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# CREATIVE PROBLEM SOLVING METHODOLOGY GUIDE



Co-funded by the  
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# Intellectual Output 3

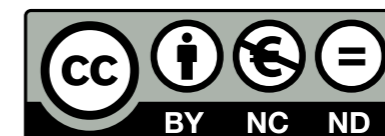
## GUIDE Creative Problem Solving

### Methodology



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# Preface

Professional workers face more complex jobs and responsibilities to be performed the last three decades. In the industrial era, jobs had to fit in fixed conditions, especially when machines needed to be operated. Vocational education and training nowadays needs to bridge the learners' knowledge, skills and thinking repertoire between leaving regular education and at the start of their job career.

Regular education focuses mainly on the transfer of stable curricular goals, while job demands become more and more complex problem solving, soft skills and strategic thinking. That's why the IV4J Project spends special attention to the more and more dynamic nature of VET skills and attitudes; can they be trained? Or is it just a case of encouraging apprenticeships to become more open to unforeseen situations, leave the comfort zones and become willing to change oneself?

This Intellectual Output 3 offers the conceptual framework to interlink Create Problem Solving Methodologies, Controlling Thinking Styles (Di- and Convergent) and finally Problem-based Learning Paradigms.

Crucial criterion is that the revealed conceptual framework becomes tangible and straightforward so that its impact can easily be grasped and implemented in various VET situations all over Europe. It is hoped that this I.O.3 output can be combined with the output of I.O.4 on the potential of the WEB 2.0 for VET. So far the expectation is that its combined message will be agile and vigorous in its working out. At least this IV4J Project has given optimal efforts to disentangle the two strands and finally blend its operational prescriptions.

Please feel welcome to all of you, to rethink our IO3/4 message and let us know how you see its potential consequences for real practice VET

The IV4J Project project team

*Piet Kommers*

# Introduction

This is a guide, supported by multimedia materials and practical vision, describing the Creative Problem Solving Methodology, explaining in details how to implement it in VET, introducing tips and providing a suggested quality management system.

The idea on the basis of this Intellectual Output is to apply the CPS methodology to innovate VET with an approach that is exploitable in large and different contexts.

## The selected approach is:

- Research all over Europe coming from the Good Practice research and further in-depth analysed and discussed during project meeting
- 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

**Chapter 1** is introducing the approach to the Creative Problem Solving all along Europe supported also by some success cases.

**Chapter 2** is describing the basic of the methodology with specific attention to definitions, the blocks to the creativity and explaining in details why CPS is important for Vocational Education and Training.

**Chapter 3** is introducing the explanation of divergent and convergent thinking patterns.

**Chapter 4** is analysing and describing in details a large series of tools and approaches to the Creative problem Solving Methodology. The content is enriched by a focus on full descriptions, practical details (ref. how to), exercises ready to be used in VET and also practical tips to increase the effective use of selected approaches, methodologies and tools.

Chapter 1. **CPS.**  
**Introduction to  
CPS and Research  
all over Europe**

## 1.1 Introduction to Chapter 1: Approach and Methodology used by each project partner

Research in own countries and and/or in other European countries.

Research is about:



Policies regarding Creative Problem Solving in education – research in own Nation and if not available extension of the research to the rest of Europe



Eventually a case study to support the policies presented – the case studies are described and collected only to support the description of the policies by highlighting the added value in terms of disruption in VET system and in order to increase the employability of the learners.

## 1.2 European Commission and the creativity

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

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



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That's the description of the objective as declared in the document ET2020:

*"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 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."*

The ET2020 framework initiatives are driving all the funding coming from the EU in the field of education and training, including Erasmus+: the EU's programme to support education, training, youth and sport in Europe.<sup>2</sup> Its budget of €14.7 billion will provide opportunities for over 4 million Europeans to study, train, gain experience, and volunteer abroad.

<sup>1</sup> 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](http://ec.europa.eu/education/policy/strategic-framework_en)  
<sup>2</sup> more info at <http://ec.europa.eu/programmes/erasmus-plus/>

## 1.3 Creativity learning needs in the world

Nevertheless, there is an evident lack of practical examples of the use of the creativity in the learning process, especially in the Vocational Education and Training, where it is evident the aim to prepare the learners for future job as required by the market.

In 2010, IBM launched a survey of more than 1,500 Chief Executive Officers from 60 countries and 33 industries worldwide, chief executives and, following the results, the creativity was selected as most crucial factor for future success.<sup>3</sup>

Guilford since 1950 declared that Western educational systems have problems providing opportunities to act creatively. The problem is that the educational system is that the students are tested for their ability to give the correct answer to established questions (convergent thinking) and rarely pushed to use a divergent thinking approach.<sup>4</sup>

Following Lene Tanggard (a psychologist from Aalborg University), the vocational education, thanks to its combination of theory and practice, might be the right environment for the development of the students' creativity – it was also proposed a model for the implementation of creativity in VET.<sup>5</sup>

The only country in Europe where it is available an evidence of creativity teaching is the United Kingdom<sup>6</sup>. In effect, there was an intensive activity connected with the will of the UK Government to implement the creativity in school system educational programmes. The largest approach converged in the Creative Partnerships programme Creativity, that defined a school as effective in the stimulation of creativity following some elements:

- Give value and celebrate creativity; the process as well as the outcome
- Develop creative pedagogies by encouraging professional collaboration, within and beyond the school
- Provide opportunities for pupils to experience a stimulating physical environment and to engage with creative people
- Manage time effectively, providing opportunities for pupils to explore, concentrate for extended periods of time, reflect, discuss and review.

Other examples and case are available in Europe, mainly in Northern countries such as Finland, Norway, Netherlands and Germany even if more focused on the creativity of arts.

In North America, some evidence is available at academic level and only in Australia there is a large evidence of the implementation of the creativity in all levels of education and training.

<sup>3</sup> News reported online: <https://www-03.ibm.com/press/us/en/pressrelease/31670.wss>

<sup>4</sup> Guilford, J.P. (1950). Creativity. *American Psychologist*, 5, 444-454

<sup>5</sup> Skilled no. 1 - Das Magazin des Eidgenössischen Hochschulinstituts für Berufsbildung - <http://www.ehb.swiss/skilled>

<sup>6</sup> Skills for the creative industries - UNESDOC – Unesco – Report of the UNESCO-UNEVOC virtual conference 29 September to 10 October 2014 - [http://www.unevoc.unesco.org/up/2014eForum\\_Creative\\_Industries\\_Report.pdf](http://www.unevoc.unesco.org/up/2014eForum_Creative_Industries_Report.pdf)

## 1.4 A structured way to measure creativity in the problem solving: OECD PISA 2012 Results<sup>7</sup>

OECD is the Organisation for Economic Co-operation and Development (OECD): the mission of the Organisation for Economic Co-operation and Development (OECD) is to promote policies that will improve the economic and social well-being of people around the world ([www.oecd.org](http://www.oecd.org)).



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OECD is running a programme named PISA: The Programme for International Student Assessment (PISA) is a triennial international survey which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students.

**In 2012, PISA programme was focused on a way to measure Creative Problem Solving Students' skills in tackling real-life problems.** The test was about student performance in creative problem



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solving, which measured students' capacity to respond to non-routine situations in order to achieve their potential as constructive and reflective citizens. It provided the rationale for assessing problem-solving skills and describes performance within and across the 44 countries and economies that took part in the assessment.

**The results of the European countries, as mean score, within the project countries, are the following:**

- **Germany:** above the average with 509 points – ranking 17th position
- **Ireland:** a little under above the average with a mean score of 498 points – ranking 22nd position
- **Finland:** it performs at top scores, over the average with a mean score of 523 points – ranking 10th position (the 1st in Europe).
- **Italy:** above the average with a mean score of 510 points – ranking 15th position
- **Netherlands:** above the average with a mean score of 511 points – ranking 14th position

**Other European countries above the average score:**

- **UK:** 517 points – ranking 11th position
- **Estonia:** 515 points – ranking 12th position

<sup>7</sup> OECD (2014), PISA 2012 Results: Creative Problem Solving: Students' Skills in Tackling Real-Life Problems (Volume V), PISA, OECD Publishing. - <http://dx.doi.org/10.1787/9789264208070-en>



- **France:** 511 points – ranking 13th position
- **Czech Republic:** 509 points – ranking 16th position
- **Germany:** 509 points – ranking 17th position
- **Belgium:** 508 points – ranking 19th position
- **Austria:** 506 points – ranking 20th position
- **Norway:** 503 points – ranking 21st position

#### Other European countries under the average score:

- **Denmark:** 497 points – ranking 23rd position
- **Portugal:** 494 points – ranking 24th position
- **Sweden:** 491 points – ranking 25th position
- **Slovak Republic:** 483 points – ranking 27th position
- **Poland:** 481 points – ranking 28th position
- **Spain:** 477 points – ranking 29th position
- **Slovenia:** 476 points – ranking 30th position
- **Serbia:** 473 points – ranking 31st position
- **Croatia:** 466 points – ranking 32nd position
- **Hungary:** 459 points – ranking 33rd position
- **Cyprus:** 445 points – ranking 37th position
- **Montenegro:** 407 points – ranking 41st position
- **Bulgaria:** 402 points – ranking 43rd position

## 1.5 Problem-Based Learning as new Learning Paradigm



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It is important to observe that the learning environment is changing continuously under the continuous pressure of the change in the society and ICT disruptive invasion in the older educational systems. Education and Training design approach underwent three rather drastic shifts the last four decades.

### Regaining ownership

Traditionally, learning has been approached as a transfer process from those who have the skills and know-how to those who have not yet. In this still-dominant paradigm, the teacher/trainer has the role of “provider” and “arranger”, while the learner’s role is mainly the one of “recipient” and novice who “needs to demonstrate” that (s)he meets the agreed criteria. As the majority of professional learning faces “job performance”, this learning as “transfer process” is still the most dominant one; OECD 2010.<sup>8</sup> Assessment in this paradigm is the attempt to monitor and measure learning progress “objectively” and “reliably”. Two trends forced the educational and training practice to shift:

- the demand for more autonomous workers (one’s ability to cope with diverse and unforeseen situations)<sup>9</sup>
- the growing evidence from learning theories that accommodation and stepwise refinement not necessarily leads to far transfer: the learner’s capacity to apply acquired skills and understanding in completely new circumstances.<sup>10</sup>

An alternative to education as transfer process is the learner as central person; the learner reclaims ownership of the learning process and takes responsibility over the what, how and when to learn. Subsequently for advance VET it is the apprentice who builds up credentials in his/her portfolio (i.e. gathered products and reflections by the apprentice to provide evidence about his or her learning process and performance over time) and actively recruits reviewers who suggest lines for improvement. The mentor coaches the learner in coping with the received comments.

<sup>8</sup> OECD, 2010. Learning for jobs. Synthesis report of the OECD reviews of vocational education and training Organisation for Economic Co-operation and Development (OECD) (2010) <http://dx.doi.org/10.1787/9789264087460-en>

<sup>9</sup> Campaign: Healthy Workplaces 2014-2015 Healthy Workplaces Manage Stress. <https://hw2014.osha.europa.eu/en/news/does-more-job-autonomy-mean-less-stress-at-work>

<sup>10</sup> Helsdingen et al. The Effects of Practice Schedule and Critical Thinking Prompts on Learning and Transfer of a Complex Judgment Task, *Journal of Educational Psychology* 103 (2011) 383–398.

## Metacognition for Creative/Critical Thinking

New learning tools are computer-based tools developed and adapted to support the learning process. The tools to be considered are the ones that are able to facilitate the cognitive processing by the learners. Gradually we start to acknowledge that each learner is unique in terms of prior experiences at that very moment. At the early beginning of 'constructionist' learning, the notion of 'cognitive learning tools'<sup>11</sup> was compelling as it opened the door to make the learner actively involved in the delicate process of 'growing to understand'.

Metacognitive methods like schematizing the contours between 'knowing' and 'ignorance' became quite popular and stimulated instructional designers to capitalize on learners' capacity to study rather than learn; the term 'active learning' was coined. Processes like 'reconciling prior and new knowledge', 'guided discovery' and 'critical/creative thinking' entered both regular- and vocational education.

The wider variety of learning activities that promote a more meaningful, flexible (far transfer) and longer term learning process are often summarized as "elaboration" and offer new challenges for blended web-based environments where simulations and problem-based learning are in the center.

The concept behind is that, rather than develop technological ways to transmit knowledge it is required to teach learners how to think and improve the thinking process.

## Learning in the Context of Meaningful Competences

Based upon the economic urgency of vocational training, both the regular- and the corporate contexts have a high demand for continuous innovation and increased technological infrastructures. VET is the main supplier for the job market and is typically seen as underpinning foundation of the economy and societal backbone. The Netherlands counts more than half a million students in the VET sector, and about 90% of them are currently undertaking courses for 2.6 B.Euro yearly (about 12% of the overall national budget for education at large). There is a continuous trend towards recognizing that VET needs to be seen as "growing young peoples' competencies" rather than just acquiring knowledge and skills; Problem solving and competencies to make authentic contributions to labor settings are affecting the VET agenda increasingly important.

## Problem Solving in the Context of PBL (Problem-Based Learning)

Problem solving, critical thinking, curiosity and the learners' need to actively search for creative solutions became almost the default format for learning. Problem solving and creativity has a slightly different basis; its essence is that learners are better off once they feel ownership and thus add relevance to one's actual life. Scandinavian countries with Denmark in particular (Aalborg and Roskilde) and The Netherlands (Maastricht) are the main initiators. The goal is PBL (Problem-Based Learning) is not only to become a better problem solver. The real asset is to build life-long learning on the trust that its goal is not to acquire just recognition or a certificate: is to make a difference in real life. The PBL method capitalizes on learners' willingness to invest in fundamental questions: What is important in life? What do I want to offer to others and society? What is worth to learn? If and how do I want to change myself?

11 Kommers, P., Jonassen, D. & Mayes J.T. (Eds) (1992) Cognitive Tools for Learning, Heidelberg, FRG: Springer-Verlag.

## PBL as Ingredient for Blended Learning

Both face-to-face, collaborative and web-based learning demonstrate that 'variety' and 'fit for purpose' are values in itself. It is a good moment to include PBL as one of the ingredients for effective VET. Once vocational education targets a broader learning- and developmental process, PBL can be catalytic for didactic innovation; it stimulates VET designers and teachers to take a wider range of instructional practices into consideration.

PBL is mainly a didactical measure to re-install the learner as owner of his/her own learning process.

## 1.6 Contexts and cases in project partners' countries

### GERMANY

In Germany, the education policy debate and changes in light of PISA 2000 were intense (e.g. Ertl, 2006). Confronted with lower-than-expected results in student performance, PISA triggered a sustained public debate about education policy and reform that came to be known as 'PISA shock'.

The PISA-inspired debate over public education has resulted in a range of significant reform measures, including generating national standards and establishing further support for disadvantaged students, especially those from immigrant backgrounds (Ertl, 2006).

Germany, for example, initiated significant education policy reforms in response to lower-than-expected results (Bieber, 2010; Niemann, 2010).

PISA results are used as an external trigger for large-scale public debate on education and relatively rapid policy dialogue and policy change (e.g. Germany and Denmark).

The nature of the changes to policy or practice in Germany:

- Revision of curriculum standards, often to include and emphasise PISA-like competencies
- PISA was judged to have played a significant role in highlighting the need to initiate further national/federal assessments in order to strengthen the evaluation and monitoring of student learning outcomes
- PISA was used to monitor the performance of the 16 federal Lander in 2000, 2003 and 2006. Since the initial of a national assessment in 2009, PISA has no longer been used for this level of monitoring."

The validation study in PISA/Germany demonstrated the feasibility of both paper-pencil- and computer-based instruments for problem solving assessment in transfer domains. These instruments address competencies which are clearly distinct from literacy domains. As expected, the following propositions have been supported:

1. There is no way to define a general, unique “problem solving competence”. Rather, problem solving assessment produces a profile of competencies, varying in terms of context and setting (complexity).
2. Problem solving indicators, especially those based upon paper-and-pencil-tasks, are strongly correlated with reasoning, which in fact is the core of problem solving.
3. Strategy indicators derived from students’ behaviour in simulated environments do provide specific additional information. The national enhancement in PISA/Germany will include cross-curricular problem solving also for the main study in year 2000. It has been decided to use a written test (project tasks), a co-operative problem situation, and – for a sub-sample of about 800 students - two computer based tests (space game and ecological simulation). Based on this work and similar work done in other assessment projects, it seems reasonable to set up an international framework which integrates both domain-specific and cross-curricular problem solving. On the international level, new challenges will arise, such as the question of culture-fair testing. However, theoretical concepts as well as assessment techniques are ready for new developments.

## IRELAND

Having reviewed Ireland’s education and skills policies and strategies there is no formal statement regarding creative problem solving and VET. There are a number of oblique references to ‘problem solving skills’ but nothing very specific, or specific to VET. That being said there are some initiatives.

### Adapt - Problem-Solving Initiative

‘The ADAPT Centre for Digital Content Technology presents the Problem-Solving Initiative (www.problemsolving.ie). This two-year (2016-2017) nationwide initiative is funded by Science Foundation Ireland and is designed to help raise the Irish public’s awareness of and appreciation for the importance and applicability of problem-solving skills across science, the economy and society, promote STEM career pathways for those who enjoy solving problems, encourage people of all ages to hone their lateral-thinking skills and, create enthusiasm within the Irish public for problem solving by engaging people directly with exciting puzzles and mind-bending challenges’<sup>12</sup>.

The main activities of the initiative are ‘An extensive public awareness campaign to highlight and provide examples of the economic and social benefit of a strong problem-solving workforce, and exemplify careers requiring problem-solving skills...A family-friendly Problem-Solving Festival that invites public to “test their minds” with fun problem-solving activities in Dublin Castle on 5th

<sup>12</sup> <http://problemsolving.ie/about-us/>



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August 2017...Mind-bending puzzles made available to the public and shared via social media. A copy of their Problem Solving Initiative flyer can be seen at <http://problemsolving.ie/wp-content/uploads/2016/08/PSI-Trifold-AW.pdf>.

ADAPT Centre is a combined programme of all the universities in Dublin and is funded by the Government and thus represents an official programme promoting creative problem solving techniques.

### Other CPS activities

There are a number of privately-run programmes in Ireland relating to the improving CPS skills. The Irish Management Institute (IMI) runs a two-day professional programme on ‘Innovative problem Solving’<sup>13</sup>. A number of other consultancy/training programmes address problem solving. However, these are professional programmes aimed at managers and are expensive programmes which are not available for the majority of citizens interested in VET.

## FINLAND

Creative problem solving is one of the life- long learning skills and it is integrated as a learning method in the vocational qualifications in the Finnish VET system. It relates closely both to the vocational subjects and to the general subjects like languages and maths. All life-long learning skills aim to support students to become independent and confident citizens and participants in the global and national labour market.

Creative problem solving aims also at developing individuals’ activity, entrepreneurial thinking, motivation and persistence. It has been noticed, e.g. given by PISA, that the motivation is one of the main factors when solving problems. The relation between the significance of the results and motivation was remarkable.<sup>14</sup>

According to the PISA results, the differences between regions and different schools in Finland are not significant. The differences between girls and boys as well as between migrants and Finnish students are a challenge that has been perceived on a national level.<sup>15</sup>

Positive and creative problem solving skills are also key factors when developing a more tolerant and human atmosphere in Finland. This tolerance for the humanity and for foreign cultures is one of the aims in all school curricula in Finland.<sup>16</sup>

<sup>13</sup> <http://www.imi.ie/short-programmes/business-and-functional/innovative-problem-solving/>

<sup>14</sup> PISA 2012 - ongelmanratkaisu - Opetus- ja kulttuuriministeriö - <http://minedu.fi/documents/1410845/4085481/PISA+12+ongelmanratkaisu.pdf/e3648d19-152b-46bb-952d-50f855221e91>

<sup>15</sup> PISA 2012 ENSITULOKSIA tutkijoiden esitys - <http://minedu.fi/documents/1410845/4085481/PISA12+esitys.pdf/e48c95dd-e327-4a4f-9537-6c1c8e7535ba>

<sup>16</sup> RAKENTAVAA VUOROVAIKUTUSTA [http://www.oph.fi/download/182479\\_rakentavaa\\_vuorovaikutusta.pdf](http://www.oph.fi/download/182479_rakentavaa_vuorovaikutusta.pdf)

## Case: OMNIA

The City of Espoo enhances creative problem solving in a most interesting way: The Urban Mill located at the Aalto University Campus in Espoo Innovation Garden. Urban Mill is a place for innovations, innovators, students, professors and entrepreneurs. It is an environment that is intentionally designed for the use of different actors to solve problems related to urban life. New, innovative solutions are created, piloted and put in practice by teams and by individuals in Urban Mill. From there the innovations can be spread into the daily life of citizens or companies<sup>17</sup>.



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Creative problem solving is also an integral part of vocational training in Omnia. Mixed groups of students from different vocational fields and from different levels (e.g. VET students, polytechnic students and university students) solve problems given from entrepreneurs, teachers or municipalities in teams. Entrepreneurial thinking and acting is part of the teamwork. Problems and solutions related to real life situations motivate and encourage the students to come out of the box and think in a creative way. These multi-sectoral and blended teams are an excellent example not only of creative problem solving, but also of the professional teamwork that is the keyword for working life today<sup>18</sup>.

## ITALY

Italian Minister of Education is trying to introduce an integrated programme named "Atelier Creativi" (Creative workshops/laboratory). The aim is to valorise the laboratory didactics as places where to meet knowledge and makers. The local laboratories are transformed in places centred on innovation and creativity. The budget assigned to this action, in the 2016 - 1st call was € 28.000.000.

Atelier design should be focused on<sup>19</sup>:

- **TALENTS:** mix of creativity and crafting – leave space to creativity, practical problem-solving, confidence with hand-works
- **LANGUAGES:** humanistic but also numeracy – discover the language of children in order to know the surrounding reality
- **COMPETENCES:** autonomy and relationship (depending on the age the learners and ever in a collaborative design process)



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<sup>17</sup> further info at <https://urbanmill.org/english/>

<sup>18</sup> <https://wiki.metropolia.fi/display/teiminnoesp/In+English>

<sup>19</sup> "Atelier creativi e laboratori per le competenze chiave" - [www.istruzione.it/allegati/2016/Allegato\\_1.pdf](http://www.istruzione.it/allegati/2016/Allegato_1.pdf)

- **METHODOLOGIES:** process and products - take care about didactical process but also about concrete final outcome useful for the motivation and the self-evaluation
- **KNOWLEDGE:** interdisciplinary approach – curricula design – cross-collaboration in the laboratories and digital citizenship competences
- **DISCOVERING AND RESEARCH:** observation, research, experimentation, invention – in immersive and virtual environment
- **TOOLS AND INSTRUMENTS:** crafts and technology
- **MATERIALS:** curricula and materials

## NETHERLANDS

Particularly in the last few decades, Dutch primary and secondary education has been shifting towards ways of teaching and learning that go beyond mere reproduction of facts. Thanks to the fact that schools in the Netherlands are characterised by great autonomy, the Pupils are increasingly encouraged to think about and reach a meaningful understanding of the world they live in (e.g., Vermunt, 1992; Bransford & Brown, 2000; Iran-Nejad, McKeachie & Berliner, 1990; Vermetten, Vermunt, & Lodewijks, 1999).<sup>20</sup>

The most obvious source of good practice in PBL in The Netherlands can be found in the medical training by the University of Maastricht as it targets future general practitioners to become keen on diagnosing patients' underlying pathology rather than just matching medication to symptoms.

The essential web site that brings both the theoretical underpinning and realistic impressions is described at: <https://www.maastrichtuniversity.nl/education/why-um/problem-based-learning>



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<sup>20</sup> Radboud Teachers Academy - Radboud University, Nijmegen - Research Programme 2016 – 2021: "Cultivating Creativity In Education Interactions Between Teaching And Learning"

# EUROPE

Several Erasmus+ projects were dealing with the creativity.

A project that is relevant and it is also recognised as Success Story and Good Practice Example by the EC is: HANDS-ON ICT: LEARN, PRACTICE, TEACH CREATIVITY AND ICT<sup>21</sup>. The website of the project is: <http://www.handsonict.eu/>



copy 30.06.17 from [http://blogs1.uoc.es/handsonict/files/2015/07/cropped-cropped-Hands-On\\_logo-Web\\_con-texto.png](http://blogs1.uoc.es/handsonict/files/2015/07/cropped-cropped-Hands-On_logo-Web_con-texto.png)

The project funded under LLP and it aims to facilitate the inclusion of ICT tools in education via 2 main outcomes:

- a MOOC for teachers training in creativity techniques with the support of ICT tools following a learning design studio approach
- a toolkit for face-to-face workshops. The course has a 5-week MOOC format putting the educators in the position of a learning designer and encouraging a hands-on approach that ensures that they get the necessary practice to use these tools and techniques in their classrooms afterward.

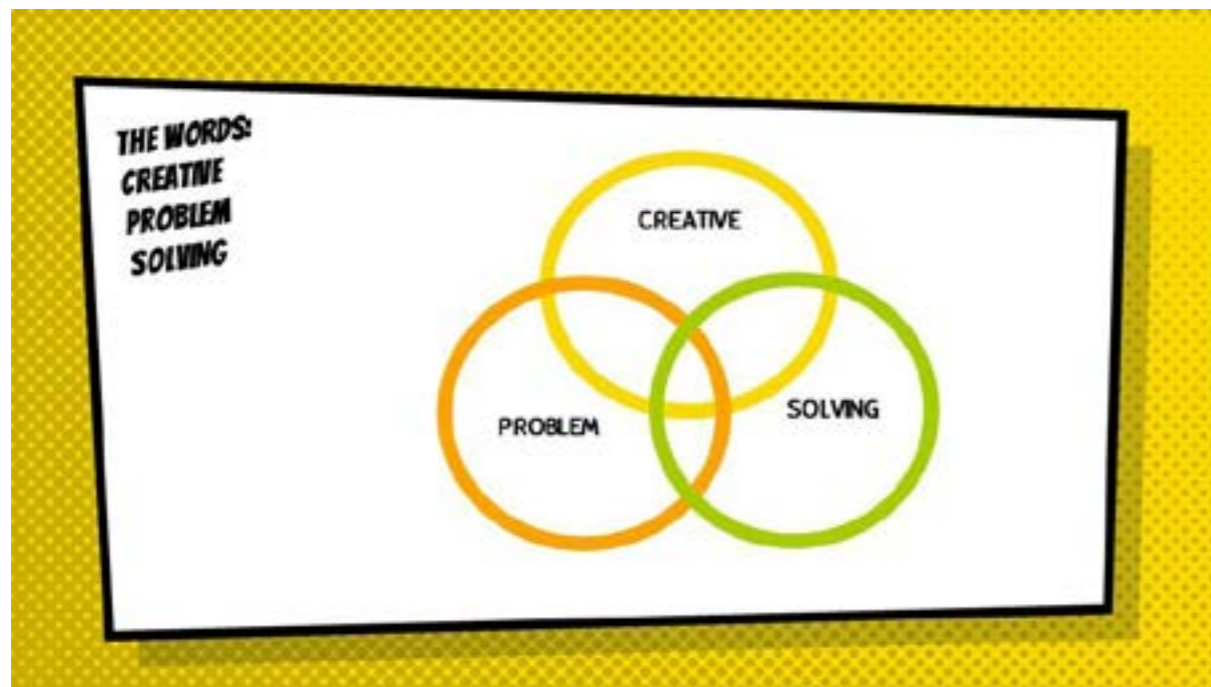
The HANDSON MOOC is particularly well suited for the Continuous Professional Development (CPD) of educators from the three sectors Vocational Education and Training (VET), Higher Education (HE) and Schools, and represents an opportunity of becoming part of a large network of teachers who have shown to be knowledgeable peers.

The HANDSON toolkit is a short version of the MOOC to facilitate the usage of the HANDSON outcomes and it is targeted to short, face-to-face teacher training activities. Both products – the MOOC and the toolkit – provide hands-on and intense experiences during which educators design an ICT-based learning activity.

<sup>21</sup> A summary and short description is published on Erasmus+ Project Results Platform by EC at: <http://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details-page/?nodeRef=workspace://SpacesStore/172af29e-66c0-4ba6-9034-fa84b93dd379>

Chapter 2. **CPS**  
**Methodology for**  
**VET – Introduction**  
**and Approach**

## 2.1 What is Creative Problem Solving (CPS)?



Noller<sup>22</sup> in 1979 tried to give a definition to Creative Problem solving starting from the three words it is composed by:

### CREATIVE

CREATIVE is about having an element of newness that is relevant to anyone that wants to create a solution. It implies to bring into a situation something that was not there before, that has elements of newness.

**About CREATIVITY:** it refers to the introduction of something in a context that has value. It is important not to confuse creativity and ART, even though ART is usually new and has value. In this specific project, creativity is about new ideas and not about the creativity of art that involves aesthetic, excellence and skills/attitudes that cannot be learned.

### PROBLEM

Noller defined a PROBLEM as any situation that presents a challenge, offers an opportunity, or is a concern to the solver. In effect, the Cambridge Dictionary defines PROBLEM as a situation that causes difficulties.

**About PROBLEM:** Peter Honey, a psychologist, defines a problem as the difference between what you've got and what you want.

<sup>22</sup> Noller, R.B., Scratching the surface of creative problem solving: A bird's eye view of CPS, Buffalo, NY: DOK, 1979

### SOLVING

SOLVING is immediately connected with PROBLEM. It is devising ways to answer, to meet, or to satisfy a situation by changing self or situation.

**About SOLVING:** in stressful situations, it's natural to just go with the first good solution emerging from an analogical reasoning. It is in fact natural to look for an answer/action to stop or remove the problem.

### A definition

In effect, the Creative Problem Solving is a lot more than 3 words put together and in reality, it could be defined as follows:

**It is a methodology based on a multidisciplinary approach dealing with the role of creativity, innovation and problem solving in various situations of daily life**

### PISA and Problem-Solving competences

A good starting point to understand the meaning of CPS is coming from the methodology developed by OECD<sup>23</sup> for the implementation of the Programme for International Student Assessment (PISA) – cited also in chapter 1 of this guide.



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### PISA 2012 defines problem-solving competence as:

*"...an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen."*

ref. <http://www.oecd.org/pisa/keyfindings/pisa-2012-results-volume-v.htm>

From this definition, it is possible to identify some key elements:

First, an **individual's capacity to engage in cognitive processing to understand and resolve problem situations:** Problem solving begins with recognising that a problem exists and establishing an understanding of the nature of the situation. It requires the individual or group to identify the specific problem(s) to be solved, plan and carry out a solution, as well as monitor and evaluate progress throughout the activity. The verbs "engage, understand and resolve" underline that, in addition to the explicit responses to problems, the assessment measures individuals' progress towards

<sup>23</sup> OECD is the Organisation for Economic Cooperation and Development that promotes policies that will improve the economic and social well-being of people around the world

solving a problem, including the strategies they employ. Where appropriate, these strategies are tracked through behavioural data captured by a computer.

Second, **where a method of solution is not immediately obvious**. This part of the definition corresponds to the definition of the “problem” as a situation in which the goal cannot be achieved by merely applying previously learned procedures (Mayer, 1990).

Third, ... **it includes the willingness to engage with such situations**. This last sentence of the definition underlines that the use of knowledge and skills to solve a problem depends on motivational and affective factors as well (Mayer, 1998; Funke, 2010). It follows that students’ willingness to engage with novel situations is an integral part of problem-solving competence. Motivational and affective factors are a distinct focus of the background questionnaire, which uses students’ answers to measure their perseverance (whether they agree or not with the statement “When confronted with a problem, I give up easily”, and other similar statements) and openness to problem solving (“I like to solve complex problems”).

## 2.2 Blocks to Creativity

Again, it is essential to understand that the creativity we are talking about in this guide is the “creativity of ideas”. The creativity of ideas is continuously under attack because there are some kinds of blocks.

There are 2 kinds of blocks to creativity:

- Individual
- Environmental/Organisational

About the individuals blocks<sup>24</sup>, it is important to analyse the following ones:

- Mindsets
- Perceptual blocks
- Cultural blocks
- Emotional blocks

### Mindsets

A mindset is a condition where an individual is over-sensitized to some part of the information available at the expense of other parts. It is about being locked into a familiar way of looking at the world that could drive in the failing to see other options. The effect is making assumptions and approach a problem from a limiting premise.

It is very useful in most of the situations, to avoid dangers and act properly after a process of learning from experience but it could limit the possibilities to find alternatives. Sometimes we have to step into the unknown in order to discover further and maybe more valuable opportunities.

<sup>24</sup> Tony Proctor, Creative Problem Solving for Managers: Developing Skills for Decision Making and Innovation, Routledge; 3rd edition, 2010

### Perceptual blocks

The perceptual blocks are about the way our brain is perceiving the outside world.

It is possible to stimulate the focus and de-focus activity in order to perceive the reality as it is in a whole vision.

### Cultural blocks

The culture and the society where anyone lives is influencing and blocking the creativity e.g. values in a society restricting the ways to behave.

It is possible to start by changing a little the ordinary habits (e.g. the pathway to come back home, the place where to sit at dinner) in order to be ready for creativity whenever it needs.

### Emotional blocks

It is about an intimate block that could become evident with a feeling to get trapped by own thinking. Creativity usually is intense and sometimes it’s not a comfortable pursuit. Faced with the unknown, it is normal to be scared of the what it is possible to discover or reveal.

Sometimes it is necessary to face the worst and come through the other side. There are a lot of things and activities that could help – such as routine, commitment, and meditation.

## 2.3 Why is CREATIVE PROBLEM SOLVING important in VET and in Education?

In Vocational Education and Training it is essential to understand that the focus is about the willingness to increase employability opportunities.

Usually, when a person is approaching to VET, he/she is dealing with a demand of skills not explored and reached up during the formal learning pathway.

As described in the 1<sup>st</sup> chapter, there is not a structured way to teach some skills, defined as soft skills, in the formal learning environment.

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*About SOFT SKILLS<sup>25</sup>: Wikipedia is describing **Soft skills** as a combination of people skills, social skills, communication skills, character traits, attitudes, career attributes, social intelligence and emotional intelligence quotients among others that enable people to effectively navigate their environment, work well with others, perform well, and achieve their goals with complementing hard skills.*

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<sup>25</sup> [https://en.wikipedia.org/wiki/Soft\\_skills](https://en.wikipedia.org/wiki/Soft_skills)



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*The Collins English Dictionary defines the term “soft skills” as “desirable qualities for certain forms of employment that do not depend on acquired knowledge: they include common sense, the ability to deal with people, and a positive flexible attitude.”*

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In 2010, IBM launched a survey involving more than 1,500 Chief Executive Officers from 60 countries and 33 industries worldwide, chief executives<sup>26</sup>. It emerged clearly they believe that - more than rigor, management discipline, integrity or even vision - successfully navigating an increasing complex world will require creativity. CEOs are confronted with massive shifts – new government regulations, changes in global economic power centers, accelerated industry transformation, growing volumes of data, rapidly evolving customer preferences – that, according to the study, can be overcome by instilling “creativity” throughout an organization.

Also European Commission is declaring the creativity, together with the innovation, as essential in one of the four strategic objectives detected in the strategic framework for European cooperation in education and training (known as ‘ET 2020’).

**The main challenge is that there is not a unique way to teach creativity.**

**Nevertheless, the good news is that the creativity of the ideas, as intended in this guide, is something that can be taught learned and practiced in large contexts such as the one we are analysing now: vocational environment.**

IV4J, the partnership that has created this guide, believes that CPS is useful in VET mainly in:

- Designing the vocational environment and programmes
- Supporting the learning of some practical skills
- Orbit-shifting the educational environment in the implementation and delivery of a training course

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26 IBM 2010 Global CEO Study: Creativity Selected as Most Crucial Factor for Future Success - <https://www-03.ibm.com/press/us/en/pressrelease/31670.wss>

Chapter 3. **Divergent  
And Convergent  
Thinking**

## 3.1 Creative Thinking

In order to start to discover the Creative Problem Solving methodology it is essential to analyse the creative thinking and how it works.

Everything we use has been invented by someone such as alarm clocks, internet, radios, pens, buttons, movie theatres etc. All those inventions resulted when someone were faced with a problem or saw an opportunity and created a way to bring their innovation to the world<sup>27</sup>.



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The creative thinking is about the ability to break the patterns and traditional way of thinking to be able to start thinking in a creative way.

## 3.2 Creative Thinkers

Following, some characteristics of creative thinkers could include<sup>28</sup>:

1. They are communicators.
2. They are open-minded to criticism, ready for new solutions and ideas, and not afraid of evaluating alternative ideas. They will learn from both successes and mistakes, being able to grow and develop.
3. They are risk-takers, resilient and they aren't afraid of taking a chance. They know that leaving a comfort zone is sometimes necessary to succeed, even if it means facing the unknown.
4. They are knowledgeable, because only by understanding of things and situations, you could develop a background story. Knowledge allows to see the full picture about the sector they work in. They are experts in what they do, and the concept of lifelong learning is what they base their expertise on.
5. They are flexible to changes and think outside the usual patterns and they aren't afraid of changing their method of work, and they are good at working with others.

27 Tina Seelig, *inGenius – a crash course on creativity*, HaperCollins Publishers, 2012  
28 <http://inkbotdesign.com/creative-thinking/>

## 3.3 Creativity and innovation

What is the difference between creativity and innovation?<sup>29</sup>

There is confusion about the difference between creativity, innovation and invention:

**Creativity** is the capability or act of conceiving something original or unusual

**Innovation** is the implementation of something new.

**Invention** is the creation of something that has never been made before and is recognized as the product of some unique insight.

## 3.4 Creating the conditions for Creativity

An interesting approach is the one used by Steven Johnson, in his book "Where Good Ideas Come From: The Natural History of Innovation"<sup>30 31</sup>

He investigated about seven key patterns behind genuine innovation that recur whenever a creativity is emerging.

The Seven Patterns of Innovation identified by Johnson are:

1. **The Adjacent Possible**: each innovation is able to open up new ideas to be explored. New ideas are built out of existing ideas – an example is Gutenberg developing his printing press borrowing ideas from a wine press.
2. **Liquid Networks** – the development of ideas is coming from a large number of ideas to be connected to ideas you already have in your brain. This was seen during the flowering of the Renaissance and in Silicon Valley. Individuals get smarter if they are in ideas rich environments. Most brilliant ideas have messy beginnings and the best environments are where people can meet and share ideas.
3. **The Slow Hunch**- most ideas start with vague hunches and the ideas sometimes take years to be realised – at this point the conclusion may come in a flash- the eureka or light bulb moment. Contrary to popular thought, the ideas take time to be developed – Darwin finally understanding the theory of evolution is a point in case. The modern work environments under continuous pressure are destructive to the development of such kind of thinking and they are not giving the right time to pick up on hunches.
4. **Serendipity** –the power of accidental connections. Serendipity is made up of happy accidents that completes hunch or opens up a new adjacent possible. Such ideas fill in gaps in the puzzle. The challenge is to develop ideas that foster these serendipitous connections. Serendipitous moments often happen at the oddest moment –while out on a walk or read-

29 <http://www.destination-innovation.com/what-is-the-difference-between-creativity-and-innovation/>

30 <http://leading-learning.blogspot.it/2012/07/creating-conditions-for-creativity.html>

31 Steven Johnson, *Where good ideas come from – The seven patterns of innovation*, Penguin 2011

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ing a book. Organisations such as Google are experimenting developing ideas to develop such serendipity to give good ideas opportunities to connect.

5. **Error** – great successes are developed through errors. Flemming discovered penicillin by accident but he was up to taking advantage of it – to learn through error. ‘Error often creates a path that leads you out of comfortable assumptions’. ‘Being right keeps you in place. Being wrong forces you to explore’.
6. **Exaptation**- borrowing and connecting. Once again Gutenberg modifying wine presses comes to mind. Gutenberg was not interested in wine – he was interested in words but he borrowed an idea from another older technology. The history of innovation abounds with exaptation including the World Wide Web – a sort of mental cross fertilisation. Chance favours the connected mind.
7. **Platforms**- environments that allow innovation. A coral reef provides a platform, or habitat, for a diversity of life to evolve. Platforms open doors to the adjacent possible.

## 3.5 Divergent and Convergent thinking

Joy Paul Guilford, an American psychologist, in 1967 developed an interesting approach in the description of the creative thinking. He invented the terms convergent thinking and divergent thinking.



<https://gratisography.com/>

Divergent thinking is a thought process or method used to generate creative ideas by exploring many possible solutions.

It is often used in conjunction with its cognitive colleague, **Convergent thinking**, which follows a particular set of logical steps to arrive at one solution, which in some cases is a ‘correct’ solution.

By contrast, divergent thinking typically occurs in a spontaneous, free-flowing, ‘non-linear’ manner, such that many ideas are generated in an emergent cognitive fashion. Many possible solutions are explored in a short amount of time, and unexpected connections are drawn. After the process of divergent thinking has been completed, ideas and information are organized and structured using convergent thinking.<sup>32</sup>

One of the principal elements of Divergent Thinking is the ability to generate novel ideas in a short period of time. Divergent thinking also means being able to think outside the box, making associations that seem less possible to others. Divergent thinking also implies originality and the ability to come up with additional details regarding a potential solution.

It is important to understand that, in effect, both divergent and convergent thinking contribute to the gaining of creative insight.

<sup>32</sup> [https://en.wikipedia.org/wiki/Divergent\\_thinking](https://en.wikipedia.org/wiki/Divergent_thinking)

Chapter 4. **CPS**  
**implementation:**  
**Creative methods**  
**and models for**  
**VET with practical**  
**solution and tips**

In this chapter are going to be presented several tools and approaches:

1. Think Outside The Box (approach)
2. Lateral Thinking and the Six Thinking Hats (methodology + tool)
3. Collaborative Problem Solving (methodology)
4. Mind Mapping (tool)
5. Brainstorming (tool)
6. Constraints (tool)

The layout used is the following:

- a) 1 page as **OVERVIEW** replying to the following questions:
  - a. What is?
  - b. Why is it useful in VET?
  - c. What are the multidisciplinary details?
  - d. Links
- b) **DESCRIPTION** pages: it consists in further in-depth analysis of the approach and of the tool, enriched by the effective implementation aspects such as the support in designing the VET for job. There is also space for the description and links to some cases – this could help to foster the effective implementation for the stakeholders interested in.



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## 4.1 Think Outside The Box (approach)

### OVERVIEW:

#### 1. What it is?

Thinking outside the box is about a thinking process, which comprehends the implementation of an unusual approach to the logical and ordinary thinking structure. It's a procedure which aims to escape from relational reasoning and thinking<sup>33</sup>.

#### 2. Why is it useful in VET?

Because the formal educational system is pushing the students to think in a more rational way (e.g. 1 problem = 1 solution) but the reality in the world is completely different and a lot more difficult.

#### 3. What are the multidisciplinary details?

Psychology, Creative thinking, Sociology, Behavioural Sciences

#### 4. Links

[https://en.wikipedia.org/wiki/Thinking\\_outside\\_the\\_box](https://en.wikipedia.org/wiki/Thinking_outside_the_box)

<https://www.youtube.com/watch?v=bEusrD8g-dM>

<https://www.aplusclick.org/ThinkOutsideTheBox.htm>

### DESCRIPTION

Think Outside The Box means to think beyond usual ways of thinking.

The term "box" represents the constraints of our traditional or standard way of thinking.

So, in reality, to think outside the box is about thinking in novel ways, to be provocative in developing a concept or to see a problem and view it and design a solution in a different way than we usually do it.

<sup>33</sup> "Relational thinking and relational reasoning: harnessing the power of patterning". Nature. Patricia A Alexander. 2016. Retrieved 27 January 2017.



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The main reason we think inside the box is because the brain forms patterns and every time we are faced with an issue the brain taps into those patterns to come up with a solution.

This is a capability that has to be worked at – we’re all used to our respective boxes. However, by continually searching for ideas, different ways of addressing the problem we’re faced with, we can get outside the box.

Through thinking outside the box “failure” does not exist, what exists are learning experiences. Indeed some leading US companies promote slogans such as fail and fail cheaply.

## HOW TO

An interesting description of the approach is described in a Wiki: “How to Think ‘Outside the Box’”<sup>34</sup>.

So you’ve been asked to think outside of the box for work, or you really want a creative idea for your new novel? Not to worry! Thinking outside the box, like any skill, is one that can be developed through practice.

To get started developing your creative thinking skills, it is essential to Change your space.

It’s important to get away from all the typical routines in order to foster creativity. The idea of changing it up is a common one amongst successful and creative thinkers. This means that you either create a specific ritual around creativity, or that you simply find a way to take a break.

- **Take a shower.** There is something weirdly conducive about showering, as anyone who’s had that amazing idea while stuck in the shower (only to forget it when you finally locate a pen and paper). If you’re stuck on an idea, hop in the shower, with a pen and some paper handy and see what comes up.
- **Go for a walk.** Like showering, something about walking fosters creativity. Whether it’s taking a walk as a prelude to getting started with your creative project, or as part of the project itself, taking a walk will help get those creative juices flowing. Steve Jobs used to hold walking meetings to brainstorm ideas. Tchaikovsky took several walks around his village before working on his latest creation.
- **Create psychological distance between your normal routine and the time for creativity.** Writer Toni Morrison always watched the sun come up in the morning before she would begin writing. She felt that this enabled her to access her creativity.

## IMPLEMENTATION IN VET – TIPS AND EXERCISE

### TIPS

- “Think Outside The Box” should be used since the designing of a VET course by giving an important space in the schedule to the “creative thinking”.
- It could be useful to understand the creative patterns, explain what “Think Outside The Box” really means and help the students to understand that the creativity is something that could be learned and trained daily.

<sup>34</sup> <https://www.wikihow.com/Think-%27Outside-of-the-Box%27>

- There are several ways to introduce the Thinking Outside the Box: it could be introduced by pushing to turn something upside-down both physically and metaphorically. This change in the orientation of things could hide the more obvious solutions and make alternative possibilities emerge. For example, you might ask what a problem would look like if the least important outcome were the most important, and how a student would then try to solve it.
- Let student to understand the power of daydreaming that could help to make connections, form patterns and recall information. In 2012, researchers found that letting the mind wander can lead to better creative problem solving. This concept could be used as effective way to introduce the approach in VET classes.
- Another possible qway to implement in VET this approach could be connected with the consideration oft he worst-case scenario as it forces to go over the fear that could block the creativity.

## EXERCISE

It is possible to include some funny and engaging exercises the students could be asked to do such as:

**You are assigned by your VET class as a motivator in the activation of the participation.**

**How can you attract the attention of your peers?**

**Be provocative and try to find out alternative ways to detect the attention in the class .**

## 4.2 Lateral Thinking and the Six Thinking Hats (methodology + tool)

### OVERVIEW:

#### a. What it is?

**Lateral thinking** was coined in 1967 by Edward de Bono, a Maltese physician, psychologist, author, inventor and consultant psychologist. It is concerned with solving problems through an indirect and creative approach, using reasoning that is not immediately obvious and involving ideas that may not be obtainable by using only traditional step-by- step logic.<sup>35</sup>

Edward de Bono invented a technique useful to train and develop the lateral thinking: “**The Six Thinking Hats**”. It is a tool for group discussion and individual thinking involving six colored hats. The approach is based on the assumption that when people think about complex issues, they are overcrowded with emotions, logic, data, hopefulness, and creativity.

#### b. Why is it useful in VET?

The Six Thinking Hats is a well-known method used in pedagogy to understand the student’s behavior.

It is an engaging and funny way to introduce the creative thinking.

<sup>35</sup> [https://en.wikipedia.org/wiki/Lateral\\_thinking#cite\\_note-1](https://en.wikipedia.org/wiki/Lateral_thinking#cite_note-1)

### c. What are the multidisciplinary details?

Psychology, Lateral thinking, Educational Sciences

### d. Links

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

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

## DESCRIPTION

### Lateral Thinking



image: pixabay.com - <https://pixabay.com/en/human-hand-company-paper-solutions-3131802/>

Compared to the “Think Outside The Box” is similar but in this case it is a deliberate provocation in order to

move from one known idea to creating new ideas.

Lateral thinking<sup>36</sup> is more concerned with the “movement value” of statements and ideas. A person uses lateral thinking to Edward de Bono defines four types of thinking tools:

- idea-generating tools intended to break current thinking patterns—routine patterns, the status quo
- focus tools intended to broaden where to search for new ideas
- harvest tools intended to ensure more value is received from idea generating output
- treatment tools that promote consideration of real-world constraints, resources, and support

<sup>36</sup> Edward de Bono, Lateral Thinking: A Textbook of Creativity, Penguin 2009

## Six thinking Hats

The premise of the method is that the human brain thinks in a number of distinct ways which can be deliberately challenged, and hence planned for use in a structured way allowing one to develop tactics for thinking about particular issues. De Bono identifies six distinct directions in which the brain can be challenged. In each of these directions the brain will identify and bring into conscious thought certain aspects of issues being considered (e.g. gut instinct, pessimistic judgement, neutral facts). None of these directions is a completely natural way of thinking, but rather how some of us already represent the results of our thinking.<sup>37</sup>

Since the hats do not represent natural modes of thinking, each hat must be used for a limited time only.[citation needed] Also, some will feel that using the hats is unnatural, uncomfortable or even counterproductive and against their better judgement.

A compelling example presented is sensitivity to “mismatch” stimuli. This is presented as a valuable survival instinct, because, in the natural world: the thing that is out of the ordinary may well be dangerous. This mode is identified as the root of negative judgement and critical thinking.

Six distinct directions are identified and assigned a color. The six directions are:



Managing BLUE

what is the subject? what are we thinking about? what is the goal? Can look at the big picture.



Information WHITE

considering purely what information is available, what are the facts?



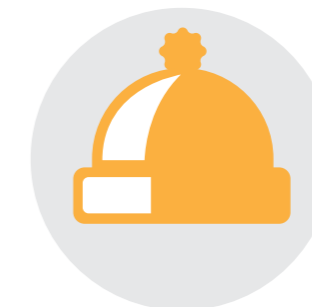
Emotions RED

intuitive or instinctive gut reactions or statements of emotional feeling (but not any justification)



Discernment BLACK

logic applied to identifying reasons to be cautious and conservative. Practical, realistic.



Optimistic response YELLOW

logic applied to identifying benefits, seeking harmony. Sees the brighter, sunny side of situations.



Creativity GREEN

statements of provocation and investigation, seeing where a thought goes. Thinks creatively, outside the box.

<sup>37</sup> [https://en.wikipedia.org/wiki/Six\\_Thinking\\_Hats](https://en.wikipedia.org/wiki/Six_Thinking_Hats)

<https://www.vecteezy.com/vector-art/121910-bonnet-and-hat-vector-icons>



## HOW TO

Let's try to think about yourself, which two hats do you feel most comfortable using?

During your daily life, let's try to use only 1 hat at once and think about how your behaviour is changing. It is engaging to understand how to watch the reality trying to walk in different shoes as usual and discover different perspective of a situation or of a problem.

## IMPLEMENTATION IN VET – TIPS AND EXERCISE

### TIPS

- Pragmatists and theorists work best when they are offered a systematic thinking, so it is essential to understand that the challenge in this case is first in the teachers (often pragmatic and theorist) and then in the students – so let the teachers to understand and experience the lateral thinking in advance and give the right time to assimilate the methodology and then introduce it in the classes
- While using the Six thinking Hats in the class, remember ever to start and end with the blue hat (the managing one) in order to be more effective in the use of the tool
- Remember that there is no right sequence in the use of the Thinking Hats
- In the VET class is not necessary, if deemed not necessary, to use all the 6 Thinking Hats
- Let's start by describing the Six Thinking hats and build up a more confident feeling by asking to the students which two hats do you feel most comfortable using?

### EXERCISE

A possible exercise is to let the students to use all the thinking hats by detailing:

- a possible context
- providing a question/ a problem to be faced
- describe the possible actions but only by wearing a single hat at once

Attention: Since the hats do not represent natural modes of thinking, each hat must be used for a limited time only.

## 4.3 Collaborative Problem Solving (methodology)

### OVERVIEW:

#### a. What is?

The capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills and efforts to reach that solution<sup>38</sup>(OECD, 2015)

#### b. Why is it useful in VET?

- Collaborative problem-solving is listed by OECD as one of the critical and necessary skill across educational settings and in the workforce
- Since Collaborative problem-solving is rarely taught in schools there is space for it in VET because if it could reinforce knowledge and improve attainment.

#### c. What are the multidisciplinary details?

Psychology, Pedagogy, Sociology

#### d. Links

[www.oecd.org/pisa/pisaproducts/Draft%20PISA%202015%20Collaborative%20Problem%20Solving%20Framework%20.pdf](http://www.oecd.org/pisa/pisaproducts/Draft%20PISA%202015%20Collaborative%20Problem%20Solving%20Framework%20.pdf)

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<https://pixabay.com/en/team-motivation-teamwork-together-386673/>

38 OECD (2015) 'Draft Collaborative Problem Solving Framework.' Paris: OECD.

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## DESCRIPTION

Collaborative problem-solving is an area of growing interest for those looking at the changing nature of both the workplace and national labour markets, as demonstrated by the OECD's inclusion of it in their 2015 international education PISA survey (results released in 2016 and later in 2017).

Collaborative problem solving (CPS) is composed of two main elements: the collaborative, sharing, or social aspects coupled with the knowledge or cognitive aspects. Thus, the primary distinction between individual problem solving and collaborative problem solving is the social component<sup>39</sup>.

In collaborative problem solving there is a group goal that needs to be achieved, the solution requires problem solving, team members contribute to the solution, and there is some foundation for evaluating whether the group goal has been achieved. Moreover, the activities of the team members are interdependent, with various roles, so that a single person cannot solve the group goal alone. The collaborative activities therefore require communication, coordination, and cooperation.

The skills required for collaborative problem solving by OECD are included in the following Matrix:

	1) Establishing and maintaining shared understanding	2) Taking appropriate action to solve the problem	3) Establishing and maintaining team organisation
(A) Exploring and understanding	A1) Discovering perspectives and abilities of team members	(A2) Discovering the type of collaborative interaction to solve the problem, along with goals	(A3) Understanding roles to solve the problem
B) Representing and formulating	(B1) Building a shared representation and negotiating the meaning of the problem (common ground)	(B2) Identifying and describing tasks to be completed	(B3) Describe roles and team organisation (communication protocol/rules of engagement)
(C) Planning and executing	(C1) Communicating with team members about the actions to be/being performed	(C2) Enacting plans	(C3) Following rules of engagement, (e.g. prompting other team members to perform their tasks)
(D) Monitoring and reflecting	(D1) Monitoring and repairing the shared understanding	(D2) Monitoring results of actions and evaluating success in solving the problem	(D3) Monitoring, providing feedback and adapting the team organisation and roles

<sup>39</sup> NCES, Collaborative Problem Solving: Considerations for the National Assessment of Educational Progress, 2017

## HOW TO

During the design of the VET course, let's think about making changes<sup>40</sup> in terms of 3 different areas:

- The tasks design:
  - Carefully consider what knowledge is being introduced or applied.
  - Balance interdependence with individual accountability.
  - Structure task to promote right behaviours (e.g. reflection time, roles).
- The teaching style:
  - Hint and ask pertinent questions, without giving the answer.
  - Monitor group and be change to willing to change them or handpick members.
  - Balance support and freedom.
  - Be patient: it may take time to embed
- Leadership support
  - Give staff time to design, embed and improve.
  - Familiarise with research, be an advocate externally (e.g. Ofsted, parents).
  - Monitor, evaluate progress and intervene as necessary.

## IMPLEMENTATION IN VET – TIPS AND EXERCISE

### TIPS

It should be necessary to introduce a careful attention to the physical and social organisation of the class and of the groups the class is composed by (e.g. taking account of the number, gender distribution, ethnicity)

- Don't underestimate the group-working skills that should take time to be developed
- While selecting the tasks to be done in group, it is important to select a challenging task in order to justify a collaborative work in group
- Take care to the role of the teacher to facilitate and monitor the process by leaving the right place to the independent group-building dynamic
- While designing the VET course, take into account to balance carefully individual and collaborative activities

### EXERCISE

Let's start by designing a possible activity to be done in collaborative way by the class. Consider to divide the class in 2 or more groups if necessary. Give time to each group to present the results (even as advance steps), collect feedbacks by peers.

Remember students to defer judgment while generating ideas – there are no correct or wrong ideas – there are only alternatives.

<sup>40</sup> Rose Luckin, Ed Baines, Mutlu Cukurova and Wayne Holmes with Michael Mann, Solved! Making the case for collaborative problem-solving, NESTA 2017

## 4.4 Mind Mapping (tool)

### OVERVIEW:

#### a. What it is?

A mind map is a creative and visual tool used to outline information during a note-making process. It is starting from a central subject and then, like a tree, there are branches connected by lines.

#### b. Why is it useful in VET?

It is a perfect way to take notes and unleash creativity. The combination of words and images is six times better for remembering information than words alone.

It could be used to test if a student has learned some topics and the main meaning of the subjects.

#### c. What are the multidisciplinary details?

Art, Organisation and Management, Psychology

#### d. Links

[https://en.wikipedia.org/wiki/Mind\\_map](https://en.wikipedia.org/wiki/Mind_map)

<http://www.mindmappingstrategies.com/mind-mapping.aspx>

<http://learningfundamentals.com.au/resources/>



<https://pixabay.com/en/woman-thoughts-girl-social-media-1169316/>

### DESCRIPTION

A mind map<sup>41</sup> is a diagram used for visually outlining information using connections and levels to generate ideas starting from a key word or a key idea.

In effect, a mind map is a diagram used to visually organize information.

A mind map is often created around a single concept, drawn as an image in the centre of a blank page, to which associated representations of ideas such as images, words and parts of words are added. Major ideas are connected directly to the central concept, and other ideas branch out from those.

Mind maps can be drawn by hand, either as “rough notes” during a lecture, meeting or planning session, for example, or as higher quality pictures when more time is available.

### HOW TO

#### Mind map guidelines

Tony Buzan, a psychologist and writer, suggests the following guidelines for creating mind maps:

1. Start in the centre with an image of the topic, using at least 3 colours.
2. Use images, symbols, codes, and dimensions throughout your mind map.
3. Select key words and print using upper or lower case letters.
4. Each word/image is best alone and sitting on its own line.
5. The lines should be connected, starting from the central image. The lines become thinner as they radiate out from the center.
6. Make the lines the same length as the word/image they support.
7. Use multiple colours throughout the mind map, for visual stimulation and also for encoding or grouping.
8. Develop your own personal style of mind mapping.
9. Use emphasis and show associations in your mind map.
10. Keep the mind map clear by using radial hierarchy or outlines to embrace your branches.

### TOOLS

Mind-mapping software can be used to organize large amounts of information, combining spatial organization, dynamic hierarchical structuring and node folding.

Software packages can extend the concept of mind-mapping by allowing individuals to map more than thoughts and ideas with information on their computers and the Internet, like spreadsheets, documents, Internet sites and images. It has been suggested that mind-mapping can improve learning/study efficiency up to 15% over conventional note-taking.

<sup>41</sup> [en.wikipedia.org/wiki/Mind\\_map](https://en.wikipedia.org/wiki/Mind_map)



## DESCRIPTION

Brainstorming was introduced by the creativity theorist Alex Faickney Osborn in 1953.

Brainstorming is a way to generate ideas within a group setting. It is usually used in the beginning stages of a project, where the possibilities for the project are not clearly understood or defined. It provides a quick means for tapping the creativity of a limited number of people for a large number of ideas. The brainstorming environment fosters an uninhibited, non-judgmental explosion of ideas, concepts, policies, decisions, and strategies. In brainstorming, all contributions are valid, and the key to a successful session is to share as many ideas as possible without evaluating them.

Brainstorming sessions can be unstructured - that is, there may not be a moderator or facilitator. Most sessions, however, are facilitated, structured discussions with guidelines to help the process move along smoothly and allow a variety of perspectives and ideas to surface.

Watch out because "Brainstorming" is often confused with different things such as meet, discuss, get together and talk in informal way, or have meetings. It is also essential to understand that there are different tools than brainstorming to come to a more effective creative problem solving.

Osborn introduced 4 basic rules for "Brainstorming":

1. CRITICISM is not permitted
2. FREE-WHEELING is welcome – it is necessary to not be afraid to come with weird ideas and to say anything that comes into one's mind
3. QUANTITY is required in terms of ideas
4. COMBINATIONS and IMPROVEMENTS to emerging ideas should be tried out.

## HOW TO

Following, some brainstorming techniques:

- Solicit quality ideas.
  - Rule: Encourage the generation of lots of creative ideas.
- Encourage everyone to participate.
  - Rule: Quantity is wanted - every idea is accepted and recorded. The more ideas, the more to choose from and the more likely ideas will spark new ideas.
- Encourage freewheeling and expression of different ideas.
  - Rule: "Freewheeling" is welcomed. Freewheeling means the wilder the idea, the better. It is always easier to tame an idea than to make one more exciting.
- Do not criticize or evaluate ideas.
  - Rule: Criticism is ruled out. Suspend judgment. Every idea is welcome without critique or ridicule.
- Build upon other group members' ideas.
  - Rule: Combination and improvement are sought. Ideas spark more ideas. Encourage everyone to participate and to build upon the ideas of others in the group.
- Record ideas accurately during the session.
  - Rule: Record the ideas. It is crucial to record the ideas generated during a brainstorming session.

There are some variants to the classical brainstorming - created in order to maximize and overcome some common problems - such as:

- Wildest-idea: it is a way to assist the effective way to find solutions by encouraging the freedom to think and stimulate the creativity
- Stop-and-go: there are different sessions with a stop introduced every 3-5 minutes in order to collect and gather the ideas emerged
- Round-robin: in this case rather than go out with ideas, the participants are asked to give a contribution to some ideas
- Gordon-Little variations: (in order to avoid the blocks to the creativity, the problem is not initially presented. The leader guides the participants to focus on some topics and situation and then gradually is going to introduce more elements of the problem to be faced)
- Trigger method: usually used together with a classical approach. The process is:
  - Read the problem in a concise and precise way to the participants
  - Ask each participant, individually, to write down some ideas about the problem (5 minutes)
  - The participants are going to read their own ideas to the rest of the group
  - The ideas are discussed in group for about 10 minutes in order to develop variations and/or new ideas
  - The process continues till all ideas are discussed

## IMPLEMENTATION IN VET – TIPS AND EXERCISE

### TIPS

Some tips about the problems of the brainstorming session:

- it is depending on the role of group leader within participants and moderators
- it is not effective for strategic decisions that need a larger vision and further skills
- it is not good for high technical problems and people motivation
- it is important to underline that criticism and evaluation has to be postponed to the sessions
- sometimes it is possible to get lost in the process, so the moderator should take the control of the process and push it back on the right path.

### EXERCISE

It is possible to use the Trigger method to introduce in the class a problem to be solved via a Brainstorming session – the problem could be close to the participants (e.g. more effective teaching in VET for job).

## 4.6 Constraints (tool)

### OVERVIEW:

#### a. What it is?

Introducing an artificial constraint in a situation could narrow the options in order force your brain to think around this new environment and so you get somewhere different.

It is a tool but also an exercise to train your brain to become a better creative problem solver.

#### b. Why is it useful in VET?

It is a way to train the students to be able to solve complex problems – a skill required by the job market and usually not explored during the formal education

#### c. What are the multidisciplinary details?

Psychology, behavioral sciences, marketing

#### d. Links

<http://www.thinking-tools.co.uk/>



<https://pixabay.com/en/domino-hand-stop-corruption-665547/>

### DESCRIPTION

In an interview, the architect Frank Gehry, (builder of the Guggenheim Museum in Bilbao, Spain) ,declared that what really inspires his work were the limitations and the constraints.

Ian Atkinson, a business books writer, in his book: "The Creative Problem Solver" , analysed 12 smart tools to solve any business challenge. One of the tools is named: "Be constrained". If we have too much freedom, this could affect the creativity. It could be useful to impose ourselves an artificial constraint in order to push our brain to come out with interesting creative ideas.

Another alternative is to introduce a constraint about something not artificial but rather desirable. In this case we are forced to introduce something and we could create interesting opportunities.

The principle is quite simple: if we already have a difficult situation, by adding an additional constraint we could disrupt the ordinary thinking patterns thanks to the chance to have a different view of the problem. If there are no problems, by introducing a constraint we could create a challenging situation and train our brain to think creatively.

A nice example is Apple introducing the first iPhone: the constraint was about to make a phone but without keypad.

### HOW TO

The questions to use effectively this tool are:

- What is the constraint we would like to introduce?
- What are the benefit that we could create?
- Do you know that we are not obliged to proceed further if there is no challenge/opportunities coming out from this exercise/training tool?

## IMPLEMENTATION IN VET – TIPS AND EXERCISE

### TIPS

- In VET classes it is possible to introduce some training sessions about finding solution to a problem or to a product design: Start by imagining a situation or a product to be designed
- This tool could be used together with other ones (e.g. brainstorm some constraints)
- Because sometimes it is about artificial constraints, it is not ever necessary to find a solution but rather to train the students to think in alternative ways
- In order to be more effective, the constraints should be connected to the commitment of just a small task that contributes to a larger goals
- It could be useful to note that not all constraints have the same impact on creativity e.g time constrains are demonstrated to inhibit the creativity, while resource constraints are important to stimulate the creativity

### EXERCISE

Let's introduce some constraints such as:

The solution must not use ICT

The solution must remove a basic element of the product

The solution must be realised in a large shorter time

The solutions could be innovative and compared within peers by adding an interesting added value in the learning process.

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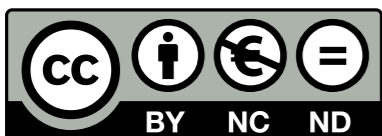
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