A set of methods and teaching tools

PEDAGOGICAL

EVOLUTION

toolbox

Photo: science by markmags_BY_CC0

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Foundation 11 Muses Innovations in Culture
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INTRODUCTION

For over 10 years we have been professionally dealing with methodological tools that improves teamwork, work of educators as well as developing train the trainers’ competencies. We execute internal R & D activities in this area. We love when our competencies meet the needs of our customers! In recent years, the number of actions to improve efficiency that we implement in IT sector, industry, science, engineering, is growing steadily. By facilitation tool we are able to rise skills in problem solving, teamwork and learning.

Year 2016 set the task of preparation, execution and implementation of case teaching, including methodological consultation for lecturers in the KIC InnoEnergy project implemented at the Department of Energy and Environmental Engineering at the Silesian University of Technology. There were also a need to strengthen the processes of teaching evolution. For this purpose we have prepared three different programs of workshops named "Pedagogical Evolution Toolbox".

They were based entirely on simple to implement, proactive techniques and methods to creatively use in teaching. From many sources we had chosen tools and methodologies which are standard activities in research and engineering projects. Proposed tools outreach beyond the traditional ways of teaching, activating participants in the actions - students.

This publication presents some methods that were tested during the training of teaching team during the workshop "Pedagogical Evolution Toolbox". It also introduces additional tools to work with groups in the areas of STEM (science, technology, engineering, mathematics). All methods have been subjected to critical analysis, to fit the nature of the engineering sciences.

These tools have been divided into three sections according to the purposes of their use. The way they have been assigned is not obligatory - these tools due to their creativity can be modified and adapted liberally depending on the form of work and the goal we want to achieve with the students. We decided to provide footnotes to Internet resources, to allow the reader quick access to alternative forms of use of these tools and to look for examples of how they can be used.

We hope that this set will help in preparing attractive classes that put challenges in front of students.

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06.12.2016, Lodz
**OBJECTIVE: STRUCTURING LECTURE AND SPEECH**

**FAQ MODEL**

**Description:**

Structure of the FAQ (frequently asked questions) was founded between 1982 and 1985, and was spread by Eugene Miya (retired NASA Ames)\(^1\) from NASA as well as users of Usenet and mailing lists.\(^2\)

FAQ is a collection of questions and answers, enabling customers to obtain information in terms of common problems.

Team members or participants for which the lecture or workshop is prepared, intuitively know this structure. The main feature of this model is to attract customers by answering questions on this topic that are important or bothering them.

The structure does not work for trivial and simple topics and simple questions - will not encourage active listening.

**Benefits for teacher from the application of this model:**

- structured and organized form of presentation content;
- this form of communication is easy for students to take notes;
- provides comprehensive answers on the most important questions in the topic;
- the ability to improvise - to respond in the same structure on questions from the audience.

**The structure can be applied to:**

- lectures during the conference;
- the part or whole lecture;
- trainings, workshops, seminars;
- as a scheme for the entire semester lectures.

---

**Instructions on how to prepare and deliver a lecture, speech:**

1. Begin by presenting the main problem of the subject.
2. Formulate attractive questions so that the topic will be explained.
3. **Introduce the first question and then give a definitive answer.** If it is a conference and you are presenting new content then **present the benefits of its use.** If benefits from the adoption of the solution will be presented the listener will remember it better.
4. **Introduce more questions and answers – all in the same structure.**
5. At the end summarize, collect applications, and ask questions.

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\(^2\) http://www.womeninjewellery.com/about/faqs/ (access 20.12.2016)
"Great Vision" Model

Description:

The "Great vision" model also known as "I have a dream" model acquired its name from the speech of Martin Luther King in 1963. This speech was a call for action in order to shape the future in accordance with dreams and possibilities to improve the situation.

The specific of this model is to attract listeners to contribute and commit in solving problems. This model is useful when the original plans and ideals have changed, and we want to motivate students to work towards the new. Also, when you have to show the evolution (revolution) of a phenomenon and a journey from imperfect to good.

Benefits for teachers from the application of this model:

- structured and organized form of presentation content;
- form of communication based on the story and narration that is easy to remember;
- a form of narrative that draws a broad context, problem, image or issue (origins - attempts to solve the problem - presentation of action);
- enables transfer of trivia that will engage the listener.

The structure can be applied to:

- lectures during the conference;
- the part or whole lecture;
- trainings, workshops, seminars;
- as a scheme for the entire semester lectures.

Instructions on how to prepare and deliver a lecture, speech:

1. Begin by presenting the main problem of the subject.
2. Introduce the past, tell how the idea came from (the initiative), refer to how it used to be - show deficits and lack of strategies used in previous years. Criticize distant past. Identify weaknesses.
3. Introduce the current state of the situation. Provide current positions on the issue. Review what brings the desired results and what is unreliable.
4. Show how it should be, present a new vision. Tell what you can expected today and show current and innovative solutions. Convince to validity of their functioning. Show benefits.
5. Finish with the conclusion, ask questions.
„Sandwich” ABA Model

Description:
ABA structure works well when there are opposing positions to the presented content. Its main feature is citing both arguments: "for" and "against". This message gives the broader context of the phenomenon and encourages students to think for themselves about the presented topic and to make choices.

Benefits for teachers from the application of this model:

- structured and organized form of presentation content;
- form of communication based on the story and narration that is easy to remember – it organizes presented positions;
- makes it possible to transfer alternative, different approaches to the situation or issues.

The structure can be applied to:

- lectures during the conference;
- the part or whole lecture;
- trainings, workshops, seminars.

____________________________

Instructions on how to prepare and deliver a lecture, speech:

While preparing a lecture on the phenomenon analyse what are the factors (arguments) that support its development. Be sure to present the counterarguments and threatening factors in case the concept develops further. Remember, the first and last arguments will be remembered particularly well – this is the way that perception works. Unless you reach for interesting illustrations, then this rule might not be working.

1. Begin by **objective presentation of the main problem** of the subject.
2. Introduce stories, facts, and arguments showing the **validity** of proposed concept development.
3. Then **introduce threats and counter-arguments** to the topic under discussion.
4. Finally, once again return to the **advantages and finish** - if you want to convince to presented approach.
5. If you want to balance the message and leave the decisions to listeners, **finish with counterarguments**.
6. Summarize and draw conclusions - you can ask questions from the audience.
Description:

Cornell Note is a way to efficiently remember lectures. It was developed in 1950 by Walter Pauk at the Cornell University in the United States.

As a result of his observation and experience he created a system of taking notes. Its aim was to improve the work at the college so that students could get better results and effects.

Cornell Note in the opinion of Michael C. Friedman of Harvard University "Harvard Initiative for Learning and Teaching" uses elements from cognitive psychology and allows you to create both linear and non-linear ways of recording, thus making it more efficient.

This method can help in note taking and synthesis, both the participants and teams. It also allows to collect in an orderly manner reference information (e.g. from conferences and meetings) so you can find and retrieve the information quickly.

Benefits for teachers from the application of this model:

- structured and organized form of presentation content;
- form of communication that is easy to remember and to take notes;
- enables effective learning by asking questions to the lecture.

The structure can be applied to:

- teaching students effective note taking and assimilation of information;
- to plan lectures content.

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Instructions on how to teach students to take notes using the Cornell method

Illustration No 1. Example of the note taking template

A – date, subject, title

B - main issues

C – place to take notes of important content

D – make a summary after lecture

References: http://reviseordie.com/search/cornell

In part A, note the date, subject, title, author, lecture or other necessary information that is important.

1. During the lecture ask participants to take notes in the part on the right side - part C.
   - Notes should be simplified, organized and legible.
   - Encourage students to make drawings, graphs and other illustrations.
   - Encourage them to leave large gaps between the lines of text - in case they need to supplement the content.

2. After the lecture, in part B, ask to create questions which are a summary of content from column C. This section allows to clarify meanings, combine links and create continuity and strength memory. Additionally, asking questions makes it easier to learn, in case the level of knowledge will be checked in the future.

5Referrals: http://reviseordie.com/search/cornell (access 10.10.2016)
Walter Pauk, „How to Study in College 7/e”, 2001 Houghton Mifflin Company
Michael C. Friedmana „Harvard Initiative for Learning and Teaching”
3. In order to consolidate ask students to cover part C with a sheet of paper. Looking at the questions and keywords encourage students to answer these questions and to mention the facts and ideas which are connected with these questions.

4. In Part D, make reflections and draw conclusions. Ask yourself questions connected with these facts, for example - "What is their significance?", "On what foundation are they based", "How it fits into what I already know?", "How can I use it?", "What else?"

5. Suggest students to spend at least 10 minutes a week reviewing all the notes. If a student will do so, he will be able to use them for the current objectives and exams more easily.
OBJECTIVE: STRUCTURING GROUP WORKSHOPS

FLOWCHART – STAGES OF GROUP FACILITATION STAGES

Description:
Workshop work with students is focused on generating knowledge and using it later in practical operations. It is conditioned by group process phenomena. The effectiveness of groups is influenced by many singularities. Example might be the social loafing observed in groups that were created for simple tasks and are too big. Or as a result of social decelerating - when team members do not want to perform the task in front of other members of the group. Likes, dislikes, trust levels in the group or its deficiencies - they all have influence on the quality of work. These phenomena that is invisible to the eye can be felt in the relations and cooperation between the members of the group. Facilitation is the process of making learning and teamwork easier.

Learning will proceeded quickly and efficiently if we are aware of the dangers that may encounter students when working in a group, and if we will be able to moderate their work.

The following flowchart presents steps of group facilitation as well as dangerous and recommended actions to help break the deadlock. I can help to plan moderation of group work on all successive stages.

Benefits for teachers from the application of this model:

- work form proposal that aims the goal;
- structured and organized form of workshop, team moderation;
- suggests on symptoms of difficulties in teamwork and how to overcome them;
- form that activates students and uses the method of discussion.

The structure can be applied to:

- planning and conducting laboratory classes;
- planning and conducting seminars;
- leading exercises, group projects;
- conducting conference meetings.
### Instructions on how to conduct a meeting using the moderation – FLOWCHART

<table>
<thead>
<tr>
<th>Action phase</th>
<th>What has to be done</th>
<th>Crises, threats</th>
<th>Typical behaviour of the leader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define the problem - the conditions under which it appears</td>
<td>specify the purpose and guidelines, conditions to solve the problem</td>
<td>moving forward without a specific expectation, no one knows where;</td>
<td>Ask for explanations and conclusions. Check whether everything is understood. Transform goals and formulate simple guidelines.</td>
</tr>
</tbody>
</table>
| Plan / building strategy                    | brainstorming; generating ideas                         | lack of mutual listening; group choose the first idea; endless conversations around the subject without conclusions; distribution of positions in the group; | 1. Sit in a circle so that all the can see each other.  
2. Appreciate the idea and encourage them to come up with more.  
3. Remind the purpose of the meeting, encourage constructive discussions.  
4. Confirm observation: "Now we must be together to work together - It is important". |
| Choose the best idea                         | authorities insist on choosing some ideas, they dominate discussion; a group talks but does not decide; |                                                                                  | 1. Invite all to the conversation, "it sounds like a good idea - let's check what other people think?"  
2. Summarize: "We talk, but we do not take a decision. Which idea seems to be the best?" |
| Specify who and what has to be done         | people act without personal responsibility - without division of roles; |                                                                                  | 1. Ask if everything is clear, if everyone knows what to do. |
| Execution of the plan                        | do not stick to the plan - the dispersion; individuals does not subject to the assigned role; | the group does not recognize the problems that she creates – it spins in a circle; | 1. Ask, "can we stop for a moment - why not to implement the plan? What if we do not stick to our plan? Do we agree to act?"  
2. Provide a notice, ask for commitment and continuation duly. |
| Solve the problems as they arise            | the group is not aware that their selected and basic approach does not solve the problem; poor communication in the decision-making process; |                                                                                  | 1. Ask for a short break, suggest that the group revolves in a circle, and encourage them to share their observations. |
| matching / selection of the new approach when the experience shows that it will not work |                                                                                  |                                                                                  | 1. As above, ask the group to stop and share their thoughts, explain why that such approach cannot work  
2. Encourage good listening; give your thoughts clearly; make sure that all voices are heard; seek to explain the key problems encountered in the application of the previous approach; ask on alternative approaches to address the key issues; secure transparency and commitment to the new plan. |
DEMING CYCLE - PDCA

Description:

The process approach to management was born from the idea of Business process re-engineering (BPR) launched at the beginning of the 90s, which was focused on the analysis and design of all conscious processes of the organization or the project. This model is used in many companies as the management process leads to effective teamwork that is focused on the goals, minimizes risk areas, which is reflected in the quality of organization services and reduce costs.

You can use a process approach in teaching students, thereby accustom students to the standards in which they will function as employees.

Process management is also known as change management. It is related to the theories of quality management.

William Edward Deming father of quality management developed (in 1951, 1986) cycle that illustrates the process management in relation to the tasks and processes.

Deming Cycle otherwise called PDCA includes 4 stages:

1. Plan – planning of what we want to achieve through our actions.
2. Do - realization, execution of what we have planned in the first stage.
3. Check - verification of the results of our actions.
4. Act – implementation of actions aimed at achieving better results.

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6 Definition by Business process re-engineering (BPR): http://www.businessdictionary.com/definition/business-process-reengineering-BPR.html, 02.10.2015
7 Deming Cycle: http://www.governica.com/Cykl_Deminga (access 02.10.2015)
Benefits for teachers from the application of this model:

- ordered and organized workshop work;
- approach to continually improve the quality of developed solutions;
- focus on constant inference and evaluation of activities;
- concentration on monitoring resources used at work;
- form of work that develops the potential of students, both more or less talented;
- method of work that engages students to act independently.

The structure can be applied to:

- laboratory projects;
- planning and conducting seminars;
- leading exercises, group projects.

Instructions on how to do project using the Deming cycle

For Deming cycle to be effective, in each of the four stages certain actions has to be performed.

Stage I "Planning" is a thorough analysis of the current situation as well as identification and description of the processes that need to be improved.

In this framework one must define a process that intends to be improved pointing his:

- start,
- end,
- essence.

Next:

- describe improved process, create a list of key tasks for the process - determine their sequence,
- assign involved employees,
- take conditions of the environment into account - the necessary tools, methods and materials.

Define:

- internal and external participants, customers, suppliers, as well as process operators;
- customer expectations - point to what they want, when and where;
- specify what data should be collected during the process in order to monitor its progress and quality;
- describe observed problems associated with improved process and point to the causes and their impact on the process. How these problems can interfere with its course;
- determine the potential ability to change and solutions, determine the extent of their impact;
- select the most promising solution (or solutions).

Stage II "Implementation (Do)" is the moment when the plan is tested. The small scale of operation minimizes the possibility of deficiencies and provides materials and conclusions aimed to improve the modified process. At this stage, you can instruct and train your team.
• Conduct a pilot study or experiment, test the impact of potential solutions on the realization on the objective.
• Identify indicators of process quality test.

Stage III "Checking"

• Study and check the extent to which selected and undertaken improvement actions allowed to achieve your goal.
• Rate and make a decision that is based on achieved results, about whether a trial action plan has succeed and if you can repeat it.

Often the primary solution must be modified or rejected. If you see a need to modify, start with stage I or II depending on the expectations and diagnosed causes of failure or poor quality.

Stage IV „Improvement (Act)“

• select the best proposed modification or solution,
• expand and bring your plan into action,
  → specify what should be done?
  → who should be involved?
  → to when the plan should be executed?
• standardize the solution - review the implementation procedure,
• inspect the process implementation.

When you finish the last step, return to the beginning of the cycle. Maybe there is something you can improve in the processes of your organization? Deming Cycle not only can be used to improve process in a specific project, but also to larger changes such as concept of operations in entire company or organization.

Example:

http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html
OXFORD DEBATE

Description:

This kind of debate derived from the University of Oxford. In Poland it was launched in the 90s by prof. Zbigniew Pełczyński.\(^8\)

Oxford debate is a kind of art of discussions that is based on the thesis or antithesis defence, in which inappropriate behaviour such as insulting, humiliating or ridiculing the opposite side is unacceptable. This is to be a duel to the qualitative substantive arguments.

The method strictly enforces students’ activity. Two teams of students compete on arguments that defend the thesis or antithesis. This method, thanks to discussion discipline, raises communicative competence: careful listening, building substantive arguments, public speaking skills, analytical and reasoning skills, constructive criticism.

The teacher takes the role of an arbiter who observes the process and quality of the debate. As this method raises emotions in groups, it is characterized by principles that cannot be broken.

Benefits for teacher from the application of this method:

- lecturer develops the hypothesis and student looks for information - explores data;
- teaches students to search for information – involves;
- demonstrates how to formulate arguments and take evidence;
- teaches how to present proposals and views;
- teaches the culture and discipline of the discussion;
- stimulates group critical thinking;
- stimulates to look at the topic from a different perspectives.

The structure of the debate can be applied to:

- supplement lectures where students enrich the content with arguments,
- as a form of group discussion,
- conducting seminars,
- leading exercises, group projects, where there are various possibilities to solve.

Instructions on how to teach using the Oxford debate:

1. **Prepare the hypothesis or thesis** for discussion.

   The hypothesis is the statement that requires proof or falsification which is the result of verification. Putting hypotheses and proving them right or wrong is the basis of the science development. Example showing the meaning of hypothesis is provided below.

   The thesis is a sentence or statement that is always true. The thesis may be a result of hypothesis that has been proven as true and does not require proof.

Example:

„Is knowledge with no practical application useless“ – this is a hypothesis.

To prove it or reject it, you should think about what arguments we have that prove the value of knowledge capital development, and which prove that knowledge capital is valuable only when it is used in practice. At the moment, in which we consider one of the positions truer than the other thesis should be put.

„Knowledge with no practical application is useless“. To confirm the thesis one must cite several arguments in favour of its veracity, thus justifying the truth of the thesis.

- The argument is based on the facts. Do not confuse facts with opinions.
- The hypothesis requires proof.
- The thesis requires arguments and confirmation or arguments and falsification.
- The hypothesis may be the source of the thesis.
- The thesis is a sentence, which we believe to be true, in the hypothesis that certainty does not exist.

2. Divide participants into two groups - each group is given a hypothesis or thesis with the task to prove it or to confute it.

3. Participants are divided regardless of their previews – they supposed to fit for the role. It is very important that they are divided regardless of the views – thanks to adoption of a different role they learn to search for information and arguments. Allowing to insist on their views threatens the skills to build arguments and to remain only with the opinion that is marked with emotions. One of the feature of the debate is that the teams give more and better, more valuable arguments without nailing arguments of the opposition. Exclusive argument thrashing forces the team to improvise responses, which can take away the merit of used information.

Then the teams develop arguments in co-operation.
**The argument** is a rhetorical proof, concept with many meanings, among other things: 1) sign, evidence of presumed truth; 2) because that is assured or a similar to faith, by which one is understood by one another; 3) proof, which is the cause; 4) clear similarity of two things; 5) matter, content to write. It is based on facts. Do not confuse facts with opinions.

Arguments can be divided into **substantive and non-substantive**. Among the non-substantive arguments we can distinguish:

- **ad personam** – argument relating to the person; personal plea, not having any relation with the topic of the speech. For example, resident of Warsaw who speaks unfavourably about the city, about who one say: "Why did not you move from the capital?"\(^9\)

- **ad auditorem** – argument, referring to the feelings of the audience frequently using rhetorical questions. For example, if someone seeks to drugs legalization, one might asks: "Why should we be tolerant of other needs, if freedom is the basis of democracy"; or "Everyone gathered in the courtroom knows how dangerous it is to function in society of people likes accused";\(^11\)

- and many others relating to the opinions, emotions, and tastes.

3 - 4 (or more) representatives take part in the debate arguing in turns, and other persons take the role of the audience giving the points to the team for the quality of the debate.

We divide the room in half, the participants take their places opposite each other on both sides of the room. The whole course of the debate ensures the arbiter, marshal - lecturer.

4. **The duel (debate)** of representatives (speakers), is conducted according to the following rules. The debate is conducted alternately. It is important that teams are not devoted exclusively to negate opponent arguments. Such discussion can lead to a dead point.

a. We start with the opening speeches during which the representatives present their position - the presentation time is 4 minutes for each team. The order of speeches can be drawn (eagle - tails, paper - stone - scissors).

The position is an overall view of the matter, does not reveal the key arguments but outlines the considered path.

For example: the position presents Team A and then Team B. Next first argument presents Team B, then the Team A.

b. The debate lasts 4 rounds or as many rounds as the number of selected speakers - every speech with the argument takes up to 2 minutes. During the debate the audience does

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9 Based on https://www.vocabulary.com/dictionary/argument (access 20.10.2016)
10 Korolko M., Podręcznik retoryki homiletycznej, Wydawnictwo WAM, Kraków 2010, str. 88
11 Korolko M., Podręcznik retoryki homiletycznej, Wydawnictwo WAM, Kraków 2010, str. 87
not speak. The beginning and the end time for speech indicates marshal/arbiter who keeps time
c. After each round - if this is their will the audience can change the place - advocating for one or other party on the discussion. The audience can ask questions to the team only after the end of the debate. Before it is not possible.

5. The open debate

During the third part – the open debate, the audience has the right to ask questions to a selected group of speakers. Arbiter keeps the order and time - everyone has the right to speak (for maximum 2 minutes). The end of time is indicated by the referee.

The debate ends with voting, during which the public has the right to once again change the place - to decide which group convinced them.

Summary of the method:

1. The lecturer is the marshal, arbiter.
2. Participants in the discussion elect hypothesis or thesis.
3. Participants are divided into two groups, regardless of the views.
4. In groups, participants prepare arguments for the adopted point of view and develop their position (10-15 minutes).
5. Groups sit on opposite sides of the room.
6. Three (or more) representatives are delegated from groups. The rest of the group sits with the public.
7. Selected person from the delegates’ present position (up to 4 minutes). The order of groups is drawn.
   a) Then alternately during the four rounds of the discussion arguments are presented (up to 2 minutes).
   b) After each round the audience can change their seats demonstrating their beliefs.
8. After the presentation of positions, the next stage is open discussion.
   a) The audience asks questions to a selected team
      (One question - one answer, 2 minutes for question, 2 minutes for answer).
   b) The audience ultimately supports the position and decides who won the debate.

Example:

https://www.youtube.com/watch?v=wqnYhugoixo
OBJECTIVE: DEFINING PROBLEMS, EXPLORING CAUSES, DETERMINING CONDITIONS FOR SOLUTIONS

6W - DEFINING PROBLEMS

Description:
Properly defining problems bring you closer to develop solution. It is worth to ask a series of questions about the specifics of the problematic situations, phenomena which should be improved. This is the first step in each project action. Working with the tool provides information that should be considered for the quality solutions development. The basic methods can be 5W, 6W, 5W + H.

Those tools come from the methodology of the problem statement, the problem definition, problem solving. They represent only a selected section among these issues. Tools are related to the PDCA Cycle (Deming Cycle: Plan – Do - Check - Act).

<table>
<thead>
<tr>
<th>5W</th>
<th>6W</th>
<th>5W+H</th>
</tr>
</thead>
</table>

1. Who? – consider for whom this is a problem and who has to solve it. What resources and needs have all the people involved in the action?
2. What? – describe what effect, solutions are expected. Does the solution must meet the needs of those for whom it is dedicated?
3. Where? – to what place solution should be developed or in what place it will function. Whether the place, the location requires special measures?
4. When? – in what timeframe the goal is to be achieved. Are there any specific conditions, limitations of time in which to be developed / implemented solution?
5. Why? – what benefits a solution to the problem will bring. Determine the cause of the implementation of the goal and benefits of achieving it.
6. Which? – describe requirements, limitations, difficulties affecting the development and implementation of solutions.
7. How? – describe how you plan to come to a solution or how you plan to achieve the goal.
These questions do not cover all the issues relevant to specific projects. You can develop your own questions relevant to the nature of taken actions and thus to specify the scope of the problems. Related methods are Ishikawa diagram (fish) and 5M method.

**Question examples:**

Who or what has this problem? How does the problem affect maximum performance, effectiveness of people or machines?

What is the problem? What are the symptoms? What are the influences of the problem? What are the conditions of the problem?

What are the causes of this problem? What improvement should be achieved so that the problem does not matter anymore?

What are the possible remedies for this problem? What are the criteria for selection of solutions for this problem?

What is the cost of the problem (before it is resolved)? What are the costs of countermeasures? What are the costs of proposed solutions implementation? What is the implementation plan and schedule? What factors, phenomena, restrictions may hinder the implementation of solutions?

How will you know if your plan is working? What problems may arise during the implementation, deployment? How can I ensure the continuation of positive actions? How improvements can be investigated / monitored?
ISHIKAWA DIAGRAM – CAUSES AND EFFECTS ANALYSIS

Description:
Ishikawa Diagram (Kaoru Ishikawa, a professor at Tokyo University) can be used for assessment and analysis of phenomena or problems in terms of causes and effects. It is also called fish diagram. This is a proposal how to organize the analysis of causes and effects in graphical way. Ishikawa diagram functions in various areas including services and project management. Initially its use has been restricted to industry.

It is important that in its creation participate as much people with knowledge or experience from different disciplines as possible, so that everyone can express themselves and give their ideas.

Diagram is used for intensify the analysis of major problems that were previously identified. You can group discovered causes with this tool. Its preparation begins with writing down the name of a problem and identification of the main categories of its causes. When seeking categories of analysis it is worth to use the 5M method. By modifying categories new research areas can be included.

This way of working stimulates the group to think critically and to seek information independently.

Benefits for teacher from the application of this method:

- stimulation of the critical thinking;
- method teaches to look for reasons - engages;
- makes it possible to transfer alternative, different approaches to the situation or issues;

Categories of causes / effects of a phenomenon:

5M
- Method
- Men
- Materials
- Management
- Machine

Variants:
These categories are not exhausted. You can add the ones that are more likely to characterize in the best way the problematic phenomenon data.

For example:
- Money;
- Environment;
- ... the processes, regulations, rules, equipment, technology, structure, personnel, systems, training, etc. etc.
Example of a diagram:

This tool is useful when it is important to recognize which from occurring phenomena underlie the problem under consideration. It is prepared as follows:

1. **Arrange brainstorming** and write on a large flip chart or whiteboard all the phenomena connected with issue that will come to team members minds...
2. **Under each noted position draw two fields**: "result" and "cause".
3. Participants compile any two positions and answer the question, which one is the result and which one is the cause. Draw an arrow in the direction of effect.
4. After examining in this way all the board it will occur that some of the problems are far more likely to be the causes of serious and relevant problems.
5. After the recognition of the source of difficult situation participants should try to get to the bottom of the issue.

Diagram can be used to work with until all causes and effects will be exhausted. It is good to arrange them, e.g. effects on the right of each of the five axes and causes on the left.

Each under cause can have its own cause.

Examples:

https://www.mindtools.com/pages/article/newTMC_03.htm
http://www.educational-business-articles.com/fishbone-diagram/
http://fishbonediagram.org/
**Diagram Why — Why**

**Description:**
Diagram "Why - why" is a tool similar to the Ishikawa Diagram. Its goal is to find the causes, factors of the problem, which are analysed on many levels. The search for causes is done using brainstorming that is organized among team members.

When working with brainstorming it is forbidden to criticize any ideas.

You should write down each of them.

It is important that all written causes have real character. What is absent in reality does not fit into the diagram.

**Benefits for teacher from the application of this method:**
- stimulation of the critical thinking;
- method teaches to look for reasons – it engages;
- makes it possible to transfer alternative, different approaches to the situation or issues;
- look at the issue from a different, new perspective;
- organizes the information transmitted data.

**The structure of the diagram can be used to:**
- conducting seminars;
- leading exercises, group projects, where there are various causes of the problem;
- supplement lectures where students enrich the content of the arguments

**Instructions on how to use the method when working with students:**
The tool, which is the "Diagram Why - Why" is used to find the causes of the problem. It is to be prepared as follows:

1. **Get a team, a group of competent people to seek the causes of the problem.**
2. **Define the problem** for which we are looking for solutions and write it on the left side on a piece of paper. Divide the rest of the sheet into several columns and write in them all the other causes
3. Gathered team members consider the question "why the problem arose", and then write all of the causes in the column just behind the defined problem.
4. At this point, all causes of the problem indicated by the team turn into problems.
5. Next to each problem ask the same question "why the problem arose" and save in the next column using arrows depicting the relationship "problem cause."
6. We continue our analysis until we find the source of our problem.
7. If causes in the diagram repeat, we circle them and number them.

8. To have full documentation of the performer analysis, we can enter the data to a computer or photograph our diagram.

9. To eliminate the cause of problems, describe how to reduce the likelihood of their recurrence or remove them, eliminate. Develop a plan of action - what changes we want to make.

10. Carry out the plan, put it into practice.

11. After some time, we assess the results of the changes.

Illustration No 2 Example of Diagram Why-Why

OBJECTIVE: BRAINSTORMING, DECISIONS, EVALUATION

SCAMPER

Description:
This is a method similar to the standard brainstorming, stimulating creativity and simple in application. This method assumes that creation of something new can be done by modification and transformation of what already exists.

This method was initiated in 1953 by Alex Osborne, regarded as the creator of "brainstorming", but it was developed in 1971 by Bob Eberle.  

Benefits for teacher from the application of this method:
- stimulation of the creative thinking;
- teaches to look for reasons - engages;
- makes it possible to transfer alternative, different approaches to the situation or issues;
- looks at the issue from a different, new perspective.

The structure can be applied to:
- conducting seminars;
- leading exercises, group projects, where there are various causes of the problem;
- supplement the lectures, where students are looking for new ideas.

Instructions on how to use the method when working with students:
First we must define the problem, which we have to solve, and then go through consecutive questions, searching for answers.

The name of this method comes from the acronym of words S.C.A.M.P.E.R, which in English means the questions that seek to answer using this method.

1. **S (substitute) – Replace**
   What can you replace? With what can you replace it? How can you replace it? What we can change, replace, e.g. shape, appearance, colour, name?

2. **C (combine) – Combine**
   What and with what you can combine? What the result will be if you connect together two solutions, ideas?

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3. **A (adapt) – Customize**
   Do you have / know projects like the present - can you use something from them, apply to the present? Does the solution can be used for other purposes?

4. **M (modify) – Modify**
   What can you modify? Can you change any of the items in order to achieve the goal quicker?

5. **P (put to other purposes) – Use for other purposes**
   Does the idea or generated solution can be used for other purposes? Who besides you, your target group can use this solution? Will it find application somewhere else?

6. **E (Eliminate) – Eliminate**
   What can you reject from the existing ideas? What can you eliminate? Is there anything that is unnecessary?

7. **R (Reverse) – Turn around, change the order**
   Can you reverse the order of generated ideas? What happens if you change the order? Maybe another order would be better?

This method can be used in several ways:\footnote{14}{Elaboration on the basis of http://designer.info.pl/mapa-mysli-metoda-scamper/ (access 21.12.2016)}

1. Asking questions until all ideas are exhausted.
2. Determining a time in which we have to answer the question, and after expiry of the time by going to the next question on the list.
3. Appointing several rounds, each of which consists of inventing one answer to one question. Going through all of them.

Examples:

- https://www.youtube.com/watch?v=G8w0rJhtz14
- https://www.youtube.com/watch?v=ru9-74qLXAo
- http://creativethinking.net/thinkpak-introduction/#sthash.XQyiL3U4.dpbs
QUESTION STIMULATION

Description:
Stimulating questions\textsuperscript{15} is one of the activating method that is associated with the lecture - indicated by a professor of teaching psychology Mel Silberman (Temple University, Princeton, USA).

This method uses teaching by generating questions and seeking answers. The scope of the problem (e.g. research) is defined by the questions.

Benefits for teacher from the application of this method:

- stimulation of the creative thinking and activation in a short time;
- makes it possible to transfer alternative, different approaches to the situation or issues.

The structure can be applied to:

- begin lectures – e.g. to formulate a list of key questions (you can develop FAQ model);
- check the knowledge of the topic;
- students activation and to make them interested in the new unfamiliar theme;
- leading exercises, group projects, where there is a need to look at the problem from a new perspective;
- supplement the lectures, where students are looking for new ideas.

Instructions on how to use the method when working with students:

1. Introduce briefly the issue, the problem - the topic of the lecture.
2. Instead of asking questions ask students to invent important and bothering questions in the area of the subject addressed. Precede with the explanation that you expect inquisitive questions that lead to a deeper understanding of the subject. If students have little knowledge on the subject, you can give those appropriate instructional materials e.g. handouts or situational materials, which will introduce students to the subject. Then ask them to be ask questions with answers that are essential for building knowledge.
3. Ask students to write down questions on sheets of paper. Then collect the sheets.
4. In the second part of the group work (students are divided into groups of 5-6) you can randomly distribute sheets with questions to students. Ask them to define what kind of knowledge will be needed to get answers, where you can search for information to questions. The aim should be to ensure that the students themselves will look for answers to the questions. If necessary, a lecturer should complement the information.

\textsuperscript{15}Silberman M., Metody aktywizujące w szkoleniach, Oficyna Ekonomiczna, Kraków 2006.
Variations:

- you can analyse the collected questions, divide them into groups, and then when grouped bigger categories you can distribute them to students;
- students can individually find answers to questions;
- questions collected on the first lecture in a given subject may also be used to create a list of questions for the final exam.
**Crushing — Reverse Brainstorming**

**Description:**
Crushing otherwise reverse brainstorming. Brainstorming we usually use when we want to solve the problem. And what happens when we begin to specify as many ideas to intensify the problem as possible?

Crushing is helpful if it is difficult to define the desired result, the purpose of the work. Inverted problem and working on it, due to the contrast delivers conclusions to determine the proper core and work goal. We get a list of risks or factors relevant to the assessment or to verification of the correct problem.

Working with this technique may be useful in prototyping. Crushing process indicates the possible risks and weaknesses of the technology.

Although the work of this method may seem funny and trivial - the results can be very surprising.

**Benefits for teacher from the application of this method:**
- stimulation of the creative thinking and activation in a short time;
- gives a picture of the problem from a new perspective;
- makes it possible to transfer alternative, different approaches to the situation or issues.

**The structure can be applied to:**
- activate students and to make them interested in the new unfamiliar theme;
- leading exercises, group projects, where there is a need to look at the problem from a new perspective;
- supplement the lectures, where students are looking for new ideas.

**Instructions on how to use the method when working with students:**
1. Name the problem or challenge and write it down...
   *E.g.:* How to get rid of traffic jams in the city.

2. Turn the problem by formulating the opposite challenge.
   *E.g.:* What do you do to effectively cork city?

3. Brainstorm and provide as many ideas on the implementation of the reverse challenge. It is important to exhaust the subject. The most creative answers fall at the end of this process - it is worth to be patient.

4. Draw conclusions from work and think about how the obtained information can help to correct the problem.

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6-3-5 BRAINWRITING

Description:

6-3-5 Brainwriting is one of the techniques of brainstorming. It can generate a large number of ideas in the area of the indicated issues, scope or the problem. Ideas arise as a result of intensive work of groups of 6 persons. The method can be used both to generate creative ideas as well as to check knowledge. The method was developed in 1968 by Bernd Rohrbach. It was first published in the journal Absatzwirtschaft in Germany.17

Benefits for teacher from the application of this method:

- stimulation of the creative thinking and activation in a short time;
- the ability to generate a large number of ideas in a short time;
- involvement of all present students;
- makes it possible to transfer alternative, different approaches to the situation or issues.

The structure can be applied to:

- check the knowledge of the topic, when there are a lot of good, creative answers;
- activation of students and to interest them with the new unfamiliar theme;
- leading exercises, group projects, where there is a need to look at the problem from a new perspective;
- supplement the lectures, where students are looking for new ideas.

Instructions on how to use the method when working with students:

1. Lecturer allots or describes with a group exact description of the problem that must be solved.

2. The lecturer divides the group into subgroups of 6 people. Each group or any person or group can have a different problem to solve.

3. Each person writes on a sheet in 5 minutes 3 ideas to solve the problem.

4. After 5 minutes, students pass their sheets to the person on their right. Another person writes its solutions. After another five minutes sheets move again into the hands of the person to the right.

5. Group works in silence.

6. After 6 rounds group generates 108 ideas.

7. Lecturer collects the sheets and the group eliminates duplications.

17 Elaboration on the basis of http://blogsession.co.uk/2014/03/635-method-brainwriting/ (access 21.12.2016)
FUKO FEEDBACK

Description:
Giving constructive feedback is an art - especially when we have to pass critical comments. FUKO Method\textsuperscript{18}: helps to discipline the way of giving the feedback and introduces a standard to justify the assessment. This method works well in difficult situations, when emotions prevail.

Benefits for teacher from the application of this method:

- factual information about the quality of students’ work and the expected results;
- a fair assessment, to evaluate students’ work.

The structure can be applied to:

- ratings justification;
- summary and evaluation of students’ activities.

Instructions on how to use the FUKO method when working with students:

1. THE FACTS
   Talk about the facts - that is about what you saw / you heard. It is important not to judge.
   Separate the person from the behaviour - refer to behaviour. Explain about which behaviour
   you are talking about. Present arguments.

   Instead
   „Jacek is disrespectful”

   Say
   „Jacek in its action does not take all aspects into account”

2. ATTITUDE
   Tell what your feelings about facts are. Do not judge the person. Refer to behaviour and
   pre-established rules. Explain why such procedure does not correspond to established
   standards.

   Instead
   „You are making me nervous because you have not made the report in time again”

   Say
   „I’m angry because I have not received the report in an agreed time”

3. CONSEQUENCES

\textsuperscript{18} Elaboration on the basis of Mackin D., Budowanie zespołu. Zestaw narzędzi, Dom Wydawniczy REBIS, Poznań 2011.
Inform about the consequences, what are the risks if the behaviour does not change. What impact this may have in the future for a person, a wider group, etc.

4. **EXPECTATIONS**

   Formulate expectations, determine what results you expect and deadline for the task.
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Internet resources

- http://blogsession.co.uk/2014/03/635-method-brainwriting/
- https://www.mindtools.com/pages/article/newCT_02.htm
- http://www.governica.com/Cykl_Deminga
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- https://www.mindtools.com/pages/article/newPPM_89.htm
- https://www.vocabulary.com/dictionary/argument
- https://www.youtube.com/watch?v=wqnYhugoixo

Other resources with teaching tools:
- http://www.uwec.edu/CETL/ActiveLearning/index.htm
- http://www.teampedia.net

Illustrations:
Illustration No 1 http://reviseordie.com/search/cornell
Illustration No 2 http://wierchola.pl/czytaj-zarzadzanie-jakoscia/narzedzia-zarzadzania-jakoscia/diagram-dlaczego-dlaczego/
ISBN Number:
978-83-946346-0-5