DS&AI

Co-funded by the Erasmus+ Programme of the European Union

Curriculum Development in Data Science and Artificial Intelligence

599600-EPP-1-2018-1-TH-EPPKA2-CBHE-JP

Teacher's guide

The good teacher explains.
The superior teacher demonstrates.
The great teacher inspires.

Version 1: 20 February 2020

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Co-funded by the Erasmus+ Programme of the European Union

PROJECT INFORMATION

Acronym	DS&AI
Project Title	Curriculum Development in Data Science and Artificial Intelligence
Contract Number	599600
Start Date	15 Nov 2018
Duration	36 months

DELIVERABLE INFORMATION

Deliverable Number	D2.6
Deliverable Title	Teacher's guide
Submission Due Date	14 March 2020 (proposal) 14 March 2020 (revised)
Actual Submission Date	14 March 2020
WP Number and Title	WP2: Development
Lead Beneficiary	LEU
Dissemination Type	Report
Dissemination Level	International
Quality Reviewer 1	AUEB
Quality Reviewer 2	Skybridge
First Quality Review Date	20/08/20
Quality Review Pass Date	22/08/20

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Abstract

This report provides an overview of useful teaching approaches, examples of best practice, and practical tips for teachers. Each chapter provides a brief overview of some teaching approaches relevant for Data Science and Artificial Intelligence master curricula, and it clarifies how these approaches can be implemented in practice.

CONTENT

1. Introduction

What is this document about?

The purpose of this document is to give teachers a compendium to the courses for the Data Science and Artificial Intelligence curricula developed in this project. It includes practical information that may be useful for these modules so that teachers can make the most out of it. For many teachers is likely that they have come across some of the information presented in this guide at one point or another, and perhaps some are very familiar with it already and use it during teaching and assessment. But for many teachers some of these concepts are just a passing reference, something they may have heard of but never applied in their own courses. It is for this group of teachers that this document is intended, to take them from a limited knowledge to a functional understanding of modern educational approaches.

This document is based upon three main concepts: that students must actively build knowledge and skills (active learning), that this knowledge is socially constructed (collaborative learning), and that courses are learner centred. In fact, in the coursework of the curricula developed in this project, collaborative projects and programming labs activities play a major role. Moreover, courses have been designed with many student-centred learning outcomes and thus recognizing that each student has different characteristics. This guide provides some practical information on how a teacher can understand these differences and how they should be employed to improve the learning experience.

The knowledge provided by this document is based on the *Teaching and Learning Guide* of Leiden University[1]. It is a good starting point, but it doesn't mean that every teacher should follow it.

[1] Available on line at https://www.teachingandlearningleiden.nl/index.php/educational-themes/

2. Knowing students' (prior) understanding

How do I find out what my students already know?

Knowing what your students know enables you to design your teaching based on students' understanding. It can also inform you about the effects of your teaching before the results of final assessment are in, when it is too late to adapt your teaching.

Below are three examples of teaching and learning activities that activate and explicate students' (prior) understanding. Using them at the start of a lecture or course helps determine prior knowledge and understanding and activates their learning; using them later on is more informative about the effects of your teaching.

2.1 Quiz

Quizzing students, for instance with a series of multiple choice questions or statements, is a fast way of determining students' understanding. Offline quizzes can use answer options as raising hands, standing up or moving to different corners. Several interactive digital Apps offer more options, including voting, rating, or open questions. Students vote using their own phone, tablet or laptop.

2.2 Mindmap

Asking students to draw a mindmap about a central concept or question, visualising (hierarchical) relations between the central concept and related ones informs you about their understanding and activates their learning. Depending on their purpose, mindmaps can be done in class or as preparation, by hand or online, individually or in groups. You can also ask students to continuously update the mindmap as they progress through the course, challenging them to directly link course content to their developing understanding.

2.3 Exam questions

Developing examination questions and answer models is a task usually reserved for lecturers, but when you ask students to do so, it requires them to think about the essential aspects of the course content, activating their learning. The wording and level of the students' questions (e.g. asking for memorisation, application, or understanding of course material) also informs you about students' expectations in terms of the level of required understanding. Using one or more of the best questions in the actual examination is motivating for students and saves you work.

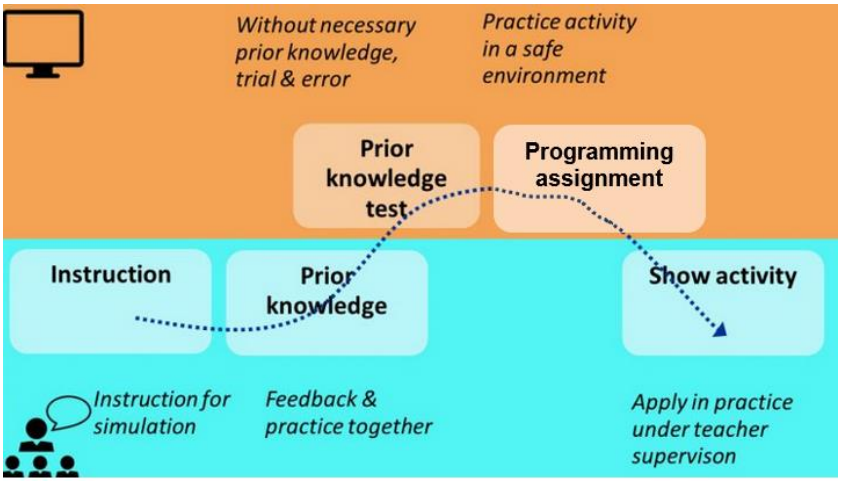
3. Blended Learning

How do I keep students engaged in my blended learning set up?

Blended learning combines learning activities in class and remotely online. The most important aspect of blended learning is that all the activities are connected and support each other. "Blended learning represents a new approach and mix of classroom and online activities consistent with the goals of specific courses or programmes" (Garrison, Vaughan, 2008). An ideal blend in education does not exist. In each learning practice you will have to strive to find the most effective blend for that particular situation. This means that educational issues are leading, and not the technology as such.

3.1 Two simple examples

The example below indicates how adding a prior-knowledge test, in this case an online test, helps students preparing for their learning experience in a programming assignment. The teacher wanted to make sure the assignment would not be used as a trial and error exercise by students, therefore the prior knowledge test was made a compulsory part of the programme.



There are different ways to provide student with online material; you can offer them digital learning material (films, articles, and websites) or provide them with web-lectures, knowledge clips, online assignments, online feedback/peer feedback assignments or online discussion platforms. Also using digital educational tools, such as a peer review tool is a possibility. Here is an example:

Students are asked to design a poster about different types of data management. In order to communicate the issues clearly, the students needed to delve into the theory and study relevant research. In the case of a very large student cohort, it may be a challenge to mark them all within a short timeframe. The teacher may thus decide to employ a peer review strategy to provide the students with feedback. She/he uses an available tool to upload the digital posters for review. The students are then assigned to assess five posters on content, references and design. In addition to written feedback, they are asked to rate the work with 1 to 5 stars. They are also asked to award their 10 favourite posters with a like. The programme ranks the posters on basis of stars and likes so that the best rated posters appear at the top. The teacher needs only to analyse the feedbacks and the ratings to check that the students were accurate in their feedback and there is no apparent bias.

3.2 Some design principles

The main question when setting a blended learning course is still *what are the learning goals? How are you going to test the students and how are you going to make sure you design your programme in such a way that it supports these goals?* When you first want to start with setting up a blended learning course, there are a few design principles to bear in mind.

- *Start small*; pilot your first redesign and evaluate under students;
- *Something in, something out*; try to avoid programme overload;
- *Sequence the activities*; put everything in an order and time line;
- *Re-use*; there is already a lot out there!
- *Use lecture time differently*; for discussion or for explaining more specific examples;
- *Be clear*; explain that the online part is part of the programme and not optional.

3.3 References

- D.R. Garrison, N.D. Vaughan (2008). Blended learning in higher education, Framework, Principles and Guidelines, Jossey-Bass, A Wiley Imprint, San Fransisco, CA.
- Randy Garrison, Heather Kanuka (2004). Blended learning: Uncovering its transformative potential in higher education, in Internet and Higher Education 7: 95-105.

4. Activating teaching and learning

How do I activate students during my lectures?

Rather than the transmission of predefined knowledge to passive recipients, teaching can be designed to foster students' active knowledge construction, by interacting with other students, classroom materials and the teacher. Actively engaging students with content (for instance by discussing course material, linking it to previous understandings, looking at it from different perspectives, and reflecting on one's choices, motivation and arguments) lead to more effective learning than what is referred to as the "consumption of knowledge".

4.1 Activating teaching

In activating teaching, knowledge is not predefined, but always enriched by interaction with teachers, students and classroom materials, and students progressively take responsibility for their own learning throughout their university careers. There are at least three ways in which teaching can be activating:

1. Activating teaching invites students to actively *construct knowledge*, for instance by teachers and students linking course content to prior understanding and looking at issues or questions from different perspectives. Teaching activities, ranging from asking questions during a lecture to mind mapping and (digital) classroom polls, reveal existing student understandings and can be used as starting points for further enrichment.
2. Activating teaching invites students to *interact* with other students, teachers and classroom materials. Collaborative teaching activities as debates, think-pair-share, peer- or self-feedback are useful here, and are likely to enrich students' understanding.
3. Activating teaching also entails students progressively *taking responsibility for their own learning*. Larger assignments, in which students have more freedom to pursue individual interests at their own pace, require students to plan their own learning and also tend to trigger reflection on the learning process.

4.2 Changing role of the teacher

Activating teaching is more than adding assignments, activities and technological tools to a lesson or course, as activating teaching not only changes the role of the students, but also of the teacher. Activating students requires preparation before and reinforcement during class. Sometimes, it also entails resisting the impulse to "take over" when students appear to be struggling; typically, this shows that they are actively engaging with the learning process.

Designing activating teaching starts with thoroughly thinking about students' needs and learning objectives. Starting with these learning goals, teachers should consider the different ways students could achieve these goals and design (inter)active teaching and learning activities in line with these objectives. In this process, the assessment design also deserves attention, as it is important that assessment is constructively aligned with the learning objectives and teaching activities.

The extent to which students will be actively engaged in class depends on what the teacher does and how the lesson is planned, but also on what students are familiar with. When students have little experience with activating teaching, or when they are confronted with different approaches to teaching and learning, they may express dissatisfaction at first. This signals that students may need guidance on how to learn actively.

4.3 A basic activating teaching strategy

Activating students during lectures can be challenging, but is rewarding. It helps to capture and maintain students' attention and engagement in order to foster deeper learning. Make sure that the activating teaching (activity) is not just entertainment or a mere alternative to listening, but conducive to students' learning. This comprises designing activities that help students achieve the learning objectives of the course.

A basic activating teaching strategy that requires little preparation is *asking questions* during the lecture. Depending on your goals, different types of questions can be useful:

- Recollection: what were the four treatments we discussed last week?
- Application: which of the treatments that we've discussed is most useful (for X)?
- Prediction / thinking along: what do you think are the main causes of X? How would you design an experiment to explore Y?
- Argumentative/ evaluative: do you agree with assertion X and why? What would be a counterargument to what I've just explained?
- Analysis: how does X compare to Y? In what ways are the findings of X and Y inconsistent/contradictory?

Answering is often voluntary, likely resulting in an interesting discussion with a particular (type of) student, but to activate all students you could consider:

- Having students discuss answers with their neighbours (e.g. during 5 minutes)
- Having students raise hands or stand/sit to indicate their response to multiple-choice questions
- Randomly asking students to answer
- Using an electronic voting system

Knowing that their answers matter is crucial for students' motivation for and engagement in class and for the activation to be effective for learning, therefore make sure to refer to their answers.

Activating students during lectures can be **time consuming**. It can save time to ask students to complete some of the activities outside of class (e.g. make a mindmap on topic X, formulate arguments for a debate, reflect on a question, make a summary) and possibly submit it online. If students submit their preparation work online *before class*, you can adapt your lecture accordingly. Whereas if students submit their "answers" to the activity related to the lecture *after class*, it will help you to assess how effective your lecture was.

4.4 More challenging ways of activating students

Activating learning involves interaction between lecturer and students in the classroom. It can include the use of a number of tools to support the teacher in creating more interaction in the classroom

4.4.1 Votes during lectures

Voting boxes and feedback tools can be used to check whether students have understood the lecture materials or to get a real-time sense of the mood in the lecture hall. Unlike voting boxes, online feedback tools depend on a live Internet connection and therefore require participants to have access to a mobile device (smart phone, tablet or laptop).

4.4.2 Brainstorm with students

You can support a brainstorming session with a mindmapping tool. A mindmap is a tree diagram consisting of concepts, texts, relations and/or images around a central theme. Via an online mindmapping tool, students can work together on a single mindmap.

4.4.3 Instruction without slides

In addition to using lecture slides, which have the advantage that they can be used as reference material for the students, it can be activating and instructive to explain models, algorithms, and concepts on the blackboard/whiteboard. It allows the students to follow the teacher's line of thought step by step, and can be more interactive than pre-made slides.

4.4.4 Active Learning Spaces

Students do so much more than listening alone. They also write, discuss and reflect. Active Learning Spaces are spaces designed to facilitate these processes. The goal is to promote interactive contact between students and lecturers by using more active teaching methods. The most basic active learning space is formed by student-centred tables and technology. Technology in this case means anything that is used to facilitate visual learning: displays, whiteboards, projectors and microphones (so all students can hear and be heard. The most common active learning space[2] allocates nine students on each round table, where the students working as three

[2] Beichner. R.,1., and J.M. Saul, "Introduction to the SCALE-UP (Student-Centered Activities for Large Enrollment Undergraduate Programs) Project". In *Invention and impact: Building excellence*

teams, and each group of three students shares a single laptop computer. With nine students on each table working as three teams, each team is likely to interfere with the work of the others, and each student to have an active role in her/his team.

One of the features of an Active Learning Space is flexibility. The atmosphere of the lecture hall contributes to this active learning process. An Active Learning Space is primarily developed for students and lecturers, but it can also be used for example for brainstorming sessions or training programmes.

in undergraduate science, technology, engineering and mathematics (STEM) education, pages 61-66, American Association for the Advancement of Science, 2005.

5. Flipped classroom

How do I increase increases classroom interaction?

In essence, “flipping the classroom” means that students gain first exposure to new material outside of class, usually via reading or lecture videos, and then use class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion, or debates. his means that students are doing the lower levels of cognitive work (gaining knowledge and comprehension) outside of class, and focusing on the higher forms of cognitive work (application, analysis, synthesis, and/or evaluation) in class, where they have the support of their peers and instructor. This model contrasts from the traditional model in which “first exposure” occurs via lecture in class, with students assimilating knowledge through homework; hence the term “flipped classroom.”

By providing an opportunity for students to use their new factual knowledge while they have access to immediate feedback from peers and the instructor, the flipped classroom helps students learn to correct misconceptions and organize their new knowledge such that it is more accessible for future use. Furthermore, the immediate feedback that occurs in the flipped classroom also helps students recognize and think about their own growing understanding

5.1 Few examples

To ensure that students do the preparation necessary for productive class time take-home assignments can be given. The students receive feedback through the processing activities that occur during class, reducing the need for the instructor to provide extensive written feedback on the students’ work.

Another example consists in providing students with a variety of tools to gain first exposure to material outside of class: textbook readings, lecture videos, and Powerpoint presentations. To help ensure student preparation for class, students are expected to complete worksheets that can be periodically but randomly collected and graded. Class time is then spent on activities that encouraged students to process and apply the concept learned, ranging from in-class discussions in response to student questions to small group discussions of some application problems.

Electronic voting tools can facilitate the implementation of flipping the classroom. For example, the teacher can use assignments or quizzes to help ensure that students come to class prepared. Class time is structured around alternating concept explanation and conceptual questions. Importantly, the conceptual questions are not posed informally and answered by student volunteers as in traditional lectures; instead, all students must answer the conceptual questions

via an electronic voting tool that allow students to answer anonymously and that allow the instructor to see (and display) the class data immediately. If a large fraction of the class (more than 30%) answers incorrectly, then students reconsider the question in small groups while instructors circulate to promote productive discussions. After discussion, students answer the conceptual question again. The instructor provides feedback, explaining the correct answer and following up with related questions if appropriate. The cycle is then repeated with another topic, with each cycle typically taking no more than 15 minutes.

5.2 How to implement a flipped classroom

The mechanism used for first exposure can vary, from simple textbook readings to lecture videos to podcasts or screencasts. The pre-class exposure doesn't have to be high-tech, students simply completing pre-class reading assignments is enough. Most important is that the material is engaging, clear, and that the students understand that the content will be fully discussed in class.

It is important to provide an incentive for students to come prepared for class. Typically, students have to complete a task associated with their preparation, and this task may be associated with points. The assignment can vary; the examples above used tasks that ranged from online quizzes to worksheets to short assignments, but in each case the task provided an incentive for students to come to class prepared was giving them points. In many cases, grading for completion rather than effort can be sufficient, particularly if class activities will provide students with the kind of feedback that grading for accuracy usually provides.

Another key aspect is to design a mechanism to assess student understanding. The pre-class assignments that students complete as evidence of their preparation can also help both the instructor and the student assess understanding. Pre-class online quizzes allow the teacher to focus on the elements with which students are struggling and the help the students to find the areas where they need help. Pre-class worksheets can also help focus student attention on areas with which they are struggling, and can be a departure point for class activities, while pre-class assignments help students clarify their thinking about a subject, thereby producing richer in-class discussions. Importantly, much of the feedback students need is provided in class, reducing the need for instructors to provide extensive commentary outside of class. In addition, many of the activities used during class time (e.g., quizzes or group debates) can serve as informal checks of student understanding.

The final key point is to design in-class activities that promote deeper learning, because the students gained basic knowledge outside of class. The activity will depend on the learning goals of the class. Examples for spending time in class are solving and discussing quizzes, engaging students in debates, doing some data analysis, or little programming exercises. The key is that students are using class time to deepen their understanding and increase their skills at using their new knowledge.

5.3 References

- C. Brame (2013). Flipping the classroom. Vanderbilt University Center for Teaching. Retrieved from http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/.
- J. Bergmann, and A. Sams (2012). Flip your classroom: Reach every student in every class every day. Or Eugene, International Society for Technology in Education.
- Center for Teaching Innovation at Cornell University. (2017). Flipping the classroom. Retrieved from https://www.cte.cornell.edu/teaching-ideas/designing-your-course/flipping-the-classroom.html.

6. Improving students learning

How do I persuade my students to prepare for class?

Class time is precious, as there is never enough time to cover all the interesting content of your course. For large- and small-scale teaching, lecturers often expect their students to come to class prepared, typically, by having read the literature or viewed the assigned videos (often referred to as flipped classrooms). If students spend time outside of class preparing, it means there is more time for in-depth discussion or challenging application of the course material during class.

Unfortunately, this does not always happen, leaving the lecturer with a difficult decision: start with explaining what should have been prepared or focus on the students that have prepared by taking the preparation as the starting point?

6.1 Teacher preparation

Consider why students do not come prepared: perhaps the preparation was not challenging, or it was too difficult, too much or there was not enough time? Or more likely: the students had other priorities and postpone the learning work for courses until it is necessary for them (a test or exam).

In the study guide and on the virtual learning environment, write explicitly that class preparation is expected and assumed for classes. Also, write explicitly that the lecturer will build upon the preparation and that if students have not prepared they will easily fall behind and that it is their responsibility. Use the first lesson to reinforce the same message about the assumed and expected preparation.

Ask your students what they expect about their own role and your role. For example, by asking: what do you think the lecturer should do if some students have not prepared? In this way an open discussion can take place in which the lecturer can steer the students towards the expected behaviour.

If students have to prepare an assignment or read literature, be clear about expectations. It could be helpful to ask a colleague to check your assignments on clarity (four eyes principle). With regards to reading in preparation for class, explain what is expected of students, e.g. what they need to find out and/or what they should focus on (instead of just saying read chapter 11). This way students know what they need to focus on (e.g. finding the main (counter-) arguments, or the research method(s) used).

6.2 Persuading students to come prepared

Expect that the students come to class prepared and design lessons accordingly. When lecturers (implicitly) assume students do not prepare, this is typically reflected in the lesson design, for instance by starting with a recap of the preparation. This in turn stimulates students to not prepare, since preparation essentially becomes obsolete.

Organise your lesson in such a way that the preparation is used in a relevant way. Instead of repeating what students should have done, you can ask the students to give a summary or a short presentation.

At the start of the lesson, ask who has prepared. After, you can start with a question that can only be answered after having done the preparation ("what is the main argument of X?"). Added value is that the lecturer also gets an impression of the students' understanding. The advantage of knowing the students' preparation at the start of the lesson, is that you can adapt your lesson to the level of preparation of the class. (You can also do this with an interactive quiz)

6.3 When (some) students do not come to class prepared

In essence, students who have not prepared should notice it is not acceptable if they have not prepared. In small groups, telling students individually (during breaks, or before or after class) that their preparation is not sufficient, can be very effective.

If a few students have not prepared, stress that it is their responsibility to prepare and that you cannot adapt your lesson to this because you have counted on (and explicitly mentioned) their preparation. Those who have not prepared could be asked to leave the classroom and catch up quickly, for example, by finding arguments for and against the issue(s), to be used during the discussion that will take place.

Another option is to let unprepared students participate as much as possible, as a punitive approach may lead to a negative atmosphere leading to even more lack of preparation and could contribute to a decline in teacher-student relations and rapport.

6.4 Using frequent assessments and feedback

Another method to improve students learning is by providing students with frequent assessments with feedback, for example by tasking them to do assignments throughout the module, not just at the end. The type of assignment may differ, it may range from a weekly test with 10 multiple choice questions to a weekly open-questions test to a monthly programming project. Intermediate assessments support students in increasing their time on tasks and spreading their learning efforts more regularly throughout a period of time, and affects learning outcome positively.

Note that formally, each test or assignment that contributes to the course grade, requires a re-take opportunity. This means that testing and assignments should be well-planned, with clear deadlines and re-take deadlines.

Offering feedback frequently is one method of promoting regular study effort as well as engaging students with the course. Students' study effort, or time spent on studying, is a predictor of study success. The more time students spend on learning, while the quality of education remains the same, the better they perform. The type of feedback also differ:

- Quantitative feedback on the task (e.g. 'your score is 8 out of 10),
- Qualitative feedback on the task (e.g. 'research questions are lacking and your method description could have been more explicit. Also, please present your results in a table')
- feedback on the learning process (e.g. 'you held 4 interviews and processed them in time');
- or feedback on the person of the student (e.g. 'you did well').

While the first three types of feedback are powerful in terms of deep processing and mastery of tasks, feedback on the person is seen as the least effective type of feedback.

7. Collaborative learning

How can I organise collaboration in teams of students?

Collaborative learning is a type of active learning in which students learn by doing a group assignment collaboratively. Students gain knowledge by exchanging ideas, dividing work to be done, finding solutions to problems together and cooperatively creating a product. The teacher either structures the collaboration or guides the students to structure their cooperation themselves.

Cooperation in an educational context has some specific aspects. For example guiding the collaboration between students, organising individual student responsibility and assessing the contribution of individual students against the required quality of the collaboration process and product. Johnson & Johnson (1994) identify five essential elements for developing successful cooperative learning assignments:

- positive interdependence (i.e., perceiving that working together is individually and collectively beneficial, and success depends on the participation of all the members of the group);
- individual and group accountability;
- stimulating mutual interaction;
- attention towards interpersonal and small group skills, and
- attention towards group processes.

7.1 Goal

Collaborative learning has a positive impact on both cognitive and social development of students related to learning results and self-esteem. Students learn to solve problems by integrating their knowledge and insight in practice. In this approach, learning is seen as a social and situated process of knowledge construction. Furthermore, collaborative learning stimulates the recognition of individual differences between students. Also, by feeling responsibility for the group's result, more students complete an assignment if it is a group assignment.

7.2 Getting started: preparation

Divide the project into different phases, e.g. analysis, design and realisation. Determine which products have to be delivered in each phase, e.g. analysis report, design (including the script) and the final product. Ask the students to think about how they can monitor the quality of the project and the products that will be delivered. This will be drawn up in a quality plan per phase.

Before starting, think of a workable method for the project groups. Work with different roles that can be changed per phase. Examples are: an organiser (keeping an eye on the broad outlines), an editor (responsible for contents and quality of products) and a secretary (arranging meetings and writing reports).

Provide an outline for team supervision. The three most important parts are: communication agreements between tutor and team, specify quality plans and the team assignment.

Have authentic assignments ready before the project starts. Identify clients in need of practical solutions to their problems and willing to act as a customer and expert.

Make clear how you will evaluate. It is not just the quality of the products per phase (analysis, design and final result) that should be assessed; the product realisation process is also taken into account. The course mark awarded to a student is a weighted average of the scores received so far (for example you can use a ratio of 20% – 30% – 50% over the three phases).

When setting the course objectives, make sure to include objectives that are relevant to team work. This will enable you to assess your students on these objectives as well.

Make sure that you organise the input of external experts and lecturers yourself, e.g. arranging thematic and guest lectures.

Divide the students into groups, with each group preferably comprising students from different disciplines. Let the students sign up individually or in pairs for a particular team based on the description of the assignment (starting from a group size of 6 students).

Enable exchange of information between the groups, for example, through an electronic discussion forum in a digital learning environment.

To manage the available tutoring time efficiently, you can tutor more groups at the same time. One group can learn from the feedback you offer to others, while the different groups can also comment on each other's contributions. These meetings can be alternated with group supervision and group tutoring sessions to discuss the specific projects of the individual groups.

7.3 Getting started: application

Include course information in your digital learning environment, such as a description of the project structure, the project procedures (different phases, quality reports, division of tasks), the supervision method and times of the (guest) lectures and supervision sessions.

Make sure that the students understand that the assessment (and, therefore, their marks) will be based on the product as well as on the process: (1) State clearly how the product will be evaluated and explain in detail what evaluation criteria will be applied. (2) The assessment of the process will be based on the quality plans and on the supervision sessions.

During the first lecture, pay extensive attention to the structure and the organisation of the project (phases, products and supervision/tutoring). Indicate what products are expected to be delivered and how these will be evaluated.

Refer to the quality control plans in the supervision sessions, and at the end of each project phase, ask students to reflect on their own product and process based on their own plans.

Create a virtual group venue for each group of students in the digital learning environment. Give access to all group members to their group venue.

At the beginning of every phase, make sure that the students draw up a good division of tasks between the team members in their quality control plans for that phase.

7.4 References

- Johnson, D. W., & Johnson, R. T. (1994). Learning together. In S. Sharan (Ed.), Handbook of cooperative learning methods (pp. 51-65). Westport, CT: Greenwood Press.
- Slavin, R.E. (1996) Research on cooperative learning and achievement: What we know, what we need to know. Contemporary Educational Psychology, 21(1), 43-69.
- Stevens, R.J., & Slavin, R.E. (1995). The cooperative elementary school: Effects on students' achievement, attitudes, and social relations. American Educational Research Journal, 32(2), 321-351.
- Veldhuis-Diermanse, E. (2002). CSCLearning: Participation, Learning Activities and Knowledge Construction in Computer-Supported Collaborative Learning in Higher Education. PhD thesis Wageningen University, Grafisch Service Centrum Van Gils (http://edepot.wur.nl/121278).

8. Group discussions

How do I lead a group discussion in class?

A prototypical activating teaching activity is a group discussion: a discussion about a topic, issue, problem or question that invites students to actively contribute to the lesson and enables the lecturer to immediately discern and correct misunderstanding.

To get a discussion going, the question or statement to be discussed deserves careful attention. Different types of questions, likely to lead to different discussions:

- Questions for memorization (what do you know about X? What does concept X mean?), likely evoke a discussion about the (prepared) literature, or general declarative knowledge. They can be used to check students' preparation and establish students' prior knowledge.
- Questions for understanding (how would you explain X in your own words?) evoke a discussion about different interpretations and are useful to reveal misunderstandings.
- Questions for analysis (how does X compare to Y?) and evaluation (what are the advantages of X?) likely evoke a debate and are useful when the goal is to explore different perspectives or formulate an informed opinion.

To get a group discussion going, your role as a lecturer should not be that of the expert answering questions or responding to statements (i.e. not lecturing), but that of a facilitator, encouraging students to participate, while maintaining focus on what is important. In a group discussion, students interact with each other: it is your job to redirect questions and statements to the group (e.g., who (dis)agrees? What would an alternative explanation be?). You can also use this technique to correct wrong statements, by actively encouraging students to correct each other's misunderstandings.

8.1 Risks and challenges

A risk in group discussions is getting side-tracked: focusing too much time on irrelevant issues. Your job is to shift the focus back to the core of the issue by paraphrasing and summarising.

A challenge in group discussions is keeping track of everything that is said. Having a student take notes, or taking notes yourself, that are visible to the whole group (e.g. on a flip chart, white

board, or on a computer being projected onto a screen), visualizes the breadth of discussion and highlights missing elements.

Another challenge is dealing with students who do not participate in the discussion. Depending on the reason (e.g., fear of being embarrassed, lack of preparation, do not see the added value), different solutions might work. For instance, you can establish communication ground rules and/or explicate why you choose a discussion over a lecture.

Knowing what your students know enables you to design your teaching based on students' understanding. It can also inform you about the effects of your teaching before the results of final assessment are in, when it is too late

8.2 References

- Linda B. Nilson (2010), Teaching at its Best: A Research-Based Resource for College Instructors (3rd). Jossey-Bass, San Francisco: chapters 13 en 14.
- Wilbert J. McKeachie, Marilla Svinicki (2006). McKeachie's Teaching Tips, Strategies for College and University Teachers, College Teaching Series, Twelfth edition, Houghton Mifflin Company, Boston New York, Chapter 5, p.35-56.

9. Inclusive education

How do I create an inclusive classroom?

Even in a seemingly homogeneous group of students, many differences between students exist. In an inclusive classroom, visible and invisible differences, for instance in class, religion, ethnicity, gender, culture, sexuality or (dis)ability, are not seen as a disadvantage, but are used as a means to increase awareness and to show more perspectives on academic and societal matters. Another prominent form of diversity among students is their prior knowledge and skills before entering the course. Not all students come from the same educational background, and their levels of understanding can strongly differ, as well as their expectations from the course.

9.1 An inclusive preparation

Be(come) aware of your own (cultural) expectations and assumptions about teaching and learning, for instance, by discussing these with international colleagues or colleagues from different departments.

Consider the literature that you are using for the course: is there a (or some) diversity in the perspectives and origin of the literature?

Consider the examples you use in your teaching: are they based on information students should all be able to know about? If you use very specific or local examples, your students may not be able to understand you. In some cases, what a lecturer presents as a problem, may not be perceived as being a problem for students with a different cultural background.

Find out who your students are and what they expect from the course prior to the course and what their prior knowledge is, by using a simple online questionnaire (e.g. in the virtual learning environment).

Discuss with colleagues how your course relates to their courses, so you can relate your course to the prior knowledge and skills of your students.

9.2 An inclusive classroom

Greet your students when they enter your classroom for the first time, it is a very simple way of showing you are interested.

During your first meeting with the students reserve some time to ask the students to share with you and/or each other a bit about their educational experience. Are they used to discussions in class? Have they worked in groups before? Have they given feedback to each other?

Reserve some time in the first meeting to explain what you expect of the students, how they should, for example, collaborate and especially why you choose certain learning activities. It is not common for all students to share their thoughts, give feedback or work together. Therefore explaining why you find this important may help to increase student understanding.

When students have to work in groups and you want to mix them based on their cultural diversity, be sure that the mix is relevant for the assignment they are working on. It helps if the assignment asks for different perspectives or experiences that your students may be able to bring forward.

Ask students about their experiences and examples pertaining to the course content; this may lead to interesting and unexpected discussions, but also enables you to check your assumptions about expected prior knowledge and skills.

Tell students that if they have specific needs in order to learn well, they can mention this to you (privately) and that you will do your best to help them.

In big lecture halls, walk around the room and also go to the back of the room. Use a microphone and inform your students you will walk around (managing expectations!). In this way you can also connect with the students in the back.

10. Integrating research and education

What are options for strengthening the role of research in my teaching?

Research-based and inquiry-based learning bring research close to education by requiring our students to adopt an active, inquisitive attitude. Students are no longer merely observers; they become participants. As a consequence, research is not just the basis of our teaching, but is actually the very core of our teaching.

Not all students aspire a career in research, however it is important that all students have the opportunity to acquire sound skills in research methodologies and learn about the latest research insights. Furthermore, the inquiry skills that students gain can be applied to question, analyse and tackle the important challenges that our society is facing today. For example, it is important that students learn to assess the value of different sources of information, that they are familiarised with the important research themes within their disciplines, and that they learn to articulate critical research questions with appropriate academic standard.

10.1 Research-based and inquiry-based learning

Research-based and inquiry-based learning are approaches to integrate research into teaching and learning; they are closely related but have a different focus. Whilst research-based learning could be understood as involving students directly in current research projects, it is often employed to familiarise students with research and research methods in the context of their discipline. Inquiry-based learning could be understood as an approach to teaching and learning in which the student is stimulated to develop a proactive attitude to fact-finding and problem-solving, rather than depending on presented facts or established knowledge. Inquiry-based learning is often employed to explore societal issues or dilemmas and is usually applied in an interdisciplinary context.

In this context there are roughly three options to research-based and inquiry-based learning to consider:

1. Focus on research content or processes and problems;
2. The students as audience or participants;
3. Focus on disciplinary research or interdisciplinary (often societal) inquiries.

Approach 2 distinguishes clearly between students as participants and students as audience, on

which we focus below.

10.1.1 Students as participants

Research-practice: Here students are directly involved in research projects. This could vary from micro-research projects that can be completed in a day to major assignments or theses.

Research-tutored: By engaging students in discussions around current research topics, students learn to appreciate and recognise different vantage points in academic debates. This could be done, for example, through involving students in the organisation of seminars or through organising classroom debates.

10.1.2 Students as audience

Research-led: This involves teaching current research in the discipline. For example, by referring to current research in lectures and sharing up-to-date research-findings in reading materials.

Research-oriented: Here the focus is teaching students research skills and techniques. For example, through teaching about different research methodologies, including laboratory skills, writing papers and fieldwork.

It is important to note that the emphasis on the approaches described above to integrating research into teaching and learning should be seen as different strategies for students to acquire knowledge and skills as well as insight in research approaches.

10.2 Engaging students in research

There are several ways to engage students in research and in doing so promoting the development of students' knowledge, skills, and attitudes. Engaging students in authentic research activities gives them the opportunity to develop essential disciplinary skills and a deeper understanding of fundamental concepts. The following questions are a starting point for teachers:

- *What student outcomes do you aim to promote in terms of skills, dispositions or knowledge and understanding?*
  For example, to promote problem solving skills the student could work on wicked problems/cases, but to promote student understanding of research reading state of the art essays may be more appropriate.
- *What student outcomes do you aim to promote in terms of student experiences of research in teaching?*
  For example, to promote student motivation for research showing theoretical or methodological models may work, yet to promote students' confidence in their own research skills it may be more appropriate to let them conduct small parts of a research study.