Flipping Education in Research Methods

Background information and teacher manual

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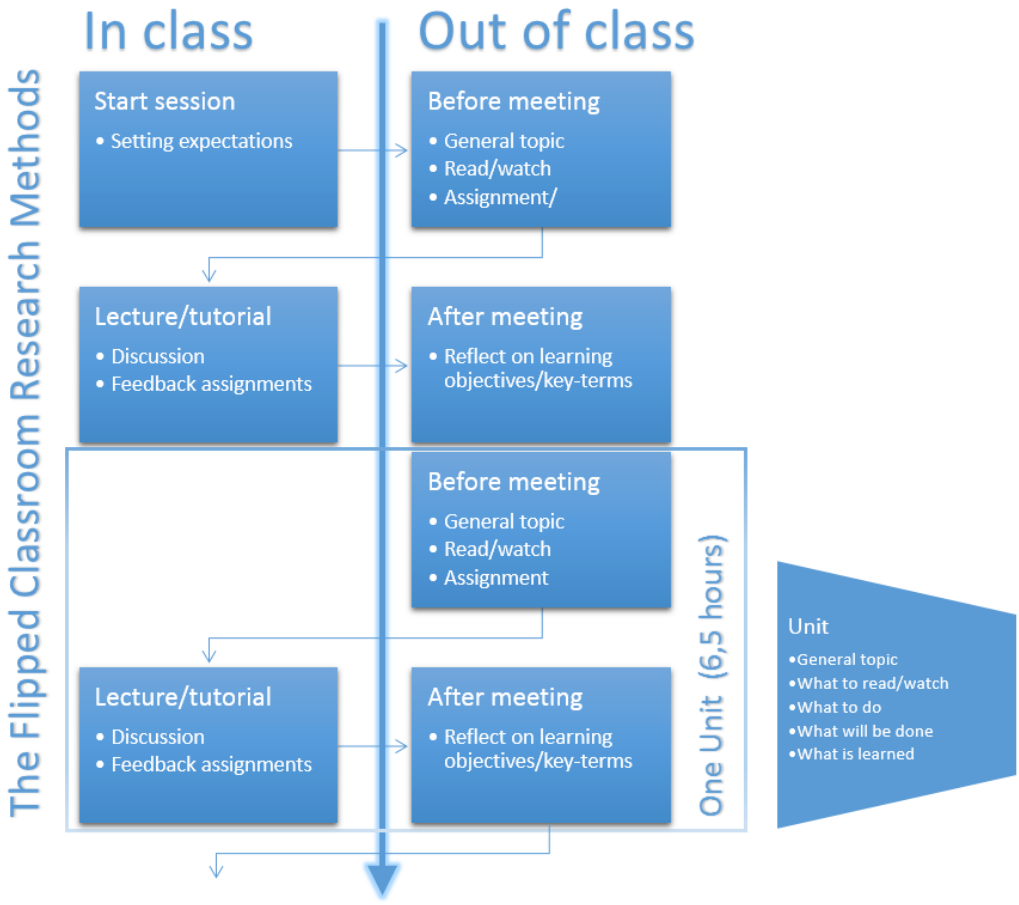
This manual contains a description for using micro lectures and assignments created in the context of the FERM project, introducing flipped classroom in the context of research methods training.

Contents

Introduction

The educational concept 'flipped classroom' is used for various related teaching methods and is similar to older teaching methods (Abeysekera & Dawson, 2015; O'Flaherty & Phillips, 2015). Most definitions of flipped classroom teaching assume that multimedia lectures being recorded so students can view them out of class at their own pace. In addition to these video materials, students can be offered with other types of instruction materials to familiarize themselves with new ideas, concepts and procedures. Some argue that requiring and checking whether students are indeed doing the pre-class preparation is a defining characteristic of the flipped classroom approach (Abeysekera & Dawson, 2015, p. 3).
The flipped classroom model as used in the FERM project is presented in Figure 1. It clearly shows the expected/planned learning activities of students in and out of class.

Figure 1 The Flipped Classroom Research methods



The pre-class preparation activities free up in-class time for student centred learning activities. A range of in-class activities have been suggested, including individual practice, group discussions, group assignments and quizzes. Especially making assignments in small groups seems to work, because in small groups students discuss things together, which empowers students learning process and solves many issues without involvement of the teacher, and because it creates a safe learning environment to ask questions to the teacher (as compared to asking questions in a relatively large class). The teacher can

provide individualised help or semi-large-scale feedback to groups on the basis of individual problems and questions.
With a grant from Ministry of Education, Culture and Science, the University of Twente developed a series of materials to be used in the context of teaching research methods in social science education using the Flipped Classroom concept. The project was called **Flipping Education in Research Methods (FERM)**. In modules and courses using elements of the **FERM** materials, students prepare their classes using video micro lectures and assignments. In the face-to-face meetings (both lectures and tutorials) students are working on exercises under supervision of a tutor. For each topic, multiple video lectures with relating PowerPoint presentation and assignments were created. All materials are licensed under Creative Commons Attribution-ShareAlike 4.0 International. The materials created in the context of the FERM project is shared using the universities website and can be used by everyone. All supporting materials are currently available as open educational resources at: https://wiki.utwente.nl/open-learning/research_methods/start. The materials will be regularly updated and improved.

As shown in Figure 1 the flipped classroom approach consists of inside class and outside class activities. A Learning Management System (LMS) like Blackboard, Moodle or Canvas can be used to deliver all relevant information and learning materials to the students.

This teacher manual describes the way we used these materials and how others can use and adapt the materials. In general, there are two ways to work with the Flipped Classroom model and materials described in this manual:

- by simply using the existing FERM framework and related materials as they are provided via the university website, or
- by adapting and extending the existing materials to match your own teaching practices. In this teacher manual we describe both ways.

This document will be updated regularly, to reflect the outcomes of our 'learning by doing'. It will also serve as an internal document to improve teaching in research methods and statistics at the University of Twente. The last version can be found on the website: https://wiki.utwente.nl/open-learning/research_methods/start.

Working with existing FERM materials in the flipped classroom approach

The current setup of methods courses using flipped classroom principles

The central structure for the course design, consists of **units** of which the educational meetings (lectures or tutorials) are a part. Every unit has the same setup consisting of

1. The general topic
2. What to read (book, papers) and watch (video lectures) *before* the educational meeting:
3. What to do before the meeting: making an assignment, sometimes it is just installing required software.
4. What will be done during the meeting (lecture/tutorial): generally this is discussing the materials and giving feedback on the assignment.
5. What the student will have learned in the context of the meeting: the key-terms and/or learning objectives.

All this can be communicated to students. Each unit has one single page on Blackboard or Canvas, for example. All relevant materials, including answers to the assignments, are communicated to the students, although some of these materials are communicated right *after* the educational meeting.

The construction of teaching units

The general lay-out of all the **units** in the course was not based on content, but on the following study load and study organization calculations:

1 EC (European Credit) = 28 hours. Most courses at our university are between 3 and 5 EC.

At the university, based on some agreements with the Dutch ministry of education, it was decided that on average 12/40 hours per week (=30%) would be used for contact with students. This does NOT include online video lectures, but it includes the exam.[1] Thus, ideally, 1 EC = 28 hours implies 8,4 hours contact time and 19,6 hours self-study, including reading time, watching video lectures and making preparatory assignments.
Since contact time is calculated as clock hours and lectures/tutorials last 1,5 hours (2 times 45 minutes connected with a 15-minute break) at the university, a 1 EC course should (on average) contain 5 to 6 lectures/tutorials. *For methods and statistics, this was seen as too much contact time*. Other courses could increase the average number of contact hours more easily. We therefore decided to go for about 6,5 hours of contact time (lectures/tutorials/contact moments) per EC, so the organizational basis for all our methods and statistics teaching was based on the idea that 1 EC should consist of 6,5 hours contact time plus 21,5 hours of self-study. The exam was assumed to be 3 hours, the re-sit too (counting for 1,5 hours, because most students are not doing the re-sit), but this was only included in the calculation for the larger courses.
Based on these organizational calculations, we decided to organize all our teaching in **units** consisting (on average, as a guiding principle) of 1 meeting of 1,5-hour, and about 4,6 hours of reading, preparation by making assignments and by watching short video lectures. For each of these units learning objectives were formulated and additional materials were selected and created.

Furthermore, we assumed that students
- could watch and prepare about 4 to 5 short videos of max 10 minutes preparing for each meeting;
- should make a 0,5 hour to 1-hour assignment for each meeting *before coming to class (this could be reduced when the number of video lectures or the amount of required readings was somewhat larger)*
- are able to study 3-5 pages per hour.[2]

The overall calculations are included in Table 1.

[1] See for our university https://www.utwente.nl/nl/excellentie/archive/Excellentietrajecten/documenten/voorstel_prestatieafspraken.pdf
[2] This is not well founded, but see, http://www.ru.nl/prospectus/fftr/rules-regulations/courses-exams/credits-study-load/ and https://www.utwente.nl/en/ces/celt/toolboxes/educational-design/designing-education/Calculating-study-load-of-a-module.pdf. Based on experience we assumed some 5 pages per hour for a methods course (for statistics courses the number of pages will probably be somewhat smaller.

Table 1: organizational principles used in the FERM project

EC	Hours	Face-2-Face time (h)	Units #	Self-study (h)	Exam (h)	Video lectures (h)	Preparatory assignment (h)	Reading time left (H)	Total reading pages #
1	28	6,5		21,5	N.A.				
3	3*28 = 84	19,5	**13**	60	4,5	6	13	41	About 200
4	4*28 = 112	26	**17**	81,5	4,5	8	17	56,	About 275
5	5*28 = 140	32,5	**22**	103	4,5	10	22	68	About 340

For one unit, this implies:

Unit	Face-2-Face time (h)	Units #	Self-study (h)	Exam (h)	Video lectures (h)	Preparatory assignment (h)	Reading time left (H)	Total reading pages #
One unit is	1,5	**1**	4,6	-	0,5h-1h	0,5-1h	3,2h	About 16

Re-designing learning objectives

For all **units** a topic and learning objectives were selected/identified. The full list of 22 topics and all key terms we used as building blocks for the learning objectives (this list was based on key terms in a few of the most frequently used text books). The current teaching design is definitely not fixed. Hopefully we can teach students more in the time we now have.

The full list of 22 topics (for a 5 EC introductory research methods course) is:

unit	General topic
1	**What is empirical research?**
2	**What are clear research questions?**
3	**What are data?**
4	**Using SPSS or R**
5	**Conceptualization of constructs**
6	**Collecting data: obtrusive and unobtrusive research**
6a[3]	**Collecting data: surveys**
7	**Collecting data: observation and content analysis**
8	**Two aspects of data quality**
9	**Displaying univariate data**
10	**Summarizing ratio variables**
11	**Distributions**

[3] 6a instead of 6 was used in the 5 EC courses. Unit 6 was a combination of (parts of) 6a and 7. This unit was used in smaller courses.

unit	General topic
12	**Causality and bivariate causal hypotheses**
13	**Visualizing and analyzing bivariate relationships using SPSS or R**
14	**Causality and the effect of third variables**
15	**Research designs for testing causal hypotheses**
16	**Elaboration: analyzing multi-variate relationships using tables (1)**
17	**Elaboration: analyzing multi-variate relationships using tables (2)**
18	**Visualizing multivariate relationships**
19	**Sampling**
20	**First steps towards inference: certainty about means**
21	**First steps towards inference: effects and significance**
22	**Research ethics**

In combination with the redesigned learning objectives, we formulated multiple-choice questions that cover the contents of these objectives. We also formulated several open-ended questions and a small SPSS test. By combining the reformulation of learning objectives and the exam questions, we were able to be very specific in our expectations and in selecting and redeveloping teaching materials.

Teacher mind set

Teaching in the context of a flipped class room set up is really different from many other ways of teaching. Teaching is shifted away from 'telling and explaining' to 'guiding, stimulating and helping'. The mindset and perception of the teacher are central in making the shift to the flipped classroom way of teaching and learning. Barr & Tagg (2012) describe this as a paradigm shift from providing instruction to producing learning.

The setup of the meetings

Biggs (2011) gives several reasons why traditional lectures are relatively ineffective. In the first place, concentration is lowered by sustained and unchanging low-level activities by the students. Also, the attention is typically only maintained for about 10 to 15 minutes. Taken this in account and knowing that change in activity or a short rest restores performance favours activating teaching and learning strategies, we thought about having more tutorials. However, given budgetary constraints, we did not change all teaching to tutorials discussing assignments. About half the meetings were (still) lectures (albeit more activating than previously, see below), the other half consisted of tutorial/small group settings.

Tutorials

Tutorials are classes with 25-40 students. We decided to form smaller groups of 3 or 4 students within the tutorial setting and let the students make the assignment/ compare their notes in these smaller groups. The tutor stimulated the groups to work and was available to answer questions. At regular time intervals the tutor centralized the discussion, asking a spokesperson of the groups to discuss the answers and the topics they did not agree on. Often groups disagreed or were unable to come up with an answer. This allowed the teacher to explain things again.

Forming groups: Organizing and managing the groups was seen as tasks of the tutor. In practise we let the students form their own groups. We considered forming groups beforehand (not practical, because tutorials were not obligatory), mixing international and domestic students (or not) (idem), and forming groups on the basis of prior formative tests (not yet implemented, but still being considered). The group

size of 3 or 4 (not 2, not 5) is rather firm. We think in larger groups one student quickly drops out. In groups of 2 there is hardly any discussion.

Peer learning: When learning in small groups *peer learning* is facilitated. All students in the smaller groups can benefit in the process of getting instruction and giving instruction. Students often change roles during a tutorial. Peer learning can be facilitated in various ways. For example, by explicitly telling the groups that students should all take the lead in answering one of the assignment questions and explain their answer to the others. In addition, we sometimes required students to assign the role of 'spokesperson' to give specific answers. By carefully selecting or assigning that job to one person in the group, we were able to involve various students instead of just the ones that were most eager to speak up. Finally, we sometimes required all students to be able to answer any class question. We told all groups to make sure that everyone was able to answer a question asked by the teacher. We thus made sure that the groups felt responsible for involving everyone in the group.

Asking questions: often, students in groups had specific questions. First, it is important to make the group (instead of the individual student) responsible for that question: "did you ask your classmates about this?". That already solved a lot of questions. Secondly, many (group) questions were rather vague/general ("can you explain about validity again"). We then required the groups to rephrase the question using the knowledge they *did* have. Since the smaller groups were both empowering students confidence (they were not alone) and were small enough to not lose face, students were engaged to ask questions.

Assignments before or in class? Preparation (reading and watching micro lectures) was supposed to be done before class. Assignments were made with the idea that you could only complete them with sufficient preparation. We tried to stimulate students to also complete the assignment before class and to 'compare answers'. Sometimes this worked, sometimes they stopped preparing the assignments and waited for class. We considered a few options:

1. Requiring making the assignment and checking that before entering class
2. Requiring making a specified part of the assignment and checking that before entering class
3. Not asking to make the assignment before coming to class.

In the end, we often ended up doing the latter in the tutorials (we still assumed they made the assignments when giving a lecture). This gave some extra room for 2 or 3 additional micro lectures and/or a few pages of extra readings.

Instruction or not?
Initially, we refrained from any additional instruction in the tutorials: the tutorials (and initially also some lectures) were completely 'assignment driven', all instruction was provided in the micro-lectures and the book. However, we learned that this design element had the adverse effect of low participation rates: students did not really feel stimulated to come to tutorials if nothing 'new' was told. We therefore decided to include short 'lectures' in all tutorials: telling the same things with different examples, giving additional applications or discussing an article showing how a specific concept was used.

Lectures

Lectures are not very good for 'knowledge transfer': students do not remember a lot after attending a lecture. However, for practical purposes we kept lectures in the set-up of the course. It appeared that

lectures could still serve some important purposes: students are stimulated to read books and prepare for the tutorials and they were reminded of the structure of the course.
When we started designing the course, the focus in lectures was very much on giving the answers to the assignment. But since these answers could be distributed largely on paper, we stopped doing that and just uploaded the full answers. The assignment was discussed only shortly in a lecture and some additional points were discussed. The assignment was also sometimes used as a starting point for a lecture. For example, the unit in which students had to learn formulating items for a survey (unit 6), was followed by a lecture in which research about the effect of question wording on answer patterns was shown. This was NOT exam stuff but showed the relevance of the topic they could have learned by watching the micro lectures and by making the assignment. The answers for the assignment were given via the LMS.

In addition, lectures are better suited to connect topics. In lectures we could more easily refer to all aspects covered in previous meetings. We deliberately mentioned 'research questions', 'units', 'variables', 'measurement levels', 'mode/median/mean', 'causality' in lectures about cross tabular analysis, for example. The original set up broke down all our teaching in units, but lectures appeared to be good to connect the units, without assuming that the pieces in themselves were instructed in these lectures.

Lectures were also made more interactive, by allowing students to ask questions prior to the lecture via, for example, Google forms. Students were allowed to ask questions about the recorded micro lectures and the assignment via a short form and answers were used as input for the lecture. *We also used devices like Kahoot and Google forms to improve student interaction during the lecture, but this often led to students using their cell-phone or i-Pad for very distracting activities not related to the lecture.* Sometimes multiple-choice questions were practised like this at the end of a lecture.

Finally, some lectures were used to discuss actual research, applying the knowledge they were now supposed to have, to show the relevance of the topic. Again, lecturing was done without the assumption this in itself, this would train students to understand the specific topics: all important topics were covered and explained in the micro lectures.

Instructing students to be involved in a flipped classroom program

For many students, the flipped classroom is a new concept. Many students are unfamiliar with this way of teaching. It is therefore important to spend some time on discussing the WHY of the course. Why should the students do their homework before coming to class? Why should they watch the video materials? Besides this, research methodology is an abstract topic for bachelor students: what is in it for them? This was done in a first lecture of the course.

Using the current FERM materials

All materials can be downloaded from the open educational resource (https://wiki.utwente.nl/open-learning/research_methods/start) and adapted to personal needs. It is not recommended to link directly to the wiki pages as they are subject to change.

In the wiki environment all materials are organized via topics. Each topic exists of one or more micro lecture videos, the related PowerPoint and the related assignments.
As shown in figure 3, the link to the video or the embed code can be found via the Share icon.
All documents can be downloaded too.[4]

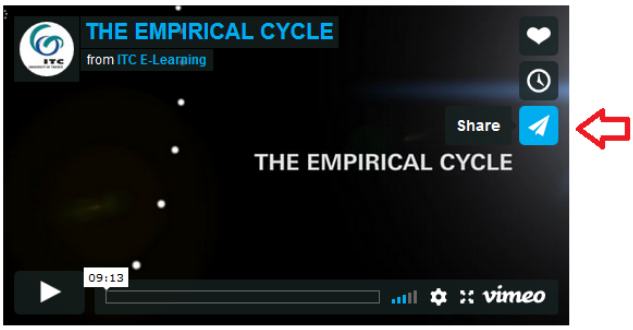


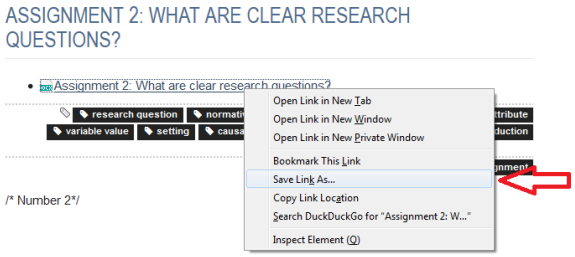
Figure 1 Share icon for Vimeo video

Adapting and creating new materials for your own teaching practice: some design principles

When (re)designing a course using flipped classroom principles, making use of existing learning materials saves time. But the materials we provide are not perfect and can sometimes be considered misleading (opinions about methods vary and mistakes are made). Also, other types of materials, like for example animation, demonstrations, screen recordings, exercises and so on are possible. We therefore discuss some underlying design principles, so you can adapt the materials and create additional materials that fit your needs.

Creating an assignment

To develop a good assignment, it is advised to use the assignment template that can be downloaded from the wiki page.
When adjusting existing or developing new assignments keep in mind the following aspects (partly based on Boye, A. 2011):



1. Assignments should have clear goals
The general learning objective should be made clear to the student. Why and on what level does the student need to achieve after finishing the assignment? Formulating clear objectives gives focus and aligns the assignment with the course in general. Learning objectives should be formulated in a SMART format: specific, measurable, achievable, and relevant. Finally, the objective should be doable in the time allocated for the assignment.
When reformulating learning objectives, it is good to focus more on doing a task and the learning process then on learning specific content. Biggs and Tang (2011) use the term '*intended learning outcome (ILO)*' because ILO emphasizes more to what the student has to learn than what the teacher has to teach. An example is given below:

Objective: In this assignment, you will practice with all aspects of the wheel of science, you will also familiarize yourself with the basic aspects of decision making and with the relationship between decision making and research.

[4] Downloading documents varies depending on the browser you use.

Intended Learning Outcome: After the assignment you can: 1. Identify the elements of the wheel of science in a given case/example of research; 2. Identify the elements of a decision-making process in a given case; 3. Formulate a descriptive and explanatory empirical research questions that could be asked in the context of decision making.
We think this way of presenting learning outcomes is to be preferred.

2. The topics addressed in the assignments should be relevant
Incorporating a challenging and authentic context will motivate students. Assignments connected to the way students experience the environment work more motivating than abstract assignments (Verheul, 2002). Assignments do not need to relate explicitly to other courses in the same quarter or the future field of occupation. Actual societal problems can be used to provide a meaningful context the students can relate to.

In short:

- Relate to the current real-life professional situation of the student
- Be concrete (give examples) and focus on application within the context
- Use real data when possible, not just mock files

An example is the assignment on 'coding' data. We identified a few articles about the refugee crisis. Reuters news articles are used in this case, but teachers are stimulated to identify their own sets of texts.

3. The complexity of the assignment and pre-knowledge of students should be aligned
For students is important that the assignment is aligned with what the students already knew and with what they can already do. Too challenging assignments will lead to frustration. Not challenging enough can lead to disinterest and lack of motivation. It is a good base to implicitly include materials which were part of a previous assignment, without mentioning that explicitly. So, for example, the idea of 'measurement levels' was implicitly included in many assignments, even after the assignment of unit 3. What sometimes helps, is having a short online test/quiz, to find out what students do or do not understand about the topic. In some assignments students were stimulated to discuss the contents of the current 'unit' but to also discuss the content of the previous unit/lecture. Some questions forced them to connect topics covered in various units.

4. The contents of assignment should be short, and clear
It is important for the student that the performance aspects are clear, so he/she can prepare and know what effort is expected. Is it an individual or a group assignment? What are supporting materials that can be used? How much time does it take on average to complete the assignment? What are the main concepts? How is feedback provided? Provide learning guidance (instructions) to fulfil the assignment.

Be aware not to add explanations or direct instruction in the assignment. This is solved by referring back to the learning materials. Vague questions like 'explain this concept' should be avoided, although in group discussion this may work.

5. Make clear what students should do AFTER making the assignment
Pay special attention to the alignment between the assignment, different learning objectives, evaluation criteria (testing and assessment) and different educational activities (for example lectures, tutorials, self-study). This implies that students should be able to know which (limited set of) learning materials will help to understand the contents of the assignment.

Figure 5 shows that is used in the assignment informing the student what to do.

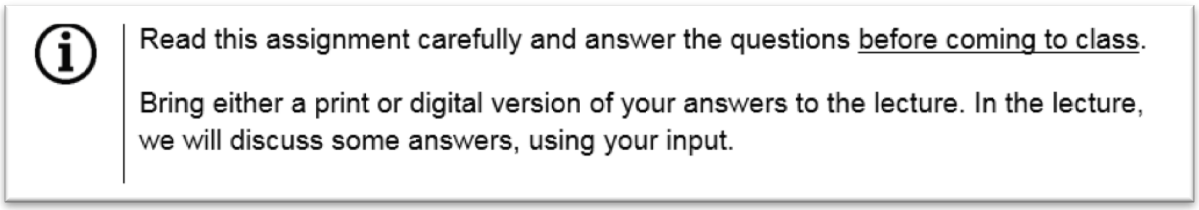


Figure 2 Example informing the student about the assignment

Elements in the assignment template
In the assignment template pictograms (see figure 6) are used to point out the various elements of the assignment as shown below.

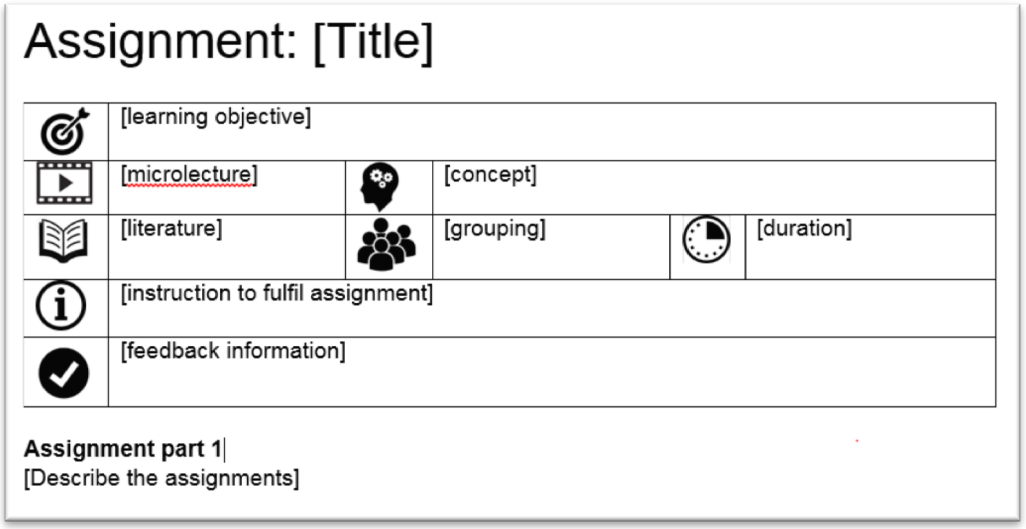


Figure 3 Icons in the assignment template

Creating a video lecture

Micro lecture videos are an important, but complex part of the flipped classroom model. Some of the benefits of using video for learning (also see: https://educationvideos.wordpress.com/why-videos/) are that it matches the way students nowadays absorb information in short periods of time. Check out https://www.utwente.nl/en/telt/solutions/Microlecture/#how-to-create-microlectures for additional information. Video production includes planning and organizing the production process. Take the following aspects into account:

Content
In the context of the FERM project we came up with a few 'design principles' that seemed to work (although we definitely did not comply with our own rules in all video's).

- **Keep them short.** It is advisable to keep the duration under 6 minutes. 10 minutes is the absolute max. Micro lectures are NOT recorded lectures. They explain a specific thing students have to understand.

- **Keep them independent.** Every lecture should be watchable on its own. We sometimes used the image of a Venn-diagram, with overlapping sets, but without relationships between the sets. It makes the materials more flexible in use.
- **Keep them focused.** Deal with only one concept or set of concepts in a micro-lecture. Again, micro lectures are NOT recorded lectures: they break up the contents of methods teaching, they do not connect things. What helps is exploring one single example (a 'problem') and one single concept to be explained. You will find out that the ONLY way to explain that concept from scratch is using other concepts 9which sometimes need quick explanation too), but the focus should be on one concept only.

Format

- **Start and end with the main idea of the micro lecture** ("in this micro lecture we will explain that reliability in the context of Classical Test Theory can be seen as either internal consistency or as over time stability" and the end "in this micro lecture we have explained … "). This keeps you and the students focused.
- **Make it personal**: although you are free to use our materials, it may be the whole thing works best if the local teacher uses the materials and is also present in the tutorials.

Production

Time management: A good time plan is essential to produce instructional videos. As for 'normal' education you need to reserve time to design, develop and produce. A rule of thumb is 1 min video takes about 15-20 min in total to produce. Based on experience and other design decisions this time can vary in a great deal. Tip is to not underestimate the time it costs to produce educational materials.

Performing in front of the camera: Giving a lecture and interacting with students is totally different from acting in front of a camera. The key word in this is: practice and self-reflection. Taking a micro-lecture training is a good start to get some professional feedback and also learn from others. (see: https://www.utwente.nl/en/ctd/staff/teaching/create-microlecture-in-a-studio/)

Finance: Producing video material sometimes involves experts: a cameraman, editor, scriptwriter or educational specialist. Also, sometimes stock photo/video or copyrighted materials are needed to get the message across. Sometimes these costs are financed from a central University budget to promote innovative learning developments.

Legal aspects: Copyright and licenses are part of producing and distributing open learning materials. Building videos on existing presentations with, for example unclear image sources and copyright is not advisable. Also making educational resources openly available implies legal issues. (see: http://www.oeconsortium.org/info-center/topic/legal-issues-in-open-education/). Basic understanding of for example the Creative Commons license (https://creativecommons.org/) is a must.

Script/scenario development: Writing a video script is somewhat different from writing an article of educational text. Technics and tools are different, for example using a storyboard and storytelling.

Context: The context is defined by the vision, policy and support for open educational resources on all levels of the organization. Does for example the Learning Management System support open access or is a separate system needed, do colleagues support the initiative. An important aspect is also professional development. The competence and mindset to create a learning experience that supports the flipped classroom approach.

Technical aspects: The technical aspects are broad and varied. Is there for example a professional studio with support or a more do it yourself webcam solution.

Collaboration: A (technical) video team and educational experts brings the design and development of educational materials to a higher level.

Addirional information
The multimedia principles of Mayer (Mayer, 2012) give specific guidelines to combine graphics with spoken text and words to maximize learning opportunities. (see for example: https://hilt.harvard.edu/blog/principles-multimedia-learning-richard-e-mayer)

More information on different video formats can be found at:
https://www.utwente.nl/en/telt/themes/Videoproduction/
http://www.weblectures.nl/

Final word

Do not hesitate to ask for support and advice in your own university. There is always help available when you experience difficulties with the aspects above. Learn by doing!

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