, generating laughter and new insight, which facilitates the ability to see a different thought pattern which initially was not obvious.

Lateral thinking requires awareness, alternatives and provocative methods.

- Awareness: it is about the way in which people look at a problem taking into account some elements such as the dominant idea within peers/colleagues, polarising tendencies (e.g. either/or even if the situations could be very various), boundaries and limits put around a problem, assumptions
- Alternatives: it is about searching for as many different ways of looking at a problem as possible in order to have a larger selection of possible solutions to be applied and so therefore, have more chance to solve effectively a problem
- Provocative methods: de Bono introduces several techniques for ideation in order to gain insights into a problem such as: distortion and exaggeration, reversals, problem switching etc.

4.2.3. HOW TO

De Bono (2016) invented a method to deal with Lateral thinking conception: The **Six Thinking Hats**.

It is a way to have different viewpoints and it is useful during the planning phase. The hats represent some different types of thinking about a problem – each hat has a different colour as follows:

- BLUE: it is for the management, control and observation of the thinking process
- WHITE: it is for the information without any judgement, merely facts
- RED: it is for feeling, intuition, emotions both positive and negative
- BLACK: it is for the judgment, to highlight risks and dangers
- YELLOW: it is for optimism, to show positive effects and values
- GREEN: it is for creativity, alternatives, new idea

The usual thinking process is composed by a mix of almost all or most of the types of thinking expressed by the hat. The lateral thinking process is using the provocation that could be generated using only one thinking approach at once even if it is not the natural way the brain is used to work.

4.2.4. IMPLEMENTATION IN VET – TIPS AND EXERCISE

Set up in the classroom a problem and try to apply later thinking approach.

As an ice-breaking activity to the lateral thinking in a classroom could be related to the understanding of the problem, maybe it is possible to start with a question like:

- *How could I behave in order to be fired by my boss at work?*

This activity is intentionally designed to focus on the cause of a problem (e.g. insane behaviours that could cause a job loss).

Now, try to use the Six Thinking Hats in the classroom:

TIPS

- Try to write down or show on a paper the thinking hats in order to facilitate the assimilation of the concepts by the students
- During the exercises, the blue hat that is used to manage the thinking process should be used at the beginning and at the end in order to facilitate the process
- All other hats may be exchanged during the session by the facilitator
- The hats could be assigned to a person or to a group even if not all the hats are assigned
- In order to start and introduce better the method, the facilitator could ask to the students what is the hat they feel more comfortable with

EXERCISE

In a Vocational class it is possible to use the six thinking hats to analyse a problem and find a collaborative solution coming out from all the groups that are separate per “thinking hat” (the one they felt more comfortable with).

The context is a workplace – the problem is “energy costs are extremely high, and we need to find a solution to cut the costs”.

Let’s come out with thinking expressions by using merely one hat at once.

At the end the blue hat group is trying to consider all the options emerged and will come out with some possible solutions.

Attention: Never forget that the thinking hats are extreme thinking modes and should be used for a limited amount of time and that the managing blue should drive the game and the conclusions.

4.3. UNDERSTANDING TOOL: 5WH (WHO? WHAT? WHERE? WHEN? WHY? HOW?)



Source 07/07/2019: pixabay.com

4.3.1. OVERVIEW:

1. *What is it?*

The 5WH is a practical tool based on counter-measures and not on solutions.

It starts with the answer to six questions that are grounded in fact: it must be an account of things that have happened – not events that might have happened. That is the way to not create a process of deductive reasoning that could generate confusion.

The questions, used to explore available data are:

- WHO? – to identify players in action
- WHAT? – to understand the things (resources, actions) related to the fact
- WHERE? – to identify places, venues
- WHEN? – to identify time
- WHY? – to understand the reasons about the importance or the need
- HOW? – to identify steps, actions, activities involved in the situation

2. *Why is it useful in VET?*

Because the exploration of data is one of the main activities a worker is asked to face in a workplace. It is essential that a worker could face coming problems and that he/she is used to a rational thinking approach.

If this method is associated to a subsequent creative approach, it could become really powerful in terms of creating a career pathway.

3. *What are the multidisciplinary details?*

Data elaboration, rational thinking, psychology, behavioural sciences

4. *Links*

<https://5whaudit.wordpress.com/2013/06/14/the-5wh-technique-for-brainstorming-and-research/>

<http://endustri.eskisehir.edu.tr/ipoyraz/ENM%20311/icerik/5WH%20Technique.pdf>

<https://www.workfront.com/blog/project-management-101-the-5-ws-and-1-h-that-should-be-asked-of-every-project>

4.3.2. DESCRIPTION

A list of possible questions related to the single WH:

WHO?

Who is involved?

Who has more information about the fact/event?

Who can I talk with to receive more observation?

Who has strong feelings about the situation (positive or negative?)

WHAT?

What are the materials available?

What information can I recall about the situation?

What are the observation about the situation/problem?

What are the elements I am not able to understand at 100%?

WHERE?

Where are the places, locations involved in the situation?

Where should I go for more detailed information?

Where are my and others' impressions coming from?

Where can I go to find replies to my unanswered questions?

WHEN?

When is the best time to gather information about the situation?

When my impressions about the situation is stronger or weaker?

When is the right time to observe or analyse the situation to have more complete understanding?

When an answer should be available?

WHY?

Why has this information become an issue?

Why has the situation observed happened?

Why the feelings about the situation are changed for me or for the others?

Why do the questions I have remain about the tasks /situations?

HOW?

How do my impressions about the situation get formed?

How the steps happened in the situation?

How the activities carried out influenced the situation?

How can I gather more useful information about the ongoing situation?

4.3.3. HOW TO

Remember that some pieces of the data collected are more useful and valuable than others.

Take care to have in mind that some data could distract the attention rather than help to understand the situation.

It is possible to use a tool called “Selecting Hits”: it is a focusing tool used to screen and analyse a wide variety of available options. A HIT is an option selected to be interesting or promising. To select the hits, it is necessary to use some internal criteria, experience and judgement.

The hits can be then sorted into the following three directions:

- KNOW: data known and available at that time
- NEED TO KNOW: data that must be available and discovered to understand the current situation
- LIKE OR WANT TO KNOW: helping or supporting information useful to better detail the situation

4.3.4. IMPLEMENTATION IN VET – TIPS AND EXERCISE

In a vocational class, a possible situation where to apply the 5WH method is a real ongoing situation the students are really aware about. This could help to involve them in the process. For example, it could be analysed in the following situations:

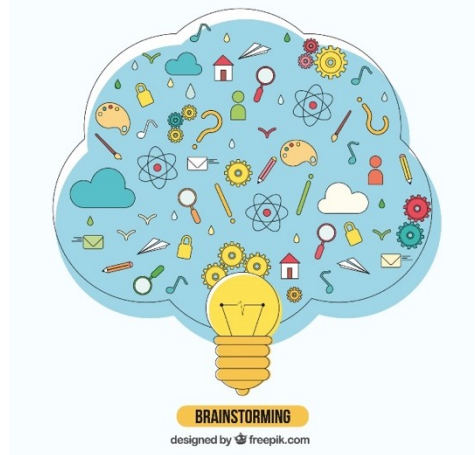
- Engagement of the students in the lessons
- Study/free time balance
- Stereotypes and bullying treatment

4.4. GENERATING TOOLS: BRAINSTORMING AND TRIGGER METHOD

4.4.1. OVERVIEW:

1. What is it?

Brainstorming is an approach invented by Alex Osborn as a set of guidelines to generate a creative collaboration in a group in order to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by the group. People can think freely and generate spontaneous insights in a context where the ideas are not criticised or evaluated.



It is important to not confuse it with group discussion where usually it is declared that all ideas are welcome.

2. Why is it useful in VET?

Because the students are not used to express their opinion even if this attitude is largely requested by the job market.

Because the students are pushed to come out with their own ideas and to work in group.

3. What are the multidisciplinary details?

Social sciences, cognitive research, psychology, marketing

4. Links

<https://www.mindtools.com/brainstm.html>

<http://www.businessballs.com/brainstorming.htm>

www.brainstorming.co.uk/

4.4.2. DESCRIPTION

Osborn (1979) set up four basic rules for a brainstorming session:

1. Criticism is not permitted- judgement of ideas is not out loud
2. Free-wheeling is welcome – weird, strange and wild ideas are asked to emerge – participants should not be afraid to express their thoughts
3. Quantity is required – more and more ideas should be generated
4. Combinations and improvements are good – ideas of others could be improved, changed and revised in order to generate a new idea



A possible brainstorming process:

1. Define and agree a clear objective.
2. Set up a time limit
3. Categorise and combine the ideas
4. Assess and analyse the effects and results
5. Create a priority and rank list if appropriate
6. Agree to a proposed action and timescale
7. Control and monitor the follow-up

4.4.3. HOW TO

In order to be more effective during a brainstorming session it is possible to use, as described following, the post-it support and the trigger method.

POST-IT



Source 07/07/2019: pixabay.com - Image by [rawpixel](#) from [Pixabay](#)

During brainstorming sessions many options can come to mind very quickly, and this can become an obstacle. During a group session if only one person is writing down ideas, it could be possible to lose some interesting ideas or to slow down the free process. A way to deal with this is to let all participants to use Post-it notes to collect ideas. A moderator might help to capture the ideas or to sort it in some way.

Participants write their ideas down – one idea per Post-it note, then they say out loud their idea and then place it on the flip-chart paper. By saying ideas out loud, it possible to foster the creativity of others in revising, changing and adapting an idea coming from another participant.

TRIGGER METHOD

The method works perfectly together with classic brainstorming.

The procedure is:

- Read out a statement of the problem to a group of participants
- Ask each participant to record idea in silence (five minutes are enough)
- All participants, one by one, are asked to read out their ideas to the rest of the group
- The ideas read out are discussed for about 10 minutes with the objective to develop variations and adaptation of the ideas
- The procedure continues until all ideas have been discussed

4.4.4. IMPLEMENTATION IN VET – TIPS AND EXERCISE

- Brainstorming should address only a specific question because the sessions addressing multiple questions are inefficient.
- Use post-it as a way to manage the process
- Use trigger method as a way to manage the group
- One moderator is necessary to set up the timing
- For larger groups is better to have more than one moderator

In a classroom, thanks to post-it and flipchart, run a brainstorming session about some topics such as: innovation in vocational education, effective ways to identify career pathways – the results at the end should be really interesting and usually different from the perception the teachers and educators have about it.

4.5. DESIGN THINKING: THE DOUBLE-DIAMOND MODEL

4.5.1. OVERVIEW

1. What is it?

The Double-Diamond model (Design Council, 2019b; Next Generation, 2018), is a model by which to spur creative processes to facilitate innovative solutions. Divided into four steps – Discover, Define, Develop and Deliver – the Double-Diamond combines both divergent and convergent thinking (see chapter 2.3 for more) in an iterative process, connoting that “ideas are developed, tested and refined a number of times, with weak ideas dropped in the process” (Design Council, 2019b). Before delving into the four steps, you must first identify a broad challenge at your place of work (*the general problem blue dot in figure 1*).

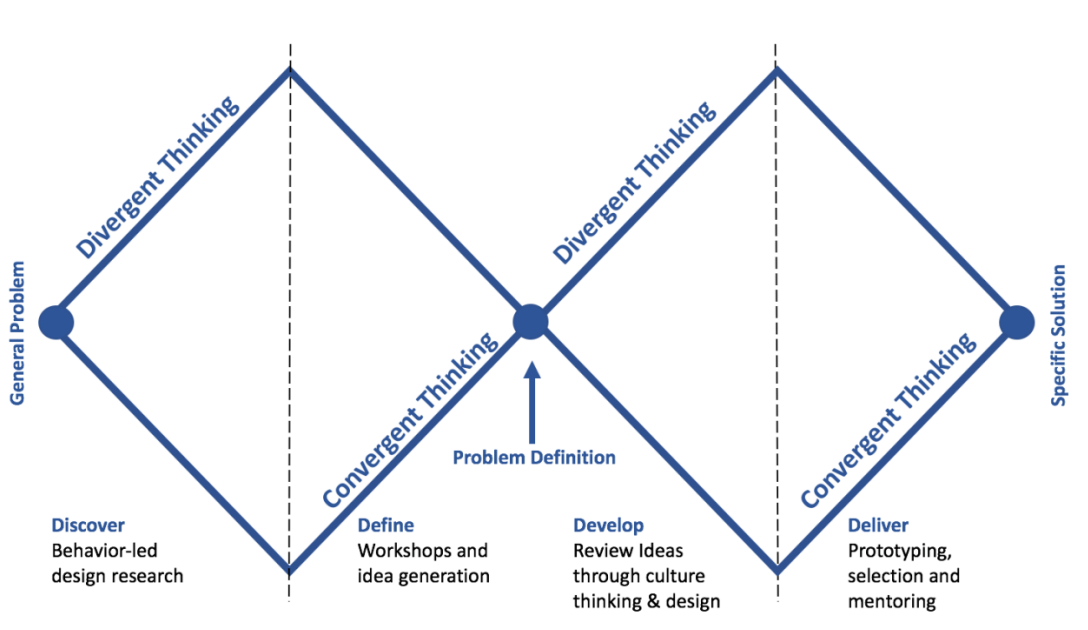


Figure 1. InnovatiVET's interpretation of The Double-Diamond Model (original version by: Design Council, 2019b)

2. Why is it useful in VET?

Tim Brown states in his publication *Change by Design* (2009), that design is a collaborative effort between diverse participating stakeholders and competences and that ideas have to be envisioned and prototyped in a hands-on way early in the design process. This collaborative effort between customers (e.g. companies, students) and other stakeholders (e.g., teachers, school boards, governmental institutions) in the definition of the problem and the development of solutions, garners a broad commitment to change (Liedtka, 2018). The Double-Diamond model encourages such collective efforts. Furthermore, personal and professional relationships are developed during the design process and they play a significant role in successful implementation and maintenance of the design (Dindler & Iversen, 2014), as well as emphasizing focus on the people you design for (Stigliani, 2018).

Change within organizations often elicit negative responses (Oreg, Vakola, & Armenakis, 2011), however, structured processes install confidence in the process, calms the process of change and generates traction.

As a consequence - psychological safety is essential to a process of change and innovation (Liedtka, 2018). According to Lucy Kimbell (2012), structure is not garnered in organizations, or in technology, but is enacted in by users in practice – so following a structured process like the Double-Diamond model can cater to a feeling of psychological safety and a willingness to change!

3. *What are the multidisciplinary details?*

Design, Innovation, Creativity, Cooperation, Empathy, Ambiguity, Collaboration, Constructive mind-set, Curiosity, Holistic mind-set, Iterative Process, Non-judgemental, Open mind-sets, Abduction (Dam & Siang, 2018a).

4. *Links*

- [The Double-Diamond Model](#)
- [Double-Diamond Explained](#)
- [TEDtalks on Design Thinking](#)
- [What is Design Thinking?](#)
- [Design Thinking Bootleg](#)
- [Hello Design Thinking](#)

4.5.2. DESCRIPTION & HOW TO

Step 1: Discover

The first action to take in Step 1 is not a mental exercise, but in fact, a physical activity – creating a project space, also known as a Solution Space. The Solution Space is a useful area to establish for several reasons (Design Council, 2019a; Next Generation, 2018):

- Aids you in making sense of large amounts of information
- Gives your project visibility and credence
- Allows you to share your vision to others and construct a story (which also allows others to contribute)
- Holding all your meetings and creative sessions in your Solution Space can help stimulate ideas



Figure 2. [The IDEO Toy Lab](#) (example of a Solution Space)

After creating a Solution Space, you must gear yourself and your team towards gaining empathy (Doorley, Holcomb, Klebahn, Segovia, & Utley, 2018) towards your users (e.g. students, teachers, industries). This is necessary in order to succeed at the cornerstone of DT: the human-centric approach (IDEO, 2012; Kolto, 2015). How can we truly understand our ‘users’ if we do not understand their values, needs and problems? We must imagine the world from multiple perspectives, and ensure a people-first approach (Brown, 2008), which therefore allows us to “focus on our users’ experiences,

especially their emotional ones” (Kolto, 2015, p.4). This means we need to conduct behaviour-led design research:

- *Observe*: Use observations of how users interact with their environment. Photo and video user-based studies can aid in shedding light on needs that users have or may not be aware of yet (Mortensen, 2019). Write down specific quotes when they comment on their experiences. Think about what seems intuitive for the users, where do they need help most, what are they missing, etc.
- *Engage*: Interview your users in order to gain empathy (Doorley et al., 2018) and a deeper insight into their beliefs and values. Make sure to brainstorm with your users (see chapter 4.3 for more).
- *Immerse*: Put yourself in your user’s situation. Understand whom you are designing for. What really matters to them, identify the specific type of user you want to design for, and “use your insights to design innovative solutions” (Doorley et al., 2018, p.3). This can also be known as “bodystorming” (Mortensen, 2019).

Once you have gained an insight into your users, you can now commence a Double-Diamond workshop!

Make sure to have several participants physically present - namely **teachers** and **company representatives** that all are involved with vocational education and training (you can also include **students** should you wish). It would be ideal if the participants already know each other, as design is best understood by entering already existing networks of working relationships and navigating from there (Dindler & Iversen, 2014).

We suggest scheduling **two sessions of four hours** with a week in between. It can also be split into **four sessions of two hours**.

You can now focus on the ‘discover’ aspect of step 1. In order to do so, you must first gain insights into the challenge you face. Ideally, with your team, open a constructive discussion and investigate a broad range of ideas, opportunities and issues pertaining to your challenge. Make sure to focus on what works and what needs to be done, instead of only looking at challenges as problems – also known as an appreciative inquiry methodology (Cooperrider, 2013).

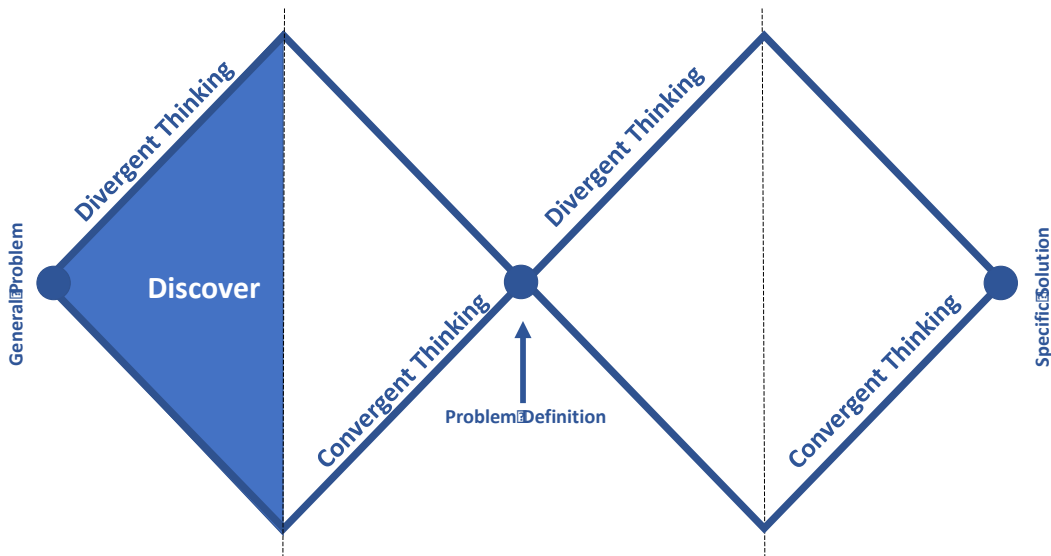


Figure 3. Discover: InnovatiVET's interpretation of The Double-Diamond Model (original by: Design Council, 2019b)

The point of the 'discover phase' is to use divergent thinking to identify strategic challenges to the organization. Participants follow a script, whereby using the Idea swarm tool (UDDX, 2015c), participants will follow three steps – namely brainstorming, presentation and thematisation (see figure 4 for more).

This session will have an approximate duration of 30 minutes. The post-its will serve as a medium for idea generation and the important notion is to hear all thoughts and have them thematised with headers. The headers are now representing the challenges. The main notion is to look at what the challenges have in common.

An example of a script on identifying a strategic challenge

This script is an example of the organization of a process when working with mapping out challenges.					
Materials, props etc.		Post-its, writing utensils, mega post-it (flip-over/A1-paper), assorted tools from the toolbox.			
Time:		o'clock			
Participants:		Strategic/organizational level, for example managers, development employees, educational counsellors and core competence employees.			
Purpose:		The purpose is to make the participants discuss and choose the most important challenge(s), the organization is facing, and that needs a new practice created for.			
Time	Focus point	Description/process	Activity	Materials	Tools
5 mins	Get ideas	The purpose is to lay as many challenges on the table as possible.	The participants are to sit individually and write down ideas of challenges on yellow post-its.	Yellow post-its, writing utensils	Idea swarm
15 mins	Share ideas	The participants are to talk about their ideas of strategic challenges.	The participants will take turns at putting their challenges with a short explanation on a mega post-it on the wall.	Mega post-it, markers	Idea swarm
5 mins	Group ideas	The participants will group challenges into topics.	Standing by the mega post-it hanging on the wall, the ideas are grouped into overall topics. The topics will make the challenges more transparent.	Markers	Idea swarm

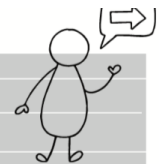


Figure 4. Identifying a strategic challenge (UDDX, 2015c, p.14)

Additional tools to help discover insight into your challenge:

- [The Five Whys](#)
- [Challenge Maps](#)
- [Mind mapping](#)

- [Photo Safari](#)

Step 2: Define

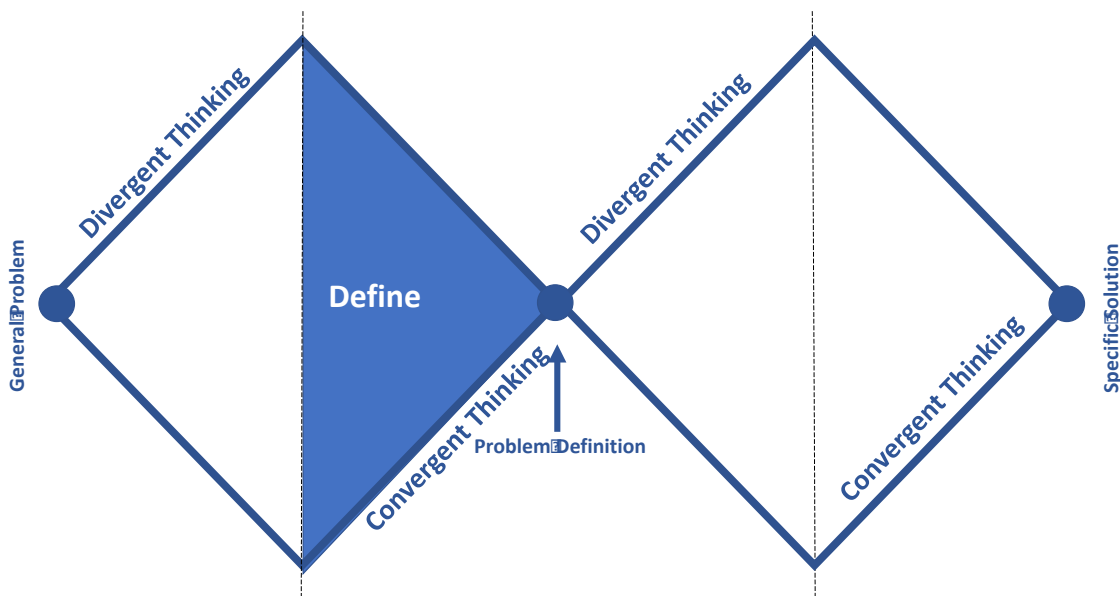


Figure 5. Define: InnovatiVET's interpretation of The Double-Diamond Model (original by: Design Council, 2019b)

Results from the discover stage now need to be analysed and developed in greater detail (Next Generation, 2018). Unlike the 'discover' phase, where divergent thinking prevails, the 'define' phase focuses on convergent thinking.

While the former step resulted in thematic challenges, the 'define' step works on prioritizing the thematised challenges. It is important to note that the double-diamond model is a non-linear and

reiterative model – if new themes have been identified in phase 2 which need more insight, then a return to step 1 to discover is very much possible!

Here you can apply the Bullseye tool (UDDX, 2015c), to prioritize and discuss in which prioritized order you see the challenges. The purpose here is that the participants co-create and stick to the thematic challenges identified and not the former personal post-it notes. The centre of the bullseye represents the most important challenge, the next outer ring in the bullseye represents the second most important and so on. This exercise should have a duration of approximately 10-20 minutes.



Figure 6. The Bullseye Tool (UDDX, 2015c, p. 17)

The next phase of step 2 is to look into detail of the found challenges and to organize them, in order to see what needs to be done more of and what to do less of, by means of the Organize-Storm tool (UDDX, 2015c).

The flip-over chart will then be organized into four squares as the following:

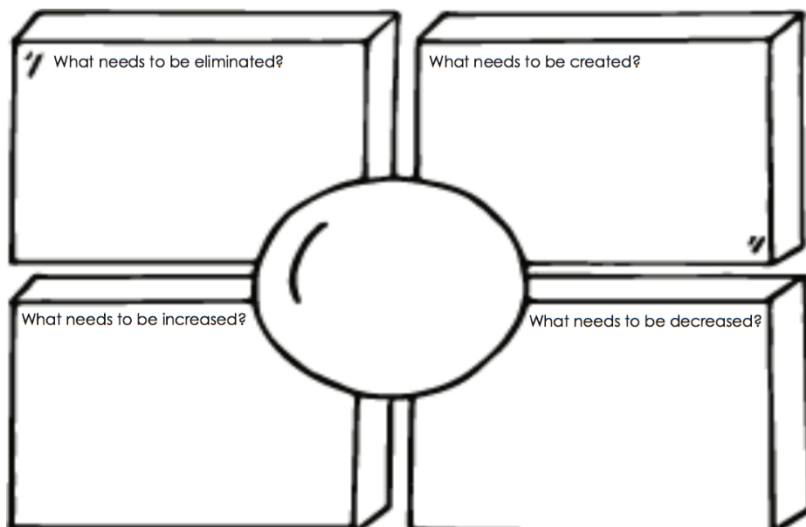


Figure 7. Organize-storm tool (UDDX, 2015c, p.19)

This tool will help to define each of the challenges. Furthermore, it is good to facilitate a discussion that brings different viewpoints and scenarios to the table. It will also highlight which one of the challenges which is the most interesting and best at addressing the initial challenge that was the initial

general problem. Applying Design Thinking processes counteract human biases that is a hindrance to creativity while addressing challenges to reach better solutions (Liedtka, 2018).

Additional tools to help the 'define' step:

- [Cluster analysis](#)
- [SWOT analysis](#)
- [Context mapping](#)
- [The Actantial model](#)

This exercise should take approximately 10-15 minutes per challenge.

Step: Problem Definition

Now we have reached the center of the Double-Diamond model and we need to follow three steps:

- 1) Defining the user and their relevant elements
- 2) Formulating a Point of View (POV) problem statement
- 3) Formulating a "How might we...?" question based upon the POV problem statement.

In order to best define the user and properly shape your POV problem statement and "how might we...?" question, you should answer the following questions (Greimas, 1987; Next Generation, 2018):

- a. **Subject:** A main actor (who may be the user)
- b. **Object:** What does the user want/ what is their goal?
- c. **Opponent:** Who or what is trying to prevent the subject from getting their object?
- d. **Helper:** Who or what can help the subject in getting their object?
- e. **Sender:** Who or what will be giving the object away?
- f. **Receiver:** Who will be getting the object at the end?

Your Point of View (POV) needs to be an actionable problem statement, a unique design vision framed by your specific users, be human-centred and be broad enough for creative freedom yet narrow enough to be manageable (Dam & Siang, 2019a; Doorley et al., 2018). Put simply, your POV needs three elements – *user, need and insight* (Dam & Siang, 2019a):

User . . . **(descriptive)]** needs [need . . . **(verb)]** because [insight. . . **(compelling)]**

Brown recommends integrative thinking (2008) to achieve this. This signifies on not only relying on processes which result in either/or choices, but also on understanding all the 'gray' areas of a problem – where contradictory statements will undoubtedly exist. This innovative technique will allow you create novel solutions beyond existing alternatives (Brown, 2008).

Additional tools to help defining your POV:

- [Affinity Diagrams](#)
- [Empathy mapping](#)
- [User Journey Map](#)

- [POV Madlib](#)

With a POV problem statement made, you now have an idea as to what the challenge is. However, we want to use this POV statement to start an individual brainstorming activity in order to create a more actionable solution-driven problem statement - namely the “how might we” question (Dam & Siang, 2018b)

For example: *How might we...design a course where students and teachers can improve their digital skills?*

This exercise should take 15-20 minutes.

Step 3: Develop

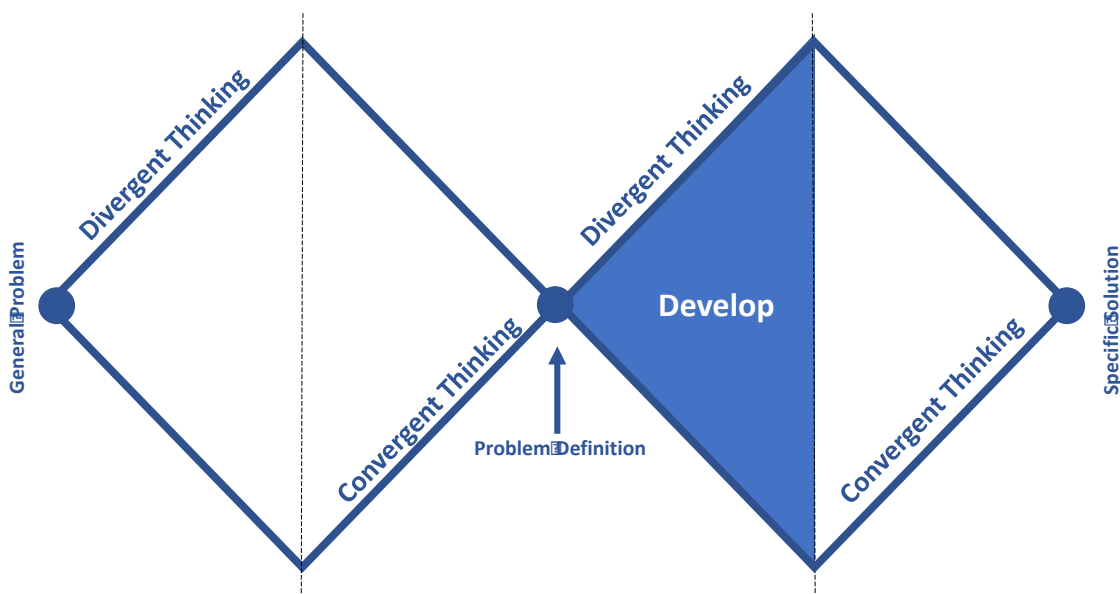


Figure 8. Develop: InnovatiVET's interpretation of The Double-Diamond Model (original by: Design Council, 2019b)

The ‘develop’ step focuses on transforming your main idea from the ‘define’ step into a specific product or experience (Next Generation, 2018). More specifically, we are trying to design a new practice/process/experience for teaching in VET that addresses our “how might we...?” question, which will abet in meeting the user’s needs and demands from the ‘discover’ and ‘define’ stages. It will be a plan of how things could and should work, as well as being different (Cobb, Confrey, DiSessa, Lehrer, & Schauble, 2003).

In the ‘develop’ phase we apply a new script for progression (see figure 10). The methodology here resembles that of the define stage but is more focused on realization (Next Generation, 2018). A brainstorming session with post-its of ideas on how to solve the “how might we...?” question starts the session in order to get creativity flowing and divergent thinking in progress (there should only be one idea per post-it as this helps facilitate the upcoming idea bazar – see following paragraph for more).

The post-it’s are then organised into themes of ideas and are given headlines. Again, the headlines are important to capture the essence of the ideas. We can now host an ‘idea bazar’, where the participants

walk around the room, read the ideas and pick three themes that they would like to work with. This leads to the effect that participants stop championing their own ideas/themes but buy into others' ideas. In addition, standing and walking around stimulates more divergent thinking and creativity than sitting (Zhou, Zhang, Hommel, & Zhang, 2017).

Once the participants' favourite themes have been selected, the next step is to apply them to the organize-storm tool (see figure 7) to a flip-over chart. The organize-storm tool will be used in a similar fashion as in the previous stage, defining what needs to be refined with the theme in order for it to work in solving the "how might we" question.

When the themes have been refined, they must now be prioritized against one another using the Bulls eye tool (see figure 6). The point here is to end up with one-two themes on which to focus on for the next step: *Pretotyping*.

Pretotyping (as opposed to prototyping), is a "set of tools, techniques, and tactics designed to help you validate any idea for a new product quickly, objectively, and accurately. The goal of pretotyping is to help **you** make sure that you are building **The Right It** before you build **It right**" (Savoia, 2019). The type of pretotyping carried out for the new educational practice is to create a storyboard (one per participant)!

By drawing images in the storyboard (see figure 9), this will help facilitate and visualize the creative themes on how they can be realized (or how the eventual prototype can appear) – essentially the vision of the solution to the "how might we...?" question. More specifically, the storyboard shows how you **wish** the solution to be. The participants must individually create a storyboard of how the idea can be realized, moving step-by-step through the storyboard squares and then present them to the group.

The entire 'develop' step should take 1-1.5 hours (see figure 10 for more).

Additional tools to help realising the 'develop' step:

- [User Journey Map](#)
- [Business Model Canvas](#)
- [Character Profiling](#)

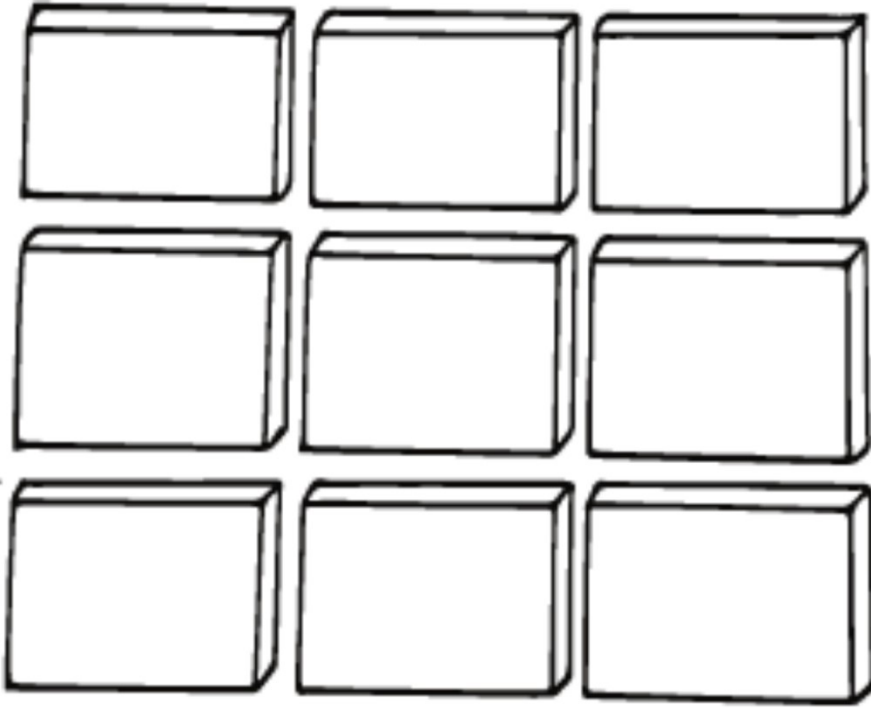
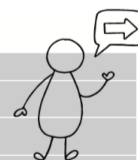


Figure 9. Storyboard template (UDDX, 2015c, p. 21)

An example of a script for the wish for a new educational practice



The script is an example of a process where you go from challenge to dream scenario.

Materials, props etc.	Post-its, writing utensils, mega post-it (flip-over/A1-paper), assorted tools from the toolbox.
Time:	o'clock
Participants:	Strategic/organizational level, for example managers, development employees, educational counsellors and core competence employees.
Purpose:	On the basis of the challenge, the purpose is to make the participants visualize the dream of a renewed educational practice. The prerequisite for using this process is that you prior to this has defined and described the challenge that needs working on. It is this challenge that provides the basis for the ideation that creates the framework for the wish for a new practice.

Time	Focus point	Description/process	Activity	Materials	Tools
10 mins	Idea swarm	The participants are to come up with ideas to describe a new educational practice (and that answers the challenge).	The participants are to individually sit and write on post-its. One idea on each post-it.	Yellow post-its, writing utensils	Idea swarm
15 mins	Share ideas	Standing by the mega post-it, the participants share ideas with each other.	The participants will take turns at putting their challenges, with a short explanation, on a mega post-it on the wall. There are only to be asked clarifying questions.	Mega post-it, markers	Idea swarm
5 mins	Collect ideas	The participants are to collect ideas in topics that belong together.	Standing by the mega post-it on the wall: the participants will group the ideas into topics and put titles on.	Markers	
5 mins	Select ideas	The participants are to select three ideas.	Each participant individually selects three ideas they believe answers the challenge in the best way.		Idea swarm
15-30 mins	Organize-storm	The participants are to use the challenge. The purpose is to create an overview of what needs to be eliminated, what needs to be created, increased or decreased in order to find a solution to a challenge.	The participants will place their challenge in the center of the tool. After this, the participants will discuss the challenges in relation to the questions in the four areas. The questions are used to emphasize what needs to be changed in the existing practice in order to solve the challenge. The four questions are: 'What needs to be eliminated' in our existing practice? 'What needs to be created?', 'what needs to be increased?' and 'what needs to be decreased?' While discussing, the participants will write in each area. If there are more challenges, each challenge needs its own sheet.		Organize-storm
10 mins	Dialogue about ideas in relation to the challenge	The participants are to select the right ideas that answers the challenge.	The participants are to revisit their ideas to a new educational practice from the beginning of the process. Based on the result from the organize-storm, the participants are jointly to select the best idea(s).		
A couple of minutes per idea	Bull's eye	Prioritization of ideas in relation to the challenge.	The ideas are placed on the target/bull's eye. The participants are to talk about what ideas answers the challenge in the best way and with than comes closest to the bull's eye.		Bull's eye
20-30 mins	Illustration of prototype of new, improved practice	The participants are to visualize their shared idea.	The participants are to illustrate their idea on a story board. They are to draw episodes/images/courses or what can best describe the prototype. There is also the possibility of drawing arrows from one situation/action to another, and in that way visualize for instance an effect or how two courses may interconnect.	Writing and drawing utensils	Story Board

Figure 10. Script – a new educational practice (UDDX, 2015c, p. 24-25)

Step 4: Deliver

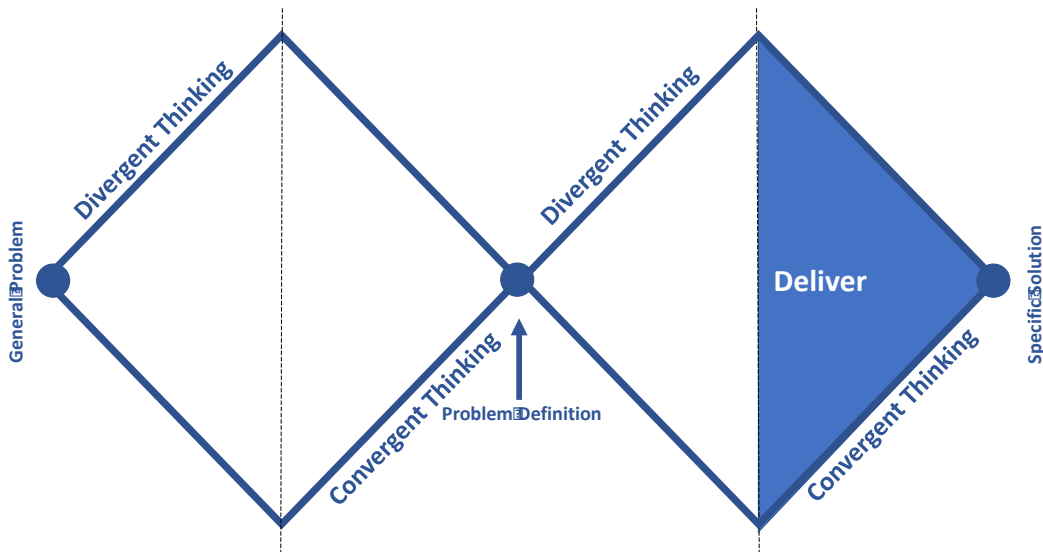


Figure 11. Deliver: InnovatiVET's interpretation of The Double-Diamond Model (original by: Design Council, 2019b)

The final step of the Double-Diamond model will result in a prototype for an educational practice and will be ready for execution. The prototype will be broken into concrete actions, all which are planned and organized (UDDX, 2015c).

Remember! Prototyping does not only mean creating a physical product and testing functionality – but also serves other purposes such as empathy gaining, exploration, testing and inspiration (Doorley et al., 2018). Beyond creating physical prototypes, it can also mean creating a wall of post-it notes with solutions and services, role-playing activities, sketching and 3D printing (Dam & Siang, 2019b; Doorley et al., 2018). Digital, physical or diagrammatic, prototypes' main objective is to communicate ideas

Prototyping tips:

Empathy Gaining

Prototyping deepens your understanding of users and the design space

Exploration

Develop multiple concepts to test in parallel

Testing

Create prototypes to test and refine solutions

Inspiration

Inspire others by showcasing your vision

(Kolto, 2015) - see table 7 for more.

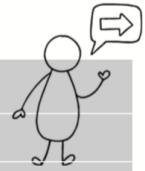
Table 7. Prototyping (Doorley et al., 2018, p.9)

The first course of action in the 'deliver' stage starts with a reflection upon the prototypes made in the 'develop' stage. Using this as a standpoint, a prototype can now be developed. A key principle for the prototype will be to 'design backwards' - meaning it provides a solution to the "how might we...?" question (UDDX, 2015c). In order to facilitate that process, we start out with another script (see figure 12).

Following the script, the following main stages are necessary in step 4:

- 1) Ideation, Sharing and Thematization
- 2) Circle writing and Pitch
- 3) Value attribution
- 4) Prioritization through innovative added value
- 5) Final selection and Prototype
- 6) Logbook implementation

Example of a script for the design of a prototype for the desired practice



The script is an example of the organization of a process where you work on getting, sorting and selecting ideas based on criteria and values. The aim is to produce a prototype.					
Materials, props etc.:	Post-its, writing utensils, mega post-it (flip-over/A1-paper), assorted tools from the toolbox.				
Time:	o'clock				
Participants:	Experiment participants				
Purpose:	The purpose is for the participants to generate as many ideas as possible, sort and prioritize them along with making a prototype.				
Time	Focus point	Description/process	Activity	Materials	Guide and tools
5 mins	Idea swarm	The purpose is to generate as many ideas as possible.	The participants are to individually sit and write on post-its.	Yellow post-its, writing utensils	Idea swarm
10 mins	Share ideas	The participants are to share their ideas with each other.	The participants will take turns at putting their challenges, with a short explanation, on a mega post-it on the wall.	Mega post-it, writing utensils. Mega post-it, writing utensils.	Idea swarm
5 mins	Collect ideas	The participants are to collect ideas in topics that belong together.	The ideas are collected, standing by the mega post-it on the wall.	Writing utensils	Idea swarm
1-2 mins	Select one idea	The participants are individually to select the idea that they think is important to work further on.	The participants will select an idea or group of ideas that belong together. The participants are not to agree on the selections and there may be coincidence in choosing of ideas.		
15 mins: approx. 5 mins per participant and 10 mins for compilation	Circle writing	In this process, the participants are to continue writing on each other's ideas.	The participants start out by unfolding their own chosen idea in the first column on the circle writing sheet ('Your idea'), approx. 10 lines. All participants pass the sheet on to the person sitting to their left, who will read it through and constructively continue expanding on the idea in the column for 1. Write through. After this, the sheet is passed on for 2. and 3. Write through (the number of write throughs depend on the number of participants). When you get your own idea back, you read through the write throughs and compile with the inspiration you have received from the other's.	Circle writing sheet, writing utensils	Circle writing
Approx. 1,5-2 mins per participant	Pitch	The participants are to share what their ideas look like now.	The participants stand/sit with their re-written idea paper in hand. Each participant pitches (presents – briefly explains) their idea to the other participants. You continue until everyone has pitched their idea.		Pitch
This process can be varied. It is important and can extend from 15 mins to several hours	Value attribution	The participants are to discuss the value of the different ideas in relation to one another.	The ideas that the group has pitched are to be discussed based on the value they add to the presented challenge. The tool will provide the framework for a wide-range talk about values. It is not as important to rank the ideas, as it is to talk about the value attribution of the designated ideas in multiple areas.	Value attribution sheet	Value attribution
Approx. 10-15 mins	Prioritization based on effect	Based on the four areas of the frame typography, the participants are to evaluate their ideas.	The participants lay down one idea at a time on the areas of the model and continuously discuss where the ideas belong. The group continues until all participants' ideas have been laid on the table and placed in the frame typography. The discussion decides the force for change of an idea and forms the basis for the final selection of the idea you wish to work further on, either in the way of an experiment or as action in the experiment.	The frame typography in print	Frame typography
	Final selection	The participants are to select the idea they jointly will work further on. What idea do they wish to make a prototype of?	Based on the value attribution and evaluation in the frame typography, the group will now select one joint idea, they will work further on.		
Approx. 30-45 mins.	Prototype	The participants are to visualize their joint idea.	Based on the following, the participants are to produce a prototype on a mega post-it: - make an expressive headline for the prototype - make a model/sketch/drawing/description that visualizes your prototype - make a metaphor for the prototype Each group is to present their idea to the rest of the participants or the recipient group.	Mega post-it, markers and accessible materials for the production of a prototype.	Prototype

Figure 12. Prototype script (UDDX, 2015c, p. 24-25)

1) Ideation, Sharing and Thematization

Start with ideation through post-its. It may seem counterintuitive to revert to ideation with post-it notes once again after developing a storyboard, but while the storyboard displays the **wishes** of the designer/user, this ideation session focuses on **how** to achieve these wishes (finished concepts).

Once the ideas have been shared with the other participants, they can then be collected in themes that fit together. The reason for doing so is to narrow down the amount of concepts (defined as themes) in order to progress to the circle writing session.

This session should take 20 minutes.

2) Circle writing and Pitch

Each participant chooses a theme to further ideate on (several participants can choose the same theme – but try to get all the themes covered) by means of a circle writing tool (see figure 13). The circle writing tool spurs creative processes by making each individual participant write down in detail the chosen theme on how to realise it. The advantage of this is that once completed by the initial participant, they must then pass the circle writing sheet of paper to the next participant, and then proceed to write down how they visualise this solution.

Once the circle writing document has been completed by all participants (one column per participant), then the participant who first filled in their sheet must collect all the thoughts into one coherent concept. This concept must then be pitched so that the idea is challenged in regards to whether it is a clear concept, that is explainable and so the design team can get an insight into the concept. You will also be able to detect any early flaws by doing this.

The circle writing session should take five minutes per participant per concept. 10 minutes per participant for compiling the participants' thoughts on each concept, and two minutes per sheet for the pitch session.

Your idea	1. write through	2. write through	3. write through

Figure 13. Circle writing tool (UDDX, 2015c, p. 29)

3) Value attribution

In this stage, we apply convergent thinking to analyse the concepts. In order to do that, you must apply the value attribution tool (see figure 14). This matrix tool serves to answer critical questions pertaining to solving the “how might we..?” question. More specifically, it highlights the positive benefits of the concept, its sustainability/longevity and identifies a clear target group. Oppositely, it also serves to highlight any potential ethical or moral dilemmas this concept could contain. The best concepts will have an ample list of benefits, while minimal to none ethical/moral downsides. The output generated here will serve to prioritize the concepts (in the following stage).

This session can range from 15 minutes to several hours.

What kind of value does the idea add?	Are there any ethical/moral or other dilemmas related to the idea?
For how long, does the idea have value?	To whom is the idea a value?

Figure 14. Value attribution tool (UDDX, 2015c, p. 32)

4) Prioritization through innovative added value

Now comes the time to prioritize the concepts you have developed in the previous stages! In order to best do so, you will now proceed to use the frame typography tool (see figure 15) for each of the concepts.

It is important to note, that at this stage the remaining concepts are all most likely well thought out and beneficial to your educational institution. However, you must now use the frame typography to prioritize the concept which will deliver the most innovative novelty value to your teachers, students, companies and other stakeholders (while still being feasible and realistic).

The best concept should focus on matrix 2 (new frame/known content) or matrix 3 (new content/known frame).

Concepts heavily reliant on matrix 1 (known frame/known content) should not be prioritised, as its contribution will only be limited and pertain to existing practises (in other words – it will not instigate change). Concepts lying in matrix 4 (new content/new frame) must be also be diligently considered to pursue, as this will take huge organizational efforts to implement such radical changes, whereas matrix 2 and 3 impose a more incremental change (Verganti & Norman, 2014).

The frame typography tool session should take 5-10 minutes per concept.

<p>1) Known frame/known content Well-known knowledge is used to qualify common working methods</p>	<p>2) Known frame/new content Well-known knowledge is used in relation to new tasks</p>
<p>3) New frame/known content New knowledge is used for developing well-known working methods</p>	<p>4) New frame/new content New knowledge is used for developing new tasks</p>

Figure 15. Frame Typography tool (UDDX, 2015c, p. 35)

5) Final selection and Prototype

After having placed all the concepts into the frame typography tool, you should have selected one concept on which to pursue a prototype for (*the final selection*).

Once you have the concept in mind, you must now apply the prototype for desired practice guide (see figure 16). The benefit with the guide, is that there is a shared concept and experiment within the design team and it will contain a concrete plan of how to conduct a new educational practice, that transforms ideas into actual actions. The prototype makes it possible to see the desired new practice and what the desired changes can lead to (UDDX, 2015c).

The time for the prototype session should take 15-45 minutes.



Guide: Prototype for desired practice

The prototype tool can be used by the experiment team to visualize their ideas for the experiment. It can be used before the team gets started on the actual planning. The aim is to prevent ambiguities and misunderstandings between the participants of the experiment and the actual experiment. It is an opportunity to concretize and clarify and by that create a shared image of their experiment ideas through actual models.

A prototype is a first unfinished model, either a picture or a sketch, of what you would like to achieve with one's actions. With the prototype you go from only using words about the experiment to using visual instruments. The visuals you compose can subsequently be used in the conceptualization and dissemination of the experiment.



What do we need?

Paper, mega post-it (flipover/A3) and writing utensils

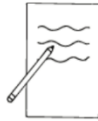
Guide:

By creating an actual model, the team visualizes their project idea. The team only creates one model jointly. Start out by asking the question:

- What is the purpose/aim of our experiment?
- After this, make a prototype consisting of:
- an expressive/illustrative headline
 - a sketch/drawing/model of the experiment
 - a metaphor

A metaphor is a proverb about the experiment, for instance, 'busy as a bee' that can be used as a metaphor for increased activity in the classroom.

The group draws out what they talk about and illustrate the connections with figures, arrows etc.



Participants: The experiment team

Time: 15-45 minutes

Good advice:

It is important that all experiment participants take part in the production of the prototype. You make a prototype in continuation of an idea selection process and before starting the actual planning of the experiment.

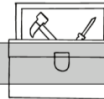


Figure 16. Guide to prototyping for desired practice (UDDX, 2015c, p. 36)

6) Logbook implementation

The final step is to create a reflection logbook (see figure 17). This logbook provides you with concrete planning tool as to whom does what, when and where (in other words – it is there to generate action!). Furthermore, it facilitates how the new practice should be tested in order to gain an outcome as well as how to collect data on the new prototypes' performance.

Tool: Reflections logbook – the design stage



Reflections logbook for the design stage			
Date:			
Focal points for the reflections logbook (examples)			
What acts need testing in the action?		What action do you need to collect data for?	
Where will you carry out the action? (education, place)		What needs evaluated in the action? (tool, method etc.)	
When will you carry out the action? (date)		What method will you use to collect data for the action?	
Who will be responsible for the carrying out of the action? (name)		Where will you collect the data? (education, place)	
Who will participate in the action? (name)		When and who Who will collect the data and when? (date and name)	

Figure 17. Reflections logbook (UDDX, 2015c, p. 38)

4.5.3. IMPLEMENTATION IN VET – TIPS

The Design Thinking Process can be implemented in VET wherever and whenever there is a *challenge* and a need for *change*. It instigates change through innovative non-linear processes, which can foster creative solutions to difficult challenges.

By applying this integrated version of the Double-Diamond model, you have now gone from a general challenge to an exact, innovative solution with the means of how to implement it, whilst co-creating with your most important stakeholders.

Keep the following in mind when starting a DT process in your educational institution (Design Council, 2019b; Doorley et al., 2018; IDEO, 2012):

- *You are a designer* → You are not a teacher using a DT tool. You are a designer! Be confident in your creative abilities!
- *Embrace your beginner's mind* → Approach challenges as a new beginner, even if you have background knowledge.
- *Stepping out of your comfort zone = Learning* → Challenge yourself, break your routine, use the outside world as inspiration, get stakeholders involved who can offer a fresh perspective, etc.
- *Problems are just opportunities for design in disguise* → Be optimistic, and say “what if” rather than “what’s wrong?”. DT is all about breaking routine and boundaries, you will not get anywhere with a negative mind-set.
- *Trust the process!* - The process can be long, sometimes infuriating and confusing. But failure is part of the DT process, and refining and improving the solution will at the end, result in a superior educational practice! But also remember....
- *Process are not written in stone* → The whole point of DT is to be adaptable to the many complex problems the world faces. Find out which processes work best for you, interchange them, adapt them. Be agile, and think like a designer!
- *Trouble with where to start?* → DT can be used to approach any challenge, but to start with, try focusing on the curriculum, spaces, processes and tools, or systems (IDEO, 2012).
- *Remember to evaluate!* → Report back by means of feedback loops (Design Council, 2019b) to inform of success and as well for future projects on how good design impacts a project’s success. Benchmarking, questionnaires and other performance metrics can all contribute to gaining a clearer understanding of how well your solution has worked!

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