# EDVANCE

Good practices in blended education within problem-based learning at Maastricht University

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**Advancing good practices in blended education that support the problem-based learning (PBL) principles: constructive, contextual, collaborative, and self-directed learning (CCCS).**

A RAPID REVIEW AND ACTION RESEARCH STUDY.

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# Content page

# Executive Summary

The aim of the EDvance project was to assist the teaching community at Maastricht University (UM) by compiling good practices in blended education, which support the Problem-Based Learning (PBL) principles of constructive, contextual, collaborative, and self-directed learning (CCCS). EDvance provides potential strategies to support students and educators, focusing on the entire educational process, as well as well-being and community building. Although many of the practices discussed within this report are innovations enhanced by technology, non-digital practices are also addressed.

As a disclaimer, the present report is intended to be informative and should not be read as a (policy) guideline. The source of the findings is presented, but did not undergo quantitative analysis. Moreover, although we aimed to provide a wide viewpoint, we acknowledge that not all relevant topics could be covered in the present report.

There are many technology-enhanced practices recommended for both the course and curriculum level. For the learning activities in courses, we recommend to use small groups, such as subgroups in breakout rooms) to facilitate in-depth discussions, to blend static media with knowledge clips, and to adapt meetings flexibly to either an online or offline format. Furthermore, course coordinators can introduce the flipped classroom concept, adopt new opportunities in collaborative learning, and stimulate students to explore real world problems, with Canvas assisting in providing structure. With regard to summative assessments, we recommend digital, on-site assessments for the convenience it brings to students and educators. With more digital elements in education, the role of the educator grows larger. Accompanying these changes, there is need to care for the well-being of both our students and our educators. Finally, at the curriculum level, investment, support, and flexibility are needed to support the implementation of good blended educational practices and the well-being of students and educators.

In the end, although we acknowledge that the literature and experience in this field is rapidly advancing and insights may change over the coming years, we find support for our initial hypothesis that the use of technology in education is a means to an end. Good practices in blended education start from having intended learning outcomes constructively aligned with the design, delivery, and assessment of education, with the CCCS principles in PBL serving as its foundation.

# Summary: Advances in blended PBL

EDvance compiles good practices in blended education, which support the Problem-Based Learning (PBL) principles of constructive, contextual, collaborative, and self-directed learning (CCCS) at Maastricht University (UM), outlined in the EDview report. From conducting a rapid review of evidence-based literature and an action research within and external to the UM community, we arrive at many good practices that could enrich the PBL CCCS experience in such a way that it could be considered as part of our arsenal at UM. It is not the intention of the report to provide guidelines for the delivery and construction of future education at UM, but to assist the UM community by providing useful examples that could enrich the PBL experience, based on the CCCS principles. In the full report, we also elaborate on non-digital practices. Here, we summarize advances in blended PBL that may add value, in addition to an offline experience.

# Part 1: Course learning activities

## When to meet face-to-face and when to go online?

The choice of online and face-to-face education depends on the goals and contexts, including learner characteristics. Research found that blended education can be very beneficial, because students spend longer durations engaged in academic content. It is not a matter of putting education online, rather, it is about redesigning education to integrate additional learning opportunities.

## Subgroups in PBL tutorials

The online experience in times of social distancing taught us that certain practices can also enrich the offline experience. For example, when video-conferencing, subgroups by the use of breakout rooms were highly recommended, which educators also found useful in face-to-face meetings because they encourage active participation. At UM, it is common to have groups of 12-15 students in PBL tutorials. Within these groups, sub-groups of 3-6 students are recommended, especially for brainstorming.

## Study resources in blended education

PBL cases/tasks, the course book, self-paced Canvas modules, and a list of resources can help structure students' self-directed learning.

### Knowledge clips and lectures

In research, shorter knowledge clips better supported students in their learning, compared to long lectures. Although the present report does not specifically address the value of lectures in a PBL context, it acknowledges that there has been a huge debate on whether lectures should be on-site or online, and whether lectures should be recorded. The final solution that reaps the most benefits appears to be on-site lectures that are live-streamed, supplemented with an online, live chat function, with the recorded lectures delivered in bite-sized knowledge clips. We provide a detailed guide on how to produce knowledge clips and (online) lectures in the full report.

### Blending static and audiovisual media

We recommend blending static media with audiovisual media. Static media, such as articles and books, minimizes unnecessary processing and allow students to stay on task. On the other hand, students are more engaged and satisfied when learning with knowledge clips.

### Flipped classroom

A flipped classroom is made up of two parts: asynchronous, self-directed learning and synchronous, classroom contact. Outside of the classroom, students self-direct their learning, usually with the help of interactive e-modules and study resources. Classroom contact is used for application of knowledge. Flipped classroom is a concept very similar to PBL, with increasing evidence that students' learning can be enhanced due to the active learning activities promoted within a flipped classroom.

### Collaborative learning

*New opportunities in collaborative learning*

Among the many ways to learn collaboratively, digital opportunities can enhance co-creation and make remote collaboration possible. Co-creation is where students collaborate to create a final product together. The final product may be a blog, website, or Wiki-page. Their collaborative learning process can be assisted by sharing documents in real time (e.g., GoogleDoc) and making shared notes on digital whiteboards (e.g., Google Jamboard, Miro).

Multi-course and multi-disciplinary collaborative learning can be enhanced with technology as students connect with other students or experts from a distance. This exposes students to different fields and encourages students from diverse backgrounds to learn from each other.

*Organizing collaborative learning*

When organizing collaborative learning, educators are encouraged to schedule milestones. For example, this can start with a welcome message sent electronically to students. Then, kick-off events that emphasize bonding and training in collaborative learning. Halfway through a project or course, midterm evaluations and intervisions can be useful in helping the group move forward. Finally, closing events can take place to present and celebrate the students' hard work as a group. Throughout these milestones, video conferencing software (e.g., Zoom, Microsoft Teams) and chatting platforms (e.g., forums, WhatsApp, Discord) can assist in connecting students with each other, with the educators, and with clients. Project management programs (e.g., Microsoft Teams, Google Docs, Google Drive) can help with project planning, progress monitoring, and sharing, editing, and storing of documents.

### Real world problems

By solving real world problems, we ensure that education for students is relevant beyond their graduation. Technology can assist in the students' partnership with local communities. Educators can structure important milestones in the students' learning with the support of Canvas's interactive modules. Online platforms can assist educators in matching students with local communities.

### Interactive learning management system

A well-designed learning management system includes structured self-paced modules, interactive modules, and possibilities for collaborating. A learning management system also provides opportunities for learning analytics, where data can be provided to understand and improve the students' learning progress. Although Canvas has been functioning well at UM, there is still space for improvement, such as having options to support programmatic assessment, more possibilities for skills training, more applications, better communication, and increased accessibility.

### Assessment in blended education

In the full report, we elaborate on programmatic assessment, regular feedback, peer feedback, and other formats. We highlight digital practices that have benefited regular education. With regard to the setting of high

stakes summative assessments for knowledge testing, digital, on-site assessments seem to be preferable. The reasons for having exams digitally include students preferring digital exams, digital exams align with the standards of the current labor market, and digital exams allow for easier grading.

## Role of the educator

Increasing forms of blended education require adjustments to make use of opportunities that arise when learning is not solely classroom-based anymore. In an online tutorial setting, teachers tend to be more directive in the discussion. We recommend that tutors regularly check-in and connect with students, adding a human touch to the digital environment. Canvas and virtual meetings enable flexible communication. Furthermore, with digital possibilities, educators have plenty of opportunities to provide just-in-time teaching, organize Q&A sessions, and regularly ask students for feedback. Finally, other roles of an educator include having the mentality of an educator, providing expertise, develop personally and professionally, join communities of practice.

# Part 2: At the curriculum level

## Implementation of good practices in blended education

Implementing good practices requires investing in educational technology, investing in our educators and students, and investing in institutional collaboration. With regard to technology, various applications within a learning management system such as Canvas are of relevance for blended education and have received praise from the UM community. Other technologies that have been highly appreciated, including video conferencing tools. National and international collaboration between institutions provide more opportunities to improve the quality of education. For example, the development of innovative educational tools such as virtual reality can be developed in a more cost- and time-efficient manner through collaboration.

## Educational support and services

In times where education is rapidly advancing, both educators and students can benefit from education support services. Various types of support can be provided, from top management, to didactical and technological support on request, to providing training both for educators and for students. Short lines of communication between educators and staff of all levels in the organization are recommended.

## Flexibility in educational paths

When students self-direct their learning, they can be empowered and can gain ownership of their own learning. One way that students can self-direct their learning is to give them the freedom in choosing what they want to learn and how they want to learn it. Other than optional courses (e.g., electives, minors, workshops), flexibility can be given through having a choice of learning goals, learning methods, and learning outcomes. Students can learn through attending a lecture (perhaps from a different university), reading an article, reading a textbook, watching a knowledge clip, or asking a teacher. Learning outcomes can be demonstrated via a (e-) portfolio, a PowerPoint presentation, a poster, a podcast, a video, poetry, a story, composing music, a painting, a performance, etc.

## Well-being of students and educators

It is important to care for the students' well-being, especially in difficult times. We have learnt to intentionally care for students' well-being, by encouraging face-to-face meetings, small group activities, and to connect students through social media and social activities. There are many parties that can support students in their well-being, including peer supporters, student associations, educators, mentors, coaches, study advisors, UM psychologists, and various well-being initiatives.

In order to provide quality education to students, it is also important to care for the well-being of our educators. This includes promoting a healthy work-life balance, encouraging self-directed teaching, and recognizing and rewarding our educators for their education endeavors and innovations.

## Conclusion

From the rapid review and interviews conducted at EDvance, we present various good practices in blended education to support students and educators. Although educational innovations enhanced by technology can enrich PBL, many non-digital practices remain a core part of education. In the end, good practices in blended education start from having intended learning outcomes constructively aligned with the design, delivery, and assessment of education, with the CCCS principles in PBL serving as our foundation.

## About the researchers

**Anne van Dijk** joined Maastricht University as a student in the FHML Health Sciences programme, where she later took on the educator role as tutor and academic skills trainer. Continuing her career, she has been developing her research and coordinating skills in projects on medical education at the School of Health Professions Education and continued to obtain her Master's degree in Developmental Psychology at FPN with a thesis on educational psychology.

**H.Q. Chim** completed her PhD in physical activity behavior and learning in higher education from Maastricht University. She holds a Master's (Honors) in Psychology and Business Studies from the University of Edinburgh, United Kingdom. She is a tutor, thesis supervisor, mentor, and coach at UM and holds the University Teaching Qualification (UTQ).

# Glossary and abbreviations

**Blended education** is the thoughtful integration of face-to-face and online education [1]. Blended education is a macro concept executed at the university level, with micro educational activities that may be face-to-face or online, as long as the micro activities are thoughtfully integrated to achieve the intended learning outcomes, usually in complementary or supplementary manner. Blended education is contrasted against blended teaching and blended learning. To teach is to give lessons to students, to help them learn something by giving information about it. To learn is to gain knowledge or skills. As for education, education refers to the entire process of teaching, training, and learning to improve knowledge and develop skills.

**Collaborative learning** – students have a common goal, share responsibilities, are mutually dependent, and need to reach agreement through open interaction [2].

**Constructive learning** – an active process in which students actively construct or reconstruct their knowledge networks [2].

**Contextual learning** – students are exposed to a professionally relevant context and confronted with cases or problems from multiple perspectives [2].

**Hybrid education** – one group of students attends a class on-site and simultaneously individuals follow the class online and remotely from the location of their choice [3].

**Self-directed learning** – students actively plan, monitor, and evaluate their own learning process [2].

Other abbreviations used in this report include:

**UM**
Maastricht University.

**PBL**
problem-based learning.

**CCCS**
constructive, contextual, collaborative, and self-directed learning.

**FASoS**
Faculty of Arts and Social Sciences.

**FHML**
Faculty of Health, Medicine, and Life Sciences at UM.

**FPN**
Faculty of Psychology and Neuroscience at UM.

**FSE**
Faculty of Science and Engineering.

**SBE**
School of Business and Economics.

this section *includes* practices that have been enhanced by technology

(unplugged)
Neither the rapid review nor the action research specified the use of technology in this section

**[UM]**
Interview input by UM students and educators

**[ext.]**
Interview input by external educators

# Introduction to EDvance

EDvance compiles good practices in blended education, which could support the Problem-Based Learning (PBL) principles of constructive, contextual, collaborative, and self-directed learning (CCCS) at Maastricht University (UM). Blended education is the thoughtful integration of face-to-face and online education [1]. The practices that we recommend may or may not be supported by technology, as we see technology as a means to an end, the end being well-designed, well-delivered, and well-assessed education.

This project builds upon important educational work made during recent critical milestones of PBL – EDview's 2018 position paper on the Do's, Don't's and Don't Knows of Teaching and Learning at UM, UM. Online's findings of student and teaching staff perspective (2020), and the Lessons from a Lockdown (2020) position paper. We have also been in contact with the Technology Enhanced Learning taskforce at SBE and the department of Educational Development & Research at FHML.

This project reports insights from two resources. First, a rapid review of scientific literature, with a focus on evidence-based practical information of good educational practices in blended and/or technology-assisted education. Second, qualitative data obtained through action research, consisting of meetings with educators and students from inside the UM-community, as well as educational experts from outside the UM-community, focusing on good practices from their experiences in the academic year 2020-2021.

# Disclaimer

The good practices we found do not stand alone. The use of these practices is not a goal per se, but a potential means to this end. The practices – design, delivery, or assessment – only work if they are aligned with intended learning outcomes. Furthermore, the choice of which parts of education should go digital and which parts remain face-to-face depends very much on the goals and contexts. As advised by our external partner,

> **"Good practices are not inherently good; whether a practice 'works' is really context-dependent.
> One should not try to create a one-size-fits-all approach,"**
> *- Chevy van Dorresteijn, University of Amsterdam [ext.].*

It is also important to note that these good educational practices are not exhaustive. Our findings are limited to the literature we consulted from 1 January 2020 until 12 January 2021 and interviews that we conducted. Importantly, the recommendations in the report are not intended to serve as guidelines, but to assist the UM community by summarizing the available evidence on this topic at the present point in time. The source of the findings is presented, but did not undergo quantitative analysis. Moreover, although we aimed to provide a wide viewpoint, we acknowledge that not all relevant topics could be covered in the present report. Where specific technological applications were discussed, this was done in the educational context of UM.

# Methods

## 1. Rapid Review

### 1.1 Inclusion and exclusion criteria

This review only included randomized-controlled trials (RCT) and design-based research (DBR) articles that are published in the English language and published in peer-reviewed journals. Articles that focused on non-higher education settings were excluded to ensure that the practices were applicable to the university population. Articles that solely compared in-person against online education were excluded if they did not provide detailed practical recommendations. This is because the aim of the current research is not to compare one against another, but rather to find practical recommendations in blended education.

### 1.2 Search strategy and study selection

Two systematic literature searches were conducted:

1. Highly cited articles: To identify the 50 most cited articles in the field, a literature search was carried out using Web of Science and Scopus.

2. Recent articles (1 January 2020 to 12 January 2021): To identify recently published articles since the COVID-19 pandemic, a literature search was conducted on PsycINFO, PsycARTICLES, Psychology and Behavioural Sciences Collection, ERIC, LearnTechLib, PubMed, Web of Science, and the Cochrane Library.

Using the PubMed Medical Subject Headings database, relevant articles were identified from their titles and/or abstracts, using the search string below:

("blended learning" OR "remote learning" OR "distance learning" OR "hybrid learning" OR "online learning" OR "computer-assisted learning" OR "e-learning" OR "blended education" OR "remote education" OR "distance education" OR "hybrid education" OR "online education" OR "computer-assisted education" OR "e-education" OR "blended teaching" OR "remote teaching" OR "distance teaching" OR "hybrid teaching" OR "online teaching" OR "computer-assisted teaching" OR "e-teaching" OR "blended instruction" OR "remote instruction" OR "distance instruction" OR "hybrid instruction" OR "online instruction" OR "computer-assisted instruction" OR "e-instruction" OR "blended training" OR "remote training" OR "distance training" OR "hybrid training" OR "online training" OR "computer-assisted training" OR "e-training")

AND (collaborative OR collaboration OR "self-directed" OR "problem-based learning" OR PBL OR "problem-based" OR "case-based" OR "project-based" OR "inquiry-based" OR "flipped learning" OR "flipped classroom" OR "flipped education" OR "flipped teaching" OR "flipped instruction" OR "flipped training" OR group OR team OR groupwork OR teamwork OR discussion OR tutorial)

AND (student OR undergraduate OR university OR college OR graduate OR postgraduate)

Figure 1. PRISMA 2009 flow diagram.



Figure 1. PRISMA 2009 flow diagram.

**Identification**

Recent records identified through database searching
(n = 1103)

Additional records identified as most highly cited articles from Web of Science & Scopus
(n = 50)

**Eligibility**

Records after duplicates removed
(n = 1153)

**Screening**

Records screened based on title and abstract
(n = 1153)

Records excluded
(n = 534)

Evaluation of full paper
(n = 619)

Articles excluded after evaluation of full paper
(n = 541)

Reason for excluding:
180 case studies
2 methods not reported
93 narrative review
157 no control group
2 protocol
45 qualitative
5 unable to find full article
36 wrong aim
21 wrong population

**Included**

Studies included for narrative review
(n = 78)

*1.3 Data extraction*

In total, 1,153 non-duplicated records were found (see Figure 1). As this is a rapid review, the two authors independently screened 50% of the records. The CCCS principles acted as a first filter for practices on design and delivery. After title and abstract screening, 551 articles were excluded because they do not answer our research question. Any articles deemed relevant, dubious, or unknown were read in full text to check if they should be included in the review. When there were any doubts, the authors would discuss the issue, sometimes consulting the project supervisors, until consensus was reached. Data on the study aim, design, intervention, outcome, setting, and target population were extracted. If necessary, the corresponding authors were contacted for further details. Finally, 78 articles were included for further analysis.

## 2. Action Research

Simultaneous with the rapid review, an action research was performed. The goal of this action research was to get insight into experiences of good practices of blended and/or technology-assisted PBL from within and outside the UM-community. A series of qualitative semi-structured interviews and focus groups were carried out (see Table 1 for the number and type of interviewees). All interviews and focus groups took place through Zoom video conferencing software, due to COVID-19 regulations (spring 2021). An interview guide was provided to the interviewees beforehand. For the detailed interview guides, see appendix A-C.

Starting with the leadership from each faculty, all six vice-deans of education were approached for an interview. Other than their input on good practices, the vice-deans informed us on important issues that are characteristic per faculty and gave recommendations on (innovative) educators to include in our study. With this method, a snowball sample was created consisting of educators from all UM-faculties.

Three focus groups were conducted, representing students from all faculties in each focus group. Recruitment was carried out mainly through the Student Project Team and other study associations at UM. The focus groups discussed educational activities as well as student well-being. The focus group duration was 90 minutes and included an introduction of the topic, two main questions for small group discussion:

- "From your experience with the education at UM in period 1-4 of this academic year (2020-2021): Which educational activities have worked well for you?",
- "What can the university do to protect student well-being, motivate students and keep students connected to each other and teaching staff?".

### Table 1. Number of interviewed participants

|  | Interviewee role | Total participants | Number of interviewees per faculty/country |
|---|---|---|---|
| 1 | Vice-Deans of education | 6 | All six UM-faculties (6) |
| 2 | Educationalists, educators, and innovators | 28 | FASoS (4); FoL (3); SBE (4); FSE (4); FPN (5); FHML (7); MUO (1) |
| 3 | Student representatives | 34 | FASoS (2); FoL (4); SBE (8); FSE (4); FPN (2); FHML (14) |
| 4 | External educational experts | 13 | Internationally:<br>• Harvard University, USA<br>• McMaster University, Canada<br>• Tecnologico de Monterrey, Mexico<br>• Universidad Nacional del Sur, Argentina<br>• Western Sydney University, Australia<br>Netherlands:<br>• Erasmus University Rotterdam<br>• Open Universiteit<br>• Tilburg University<br>• TU Delft<br>• University College Roosevelt<br>• University of Amsterdam<br>• University of Twente<br>• Zuyd Hogeschool |
| Total |  | 81 |  |

For the sub-group discussions, the students were provided with sub questions that they were asked to answer using written post-it's on Jamboard, an online white-board tool. This way, the students were given the opportunity to write down their individual experiences and the results of their discussions. Finally, both the small group discussions were closed off with a plenary recap discussion. A detailed moderation guide is provided in Appendix D.

A snowball sample was conducted with educational experts from outside the UM-community. These experts were selected based on their involvement with education at their PBL-characteristic institute or their extensive knowledge of and experience with online and/or blended-education. The input of external educational experts aimed to provide insights on good practices in blended/technology-assisted education executed at other PBL-characteristic institutes. Approaching external experts build a bridge between the practices acquired at our own UM-community and the global community, supplemented by the scientific literature in the rapid review.

## 3. Data analysis

Analysis was conducted thematically, using a mixture of deductive and inductive approaches. An initial framework consisting of three pillars was used, consisting of design, teaching and learning, and assessment. With data gathered across both the rapid review and action research, we ended up with a more comprehensive framework, described across the headings in this report.

## 4. Data reporting

The good practices compiled are divided into two parts for ease of reading: first, practices for course learning activities and second, practices at the curriculum level.

With the various teaching functions that we came across (e.g., tutors, teachers, course coordinators, course designers, lecturers), we decided to use the term "educators" from here onward for two reasons: first, because educators tend to take on multiple roles, and second, we did not want to assign too heavy a responsibility to any sole function (e.g., "tutors should do X, course coordinators should do Y"). Instead, as recommended later, educators should collaborate and support each other in providing high quality, student-centered education.

Finally, we cite sources from the articles found from our rapid review and the findings from our interviews. Articles are cited numerically. The interviews are cited as [UM] if they come from UM educators or staff members and [ext.] if they come from our external partners from other universities.

**Part 1**

# Course learning activities

# Problem-based learning in blended education 💻

> "Problem-based learning is the most natural way to learn. You always have some information (know something) before you see a new situation. You try to figure out what is going on in relation to what you already know and when you learn something new, change your mind. That's all there is."
> – *Prof. dr. Patangi Rangachari, McMaster University, Canada [ext.].*

Problem-based learning (PBL) is the education model used at UM, where students solve contextually-relevant problems collaboratively, under the guidance of a tutor. As previously emphasized by Dolmans et al. [2] and EDview, PBL is a model that allows for flexibility in educational activities and assessment, as long as learning is constructive, contextual, collaborative, and self-directed (CCCS).

## 1. CCCS learning principles

At UM, PBL is recalibrated as and guided by the CCCS learning principles. Briefly,

- **constructive learning** is where students actively construct and reconstruct their knowledge constructs.

  For example, students may have prior knowledge about subject A. New information is discovered and so now the student learns of A-B. The student then learns of C and mistakes the larger picture for A-B-C. From peer-discussion or with the guidance of a tutor, the student may change their understanding to A-B and C-D.

- **contextual learning** is where students are exposed to and learn from multiple professionally-relevant contexts.

  For example, a biology student may view their field from the lens of a researcher, plant breeder, citizen, policy maker, etc.

- **collaborative learning** takes place when through discussions, the students share responsibilities and are mutually dependent in achieving a shared goal.

  For example, students may learn collaboratively in PBL tutorial groups to achieve shared learning goals, or they may learn collaboratively while producing an end product for a project. Technically, PBL does not require a group, because PBL is about starting with a problem and finding information to solve the problem [ext.]. Nonetheless, as elaborated in a later section, learning collaboratively is beneficial for learning, developing a sense of community, and for protecting the students' well-being.

- **self-directed learning** is where students actively plan, monitor and evaluate their learning process.

  For example, the student may know of A and realize they do not know about the next step, B. So they ask questions about B, seek out information about B, and check their understanding of B by discussing and applying their newly gained knowledge.

We loosely base the structure of this report on the CCCS learning principles. However, the chapters on each of the principles cannot be perfectly isolated from each other, because they are often mixed with each other in certain formats, learning activities, assessment methods, etc. This is especially true for *constructive learning*, where changing knowledge constructs is a process and an outcome that underlie and integrate with the other CCS learning principles. Hence, in this report, constructive learning will not be used as a separate chapter.

Every interviewed UM educator agreed that the CCCS principles were essential in PBL. When education had to adapt to the COVID-19 circumstances, some aspects had to be redesigned, for example, by providing further support to students with regard to their collaborative and self-directed learning [UM]. Although PBL can be flexibly executed under the CCCS principles, the 7-jump/steps of PBL were still seen as a useful framework to structure the students' learning [UM]. This structure is especially useful to guide students who are new to PBL (e.g., first year bachelor or master student).

## 2.   Relevance today

PBL continues to present evidence of its efficiency as an educational model. A recent study found students having better academic performance in PBL, compared to lecture-based education [4]. This study utilized case-based lectures, where ill-structured cases with applicable knowledge were introduced in lectures, before being analyzed within smaller groups. Every other week, there is a class quiz, where questions are randomly chosen from a larger pool of questions. Then, there is a final exam at the end of the course. Additionally, the students' performance during the discussion of the cases were evaluated on participation, presentation effectiveness, teamwork and communication, material preparation, leadership, and empathy [4]. From this study, there were many elements that contributed to the success of PBL. We will cover each element and more across the various chapters of EDvance and highlight where technology may play a role in blended education.

## 3.   Common mistake

Educators realized that the misinterpretation of PBL is becoming more common. For example, PBL has been misinterpreted as a shallow brainstorm during the pre-discussion and summary of literature in the post-discussion [ext.]. Students may attend tutorial sessions to share information, rather than discuss information [UM]. One UM educator explains that, **"What I observed quite frequently is how we'd go through things during a tutorial that should actually be part of the preparation… which would take away the time that you really want to use for the more in-depth discussion and questions that go to a higher level… What you want to see is engagement, interaction, collaboration between the students and the staff."** [UM].

UM students have expressed: **"PBL should not turn into repeating the same things three times (when you solve them yourself, when you talk about it in your study group, then you talk about it in the main lecture)"** *– UM student [UM].*

Over time, it may be easy to overlook the foundational principles of PBL. However, PBL should not be misconstrued as a rigid repetition of activities. Educators should always go back to the CCCS principles of PBL, to ensure that students are truly learning in a manner that is constructive, collaborative, contextual, and self-directed.

## 4.   Flexibility within the classic 7-jump format

The EDview report from 2018 reminds us that we can be flexible and creative with the execution of PBL. Nonetheless, the classic 7-steps approach is useful for introducing students to PBL.

### *4.1 Blended pre-discussion*  

The pre-discussion of PBL is a phase where students are given information about a problem, they draw upon prior knowledge, make sense of the problem, pinpoint important issues, and identify their tasks, including whether they are able to obtain necessary information within a limited time and how to obtain that information [ext.]. It is an information-packed phase. However, that does not mean that it needs to be a rigid phase. There have been suggestions to be more creative with the pre-discussions. Innovative examples include:

- By having online preparatory work,
  - having **simple explanations online** to enhance the prior knowledge of students, which can enable a richer, more in-depth pre-discussion [UM].
  - having **tasks given online, ahead of time**. One student then acts as the discussion leader, to come up with questions/learning goals, which the other students have to find answers to in the post-discussion (one person/sub group per question). This practice was favored by UM students. The students explained that this practice can be helpful to encourage participation. This practice has been carried out at the SBE and was also recommended by SBE educators [UM].
  - having Zoom **polls or quizzes** on Canvas. Some educators even require students to pass a quiz before being able to access the pre-discussion [ext.].

- **moving the pre-discussion to online discussion forums**, sometimes led by two students, monitored by the tutor. An expert in distance education warned that students may miss posts on forums or may be overwhelmed by the number of posts and replies. When the discussion is led by two students, the students are also tasked to create a summary in the format of a concept map. This can help ensure that every contribution is taken into consideration [UM].

- by having **pre-formulated learning goals**, so that the pre-discussion can be focused more on activating prior knowledge, brainstorming, and a more open group discussion. **"We gave the learning goals, but then the learning path was much more owned by the students"** – *UM Educator [UM]*.

- Although students are expected to brainstorm during a pre-discussion phase, one UM educator realized that students have not actually been taught on how to brainstorm. Therefore, creativity training has been proposed and planned for students, which can help them in brainstorming [UM].

### 4.2 Self-directed learning in blended education 💻

There are a few creative ways to guide and enhance self-directed learning in students. Due to the large amount of information available, we discuss this in detail in a separate section.

### 4.3 Blended post-discussion 💻

The post-discussion phase is where students reconvene in their tutorial classroom after having conducted some self-directed learning to find solutions to the given problem. Here, we cover some creative ways to conduct the post-discussions:

- by having students **summarize their study resources** in a knowledge clip, which they then go through and discuss further in their tutorial meetings [ext.].

- by having a **pre-post-discussion** outside of the classroom, organized either by the students or the tutor, conducted independent from the tutor. This way, the actual classroom contact hours can be used for more in-depth discussions (see Flipped Classroom). This has been conducted at two UM faculties and students who had experienced this have expressed liking this format [UM].

## 5. Other possible format within blended PBL: Flipped classroom 💻

Flipped classroom, as an educational format, requires students to learn theoretical knowledge outside of the classroom, whereas the classroom can serve as a place where knowledge is applied and discussed. Synchronous contact (e.g., tutorial meetings) with peers and educators is used for active learning, involving collaborative learning discussions, applying knowledge, creativity, and critical thinking.

Flipped classroom is a concept that has similarities with PBL conducted at UM, with a heavy emphasis on students self-directing their learning outside of the classroom and applying knowledge within the classroom. In literature, one study merged the concept of flipped classroom with PBL, plus blended education – forming the *flipped-blended PBL* [5]. This gives us an idea of how PBL and flipped classroom can be integrated harmoniously. In fact, flipped classrooms have already been implemented in most faculties of UM [UM] and at other institutions [ext.]. Some faculties have tried alternating between regular tutorials in one week, and flipped workshops in the next week [UM]. As with any course, the number of hours that students spend preparing for a flipped classroom are taken into account and matched with the ECTS that are assigned to that course [ext.].

### 5.1 Benefits

Overall, flipped classroom can promote collaborative learning, encourages just-in-time formative feedback, can increase engagement and motivation, can guide students to learn at their own pace, and can improve overall learning performance.

### 5.1.1 Improvements in learning outcomes

Flipped classroom [5]–[9] has been found to improve learning in students in various studies, compared to instructional models that simply transfer information and homework. Furthermore, the students also report cooperating more with their peers, meaning that they know, help, and are friendly towards each other [10]. When paired with learning analytics, students have reported perceiving flipped classroom as being more innovative, with class activities that were less clear and organized, compared to lecture-homework type of pedagogical models [10].

### 5.1.2 Applying knowledge

When asked about their educational wish list, students have requested for more practical activities where learning is applicable [UM]. One student explained why application is important: **"You're actually actively doing something with what you need to learn, instead of only reading it. You're applying what you need to learn"** – *UM student*. Flipped classroom can fulfil this wish as it is an instructional model that focuses on application of knowledge. From educators at UM, flipped classroom is seen as future-focused, aligning education to intended learning outcomes, and ensuring that students are able to apply their theoretical knowledge [UM].

### 5.1.3 Enhancing student motivation and engagement

Student motivation has been found to be improved after using the flipped classroom approach, compared to both traditional and distance education [8]. Students in flipped classrooms reported higher active student engagement, more effective synchronous contact learning, and higher attendance rates, compared to those who attended non-flipped classrooms [6]. An educator external to UM explained that students are not able to come to a flipped classroom unprepared, because they know they have to be engaged in the flipped classroom [ext.].

**"We capitalize on the time when we are all together, be it online or on campus, and try to engage with each other"** – *Nikos Basbas, Tilburg University [ext.]*.

Educators both from within and external to UM find that flipped classroom can introduce elements of novelty, sparking excitement in learning. This can provide more creativity and flexibility in education, rather than rigidity that can induce fatigue [UM, ext.].

**"Rotgans and Schmidt [11] call it the thirst for knowledge: they (students) are confronted with something they don't know the ins and outs yet, so it sparkles interest. So, when I look for ways to apply knowledge I think a new problem can spark this interest again"** – *Prof. dr. Sofie Loyens, University College Roosevelt*.

### 5.1.4 Active learning

The benefits from flipped classroom may be due to the active learning component. Two studies argue that as long as active learning is present, the type of instructional model does not matter. One study did not find any differences in academic performance between flipped classroom with adaptive learning, flipped classroom without adaptive learning, and groups that had blended education supplemented with regular quizzes, suggesting that all three active learning methodologies are just as effective for student learning [12]. Another study did not find flipped classroom to be any different from education that is designed for active learning [13]. This suggests that it is the active learning (specifically, applying knowledge) that brings about the benefits in flipped classroom.

### 5.2 Structure of Flipped Classroom

The flipped classroom concept is mainly made up of two parts: the self-directed learning phase (asynchronous learning) and the classroom contact (synchronous learning).

### 5.2.1 Self-directed learning (synchronous learning)

Based on the intended learning outcomes, students self-direct their learning with study resources (e.g., lectures, knowledge clips, books, and articles). It is also possible to guide their learning with the use of asynchronous systems such as a learning management system (e.g., Canvas). At their own convenience in time and location, students can pause and/or repeat the modules, study resources, and self-assessments as many times as they want or need to. The self-directed learning phase involves lower cognitive load activities, such as reading, listening, observing. This flipped and blended manner of learning has been argued to improve student learning because cognitive load needed to understand a complex concept is spread out [5]. When students meet synchronously with the tutor, they would have stronger prior knowledge in preparation for the discussion of a more complex task.

One concern was that students may not have grasped a basic understanding of concepts after learning on their own [UM]. A few solutions have been proposed for this:

- One way is to make use of interactive e-module on Canvas, where students have to complete certain modules, study resources, and formative self-assessments before joining the class.
- Discussion forums may serve as a platform where students may ask each other or the tutor questions asynchronously or used to summarize the study resources [ext.]. This way, basic concepts are covered, and complex questions that are posted on the forum can be brought to class [5].
- At one UM faculty, pre-post-discussion were carried out between students without a tutor. These pre-post-discussions were arranged either by the students themselves or by the tutor. This way, the students cover basic theoretical concepts and ensure that classroom contact is used for in-depth discussions [UM].
- An external institution allows 15-20 minutes of clarifying difficult or contradictory learning materials (not going through materials that are clear), before moving on to the application of knowledge [ext.].

### 5.2.2 Classroom contact (synchronous learning)

Classroom contact (e.g., tutorial meetings) with peers and educators is used for active learning. Activities include interactivity, discussions, application of concepts, creativity, and critical thinking, possibly revolving around activities such as solving problems, case analysis, or project/task development. In literature, these sessions typically last 75 minutes. Here, we emphasize that synchronous contact is meant for higher order discussions such as complex problems – not to cover basic facts that can be easily found in a textbook. However, some institutions do allow for up to 15-20 minutes of summarizing the literature [ext.]. Furthermore, synchronous contact is always a moment for formative assessment, where students' understanding of concepts can be evaluated in a low threshold manner, to guide them in the right direction. Similar to PBL, synchronous contact is student-led and student-centered. Good practices on group dynamics are detailed elsewhere in this report.

With flipped classroom, education is more flexible in the sense that educators can change up the format [UM]. PBL experts from other institutions advised to **"make your synchronous time as engaging as possible!"** [ext.]. Other institutions also encourage to apply knowledge, according to Bloom's Taxonomy [14]. Activities that can be carried out include:

- **Questions** [6]. Educators may start the flipped classroom session by administering a set of (7-10) questions or polls, by which students answer anonymously (e.g., with WooClap). Then the educator may assess the answers and provide immediate feedback. After showing that the educator is open to giving feedback, the educator may also welcome further questions from the students, to which, the educator or other students may answer.
- **Q&A.** The students may discuss materials that they had learnt, specifically on content where things are still unclear, where they have questions, where they are curious about. Students have expressed that they appreciate being able to use tutorial meetings for asking questions.

- **Assignments/projects**. Having studied theoretical knowledge outside of the class, students meet up in tutorials to work and update each other on their assignments or projects [UM].

- **Pair & Share (PS)** [6]. PS activities are a means of keeping educational activities interesting, with student-centered learning at its core. Educators may rotate between the following three types of PS:
  - In Rapid PS, the educator presents a question or problem to the class. The students then pair-up, discuss their ideas, and then present their ideas in a plenary session, which is followed-up with feedback and further discussion.
  - In Reflective PS, the educator posts reflective questions in the online discussion forum, 24 to 36 hours before class. Students are asked to prepare their well-thought-out answers (<400 words, references if needed) before class. The educator then chooses certain answers for discussion in class (keeping the student's identity anonymous).
  - In Proactive PS, upon receiving input from the educator, one or two students design, prepare, and chair the discussion. This type of student-led discussions have been executed at other universities [ext.]. More details on why and how to execute student-led discussions are elaborated elsewhere in this report.

- **Presentation and Discussions** [6]. For two sessions per course/semester, students will team up, with no more than 5 students per group, to present a summary and interpretation of their self-directed learning phase outside the classroom. The educator will randomly select a group to present. A discussion will follow the presentation, where students in the audience ask questions for the presenters to answer. No matter, all groups will be graded on their presentation materials. UM students have expressed liking presentation-based learning, **"to engage students more efficiently… (and) makes it easier to learn"** [UM].

- **Paired Quiz** [6]. At the end of each class, a 10-question multiple choice quiz can be offered to pairs of students, focusing on the content of only the class's material. Some of these quizzes can be accumulated to the final course score, depending on student workload and exam schedule. In pairs, students can openly discuss the questions. This quiz will ensure students are up-to-date with the course, learn from each other, and provide feedback to the educator as to how well the course is progressing.

- **Role playing**. By putting students in the shoes of their future careers, the students get to experience and learn in a contextual manner. Educators who have experience in the industry are able to take a case from their own practice or from their contacts, exposing students to real-world problems [UM].

- **Creating mind maps**. After the students have been exposed to literature, videos, spoken to industry experts and customers, and so on, the students come together as a group to create a mind map [UM].

- **Debates**. Having gone through literature and case studies, students will have to prepare themselves for a debate in the classroom, perhaps using a certain method of argument (e.g., legal methods or negotiation strategy). Breakout rooms may be formed temporarily to allow teams (affirmative and opposing teams) to meet up before the debate [UM].

- **Fishbowl**. In a fishbowl, typically a small number (e.g., 5) of students are invited to an inner circle to be the "fish", while the others remain as the human audience. They are presented with a question to discuss. The audience can be invited to join or swap places with the inner circle students. After some time, the audience is randomly called upon to summarize the fishbowl's arguments and answer the question based on what the fish discussed. Then the teacher may show the correct answer and explanation, if it was not part of the discussion. In this way, peer-to-peer as well as teacher-to-student formative feedback are given, while keeping engagement high [ext.].

- **Microlectures** have been thoughtfully integrated into the flipped classroom during synchronous contact [6]. Microlectures only last 1-3 minutes, serving to reinforce or redirect students' learning. This practice has also been conducted at other institutions. One institution replaced lectures with flipped classrooms and microlectures, although these microlectures may go up to 20 minutes. Another institution also use short video clips as microlectures. Microlectures are not necessarily part of every flipped classroom session – it is only used when needed. Microlectures serve to reassure students that they can self-direct their learning as a group knowing that the educator would guide when needed. Furthermore, the term *microlecture* is

a mindful term to remind educators and students that the educator's role is small, and that learning is student-centered.

## 5.3 Appropriate assessment

Appropriate assessment is essential to ensure alignment in education, with the purpose of measuring the students' understanding and achievement of intended learning outcomes. The aforementioned classroom contact activities already provide a type of formative assessment, where students receive regular feedback on their learning progress from these activities. To form a final course grade, a previous study awarded various percentages of grades to the presentations, quizzes, scheduled mini exams, projects, and the remaining 32.3% for a final exam [6]. Furthermore, some activities provided bonus points that the students can achieve [6]. Further details of assessment can be found elsewhere in this report.

## 5.4 Role of the educator in flipped classroom

Learning resources and content should be made available and accessible. If so, then the role of the educator in the classroom is to guide and scaffold the learning process [7], similar to a PBL tutor.

## 5.5 Preparations

To ease the students' transition to flipped classroom, it is recommended to provide students with a comprehensive syllabus, including the course description and reasons for the redesign. Furthermore, providing students with tips for success will give students a transparent understanding of what it takes to do well in this course.

Other than preparing the students, educators and staff have to be prepared for the change as well. One study found that introducing a successful flipped classroom approach took 127% more time to prepare the setting and materials. However, it is expected that the high quality academic materials will be reused in the future, hence reducing future time commitments [6]. Finally, educators can benefit from additional training in preparation for the flipped classroom.

## 5.6 More on why flipped classroom work

Using Keller's ARCS (attention, relevance, confidence and satisfaction) motivation strategies [15], one study explains why flipped classroom improves learning via student motivation [8]. Accordingly, student motivation can be enhanced by stimulating the ARCS category:

### Discussions

- With discussion forums provided, the students can ask their peers and educators any questions that they may have prior to the synchronous contact, stimulating their sense of inquiry
- When students learn from each other, there is a sense of variability, as different perceptions and different questions are posed
- For unanswered questions, the educator guides the students to the answers, changing their perception on certain concepts

### Relevance

- When the objectives of the course is provided on the learning management platform, it allows students to find relevance in the course
- With different assignments and even worked examples provided for the students as study resources, the students can feel a sense of familiarity

### Confidence and satisfaction

- When the students are able to self-direct their learning with the easily-available resources, this stimulates personal control

- When feedback is given by peers or educators during the synchronous discussions, this creates opportunities for success
- Practice assignments with feedback makes the assessment criteria clear and stimulates satisfaction

## 6. Other possible design frameworks within blended PBL

Other than the ADDIE model that is commonly used at UM when designing education [16], here we provide several design frameworks that can be useful for blended education. Nonetheless, **"constructive alignment is very critical to enable any good practice"** – *UM educator [UM]*. Constructive alignment should still act as a guiding principle, no matter the design framework used. The principle of constructive alignment is to design education by seamlessly integrating intended learning outcomes, teaching and learning, and assessment [17]. This is the case for blended education as well. When designing blended education, the intended learning outcomes serve as a starting point. Then, decisions on teaching/learning activities and assessments are made accordingly, aligning to the intended learning outcomes.

Briefly, the other possible design frameworks are:

- **5-E Learning Cycle -** where students learn collaboratively by engaging in, exploring, explaining, elaborating, and evaluating the content, under the guidance of an educator.
- **Community of Inquiry -** enriching education by improving cognitive presence, social presence, and teaching presence.
- **ARCS motivation strategies -** enhancing student motivation by stimulating attention, relevance, confidence, satisfaction, and volition.
- **Learning Development Cycle -** a step-by-step overview of education design, encompassing the scope, creation, pilot and user experience, and evaluation.
- **Other theories to consider when designing blended education -** including the self-determination theory and Tuckman's stages of group development

### 6.1 The 5-E Learning Cycle

The 5-E learning cycle is similar to PBL, where students learn collaboratively through the use of problems, guided by an educator [18]. The only difference is that 5-E emphasizes the application of knowledge on a novel problem. The 5-E learning cycle is made up of two parts: Content attainment (engage, explore, and explain) and content application (elaborate and evaluate).

Content attainment:

- **Engage -** introduce students to a problem, to spark interest in the material and engage students in learning.
- **Explore -** with regard to the problem, students explore the content by identifying patterns and coming up with their hypotheses
- **Explain -** the educator provides some academic content, such as mini-lectures, so students can construct their knowledge by linking their prior knowledge to academic concepts

Content application:

- **Elaborate -** apply knowledge to new problems, to strengthen their understanding of the newly learnt concepts
- **Evaluate -** formative and/or summative assessments

One study compared flipped classrooms with non-flipped classrooms [13], both using an active form of learning designed based on the 5E-learning cycle [18]. No significant differences were found between the two types of instructional methods, suggesting that it is the active learning component that brings about the benefits in flipped classrooms - and as long as education is delivered in an active manner, then student learning is supported. An important disclaimer: This study did not compare active forms of learning to passive

forms of learning. We assume that active forms of learning are better for student learning, based on extensive existing literature on this subject,

## 6.2 Community of Inquiry 💻

At UM, one educator recommended designing education based on the Community of Inquiry (CoI) framework [19], commonly used to study computer-mediated communication. CoI is made of three types of presences:

- **Cognitive presence** refers to the degree that students construct knowledge through sustained thought and discussion
- **Social presence** refers to the degree to which communication, usually social or emotional, is perceived as real.
- **Teaching presence** refers to the design and guidance of cognitive and social processes to realize intended learning outcomes.

From the rapid review, we found one study that used the CoI framework to enrich the students' perceived presence in online learning, which led to better learning outcomes compared to a control condition which only had lectures and student discussions guided by an educator [20]. Specifically, the study included the following practices:

- **Cognitive presence** is defined as the degree to which students can construct knowledge through reflection and discussions.
  - Provide ill-defined problems from contextually relevant situations. These ill-defined problems are naturally confusing, which come with multiple solutions
  - Encourage students to look up information from various resources
  - Encourage students to share prior knowledge and suggestions
  - Encourage students to ask questions and build on each other's ideas
  - Encourage students to defend their stance, such as by providing evidence
  - Stimulate students to reflect on their newly learnt concepts
  - Assign roles to students in each group prior to the online discussion
    (e.g., chairperson, scribe, and analyzer).

- **Social presence -** is the perceived realness of social and emotional aspects in communication.
  - Encourage students to use paralanguage (e.g., signs, capital letters, emoticons, and avatars)
  - Encourage voice messages, images, and videos
  - Provide training on social connection skills
  - Acknowledge and appreciate group participation
  - Respect and appreciate classmates as friends (e.g., use first names)
  - Use "we" when acknowledging the group

- **Teaching presence -** is the guidance of cognitive and social processes to achieve intended learning outcomes.
  - Set goals
  - Select educational activities and content based on intended learning outcomes
  - Organize small collaborative groups from the beginning of the course
  - Guide students' participation and reflection
  - Provide just-in-time information
  - Encourage peer-teaching
  - Synthesize information from different resources
  - Summarize group discussions
  - Guide self-directed learning (e.g., related databases)
  - Provide self-paced study resources (e.g., lecture notes)

- Training on effective media usage
- Provide regular feedback
- Ensure equal participation in group discussions
- Scheduling educational activities, ensuring sufficient time for deadlines

## *6.3 Keller's ARCS motivation strategies*

Keller's ARCS motivation strategies [15] aim to stimulate motivation via attention, relevance, confidence, and satisfaction (some studies also include volition [21]). Two studies used Keller's ARCS when designing education, and both studies found an improvement in students' academic achievement and motivation [8], [21]. One study explained that flipped classroom is one model that stimulates ARCS [8]. The other study followed the ARCS framework in online education to provide messages, assignments, video's, special lecturers, and rewards to spark student motivation, which succeeded and also led to better academic achievement [21]. Specifically, strategies used are detailed in Table 2.

**Table 2. Motivational strategies used that led to better motivation and academic achievement [21].**

| Components | Motivational strategies |
|---|---|
| **Attention** | • Sending a welcome message and a short bio of the instructors to the participants.<br>• Inviting a guest instructor to the online course.<br>• Humorous introductions, graphic design posters, presentations, and animations used. |
| **Relevance** | • At the beginning of the lesson, the importance of the course was explained.<br>• The future use of the instruction was explicated.<br>• A graduate was invited to the online course. |
| **Confidence** | • The evaluation criteria of the course were explained in detail.<br>• A detailed, informative, and motivating feedback on homework and exams was given.<br>• The instructors wanted the learners to prepare a weekly study plan to reach the goal of the course. The study plans were checked through the course. |
| **Satisfaction** | • Individual thank you e-mails were sent to active participants after the course.<br>• Motivating verbal praise and feedback were given.<br>• Unexpected rewards, like books, were given to the active participants. |
| **Volition** | • The importance of the participants' effort and persistence was explained and e-mailed.<br>• An online invitation was sent to participants who did not attend the course.<br>• Reminding messages and e-mails about course and exams were sent to participants. |

Adapted from: "Effects of the ARCS-V-based motivational strategies on online learners' academic performance, motivation, volition, and course interest", by U. Hasan, and A.T. Kumtepe, 2019, *Journal of Computer Assisted Learning*, 36, p. 335-349. Copyright 2019 by John Wiley & Sons Ltd.

## 6.4 Learning Development Cycle 💻

One study that improved online learning utilized the Siemens' learning development cycle to design an online learning environment [22]. Specifically, the following stages were involved:

### Stage 1: Scope

- Planning
  - Stakeholders
  - Budget
  - Delivery methods
  - Connection to institution strategy
  - Formal or informal learning?
- Analysis
  - Who are the students?
  - Students' learning range
  - Available technology
  - Nature of content
  - Support required
  - Pilot

### Stage 2: Creation

- Design
  - Intended learning outcomes
  - How to foster interaction
  - Technology and media needed
  - Layout and visuals
- Development
  - Skill sets needed
  - Content experts
  - Development timeline
- Delivery
  - Check delivery of content
  - Instructor tasks
  - Design feedback

### Stage 3: Pilot and user experience

### Stage 4: Meta-evaluation

### Stage 5: Formative and summative evaluation of stages 1, 2, and 3

## 6.5 Other theories for designing education 🔌

- **Self-determination theory** by Deci and Ryan [23], as suggested by an external educator, is important to keep in mind when designing education [ext.]. Part of theory focuses on students' psychological needs for growth, which are to have a sense of *autonomy* in their learning, to feel *competency* in achieving their learning goals, and to have a sense of *relatedness* or connection with others while learning.
- **Tuckman's stages of group development** [24] or the "forming-storming-norming-performing" model of group development, as suggested by an external educator [ext.]. Specifically, all collaborative groups are expected to go through each stage, where groups can develop, face problems, solve problems, and deliver results. Hence, educators can keep in mind how groups are expected to develop across time.

# (Re-)Designing blended education 💻

**"You can do group-based learning, assignment-based learning, you can do flipped classrooms, whatever. If everybody is going to get exactly the same exam, then the question is what is going to be in the exam,"** *warns one UM educator [UM]*. In other words, there may be different education design formats, but what matters the most is that education should be designed in a manner that is constructively aligned, from the intended learning goals, to the delivery of knowledge, to the assessment of knowledge. We describe assessments in another section.

**"A program might be a success, it doesn't mean that it's set in stone,"** - *UM educator*. It is important to regularly evaluate and redesign the courses when necessary, to regularly check that the courses are still aligned with academic, labor market, and global developments. This includes alignment across the program, across the various educational elements, and across the (design, delivery and assessment of) intended learning outcomes [UM].

**"We need to make sure that we keep education aligned to the current job market, because we want to bridge the gap between study and career."** – *UM educator [UM]*. COVID-19, for example, has changed the job market drastically, and education needs to align intended learning outcomes to changes in our dynamic global society. Therefore, reviewing the design of a course (and possibly redesigning after the review) should be common practice [UM]. A UM educator advises that it is a lot easier to re-design the entire program, than it is to look for quick fixes. UM educators emphasized revisiting the foundational principles of CCCS that builds PBL.

## 1. Course evaluations 💻

UM educators informed us that evaluations are carried out with an online evaluation form, during or after the last tutorial session of each course [UM]. UM educators have advised to listen to the students, **"their input is really input that helps the group [move] forward"** – *UM educator [UM]*. **"What do you think works well in keeping students engaged? Listen to them."** – *UM educator [UM].* Students think that having regular feedback sessions for their courses should be a universal good practice. One way to receive student feedback is to have a box of suggestions online.

At an external institution, course evaluations are carried out by [ext.]:

• having students give very specific feedback on the case problems of the course;

• having an online forum to overview all the questions the students made per case, so the students' learning progress are evaluated against the initial plans when designing education;

• after each tutorial, tutors evaluate the case online (e.g., through the learning management system). The tutors tick boxes of case elements that the planning group has set, such as the list of themes and the objectives connected to that problem.

Regular course evaluations are highly encouraged. Nonetheless, some UM educators remind us that it is important to uphold the quality of education – improving educational experiences should never be at the expense of the quality of education [UM]. The analogy of student as the customer was brought up. The university should act as an educational institution, delivering quality education, rather than having a focus on pleasing the customer.

## 2. Programmatic design 🔌

UM and external educators have advocated for educators to collaboratively design education at the program level, so certain intended learning outcomes are planned and achieved by the end of a bachelor or master program [UM]. Specifically, there is structure and scaffolding in the students' learning, where the learning curve is explicitly designed with diminishing support [UM].

Programmatic design has been argued to improve individual courses [UM]. Courses would fit better with each other, resulting in a smoother module-to-module experience within the overarching program [UM]. For example, at other universities, educators have collaboratively designed courses of 15 ECTS [ext.]. Additionally, through tutor instructions, tutors can be informed on how certain topics relate to previous courses, so they can assist students in activating prior knowledge and connecting knowledge learnt from one course to another [UM].

UM students have also expressed the need for more unity among course coordinators and tutors, **"Every tutor would do it differently, every coordinator has different, every course has different formats. So there's always some pretty steep learning curve." – *UM student [UM]*.** Another external educator shared that through programmatic design, collaboration among educators is increased [ext.].

When it comes to assessment, programmatic design aligns well with the concept of programmatic assessment (elaborated elsewhere in this report). On a similar note, students have also requested for grading systems to be more consistent from one course to the next, which can be achieved via programmatic design and assessment of education.

An important caveat to note is that planning a seamless experience does not mean cutting out innovations because they do not fit in. Instead, by having course coordinators collaborate, this should encourage for more innovation, because then the innovation can be deliberately planned in to fit with the other courses [UM]. An external educator explains that working with a design relay (ontwerp estafette) structure in the design team worked efficiently [ext.].

### 3. Diverse education design team

The team (re-)designing education is recommended to consist of members of diverse backgrounds, knowledge, and skills. Previous studies who have had significant success in their blended education delivery included a diverse group of people to redesign their courses, such as educational specialists [25], instructional designers [25], Director and Deputy Director of studies [26], [27], established interprofessional experts [25]–[27] course coordinators [26]. Furthermore, one study that successfully implemented online PBL reported that staff members acknowledged the importance of establishing an e-assessment committee to formulate, revise, upload, and evaluate online assessments [28]. Another study that successfully implemented online patient simulation had real patients co-design the training [29].

Aside from content knowledge, pedagogical and technological support is needed from instructional designers and from instructional technologists. For example, the educationalist structures education for effective learning while the technologist provides digital opportunities and caveats [30][UM, ext.]. Various types of support are elaborated elsewhere in this report.

Other than involving teaching and support staff of various expertise, students can be part of the (re-)design process as well. Studies that had successfully delivered blended education had also included students in their education design process students [26], [27]. UM students have voiced out their preference for assisting in the re-design of their education: **"It's important… that we do involve students in helping the admin in making these rules, to take these decisions…for example, throughout the year, we have been planning quite well what we will do next semester, what we will do next period. And whenever these decisions were made, students were allowed to voice their opinions, and I think that's quite important as well, having students be able to interact with management of their university, faculty, to ensure that their voices are also heard" – *UM student [UM]*.**

The idea of student co-design has received support from UM educators. One UM educator proposed having a team where tutors, course coordinators, educationalists and students come together to design education, with the end goal having education that is student-centered [UM]. Another perspective is to give students the freedom in designing the types of assessment, within the boundaries of the intended learning outcomes. This successful practice is elaborated in assessments.

## 4.  Reminders

There are many aspects to designing courses, detailed in various chapters. Here, we cover additional reminders:

1. **Reasons for decisions.** Keeping the CCCS principles in mind and considering the limited time that we have with students, each activity has to be given deliberate thought and pursued only with reason [UM, ext.]. UM educators emphasized that blended education has to be well-designed. Elements that remain face-to-face and elements that go online have to be grounded in good reasons, instead of choosing one over the other because it is more trendy or traditional [UM]. UM students have requested for educators to divide activities reasonably into those that must be done on-campus and those that can be done online. At other institutions, after courses were redesigned, their students expressed appreciation because they felt that the educational activities were intentional [ext.].

2. **Structure**. Structure is important for student learning, student well-being, and to help with teacher workload as well [UM]. Providing structure has been incorporated as part of a larger motivational strategy in literature, which led to better student motivation and academic performance [21]. Students expressed that having routine in the course and having something to work towards (e.g., an exam) can help them engage with their course. Another UM educator observed that in student evaluations, when a course is rated badly, there are comments about the lack of structure; while when a course receives good evaluations, there are positive comments about the structure [UM]. Furthermore, a UM educator explained that it is important to be transparent with the structure of the course, to allow both students and educators to plan their schedule accordingly.

   **"Omdat je enerzijds natuurlijk de studenten autonoom wil laten, zodat ze zo flexibel mogelijk hun onderwijs kunnen of, ja, hun studie kunnen volgen, maar anderzijds ze die structuur heel erg nodig kunnen hebben, de juiste balans hierin is belangrijk"** / **"Because on the one hand, of course, you want to give students autonomy, so that they can be as flexible as possible in their education/studies, but on the other hand, they may need that structure very much. The right balance in this is important"** *– Guus Lambert, Zuyd Hogeschool [ext.]*

3. **Scaffolding**. Another UM educator acknowledged that educators have to adjust the amount of support given to students, because different students will be ready for different levels of autonomy, sometimes dependent on their mastery of knowledge in the field [UM]. This resonates with external educators, as they have emphasized the need to provide just the right amount of instruction and support to students in their learning [ext.].

4. **Learning environment**. **"A good tutorial stands and falls with having a good learning environment,"** explains one UM educator [UM]. One way of doing so it to make time to check in with students, which pays off in engagement throughout the course.

5. Students need to **experience the CCCS principles in education** [UM]. For example, tutorials meant for collaborative learning may not actually be experienced as collaborative learning. Educators need to regularly evaluate their course delivery and re-adjust when needed.

## 5.  What not to do

Do not start with the structure or time requirements. Avoid thoughts such as "we need one more lecture, what should we do in that lecture?". Instead, every course should start with the intended learning outcomes and then make decisions based on sound reasons.

# When to meet face-to-face and when to go online? 💻

When education was moved online due to the COVID-19 pandemic, both educators and students did their best to cope and adapt. There were moments where we thrived and there were moments where we struggled. Overall, there was general consensus that technology can assist education in achieving its goals of educating. Nonetheless, the use of technology is not a goal per se, but a potential means to this end. The choice of which parts of education should go online and remain face-to-face depends very much on the goals and contexts, including learner characteristics.

> **"Technology is never a solution in itself. It's always context dependent, it always depends on what you do with it."** – *UM educator.*

## 1. Goals and context

### 1.1 Academic performance

Both from the community's practical experience and from literature, online education can either be just as beneficial as, or even more beneficial than, face-to-face education in terms of students' academic performance.

From the community, UM students, UM educators, and external educators expressed that the students' discussion of content and information retention in online tutorials appears to be the same as face-to-face tutorials [UM, ext.]. Similarly, students have also expressed that online tutorials worked well and there were many opportunities to ask questions when they needed to [UM].

In literature, when education was moved online, one institution found that exam grades were just the same as before [31], while others found an improvement in exam grades [26] (with one study finding improvements only in female students in their PBL curriculum [28]). Furthermore, the online education provided by one institution led to increased enrollment, overall satisfaction, and a lower dropout rate [26]. These findings have to be interpreted carefully because the emergency move online had generally involved large institutional investments, change in management structure [26], and various changes in education delivery, such as the added use of forums (e.g., Piazza, [31]).

A meta-analysis comparing the effectiveness of face-to-face, online, and blended education revealed that blended education was more advantageous than face-to-face education for achieving learning outcomes [32]. When purely online education was compared against traditional face-to-face education, no differences were found in terms of achieving learning outcomes. Specifically, the authors state that: **"The meta-analysis findings do not support simply putting an existing course online, but they do support redesigning instruction to incorporate additional learning opportunities online while retaining elements of face-to-face instruction"** [32]. The advantage of blended learning is suggested to be due to students spending more time engaging in academic content such as additional instructional resources and more opportunities to interact with each other more. Indeed, in another study, when contact time in a flipped classroom was reduced from 3 times/week to 2 times/week, exam grades dropped by an average of 4.4% [33]. Another study reported a lack of differences in learning between groups that were exposed to face-to-face classes vs. shorter durations of blended classes [34], suggesting that education is only enhanced by technology if additional learning opportunities are provided on top of regular education. Otherwise, when time spent in learning activities were the same, then students have expressed that face-to-face learning was more valuable [35]. As highlighted in the meta-analysis [32], the improvement of learning in blended education is expected to be due to the additional time spent in learning activities.

### 1.2 Motivation, engagement, attendance, and participation

For many UM students, UM educators, and external educators, online tutorials and face-to-face tutorials were reported to be no different in terms of student motivation, engagement, nor participation in discussions [UM, ext.]. However, in literature, intrinsic motivation was highest in those who attended classes face-to-face,

compared to those who were online in hybrid meetings [36]. The authors of this study also measured feelings of relatedness and posit that relatedness contributes to intrinsic motivation (see Self-Determination Theory [23]). They find that face-to-face remains the best available option for a sense of relatedness to both the educator and their classmates, compared to online or hybrid meetings [36]. Another study also advocated for face-to-face tutorials [35]. When tutorials were moved online in 2020, they saw a drop in student attendance and attributed this to online tutorials being less engaging for the students [35].

### 1.3 Attention

When online PBL, blended PBL, and flipped PBL were contrasted, there was no difference in students' self-rated attention to instructional content [37]. However, in practice, educators perceive students' attention span to be longer when face-to-face [UM, ext.], with fewer tendencies to be distracted by other web pages that are simultaneously open [ext.].

### 1.4 Course satisfaction

One study compared online PBL, blended PBL, and flipped PBL, and did not find any of the methods to affect course satisfaction [37]. The students of this study also did not find the different instructional settings to affect their perceived relevance of the academic content nor confidence in their learning [37].

### 1.5 Type of information delivered

Online classes and meetings are preferred by students when these type of information are delivered:

- Theoretical information (without cases)
- Short meetings with educators
- Brief information sessions online appear more professional and effective

### 1.6 Convenience

#### Breaking down geographical barriers

- Online meetings and courses can take place from various geographical locations possible [UM, ext.]. At some UM faculties, students are already meeting other students from other continents, stimulating global exchange of knowledge and development of soft skills, e.g., being sensitive to cultural differences.
- Logistically, online meetings can be more cost-effective.

#### Effective planning and collaboration

- Discussion of content in online meetings can be more effective, shorter, especially when it comes to planning [UM].
- Online meetings can lower barriers to organize meetings, allowing students to schedule (and reschedule) meetings with educators and even industry experts more easily. An interviewee mentioned **"Maybe just the introduction and final presentations we will do offline."** [ext.].
- Students have expressed liking online meetings when collaborating on group projects because meetings can be more efficient [UM].
- Video-conferencing software makes it easy to share screens and collaborate [UM].

### 1.7 Social connection and collaborative learning

Connecting on a social level is not only important for forming friendships, but it also helps in establishing good team dynamics for better collaborative learning [UM]. Learning to form connections via informal conversations, learning to establish good contact, learning to build good networks, learning to be sensitive to the cultural aspects of communication, and learning to have effective nonverbal communication – these are important learning objectives in most professional fields [UM].

It is easier to connect face-to-face because we are able to see facial and bodily reactions. Students do find it important to connect with each other face-to-face, and educators (within and external to UM) recognize the importance of this as well. When learning collaboratively, UM students have also expressed that group members are more accountable for their actions when they meet face-to-face, compared to when being online. Educators themselves find it easier to connect with students face-to-face [UM, ext.]. When educator notice that a student is not doing well, it is much easier to speak to the student one-on-one, face-to-face, for example, after a class has concluded. Digital means of communications, such as WhatsApp and Zoom breakout rooms, were not able to replace the informal conversations [UM].

Face-to-face connections are supported by literature as well. When it comes to a sense of relatedness, face-to-face remains the best available option, compared to online or hybrid meetings [36]. Students experience higher sense of relatedness to the teacher in face-to-face settings. Relatedness to peers was also highest in face-to-face settings, compared to a hybrid or online setting. Relatedness to peers was the worst in those who were online in a hybrid meeting [36].

UM students propose that at the beginning of a new program, course, or project, meeting face-to-face is important to build friendship and networks. Students expressed that first, middle, and final meetings of group assignments should be face-to-face for teamwork purposes. Students recognize that social life is part of their education. A UM educator in distance education agrees that in previous years when students were able to meet up face-to-face once before their distance education began, their later communication with the educator was good. However, during COVID-19, when students were not able to meet, communication with staff suffered [UM].

Nonetheless, there are students and educators who expressed that a sense of intimacy and closeness can also be achieved online, if done right [UM]. In the next section, we cover some tips on (n)etiquette, some of which may help improve connections online.

## (N)etiquette 💻

There are different protocols when conducting meetings face-to-face and online, as suggested by UM students, UM educators, and external educators. The protocol for online meetings includes:

- **Active learning** is important for both face-to-face and online settings. However, it is especially crucial in online meetings. Meeting materials have to be very interactive, allowing students to contribute [UM].
- **Checking in**. One UM educator explained that, **"In online team meetings, we encourage supervisors, mentors, and coaches to do an icebreaker in the beginning to, you know, check in with everyone... When you do things online, there needs to be more attention to the human aspect... because the whole body language is missing"** [UM]. Another UM educator explains, **"just having a chitchat on how life is going and how the weekend was and so on, because all that pays off in more student engagement"** [UM]. UM students have also expressed appreciating their educators checking in with them, as it is important for their well-being [UM].
- **Include informal moments**, especially at the start of any course or project, so students and tutors can get to know each other and ask questions.
- **Preference for 2-hour tutorial meetings**. Students and educators prefer 2-hour tutorial meetings, twice a week, instead of the 1-hour format that was used at some parts of UM during COVID-19 [UM]. Students explain that this is because it keeps students involved in their learning and education. Shortening the time reduces the educational hours that students experience. Educators explain that in 2-hour tutorial meetings, there is more time to create meaningful discussions and engagement between students.
- **Condensed materials**. Because attention span is shorter online, materials need to be condensed [UM].
- Further netiquette:
  - Cameras are recommended to be switched on, because it enables connection between people, especially in difficult times [UM].

- Microphones are recommended to be switched on as well, unless there is a lot of unavoidable background noise. This recommendation was given because having microphones muted stunts the natural flow of conversation, where the small yet technical need to wait turns, unmute and mute oneself, takes away from the process of collaborative learning. There is no mute button in a real-life setting, anyway, so why mute ourselves in an online meeting? [UM, ext.]

## 2. When online: PBL vs. traditional education

Scrutinizing on just the online setting, one study compared PBL to a pedagogical model where discussions were instructor-led and information provided to the students [38]. Although there were no significant differences in content knowledge acquisition, PBL was significantly better for developing critical thinking skills. Another study that focused on blended settings also found PBL to be superior than conventional learning in developing students' spatial thinking ability and academic learning outcomes [39]. Therefore, the PBL pedagogical model is still preferred when in a digital setting.

## 3. What about hybrid education?

Hybrid education is where one group of students attends a class on-site and simultaneously individuals follow the class online and remotely from the location of their choice [3]. Some educators have recommended smaller groups (12 or fewer students) for hybrid education. Furthermore, technology is a prerequisite, as every attendee must be able to see each other in a hybrid setting [UM, ext.].

However, there are challenges, such as:

- student participation in discussions were negatively affected [UM];
- not having a natural flow in the group discussions [UM];
- difficulties paying equal amounts of attention to both online and on-site groups [ext.];
- not getting the groups online and the groups on site to be engaged with each other [ext.];
- those on site being seen more positively (e.g., more efficient and hardworking) than those attending online [UM, ext.].

One institution that successfully implemented hybrid tutorial meetings had a peer system, where each student online is paired with a student who is attending face-to-face. Then, whenever the student online was not able to share their thoughts or questions with the group, their peer would be able to assist them in doing so. This resulted in stronger engagement in the discussed content, both for those present in the classroom and those present online [ext.]. This institution also has students who focus on the technology aspect of the tutorial meeting, for example, keeping track of the chat function. This institution is attempting to pursue the *HyFlex* (Hybrid-Flexible) model.

## 4. Can we formulate a best format for blended PBL based on current evidence?

Most educators internal and external to UM are now convinced that having forms of blended education would be part of the future, but the question remains: "What is the optimal blend between online and offline educational activities?". It is important to realize, the blend itself is a means to an end. Choosing which blend to use should be based on sound reasoning, such as whether meeting face-to-face or online would enhance the achievement of intended learning outcomes.

When students were asked about their preferred blend, roughly half the students preferred online meetings, while the other half preferred face-to-face, on-site meetings. With 100% online learning leading to fatigue with video conferencing among students and educators, there needs to be a good blend of how much and how frequent we have face-to-face and online meetings [UM].

According to students and educators at UM, future meetings should be given the options of both face-to-face and online, so there are always opportunities to meet each other Many students and educators have really

enjoyed using video conferencing tools thus far. Some have suggested leaving the decision to the student group and the supervisor [UM]. However, some UM educators have warned that it may become too easy to just attend online meetings from the comfort of one's home, at the expense of the face-to-face benefits, so certain guidelines need to be put in place [UM]. In the end, elements that remain face-to-face and elements that go online have to be grounded in good reasons, instead of choosing one over the other because it is more trendy or traditional [UM].

In the end, similar to what is found in literature, the choice of online and face-to-face education depends on the goals and contexts. Digital tools do not directly lead to better or worse learning performance. Technology is only a means to an end, the end being well-designed, delivered, and assessed education that is constructively aligned and promotes the CCCS principles of PBL. That also means that we can use digital tools when it helps us to achieve our educational objectives and we use traditional means of education when that helps us to achieve our aims better. As our external partners put it,

> **"A good blend doesn't rule out a good single malt (translated from Dutch)"**
> *– Eduardo Hermsen and Chris Rouwenhorst, University of Twente*

> **"As long as a tutor is engaged and attentive to students in the teaching sessions. I think that is the most important thing regardless of whether teaching is face-to-face or online."**
> *– Dr. Victoria Mansour, Western Sydney University [Ext].*

# Collaborative learning in blended education

> **"Learning is a social thing"**
> – *UM educator [UM].*

## 1. Principle of collaborative learning

Collaborative learning is more than putting students in a classroom and pushing for discussions. UM educators emphasize that collaborative learning has to be genuine, in the sense that students really experience learning together, in a manner that is meaningful and has added value [UM]. Students should not be in tutorial meetings just because there may be an attendance requirement [UM]. Rather, they should be there because they genuinely enjoy learning from and with each other [UM]. One way is to inform students of why they are in small groups and the importance of collaborative learning [UM].

## 2. Benefits of collaborative learning

From our rapid review, we find one study reporting that both working in teams and working individually appear to have different perceived benefits, according to students. In this study, students that worked on quizzes in teams rated rapport-building skills and innovative thinking skills as higher than those working on the quizzes as individuals, whereas those working individually rated time management skills as higher than those working in teams [40].

While using a learning management system), students who learnt collaboratively by participating in online discussions to share ideas and information experienced higher learner satisfaction, compared to students who only interacted with their educators on content-related matters [41]. These students who learnt collaboratively also had a higher level of participation in the forum discussions, compared to students who only had content-related interactions with their educators. Hence, collaborative learning enhances the learning experience.

At an external institution, students were given multiple choice conceptual quizzes at the start of the class, then they discuss their answers, and when the same quiz is introduced after the discussion, usually 70% of the students will get the right answer [ext.]. This shows that the discussion brought about changes in the students' knowledge structure, guiding their learning as a group.

At UM, educators describe collaborative learning as one way to help students structure their learning. Because students expect their learning to progress alongside their peers, they make an effort to go through their course materials. Collaborative learning can thus be conducted throughout a course (e.g., a tutorial) or as part of a course (e.g., an assignment) [UM]. UM students have also expressed enjoying activities that encourage more participation in tutorial classrooms, such as presentations or projects.

## 3. Benefits of small groups

**"Het is belangrijk om in een samenwerkende leergroep verbondenheid en wederzijds vertrouwen te scheppen, zodat er een veilige omgeving ontstaat om elkaars ideeën vrijelijk en kritisch te bespreken. Kleine groepen zijn beter in het bereiken van dit doel dan grote groepen / It is important to create bonding and mutual trust in a collaborative learning group so that a safe environment exists to discuss each other's ideas freely and critically. Small groups are better in achieving this goal than large groups"** *- Prof. dr. ir. Karel Kreijns, Open Universiteit [ext.].*

Smaller groups improve group discussions [UM]. One reason may be that small learning groups allow students to participate more actively in the process of collaborative learning [UM]. Many UM students like small group tutorials, because everyone is able and encouraged to participate. Having larger groups lead to the by-stander effect, where it is easy to excuse oneself from contributing when there are many others in the group [UM]. With smaller groups, students would feel that their contribution is important, motivating them to contribute [ext.].

When online, students have expressed enjoying breakout rooms because these rooms **"are more intimate and give more freedom"**.

Similar to self-regulated learning, groups should regulate their learning as a group [ext.]. This includes the regulation of emotions and motivation, which is better done in smaller groups [ext.]. Some educators assert that learning in a small group builds a sense of belonging and community, which is important for student well-being [UM].

## 3.1 How small is small?

### 3.1.1 Tutorial groups

At UM, it is common to have groups of 12-15 students in PBL tutorials. During times of social-distancing, some educators have experimented with even smaller tutorial groups (no more than 9 students per PBL group at another university [ext.]) and found improvements in group discussions. However, smaller tutorial groups are not practically feasible in regular times, especially with the increasing student population. Hence, *subgroups within larger tutorial groups* can be formed, with 3-6 students per subgroup [UM, ext.].

Smaller subgroups are recommended both in the face-to-face and the online setting, but it is especially important in online meetings (through breakout rooms) to encourage participation and stimulate in-depth discussions [UM, ext.]. Smaller subgroups are especially useful when the students have to brainstorm together (e.g., part of pre-discussions). UM students have expressed liking subgroups. At the same time, students have expressed that when the tutor is not present, subgroups online tend to go off-topic [UM]. Therefore, subgroups should be given sufficient preparation to function without the tutor being present [ext.].

Although having smaller subgroups are encouraged, one practice that was discouraged by a UM interviewee, is to have subgroups return to the plenary session *to repeat their smaller group discussions*. This practice was discouraged because it is time-intensive – time that could be used for more in-depth discussions [UM].

### 3.1.2 Group work and assignments

Small groups of 4-6 students have been a common practice for group work and assignments [UM, ext.]. These small group assignments are usually project-, case-, or challenge-based learning, elaborated elsewhere in this report.

## 4. Types of small group collaborative learning

The PBL tutorials and group work (e.g., projects, assignments) conducted at UM are ways of conducting small group collaborative learning. Here, we share more ideas on the types of small group collaborative learning. It is not the intention for educators to adopt all practices in one go. Rather, we recommend for educators to select the practices that best fit their intended learning outcomes and course structure in general.

## 4.1 Student-led discussions

When students are expected to lead the discussions, it is important to empower the students to actually lead the discussions. An external educator explains that at their institution, students sign-up in pairs to lead the discussion of a particular topic. This way, the students are co-leading the discussion, becoming each other's accountability partners and making sure that they are not on their own – they are a team. Then, the pair of students meet with the educator a day or two before the class, to discuss their plan of leading the class, or "choreographing the class". Topics that are discussed include how to navigate the discussions, how to design conversations, what is the opening prompt, how to provoke questions, challenges, or problems, and how to reach the end goal. Furthermore, the structure of the class is up to the student-pair, whether to divide the hours into specific segments, whether to divide the class into smaller groups, whether to use video clips, exercises, simulations, or debates. "The sky is the limit" as long as the learning objectives are achieved. When the class is in action, the teacher minimizes their interruptions [ext.].

**"The 'led' is just as important as the 'student' in these 'student-led discussions'," *Prof. Dr. Timothy Patrick McCarthy, Harvard University,* "It's not just my class, it's their class, and they have to do the work to get ready to take the lead."**

### 4.2 Peer teaching

One way for students to learn from each other is to stimulate peer teaching. For example, at some parts of UM, "bold lectures" are held at the end of the course, organized by the students [UM]. In these lectures, students share and learn (often exam focus questions) from each other, supervised by the course coordinator [UM].

Students can also take on the role of teaching each other in a more formal manner than the collaborative learning that is commonly conducted in PBL tutorial meetings. One institution had many students form groups of 3 to learn a particular topic [ext.]. Then, when certain groups gain more mastery faster than the others, these groups would then teach the other students.

Another idea is to have senior students take on the role of teachers, for example tutors or supervisors in practicals [UM, ext.]. This practice has a few benefits, such as giving senior students more responsibility, enhancing the knowledge of senior students, and connecting senior and junior students, because senior students are able to relate to the junior students in many ways. This practice can be either a part of the course, where students are required to fulfill some teaching hours, or paid as a regular job [UM, ext.].

### 4.3 Student-generated questions

Student-generated questions are where students create formal questions to stimulate a discussion or to be used in an assessment. Student-generated questions are therefore different from the questions that arise naturally in learning. From literature and from practice, we find that student-generated questions can lead to a good educational experience.

A study found that a mixture of student-generated questions and forum discussions led to better engagement (compared to the sole use of forum discussions) on the learning management system in an online course [42]. The students were given guidance to generate their questions, following Bloom's Taxonomy [14] and the effective approaches for writing multiple choice question (MCQ) items [43]. Specifically, the students were requested to generate MCQ at the knowledge level, comprehension level, and application level, and participate in a forum discussion. Compared to those who solely participated in forum discussions, those who generated their own questions were more engaged in their learning – visiting the learning management system more frequently, creating more threads of discussion, and replying to posts more frequently [42].

In practice, UM educators have also found student-generated questions to lead to more in-depth discussions, where peers answer these questions in group discussion under the guidance of an educator [ext.]. Another example from UM is to have students generate their own conceptual exam questions covering certain topics, where the students link concepts from different problems together and being creative in explaining how these are related [ext.].

### 4.4 Co-creation

With some training, students can co-create knowledge together on shared documents (e.g., GoogleDoc), blogs (e.g., via WordPress), or Wiki's, where students can edit each other's work, with the edit history retained [ext.]. Co-creation can also occur through collaborative annotation tools, where students read texts together, make notes, and ask questions. In online tutorials, smaller groups can work on the same online whiteboard but in different areas/corners, before bringing all discussions visually together [UM]. Co-creation tools similar to GoogleDoc and Wiki's can be a feature of Canvas [UM].

Co-creation has been suggested to increase active learning and motivate students to go through their learning materials [UM]. Co-creation can also increase motivation and prevent social loafing because there is shared

ownership, the students know that the teacher follows their progress and contribution, and there is visible epistemic interaction [ext.].

One study had students conduct debates online, where students received training on team-building, then collaboratively wrote and edited their essays on Google Docs, encompassing online communication between team-members (using the chat function on Google Doc), and prompt guidance from the instructors [44]. The students' online debate performance was no different compared to their peers who debated face-to-face, suggesting that online debates are possible and can be just as effective as face-to-face settings.

Another study used group Wiki's as students learn collaboratively (e.g., flipped classroom) in a blended setting [45]. Group Wiki's led to better exam grades and were reported by students to be a satisfactory form of group assignment [45]. The Wiki's had numerous features, for example, inserting and editing text, tables, statistical formulas, images, hyperlinks, audio, and video. The educator can also assess the group Wiki's at any time, so when the quantity or quality of the group Wiki's is lacking, feedback can be given just-in-time [45]. According to students, group Wiki's motivated them to learn, enabling them to identify their weakness and strength, and built teamwork [45].

Students may also co-create the same document or program (e.g., making minutes or notes on virtual whiteboards, using mind mapping tools such as Miro or Google Jamboard or brainstorming tools such as WooClap). Doing so may help students make connections from one topic to another as well [ext.]. Online co-creation has been more time-efficient than doing this on a physical whiteboard [UM]. One UM educator suggested having multiple smaller groups work in the same online whiteboard on different areas/corners, before bringing all discussions visually together [UM].

Although the university can provide co-creation platforms, UM students and students from other institutions (according to their educators) preferred to find online platforms on their own, such as Google Docs. Therefore, students should be given the freedom to plan how they meet, how they communicate, which tools they use, and how they plan their work [UM].

### 4.5 Learning skills collaboratively

Skills can also be learnt collaboratively. For example, at another university, groups of five students learn certain skills collaboratively throughout an entire semester. Each week the students would be given a prompt to work on a skill, for example, contentious communication, storytelling, pitching an idea, etc. Each week, one student would lead the team in developing this skill, facilitating the time together, scheduling, and then writing a report, so that the educator knew what was going on. These groups would function independently from the teacher throughout the semester. This practice is recommended because the students learn by doing, learn from each other, and connect with each other [ext.].

### 4.6 Cross-course collaborative learning

At another institution, students from various courses came together to learn from each other. Although this particular practice may not be generalizable to all courses, this practice was highly recommended by the partner institution. Specifically, two bachelor courses, which were traditionally taught in different languages (Dutch and English) were brought together so the students could learn about intra-cultural awareness and inclusion through forming international treaty negotiations. Then, students from a master course, whose intended learning outcomes were about negotiation mediation, were brought forward to help the students from the two bachelors courses negotiate. This practice highlights the possibility of students learning from each other in a contextual and applicable manner [ext.].

### 4.7 Multidisciplinary (remote) groups

Interdisciplinary student projects are encouraged at UM, so students can learn collaboratively [UM]. In a design-based research focusing on benefits and challenges of online learning [46], the researchers identified practices to stimulate knowledge co-creation in a multidisciplinary, virtual group. The research was designed

to promote practices that stimulate individual and collective agency, practices to organize participation, and practices for learning and creating knowledge iteratively. To support participation and negotiation:

- An orientation meeting was organized at the start of the course, where groups of students were given an orientation task in which they had to organize roles, to help students better negotiate their future collaboration.
- The course was structured to switch between assignments (individual and group) and teaching (video lectures and peer-group tutoring)
- Students were given explicit explanations on the purpose of case-based learning, organizing group work, and co-authoring

To foster reflection, a group-level written reflection was required every 2 weeks to encourage group members to express their thoughts on how they were doing and how to do better. Instructions on how to carry out a group-level written reflection was provided on the learning management system.

For this particular study, these practices led to a better overall course experience and multidisciplinary collaborative learning. These practices led students to realize that multidisciplinary and remote collaboration meetings are part of their future work life. The course structure of intermittent assignments and teaching allowed students to distribute their time more evenly. Yet, comments were still made on limited face-to-face interaction, suggesting that virtual collaboration may not be optimal [46].

## 5. Organizing collaborative learning in blended education

### 5.1 Group roles

When learning collaboratively, it is common to have group roles, such as the chair and scribe, assigned to group members (e.g., [20]social, and teaching presence).

One study found that collaborative learning online can be boosted by promoting group leadership, which led to better academic performance, creativity, problem-solving, and critical thinking [47]. This approach of group leadership engages students in active learning while working with their peers to achieve shared learning goals, with the guidance from a leader. Group leadership promotion has four steps:

1 **Duty declaration**: Either the instructor or the learning management system introduces the learning task and provides guidance on collaborative learning, including advice on discussing, sharing, debating, and synthesizing knowledge of classmates.
2 **Division of labor**: The group leader is given advice on how to delegate and schedule tasks. Upon reaching agreement, the duty of each student is declared on the forum and the students start learning collaboratively.
3 **Summary of discussion**: Reminders are given to the group leader (or scribe at UM) to organize the learning outcomes and manage group members' ideas. Advice is given to the group leader on how to summarize these ideas. The learning management system enables group leaders to communicate with their group and synthesize the gathered data into a coherent learning task. A specific group discussion forum allocated for this step.
4 **Reflection**: Upon completing the learning tasks, the learning management system provides feedback on group-work and learning performance. The group leader is asked to acknowledge individual group members' contributions. The students then reflect on a separate group reflection forum, before preparing for the next learning tasks [47].

### 5.2 Proposed schedule

When it comes to collaborative learning, the process is just as important as the outcome. For some educational activities at UM, certain milestones are marked with special events [UM]. According to UM educators, a clear schedule motivates the students to learn, protects student well-being, and helps with teacher workload [UM]. For example,

- Prior to the start of the course, a welcome message is sent to the students
- A kick-off event starts the course, where students get to meet their peers and educators
  - A blitz/introductory class is given, where quick-and-easy guidelines are given on the topic of the course
  - A team-building activity is conducted, to encourage students to form connections and to set agreements for their collaborative learning
  - A team-building training is conducted, for students to learn how to conduct difficult conversations if needed [UM]. According to a UM educator, it is important to teach collaboration if collaboration is something that is assessed.
- Midterm event, to evaluate the students' progress of learning
  - This can be a fun event, such as setting a competitive challenge between groups, where groups of students give a pitch and receives feedback from other students. This is also assessed, usually by an external expert.
  - Intervision, where students of different groups give each other feedback on the collaborative learning process and content of their assignment.
  - A reflection session, where students reflect on their group processes and improve where necessary. One UM educator pointed out the need to develop skills across time (e.g., collaboration, communication, organization, etc.). A reflection report is also written and the students receive feedback on this report.
- Closing event, where students present what they have learnt across the course.
  - Educators at UM have suggested to give students the freedom to express their findings in their preferred format, for example, via PowerPoint presentation, poster, podcast, video, poetry, writing a story, composing music, paint, give a performance, or make a quiz [UM]. This can be done at an organized symposium. Streaming online with chat forums allow the possibility for students of all years, educators, and external clients to attend this symposium, allowing for further opportunities of exchange and connection. Online symposium program examples, recommended by our interviewees, include Remo. Finally, the students' findings are judged by a jury of experts, halfway through the course, and at the end of the course [UM].

### 5.2.1 Training

According to UM educators, it is important to teach collaborative learning if it is expected of students and assessed [UM]. The types of collaborative learning training include social skills, learning to be accountable and to be able to address peers on accountability, learning to have a collaborative responsibility to finish group products successfully, learning to handle a conflict with peers, learning to hold different group roles [UM].

When students are expected to lead the discussions, they should be given training on how to lead as well. At an external institution, the student(s) who will chair the meeting meets with the educator a day or two before the class to discuss their plan of leading the class, or "choreographing the class". Topics that are discussed include how to navigate the discussions, how to design conversations, what is the opening prompt, how to provoke questions, challenges, or problems, and how to reach the end goal. The educator can then give guidance or advice on best practices and common pitfalls [ext.].

At some parts of UM, a mid-term evaluation is scheduled (as mentioned in the proposed schedule). This is so students can reflect on and address issues on group processes should they arise.

### 5.2.2 Bonding

When a safe and motivating space is created, students can feel motivated to share and learn collaboratively with each other [UM]. UM students have suggested always having an ice-breaker in the first tutorial meeting, so that a bond can be created between students and between students and tutors [UM]. At some parts of UM, a kick-off meeting is organized at the beginning of the project, to introduce the project and for students to get

to know each other. The kick-off meeting is recommended to foster positive team dynamics, such as setting up collaboration agreements and having team-building activities.

Outside the classroom, students tend to remain connected with each other through WhatsApp groups. **"It was helpful to ask others in the class about how they are dealing with problems"**, explained one UM student [UM]. A group page can also be set up in Canvas as well, to encourage intimate academic discussions between students [UM].

We discuss more about creating a sense of community elsewhere in this report.

### 5.2.3 Intervision

To improve collaborative learning, some UM educators arrange for a type of practice - intervision. Students perform intervision or peer review, i.e., giving each other feedback, without the presence of the educator. At least once throughout the course, intervision groups discuss the collaborative learning process and also content of their group assignments. Intervision group members are different from the students' actual collaborative learning groups, so students can receive unbiased feedback [UM].

Another working example from a UM educator is having two project groups prepare an in-between product (e.g., first draft of a report). The students then give feedback to each other [UM].

### 5.3 Technology in group work

Group work such as assignments and projects are already a part of UM. Collaborative learning through a learning management system is possible and preferred by students, but learning performance would not be any different from face-to-face collaborative learning [48].

Due to the accelerated adoption of more online group work, here we discuss how software programs may assist students in their collaborative learning:

- **Video-conferencing software** (e.g., Zoom, Microsoft Teams) can assist students to work together online. Students are able to share screens while discussing their work [UM, ext.].
- **Project management programs** such as Microsoft Teams can help students collaborate, with options for project planning, monitoring the progress of those plans, and sharing, editing, and storing of documents [ext.]. That said, as self-regulated learners, students should be given the freedom to plan how they meet, how they communicate, which tools they use, how they plan their work [UM]. Students have their own preference as to which social media platforms and which co-creation platforms to use. For example, UM students and students from other institutions (according to their educators) preferred to find online platforms on their own, such as Google Docs, Google Drive, and Google Hangouts.
- Other institutions have used Wacom tablets, so both educators and students can **express their thoughts visually** [ext.].
- For group discussions, **forums** have been recommended because of their ability to visually build up the discussion [ext.].
- **Chat functions** can provide a feeling of social presence, as students can see if someone else is online or when someone else is typing [ext.].
- **Learning analytics** can improve quality of online interactions, by providing data on group performance [49]. This is elaborated elsewhere in this report.

Nonetheless, as stated before, technology remains a means to an end, the end being well-designed education.

# Contextual learning in blended education 💻

**"We need to make sure that we keep education aligned to the current job market, because we want to bridge the gap between study and career"** *– UM educator [UM]*. COVID-19, for example, has changed the job market drastically, and education needs to align intended learning outcomes to changes in today's society. In a recent scoping review of anatomy pedagogical approaches, the reviewers found a study reporting that medical students who had clinical exposure also had better knowledge retention, compared to students who learnt theory only, emphasizing the importance of contextual learning [50].

**"Keep this focus on the learner, because generations that will come with a skill set that is different from the skill set of our current students, and we'll just have to keep attending to how they learn, and make sure that we remain sensitive to them."** *– UM educator [UM]*.
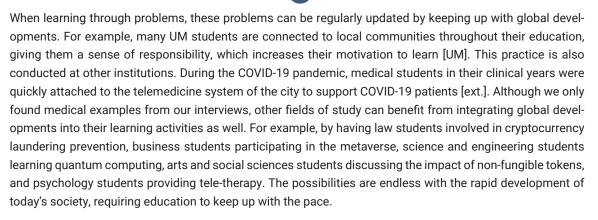
## 1. Tutorials 🔌

In tutorial group meetings, case studies have always been the go-to at UM to provide contextual learning. The content of the cases are contextually relevant to the future careers of the students. One way of ensuring that the cases are still relevant in society is to have experts give input to, or even design and evaluate the cases – these experts could be educators who are or have worked in the industry, or invited experts/alumni from the industry [UM]. At another institution, investment has been made into a subscription service that offers access to 10,000 cases. This gives teachers the option to provide students with real world cases, but requires limited time investment of the teachers to create all the learning materials [ext.]. Further practices on tutorials are elaborated in small group collaborative learning.

## 2. Real world problems 💻

One contextual practice that has been highly recommended is for students to learn through solving real world problems. Here, we cover three ways to learn through real world problems.

### 2.1 PBL tasks adapted to global developments 🔌

When learning through problems, these problems can be regularly updated by keeping up with global developments. For example, many UM students are connected to local communities throughout their education, giving them a sense of responsibility, which increases their motivation to learn [UM]. This practice is also conducted at other institutions. During the COVID-19 pandemic, medical students in their clinical years were quickly attached to the telemedicine system of the city to support COVID-19 patients [ext.]. Although we only found medical examples from our interviews, other fields of study can benefit from integrating global developments into their learning activities as well. For example, by having law students involved in cryptocurrency laundering prevention, business students participating in the metaverse, science and engineering students learning quantum computing, arts and social sciences students discussing the impact of non-fungible tokens, and psychology students providing tele-therapy. The possibilities are endless with the rapid development of today's society, requiring education to keep up with the pace.

### 2.2 Flexibility in contextual learning 🔌

One UM educator emphasized the importance of contextual learning in their course. In order to achieve the goal of contextual learning, students were involved in a project where they had to make a portfolio of a self-selected career path (e.g., researcher at a university, researcher in the industry, farmer or plant breeder, citizen, or policymaker) within 6 weeks. Then based on the selected career path, the students had to show what they have learnt through writing, making a video, podcast, or poster. For example, as a plant breeder, a student may reflect: **"I want to improve the yield of wheats. I have learnt about roots from this class, leaves from another class, and stems from a video. How do I apply my knowledge to crop improvement, to wheat improvement?"** We elaborate on flexibility in educational pathways elsewhere in this report.

## 2.3 Project-, case-, challenge-based learning 💻

In this section, we cover a type of practice where students work together with the community to solve real-world problems. Different names have been used for this practice, including "challenge-based" [ext.], "wicked problems" [ext.], and "serious games" [ext.]. Essentially, students work together in small groups of 4 to 6 students and apply their knowledge to solve problems for external clients [UM, ext.]. Students are considered professionals or colleagues by the external clients [ext.]. A diverse (interfaculty) group of students facilitates collaboration and learning beyond their own discipline and knowledge areas. [UM]. Educators explain that working on real-world problems is exciting and motivating for students, because they get to apply their theoretical knowledge. Educators may also feel empowered to make positive changes beyond the university [ext.].

Usually, the external client takes the lead on content, in collaboration with a dedicated teaching staff who mainly monitors the quality group's activities and interactions, ensuring that learning goals are achieved. It is also common to have external clients organize diverse workshops for the students [UM, ext.]. Working with external clients gives students opportunities to translate their knowledge to the job market and pick up practical experience. This also allows the external clients to scout for talent. Furthermore, it can be interesting for teaching staff to continually be connected with industry experts, to develop connections, and to continue learning, too [UM, ext.].

Within UM, solving real world problems is practiced at many faculties [UM]. At another institution, a competitive form is implemented, where groups of students compete against each other [ext.]. However, these practices were not encouraged in first-year Bachelors, and especially encouraged for Masters, because a certain level of knowledge is needed before being able to participate efficiently in solving real-world problems.

Solving real world problems are core to UM's Honors program. UM's Honors program has always been a platform for educational innovations, with the end goal of having good practices implemented into regular educational activities [UM]. This idea of rolling out good educational practices from the Honors program is also practiced at other institutions. The next step, according to one external interviewee, is **"how can we further develop these interesting forms of challenge-based education which I really think is education for the future"** [ext.].

### 2.3.1 Requirements

There are some prerequisites for successfully implementing real-world problems:

- Students need to be given just the right amount of support so they can self-direct their learning. For example,
  - by giving structure to the students' learning. This can be done via weekly planning, possibly with the use of interactive modules on Canvas. Important milestones include making time for activating prior knowledge and brainstorming in the first week(s), frequently identifying individual learning goals, then having moments of reflection on learning that have occurred. Some institutions require students to hand in assignments and receive feedback as the educator/coach/mentor monitors their progress [ext.].
  - by giving students contact information of experts they should contact should they have questions [ext.].
  - Coaches function to guide students in their personal and professional development [UM, ext.].
  - Mentors and tutors monitor the students' learning progress and ensure a safe learning experience for students. For supporting students in their project development, mentors and tutors can hold open office hours [UM]. Furthermore, students at another institution have given feedback that they need the mentor to clarify expectations with the external client from the beginning, that the external clients need to provide feedback at fixed and regular intervals (e.g., once a week/month) [ext.].

- Students have to be matched with the clients. This can be arranged by either the university or the students themselves. Platforms that have been used by other institutions to match the university with external clients include https://masterchallenge.me and https://practera.com/virtual-internships/ [ext.]. Input for real-world problems can be derived from the Dutch National Research Agenda or UN's Sustainable Development Goals [ext.]

- Final assessment – the final assessment depends on the type of project and client. However, it has been suggested to give students the freedom to express their findings in their preferred format e.g. PowerPoint presentation, poster, podcast, video, poetry, writing a story, composing music, paint, give a performance, or make a quiz [UM]. All student final products can be displayed and presented at a dedicated technology-enhanced symposium. Online symposium environment provides further opportunities for exchanges and connections, such as chat functions and forums. "Remo" has been suggested to us as a well-functioning online symposium environment [UM].
- Video conferencing software can assist students to meet with industry experts easily and more frequently [UM].
- Ensure that the number of targeted ECTS is achieved without exceeding it [ext.].

## 3.   Multicourse Problems

One good educational practice is to have small groups of students (e.g., 4-person team) learn through solving problems that reflect the real world. Just like the real world, problems are not compartmentalized into course topics. Hence, when the student needs to solve the problem, they will require knowledge from different topic areas. For example, when learning thermodynamics, students can construct a solar stove, where physics, mathematics, and computer science are involved. Another example is to organize a music festival, where administrative law, private law, and taxes are involved.

A multicourse problem is structured so that the students receive structured classes two hours per week, while working on the case for four hours per week, across a semester (not period). The assignment is graded on three course topics, by three different colleagues who are experts in their respective fields, at multiple time points. These grades will then contribute to the final grade of the students' respective courses. This practice of multicourse problems has already been conducted in parts of UM and other institutions [UM, ext.].

## 4.   Skills/practicals/workshops

Practical skills are best learnt in practice and not in a tutorial classroom, according to an external PBL expert. In this case, direct instruction and experience is a better way of learning, compared to learning through theory or discussion [ext.]. At UM, students have also expressed enjoying practicals **"because you're actually actively doing something with what you need to learn, instead of only reading it, you're applying what you need to learn"**.

With training in practical skills, it may be easy to forget the theoretical underpinnings of the skills. One UM educator advised to guide students in being aware of why certain skills are conducted in a certain manner, among the many other possible manners of carrying out the skill [UM].

### 4.1 Instructional model for computing skills: design-based learning (DBL)

From our rapid review, one study compared different methods of online instruction on learning computing skills [51]. Design-based learning (DBL) was found to be beneficial for learning computing skills (specifically Power-Point), compared to competence-based learning (CBL) or traditional instruction. DBL, students are encouraged to learn just-in-time while trying to solve real-world problems. Students were required to (re)define problems, plan action, implement actions, evaluate, and specify findings. In contrast, CBL focuses on skills, abilities, knowledge, and psychological factors. In CBL, students were required to focus on analysis and judgment, communication, taking initiative, learning continuously, and teamwork. Although CBL appears attractive as an instructional model, only DBL was found to be beneficial for learning PowerPoint skills. Both DBL and CBL did not contribute to better self-directed learning online. Overall, when students learn in a manner that is contextual, while receiving information just-in-time, this appears to be beneficial for learning computing skills (i.e., PowerPoint) [51].

### 4.2 Learning skills collaboratively

Skills can also be learnt collaboratively. For example, groups can function independently by having students take turns to lead the team in developing a particular skill and reporting the group process and results to the educator [ext.].

Students from different courses can come together to facilitate the learning of different skills as well. At another institution, two bachelor courses, which were traditionally taught in different languages (Dutch and English) were brought together so the students could learn about intra-cultural awareness and inclusion through forming international treaty negotiations. Then, students from a master course, whose intended learning outcomes were about negotiation mediation, were brought forward to help the students from the two bachelors courses negotiate. This practice highlights the possibility of students learning from each other in a very contextual and applicable manner [ext.].
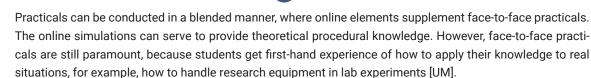
More information on collaborative learning can be found elsewhere in this report.

## 4.3 Simulations 🖥

Simulations can be an active form of learning and assessment. For example, debates or role-playing, where students assume the position of their future careers and work out real-world cases. This has been standard practice at many UM faculties [UM]. At some parts of UM, education is alternated between theory and practical within a week, so the students practice the theory that they learn [UM].

One study that improved learning used many practices, including story-telling animations based on contextually relevant cases. The purpose of these animations were to ease understanding and increase interest of students. The story would revolve around contextually-relevant characters who faced certain problems and required specific solutions. Multiple characters may be used where necessary, such as to present different viewpoints. These characters can also be brought back in formative assessments, to integrate the learning and assessment [52].

### 4.3.1 Online possibilities as a supplement 🖥

Practicals can be conducted in a blended manner, where online elements supplement face-to-face practicals. The online simulations can serve to provide theoretical procedural knowledge. However, face-to-face practicals are still paramount, because students get first-hand experience of how to apply their knowledge to real situations, for example, how to handle research equipment in lab experiments [UM].

Simulations can also be assisted by digital technology. For example, interactive, self-paced modules on Canvas can act as a *supplement* to skills, practicals, and workshops – a practice that is familiar at UM [UM]. Students have also expressed liking the theory sessions that are carried out before the actual practical session [UM].

**Literature: Online simulations can be better than theoretical learning for skills**

Empirical research found online simulations to enhance the learning of skills, compared to learning about these skills theoretically. However, it is important to note that most of the studies were based on medical school students, with only one exception from business school students [53]. Hence, further research is needed to check if the findings are generalizable to the entire student population. Also, it is important to note that these studies did not compare physical simulations against the online simulations. Here, we summarize the findings from the studies:

- In a meta-analysis, **technology-enhanced simulations were useful for learning knowledge, skills, and behaviors (e.g., behavior with patients) when compared to no simulations at all** [54]. However, the types of instructional design across the studies in the meta-analysis remains diverse, with no particular simulation design being proposed as the magic bullet. It is important to highlight that this meta-analysis did not compare physical simulations vs. technology-enhanced simulations. It merely highlights the possibilities that technology-enhanced simulations may bring.
- **Online simulations led to better learning outcomes, compared to theoretical instructional models.** One study found that online patient simulation training improved the students' learning, compared to those who received teaching as usual (i.e., integration-based, systems-based, or problem-based learning) [29]. These online patient simulation training was co-designed with real patients, with actors acting as patient and physician [29].

- **Online simulations encourage engagement with learning materials, compared to textual information.** One study found that students were more likely to interact with the learning materials if they were participating in a case via simulations, compared to students who received theoretical information about the case [53]. Hence, online simulations, compared with traditional, theoretical instruction, appear to be beneficial for learning skills.

- **Online simulations prepare students for their clinical rotations.** One study also found that knowledge retention can be improved by providing students with an online virtual simulator prior to their clinical rotations (compared to those who attended their clinical rotations without receiving the online simulation). In these online simulators, students work through modules, where they apply their knowledge and receive immediate feedback. This interactive, experiential learning experience follows the flipped classroom model [9].

- **Blended education is more effective than just face-to-face instruction, in relation to skills education.** One study compared blended anatomy education against traditional face-to-face methods [55]. Students in the former achieved better academic performance. The participating students explain that the online lectures allowed them to self-pace their learning and to spend more time self-studying. In this study [55], the following educational activities took place:
  - Lectures were delivered both synchronously and asynchronously through the learning management system. Students and educators could interact through the chat function in synchronous classes. For the asynchronous classes, a discussion forum was provided for questions and answers. Lecture materials were provided prior to each class.
  - Students were required to study knowledge clips on dissection sequences and methods, then submit assignments illustrating the location and shape of 3D anatomical structures. Anatomy dissection videos were provided on e-Anatomy® (Panmun Education, Seoul, Korea) and assignments were submitted to Complete Anatomy® (Elsevier, Amsterdam, Netherlands).

- **Attitude development not improved through e-learning modules.** One study found that e-learning modules did not contribute to better nor worse interprofessional (nursing and medicine) collaboration attitudes between students who already collaborate together in patient simulations [56]. Therefore, simulation exercises remain important and irreplaceable by e-modules. The authors suggest that e-modules could be used as a scaffolding activity to prepare for more advanced simulation exercises.

- **Self-paced modules are more effective than traditional lectures for skills learning** [57]. This study compared three conditions: dental students who learnt via an online program, those who learnt via an online plus simulated patient program, and those who learnt via lectures. Students who had the online program had superior learning performance compared to those who attended lectures, although the simulated patient program did not improve or worsen the effects for the online program. This suggests that the online program, which consists of video sequences of a phantom patient plus lecture notes, is superior to just attending lectures [57].

- Procedural skills were improved when learning was supplemented with self-paced modules. The following training format was used on the learning management system [58]:

|  | **Instructional stages** | **Components of online training** |
|---|---|---|
| **Introduction** | Pre-test<br>Make commitment | Video demonstrations of successful and unsuccessful examples |
| **Skills training content** | • Description of skills<br>• Demonstration of skills<br>• Verbal practice of steps in the skill | • Text/audio description<br>• Video model of skills<br>• Point-form open ended questions to recall steps |
| **Practice activities** | • Controlled practice and feedback<br>• Advanced practice and feedback | • Recognition exercise: Video scenario with questions to assess recognition of skills<br>• Application exercise: Video scenario with pauses and prompts to demonstrate skills. Use checklist for steps. |
| **Conclusion** | Post-test and commitments<br>Generalization | Final application exercise: Video scenario with pauses and prompts to demonstrate skills. Use checklist for steps. |

**In practice**

At UM, online simulations are a common and recommended practice. Online simulations may help demonstrate skills (e.g., lab work) to students. For example, when using a microscope in histology, online practical cases allow for students to zoom into the cell. Educators can provide manuals and questions such as **"Go to X section, identify Y structure, make a screenshot of it, and annotate it"**. This can be brought to the plenary session with their peers. Students can then take turns to present each case, shared on a larger screen, and discussed with the entire group.

When students are learning a skill independently (e.g., of a laboratory skill or communication skill), they may film themselves to receive feedback, either from a teacher or from their peers. This can also be done via a program called TrainTool. This manner of feedback works because students are confronted with their own mastery of skills, allowing them to learn their strengths, their weaknesses, and how to improve their skills.

Educators need not reinvent the wheel when it comes to finding online modules. At some parts of UM, there has already been investment into online course modules that students can take. For example,

- Topic Oriented Open Learning (TOOL) platform for Anatomy (Leiden-Maastricht partnership)
- Data Camp to learn data skills such as working with Python and R, machine learning, etc.

However, these online simulations cannot substitute the experience of actually carrying out the skills first-hand [UM]. For example, a UM educator noticed that although students watched videos on handling pipettes, they did not actually know how to handle pipettes in the lab. For soft skills, some UM educators prefer the training to be conducted face-to-face, because non-verbal communication is more prevalent face-to-face [UM]. Therefore, physical, face-to-face simulations remain a preference at UM.

### 4.3.2 Online simulations - Virtual reality 🖥️

Online simulations, such as virtual reality (VR), can act as a supplement to live simulations. In a study where students learnt through role-playing, live simulation was found to be a better format of learning than VR-supported, participatory simulation [59]. Despite the feasibility and further opportunities that VR presents, interviewed students explained that VR poses certain challenges:

- Having less accountability therefore unequal contribution in the collaborative role-playing,
- VR requires more one-to-one interactions, taking more time to commit to the simulation, and
- Considering the current exposure of the general public to VR, the novelty and learning curve of VR is more demanding, thus VR requires tailored training [59].
- Having many VR meetings in one day can be tiring [UM].

Nonetheless, VR can be useful, especially in situations that are rare, dangerous, and/or when social distancing is required. When theoretical concepts are complex or intangible, VR may assist students in grasping these concepts. Students can also receive instantaneous feedback by making choices in VR, which also allows them to deliberately explore consequences of mistakes in a safe manner [UM].

VR has been introduced at some parts of UM prior to COVID-19, which have been received positively by UM educators [UM]. VR is used to "travel through a cell", visualizing cell processes. Furthermore, experiments can be conducted with international partners [UM]. With the use of wearing the visors, a more immersive tutorial can be created where people feel more cohesiveness and working on the same problem. Other institutions use VR for prototyping industrial designs [ext.].

### 4.3.3 Game-based learning

Game-based learning or gamification has been making its way into education because of how motivating and engaging it appears to be. Some studies used points to gamify education and found improvement in student learning. For example, researchers in one study designed a "game narrative" on their learning management system and used game elements such as quests, levels, leadership boards, and badges [60]. There were two types of educational activities:

- **"Essential learning" (EL)** – compulsory activities. ELs used flipped classroom, where e-modules consisted of short texts, quizzes, and knowledge clips.
- **"Super learning" (SL)** – optional activities. SLs had three levels of difficulty, based on Bloom's taxonomy [14]. The purpose of SLs was to challenge students, while giving them the flexibility and autonomy to learn. Gamified elements such as points, badges, and leadership boards were used to encourage students to accomplish more SLs.

These activities align with the self-determination theory as well, where SLs tap into students' need for *autonomy*, rewards were given for achieving certain *competencies*, and there were co-creation tasks for a sense of *relatedness*, where students have to collaborate on Wikis and forums. Students who underwent the gamified condition had better academic achievement. It is also possible for gamification to improve engagement, in terms of average view count and views per educational activity.

In another example, gamified exercises were provided for students after lectures. Regular software-based exercises were given, which provided immediate feedback to students. When answered correctly, the students obtain points, scored based on the complexity of the problem solved. The point system is argued to stimulate a sense of achievement, and allows students to see where they stand in comparison to their peers. Compared to students who completed exercises with pencil and paper, this gamification of exercises led to improvements on the exercise performance [61].

However, one study did not find game-based learning to have an effect on student learning, when they had students solve problems in engineering. User-centered game design ensured that the game was not too simple, but not too complicated. The game started with an explanation on the tasks and content of the game, then explanations on the intended learning outcomes. The game consists of mathematical problems, where the students had to calculate and click on the correct solution to the problem. There are 6 levels of difficulty of problems with different time provided to solve the problem. The results are registered if they reach a high enough score. Results are shared via "the best of the month" and "current high score". The authors concluded that despite not having an effect on learning, the students enjoyed this method of learning, with the use of "high scores" encouraging students to play the games repeatedly [62].

In practice, some UM programs organize mid-term and final presentations, where student groups present their project and the best team in various categories are awarded [UM]. Organizing events such as this was recommended as one way to motivate students. Another way to gamify education is to organize a "2 voor 12" game in the classroom, where the students are asked a question. If they do not immediately know the answer, they are able to search for it using online resources (e.g., Google), imitating the real world [ext.].

Although gamification has been on the rise, more research is required before games that simulate real-life situations are integrated into education, at least in the surgical field. In a systematic review of serious games (i.e., digital games to simulate a contextually-relevant learning environment for learning), it was concluded that none of the serious games have completed a full validation process to truly represent the surgical field [63]. Future serious games have to be checked for content validity, face validity, construct validity, concurrent validity, and predictive validity. Furthermore, despite gamification introducing motivating and engaging elements, we should be careful that the competition it may induce does not go against the PBL principle of collaborative learning.

# Self-directed learning in collaborative learning 💻

**"The future of work will really call for very flexible, adaptive professionals who can change the course of their lives"**, explains a UM educator [UM]. Therefore, self-directed learning is an important skill to equip students with. Furthermore, it makes learning more fun when students can acquire knowledge themselves, then discuss the content with their peers and educator [UM].

Self-directed learning, as part of CCCS, is part of the larger self-regulated learning process. Self-regulated learning refers to the individual student's intentional metacognitive planning, task performance, reflection, and further adaptation [64]; whereas self-directed learning is where students take up an active role in planning, monitoring, and evaluating their learning [2]. For the purpose of this report, we will focus on the term self-directed learning as it is used within the CCCS principles and interpreted from the qualitative aspect of this research.

Conventionally in a PBL 7-step format, after discussing the problem and formulating learning objectives (pre-discussion), the students set out to obtain necessary information to solve the problem. An external PBL expert emphasizes that it is the "how" that is important in self-directed learning, specifically, how the students seek out information [ext.]. PBL should also assess the students' self-directed learning, whether the students know how to find the right information, where to find the right information, and whether they are able to evaluate the information [ext.]. A UM educator explains that by spending a fraction of time helping students to train their meta-cognitive skills (i.e., to be aware of what they know, what they do not know, and how they learn), the students can develop better study methods, which then aids them in learning other future content [UM]. As a disclaimer, how to best train students meta-cognitive skills was not part of the present project.

## 1.  How to ask questions? 🔌

In this section, we provide some frameworks for guiding students to ask analytical questions. Framing the way that questions are asked is important to assist in the students' in-depth learning.

- **Asking questions at the knowledge level, comprehension level, and application level.**

  **Knowledge level question:** What is a non-fungible token?

  **Comprehension level:** How are non-fungible tokens different from blockchain cryptocurrencies?

  **Application level:** How do we create a non-fungible token for commercial use?

  One study found that a mixture of student-generated questions and forum discussions led to better engagement (compared to the sole use of forum discussions) on the learning management system in an online course [42]. The students were given guidance to generate their questions, following Bloom's Taxonomy [14] and the effective approaches for writing multiple choice question (MCQ) items. Specifically, the students were requested to generate MCQ at the knowledge level, comprehension level, and application level, and participate in a forum discussion. Compared to those who solely participated in forum discussions, those who generated their own questions were more engaged in their learning – visiting the learning management system more frequently, creating more threads of discussion, and replying to posts more frequently [42].

- **PICO: population/problem (P), intervention (I), comparison (C), outcome (O)**

  For example, in students (P), how does sleep deprivation (I) affect work productivity (O), compared to when students get sufficient sleep (C)?

  One study that improved learning in students utilized many practices, including helping students to phrase their questions that are directed to both educators and peers. The question structure followed the PICO framework, i.e., problem, intervention, comparison, outcome [52].

- Other institutions have taught students to use a **hypotheses-generation method** when facing a new problem.

  For example, when faced with the problem regarding the stomach, the students hypothesize that it is the physiology or structure of the stomach that is causing the problem, then they figure out whether their hypothesis is supported by evidence [ext.]. **"Students understand that self-study is a step that they need to do to verify their hypotheses, that there are no questions that came as a list from the book, but it came from their hypotheses. They say: 'Well, we think that this problem is this or that, and the mechanism is this or that, or the causes are this or that.' So when we say that, the question is a way of phrasing a hypothesis to be checked. It's just not a list of for study. If the tutor focuses on hypothesis generation, there are better questions to be solved,"** – *Dr. Marcelo Garcia Dieguez, Universidad Nacional del Sur [ext.].*

  As students learn more, gain more experience, and progress through their learning, the questions that they ask and the questions that they can answer will become more in-depth [UM].

## 2. Study resources 💻

### *2.1 Structuring self-directed learning* 💻

Structure can assist with student learning, well-being, and reducing teaching workload [UM, ext.]. Providing structure has been incorporated as part of a larger motivational strategy in literature, which led to better student motivation and academic performance [21]. Students expressed that having routine in the course and having something to work towards (e.g., an exam) help students to engage with their course. Another UM educator observed that in student evaluations, when a course is rated badly, there are comments about the lack of structure; while when a course receives good evaluations, there are positive comments about the structure [UM]. Furthermore, a UM educator explained that it is important to be transparent with the structure of the course, to allow both students and educators to plan their schedule accordingly.

### 2.1.1 PBL cases / problems / tasks 🔌

At UM, students are supported in their self-directed learning with learning tasks that vary in terms of difficulty and complexity [UM]. The level of support given to students in their literature search varies as well [UM].

### 2.2.2 Course book 🔌

For each course at UM, students are provided with a course book where pre-specified learning outcomes are listed. Study-check questions given within the course book allows students to check if they have sufficient understanding of the different concepts. Having the course book therefore guides students in their self-directed learning [UM].

### 2.2.3 Self-paced, interactive modules on Canvas 💻

Canvas can provide many opportunities to guide students in their self-directed learning. Due to the large amount of information available on this topic, we cover self-paced, interactive modules in another section.

### 2.2.4 List of resources 🔌

At other PBL institutions, the educators make an effort to ensure that students are searching up information from reliable resources. For example:

- At one institution, the students make a list of the resources that they use and upload it onto their learning management system. Then, the educator checks it to ensure that students are accessing the right materials [ext.].
- Another institution provides the resource list to students, encouraging them to go through lecture notes and all other curriculum content that aligns for that week's learning objectives [ext.]. Such a full resource

list may be given to students who require higher levels of support in searching for information, for example, first year students.

## 2.2 Accessible resources

Students need access to the information and learning resources [ext.]. UM students have also commented that often they were not able to access papers that they needed [UM]. Therefore, study resources, including journals, books, e-books, libraries, videos, and cases should be made freely available, at least to UM students. Furthermore, UM students have also requested online access to the library's material.

## 2.3 Knowledge clips and lectures

### 2.3.1 Knowledge clips are better than long lectures

**"Knowledge clips are quick and easy and very visual"** *[UM]*.

Knowledge clips, or microlectures, are short videos that deliver content. Knowledge clips have been recommended to last 10 to 15 minutes (or 25-30 minutes for complex topics [ext.], [65]) according to educators within and external to UM, and 1 to 7 minutes according to literature [66]. The benefits of knowledge clips are that they are readily available and unscheduled, being a very attractive online learning method. Unsurprisingly, knowledge clips have been highly favorable by the UM community, and have even been suggested to replace all moments where the teacher just sends information to the students [UM].

The popularity of knowledge clips is not unfounded, as research have found knowledge clips to be more beneficial than traditional lectures for learning. One study found that compared to traditional (approximately 100-minute) long lectures, having multiple microlectures or knowledge clips (2 to 7 minutes long) led to improved learning [66]. Shorter lectures encourage students to ask questions, leading to naturally longer discussions. Other studies that used knowledge clips (as part of a larger redesign of education) have also found improvements in student learning [67].

### Purpose of knowledge clips

- Knowledge clips serve as a type of study resource, giving students more options than just written text [UM, ext.].
- Knowledge clips can be used to indicate topics that will be discussed in tutorial sessions, hence activating prior knowledge in students and stimulating more in-depth discussions [UM, ext.].
- Knowledge clips, as opposed to lectures, can be used to give extra attention to topics that students tend to struggle with [6], [UM, ext.].

### 2.3.2 Lectures

The purpose of lectures is to transfer knowledge from teacher to student [UM]. A lecture can help create an overview of the content that students may struggle to grasp [UM]. For example, how certain knowledge is acquired, which kind of experiments are needed to arrive at a conclusion and how processes are developed [UM].

As previously mentioned, knowledge clips are more effective than long lectures for student learning [66]. At UM, many courses have turned their lectures into knowledge clips, and replaced the allocated timeslot of lectures for weekly Q&A sessions with the content expert [UM]. Nonetheless, Some UM educators believe that on-site lectures are valuable [UM]. In the next sections, we cover the arguments for on-site lectures vs online lectures, and why lectures should be recorded. Then, we provide a final recommendation of how lectures should be conducted and tips on how to carry out lectures.

**Benefits of on-site lectures** 🔌

*Adaptive teaching*

On-site lectures allow lecturers to evaluate the audience, getting immediate feedback about how the audience is receiving the lecture, allowing the lecturer to adapt accordingly. For example, when the lecturer detects that attention levels have dropped, then the lecturer could react by having more interactions or sharing findings that are more interesting. When the lecturer detects that certain topics are not fully understood, then the lecturer can repeat, explain the topic in a different manner, or give different examples [UM].

On-site lectures are preferred by some UM educators, because the alternative of online lectures reduces the feedback that they get from the audience, which makes it uncomfortable and decreases the confidence of the lecturer [UM].

*Social function*

On-site lectures have a social function whereby students can easily connect with the teacher and their peers [UM].

*Possible better grades?*

A UM educator observed that students who attend on-site lectures achieved better grades than students who watch recorded lectures [UM]. The reason behind this is still unclear - it could be that high achieving students prefer on-site lectures, there could have been proximity bias, or maybe, attending lectures on-site does lead to better grades. Based on the limited evidence, this topic needs further study.

**Benefits of online, live-streamed lectures** 💻

*Accessibility*

The argument for online, live-streamed lectures stem from its accessibility, allowing students and the lecturer to attend from various geographical locations [UM]. Furthermore, traditional on-site lectures tend to have low attendance, whereas online, live-streamed lectures tend to attract larger crowds [UM].

At another university, "national classrooms" are organized, where multiple interdisciplinary professors would gather online for an online audience of 300 interdisciplinary students. The goal of this classroom is for third year students to see what else is out there and to evaluate their study track through experiencing other study fields [ext.].

*Questions*

Online, live-streamed lectures allow for students to ask questions verbally and through the chat function, reported both by UM educators [UM] and in literature [28]. Some have argued that it is difficult to receive verbal questions from the online audience, due to the mute function. Yet, the experience is that more questions have been received online, compared to on-site [UM]. One reason is that the chat function online lowers the barriers for asking questions. The possibility of asking questions then increases student engagement [UM]. We elaborate on how increased interactivity enhances learning in another section.

**Benefits of recorded lectures** 💻

There are many ways to record lectures, for example, by literally recording an on-site lecture, recording a video-conferenced lecture, recording a voiceover of PowerPoint slides, inked videos (e.g., Khan Academy), and videos that use green screens. In EDvance project, we did not find a preference or any evidence that one type of recorded lecture is better than the rest.

## i) Self-paced learning

Recorded lectures and knowledge clips are highly recommended because students are able to re-watch the lectures at their own pace [UM, ext.], which students have also expressed appreciation for [UM]. Students should be given freedom to self-regulate their learning, as education is not one-size-fits-all.

One study compared blended anatomy education against traditional face-to-face methods and found that blended education led to better academic performance [55]. The participating students explain that the online lectures allowed them to self-pace their learning and to spend more time self-studying. The online class made it possible for students to tailor their learning, save more time for self-studying, easily access the course materials, and repeatedly study at their own pace. Students responded that studying in their own desired learning environment helped them enhance their concentration in the study. In this study, the following educational activities took place:

- Lectures were delivered both synchronously and asynchronously through the learning management system. Students and educators could interact through the chat function in synchronous classes. For the asynchronous classes, a discussion forum was provided for questions and answers. Lecture materials were provided prior to each class.
- Students were required to study knowledge clips on dissection sequences and methods, then submit assignments illustrating the location and shape of 3D anatomical structures. Anatomy dissection videos were provided on e-Anatomy® (Panmun Education, Seoul, Korea) and assignments were submitted to Complete Anatomy® (Elsevier, Amsterdam, Netherlands).

At UM, some educators expect that improvements in their course evaluations may be partially due to students enjoying the course's recorded lectures [UM]. Students explain that recorded lectures were **"helpful because we could skip to parts we did not understand"** [UM].

## ii) Allocating more time for teacher-student interactions

At UM, some courses provide recorded lectures online (in the form of knowledge clips), and replaced the allocated timeslot of lectures for weekly Q&A sessions with the content expert [UM]. Therefore, more time is available for real interaction with the students, where the magic of education happens [UM].

## iii) Saving time

Pre-recorded lectures save teachers time, because lectures on basic concepts can be recorded once and used for multiple years. Only lectures with changing content have to be created and recorded each year [UM].

## iv) Learning analytics

It is possible to be informed of how frequent knowledge clips are viewed or downloaded on Canvas, so educators know which topics the students struggle with the most (i.e., usually the ones that are watched and downloaded most often) [UM]. We elaborate on learning analytics elsewhere in this report.

## v) Risks

- There is a concern for potential behavioral changes when students know that the lectures are recorded (e.g., not asking questions because they feel they may "get it" eventually by re-watching the lectures) [ext.].
- Some argue that recorded live lectures can result in lower attendance, since students know that the lecture can be re-watched afterwards [UM]. Yet, students should not attend classes just because there are attendance requirements, they should attend classes because they are motivated to learn, because the educators give great education [UM].
- One UM educator felt concerned that students may not be comfortable with the lectures being recorded [UM].

To summarize, whereas some risks of recorded lectures were reported, we recognize that these are based on anecdotic evidence and should be addressed in future studies.

## Hybrid lectures: best of both worlds? 💻

After considering the arguments given, hybrid lectures may reap the most benefits, combining on-site lectures that are live-streamed, supplemented with an online, live chat function [ext.]. The entire lecture can be recorded but delivered online in bite-sized knowledge clips.

Benefits:

- On-site ensures human-to-human transfer of knowledge and social exchanges
- Chat function encourages questions, to which the lecturer may choose to answer on the spot or at the end of the lecture.

Still, there are risks:

- That students rely on eventually "getting it" from watching the recorded lectures, preventing them from asking questions upfront
- Live-streaming and recording increases accessibility of lectures.
- A moderator is needed to manage the live streaming and chat function. Students may be appointed to assist with this.
- Investment in terms of time, money, people, software and hardware

### *2.4 Practical tips*

### Tips on how to make a knowledge clip 💻

- Content
  - Set aside time to create a knowledge clip. First, plan the structure and build it up [UM].
  - Knowledge clips need to be small elements of information [UM], only emphasizing critical concepts, information, and illustrations [6]. Knowledge clips should be to-the-point, adjusted to the format of a small video, and not just a fragment of a regular lecture [UM].
  - Knowledge clips can be made interactive, where questions are added or links to other videos are provided [26, 27][ext.].
  - Provide worked examples with hints. One study found that worked examples with hints lead to better learning of communication skills, compared to text-based examples and video-based examples, because attention is guided to these important learning points [68].
  - Do not overlap content of the knowledge clips with lectures [UM].

- Location
  - Knowledge clips can be placed on Canvas according to the topic of the week. Do not present all knowledge clips of one course in one folder [UM].

- Schedule
  - Educators can incorporate knowledge clips at the beginning of the week, organize interactive classes throughout the week, and end the week with a Q&A wrap-up session [UM]. **"So the teacher makes a knowledge clip and then students watch it at their convenience, but they still have to come to the campus to discuss that. And I think that combines the best of both worlds that students have the flexibility and in-class time is made better use of."** [ext.].

- Production
  - UM students have also been using online channels such as YouTube to learn. There are plenty of open educational materials available, so there may not be a need to "reinvent the wheel" by producing their own knowledge clips [UM, ext.]. Educators can easily search for knowledge clips (e.g., YouTube) to share with the students.
  - Various tools have been used for recording and editing videos:
    - Camtasia, a software for recording and editing of videos [UM].
    - Zoom, a video-conferencing software that can record videos [UM].
    - OBS (Open Broadcaster Software), a free and open source software for video recording and live streaming [UM].
    - Mediasite Recorder, a UM-preferred program to record and edit videos. Videos are automatically uploaded onto the server, and can be integrated in Canvas [UM].
    - Explain Everything, an online whiteboard and video making tool, but a license is necessary [ext.].
    - Lightboard, a physical, lighted, glass chalkboard for recording video lectures [ext.].
  - Use virtual blackboards, with real-time writing appearing on the screen as the presenter narrates the content. The presenter does not need to be on screen, allowing complete focus on the text and drawings. Popular examples include Osmosis and Khan Academy. Inked videos can be produced by using an Apple iPad and Apple pencil, plus Microsoft OneNote and the iPad's built-in screen capture feature. The audio can be recorded with an external microphone. Apple iMovie can be used to edit the videos, such as cropping, changing the speed, and overlaying the voiceover [69]. Other institutions have used Wacom tablets, so both educators and students can express their thoughts visually.
  - Label subjects in the video [65].
  - Allow students to go back-and-forth in the video [65], [69]. Students should be able to watch specific sections simply by searching up keywords in the subtitles.
  - Narrate each step of the skill [65], [69].
    - The voices used in narrating videos can make a difference. One interesting study found that bringing in a celebrity (i.e., Seth Rogan) to voiceover lectures, whether interactive or not, can lead to better quiz scores, compared to lectures held by a medical doctor or a non-celebrity-non-doctor [70].
  - Use subtitles [65] with transcriptions produced.
    - Subtitles can be generated using Web Video Text Tracks (WebVTT) and the open-source software Subtitle Edit [65].
    - Considering the Netherlands's increasing push for accessibility, knowledge clips should be created with high quality narration, subtitles, and transcriptions [ext.].
  - At another university, dedicated teams are set up to produce knowledge clips, consisting of professional graphic designer and teachers. Educators submit a script that contains the content, then the team creates the graphics, text, and narration with subtitles and transcriptions produced with artificial intelligence [ext.].
  - Skills can be demonstrated via various perspectives [52], [65] but changing perspectives have not been found to affect learning [71]. One study compared first- and third-person perspectives and did not find any differences in time taken to achieve mastery between students who learnt laparoscopy from a first-person's perspective (combining endoscopic view and view of hands/instruments/forearm motion) or only via endoscopic view [71].

**Some tips on how to conduct lectures in general 🔌 (not intending to be complete)**

- Duration
  - Lectures should be shorter than 120 minutes according to educators [UM], and shorter than 100 minutes according to literature [66]. Either way, students have requested for lectures to be split up into shorter parts [UM].

- Content
  - Lectures should not be a presentation of facts that students can get from articles or books [UM].
  - Lectures may include knowledge clips for more variety [UM].
  - Do not overlap content with knowledge clips that are provided [UM].
- Format: **Interactive lectures** were proposed at many external institutions, as it incorporates more active learning than a one-sided lecture [ext.]. Interaction can happen in two ways:
  - **Teacher-student interaction** [UM]. Interactivity can occur when the lecturer poses questions to the students or when the students asks questions on their own initiative. Interactivity is essential in lectures because it is a form of formative feedback. Regular feedback that comes from the teacher-student interactivity has been found to improve student learning [44, 47]. Lecturers can also incorporate digital possibilities, such as Kahoot, WooClap, Mentimeter, and so on, which students have received positively. We elaborate more on interactivity elsewhere in this report..
  - **Student-student interaction**. At another university, lecturers ask prompting questions, which the students answer individually (e.g., in a poll), discuss it in a group, and then re-answer the questions, before receiving the correct answer and feedback from the lecturer [ext.].
- Schedule
  - The scheduling of lectures plays a role in having a good course structure. In a collaborative learning design-based research [46], many practices were used. Specifically, the researchers found that course structure could be improved by switching between assignments (individual and group) and teaching (video lectures and peer-group tutoring), in order to encourage student participation and negotiation in their collaboration. The course structure of intermittent assignments and teaching allowed students to distribute their time more evenly [46].

**Tips on how to conduct online lectures** 💻

Other than the general recommendations on how to conduct lectures, here we provide recommendations specific to online lectures:

- Format: Interactive
  - Break up topics into 15-20 minute sessions [UM, ext.].
  - Give students interactive exercises or cases to discuss and complete in breakout rooms [4][UM, ext.].
  - The host (or co-host) can still share screens into each breakout room [UM].
- Managing online lectures
  - A moderator (possibly a staff or student) should be appointed to manage the live-stream and chat function [UM, ext.].
- Schedule
  - Educators have suggested having at least a start with on-site educational activities, before moving online [ext.].
  - Online lectures should be kept to a limit, but can work for small courses, because online lectures only allows lecturers to capture limited feedback from the audience [UM].
- Software
  - Possible video conferencing programs include Zoom, Microsoft Teams, and Blackboard Collaborate Ultra [UM].

**What to consider when recording lectures** 💻

- Education decisions
  - The allocated time and space for lectures should be used for teacher-student interactions [UM]. The decision to record lectures should not discourage students to come to campus [ext.].

- Do not practice leaving questions to emails or for Canvas. Questions should be asked synchronously, whether verbally or via chat functions [UM].

- Production
  - Mediasite Recorder is a UM-preferred program to record and edit videos. Videos are automatically uploaded onto the server, and can be integrated in Canvas [UM].
  - Various other tools have also been used for recording and editing videos:
    - Mediasite Recorder, a UM-preferred program to record and edit videos. Videos are automatically uploaded onto the server, and can be integrated in Canvas [UM].
    - Camtasia, a software for recording and editing of videos [UM].
    - Zoom, a video-conferencing software that can record videos [UM].
    - OBS (Open Broadcaster Software), a free and open source software for video recording and live streaming [UM].
    - Explain Everything, an online whiteboard and video making tool, but a license is necessary [ext.].
    - Lightboard, a physical, lighted, glass chalkboard for recording video lectures [ext.].
  - The voices used in narrating videos can make a difference. One interesting study found that bringing in a celebrity (i.e., Seth Rogan) to voiceover lectures, whether interactive or not, can lead to better quiz scores, compared to lectures held by a medical doctor or a non-celebrity-non-doctor [70].

- Future-proofing
  - Create high-quality, well-designed lectures that can be automated and re-used for future purposes [UM].
  - For recorded lectures that utilize the voiceover-PowerPoint format, it is advantageous to record slide by slide, because individual slides can be easily replaced with a new voiceover whenever content needs to be updated [UM].
  - Considering the Netherlands' increasing push for accessibility, knowledge clips should be created with high quality narration, subtitles, and transcriptions [ext.].

## 2.5 Static (books) vs. audiovisual media (knowledge clips)

In this section, we discuss static (i.e., non-animated text and images) media and audiovisual media. Static media includes articles, books, and other traditional forms of media in text, whereas audiovisual media include images, videos, and animations.

Computer-assisted learning has been positively received since the 1990's. A recent scoping review of anatomy pedagogical approaches found that studies from 1992 and 1996, where students already had the preference for customized, computer-assisted learning [50]. "If a theoretical 2D aspect of the course was well-learned, it could efficiently be applied on a 3D surface", the reviewers explained. Yet, mixed results was found for learning when static media (i.e., traditional, non-animated text and images) was compared against animated media:

- One study found that learning was significantly better when static media was used, compared against narrated animations, argued to be because static text and print minimizes unnecessary processing, allowing students to stay on-task [72].
- Two studies found that both types of media resulted in no differences on learning performance, but students were more engaged and satisfied when using audiovisual knowledge clips [65], [69].
- The following studies did not compare audiovisual media to static media. However, these studies successfully improved learning online after implementing a variety of practices, including the use of audiovisual media, such as:
  - ostorytelling animations of skills by characters [52]
  - narrative voice-over materials [25]
  - YouTube videos [7]

- knowledge clips (average = 34.6 minutes, ranging 21 − 55 minutes), with a total viewing time of 14.4 hours) that emphasized only critical concepts, information, and illustrations [6].

In the end, it is not a black-and-white argument of which is better, instead, educators should provide a blend of static and audiovisual media, which may assist better and more engaged learning. One study found that when the university supplemented traditional teaching with videos (vignettes of short and authentic cases), the students ended up having a significantly higher score on their exams. Of those that were given access to the library of videos, 99% made use of the videos while 84% reported that the videos helped their learning [73]. One interesting example of blending static and audiovisual media comes from an external institution - "living textbooks" are create where educators continuously update a field of knowledge in a library of wiki-pages. Through a word-cloud overview, the students can choose to click on concepts that are interesting to them [ext.].

Overall, static media remain important in education, while animated media may bring more engagement and satisfaction. Both can be used in a blended manner.

### 2.6 Other learning materials

At some parts of UM, there is investment into online course modules that students can take. For example:

- Topic Oriented Open Learning (TOOL) platform for Anatomy (Leiden-Maastricht partnership)
- Data Camp to learn data skills such as working with Python and R, machine learning and etc.
- 3D anatomy interactive models, an online resource that can be used as preparation before coming to the practical.

### 2.7 Other support

Having space to study was requested by our UM students as well: **"Promote physical locations/options more. Students are stuck in their tiny rooms and the barriers between private life and uni is fading. Their (bed) room is also an office and classroom."**

## 3. Flexibility in educational paths

When students have ownership of their education, this can be beneficial for their learning experience. One way to encourage ownership is to offer students flexibility to choose optional courses and craft their own learning goals, learning methods, and learning outcomes.

> **"We have to give people the space to be creative. I think they also learn a lot better because they do what they find interesting,"** - *Dr. Giselle Bosse, Vice Dean of Education, FASoS [UM].*

An external PBL expert cited Elliot Eisner's [74] model for instructional and expressive educational objectives, positing that both objectives are needed in education [ext.]. The instructional objectives are the intended learning outcomes of each course; whereas the expressive objectives invite students to explore subjects that are of interest to them. Both objectives are important in education, to allow students to learn what is necessary and to explore their personal interests. Furthermore, after the learning objectives/intended learning outcomes are set up, students should be given the freedom to choose the way they want to learn [ext.]. Although it is recommended to give students the freedom to choose how they learn, the amount of support given to students needs to be carefully adjusted, because different students will be ready for different levels of autonomy, sometimes dependent on their mastery of knowledge in the field.

### 3.1 Optional courses

Education is not one-size-fits-all. Although some academic content is important to ensure that students have certain knowledge upon graduation, others may be taken up voluntarily. For example, students can be given certain courses or learning tasks that are mandatory, and other courses or learning tasks that they may
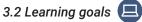
choose out of personal interest (e.g., elective courses, minors, workshops), as long as the required number of ECTS are achieved in the end [UM].

UM students have also requested optional academic-related or professional development activities. Educators have suggested having an event calendar, where students can voluntarily sign up for diverse workshops, possibly held by external organizations. These events are open to students of all years, allowing students to also learn from each other [UM, ext.]. These optional courses may be just-in-time, meaning that they are offered just when the students need them. For example, pre-departure training before the students go abroad for a year, consisting of a face-to-face meeting preceded by an online module that the student can schedule and finish at their own pace [UM].

### 3.2 Learning goals

At UM, some faculties have provided opportunities for students to set up their own learning paths, where students have mandatory courses, but also certain (elective/minor) courses that they can choose to pick up [UM]. This is a start to a larger goal, where UM educators envision individual learning paths, so eventually students can go through the program at their own pace and choose their own learning goals from different faculties. The idea is that after completing a certain number of courses, then the students will qualify for graduation [UM].

Learning skills can be flexible as well, where students choose their own learning goals and action plans for practical skills [UM]. A skills coach assesses the progress of achieving these goals on an online portfolio (eP-ass) and provides feedback and guidance to the students accordingly [UM]. Although the idea of a completely open curricula sounds like a good idea, it may not be possible for certain fields, such as law or medicine. Therefore, having flexibility in choosing learning goals regarding skills within these fields then allows for more flexibility and a certain level of autonomy.

At other institutions, "living textbooks" are created, where educators continuously update a field of knowledge in a library of wiki-pages. Through a word-cloud overview, students then choose to click on concepts that are interesting to them [ext.].

### 3.3 Learning methods

Other than choosing one's preferred learning goals, another way of personalizing learning is by giving students a choice of how they want to learn, as long as the intended learning outcomes are achieved. For example, in order to learn about a topic, a student may choose to attend a lecture (from a different university perhaps), reading an article, reading a textbook, watching a knowledge clip, or asking a teacher [UM].

### 3.4 Learning outcomes

When presenting findings of a project, UM educators have also suggested giving students freedom to express their findings in their preferred format – PowerPoint presentation, poster, podcast, video, poetry, write a story, composing music, paint, give a performance, even make a quiz [UM]. In more traditional summative exams, UM educators have also started to introduce self-chosen questions, additional to a number of fixed questions [UM]. This way, students can answer exam questions based on the learning goals that they had set from the very beginning. More information on summative assessments is available elsewhere in this report.

# Interactive learning management system – Canvas 💻

Canvas is the learning management system that UM adopted/rolled out in 2020, replacing Blackboard. Other types of learning management systems include Moodle and Edmodo.

Canvas has been positively received by UM educators, as it is intuitive and user-friendly [UM]. Yet, having a learning management system does not automatically lead to improvements in supporting students through their education. For example, in one study, students initially reported that learning through digital platforms were among the least useful. However, after their institution put thought into redesigning their platform, including new images, videos, 3D-models, and tutorials, there was a significant increase in the students perceiving the platform as being one of the most useful [27]. Therefore, education must be thoughtfully designed.

## 1. Self-paced modules 💻

Through the learning management system used at UM, Canvas, interactive e-learning modules can be incorporated for self-directed learning purposes. Studies that provide students with self-paced modules have found improvements in student learning [25], [58], [75]–[77]. These learning modules are designed based on intended learning outcomes, containing specific sets of learning activities [58], [76].

Studies that successfully improved learning with the implementation of learning management systems utilized many practices, including:

- Narrative voice-over of modules, lectures, lecture notes, illustrations, animations, and cases [25], [52], [75], [76], [78], [79] with terms displayed (e.g., subtitles) [75]
- Static images, aligning with those to be used in the exams [30], [75]
- Arrows, colored markings, and different magnifications of images emphasized important details [75]
- Wikis [78]
- Contextual content (e.g., HTML files for computer courses [79])

Although positive findings have generally been found with the use of self-paced learning management systems, there was one study that did not find a difference in learning performance when comparing students who did and who did not receive e-modules. The e-module in question was developed using Articulate Storyline, with teaching materials including theory, cases, and interactive Q&A features on the case or diagrams [80].

As per usual, there are many considerations when designing education, such as upholding the CCCS principles, designing education that is constructively aligned from the intended learning outcomes, to delivery, to assessment, and so on. Here, we re-emphasize the importance of structure when designing self-paced modules.

### 1.1 Structure

Structure can be especially important for online components of education [ext.]. Students need this extra clarity because they will need to be self-reliant online [ext.]. By having a clear structure in Canvas, students' expectations can be managed. For example, by creating a "getting started" module to inform the students of the intended learning outcomes, course structure, course highlights, mode of teaching, study load, schedule, and educational activities. This information can be visualized for easier readability too [ext.]. Having such a clear structure allows students to plan ahead and regulate their learning [ext.].

With regard to the academic content placed within the self-paced modules, a common practice is to give students access to the content 1-week prior to class [30]. However, this practice may not suit students who prefer to plan ahead and cover these materials sooner [UM]. After all, self-paced modules are meant for encouraging self-directed learning. Therefore, although the expectation is that students are given access to the modules 1-week prior to class, these modules should also be available to students who had completed previous modules and who wish to continue completing more modules [UM].
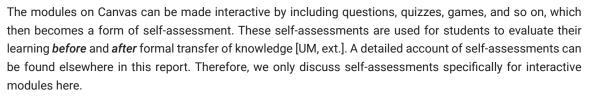
Just-in-time teaching (JIT) has also been a recommended practice. One study utilized JIT in combination with an online learning management system, finding improved learning performance in students. In this study, 24-hours before class, academic materials were made available to the students, which they had to review and submit a response before class. The educator then adjusts the in-class lectures based on the students' performance. In class, the educator provides another quiz to assess the students' learning and provides further feedback based on their performance [67]. More on just-in-time teaching is elaborated elsewhere in this report.

With regards to the sequence of learning activities, self-paced learning of concepts through web-based instruction is highly encouraged to go first, as it has led to better self-efficacy scores and highest ratings based on preference [81]. After that, small-group exercises can take place, either via virtual reality or face-to-face exercises. For simulations, students had previously reported having a preference for virtual reality before face-to-face simulation exercises [81].

Skills, practicals, and workshops can be supplemented by interactive, self-paced modules on the learning management system as well, a practice which is familiar to UM [UM]. We discuss skills, practicals, and workshops in detail elsewhere in this report.

## 2.  Interactive modules: self-assessment

The modules on Canvas can be made interactive by including questions, quizzes, games, and so on, which then becomes a form of self-assessment. These self-assessments are used for students to evaluate their learning *before* and *after* formal transfer of knowledge [UM, ext.]. A detailed account of self-assessments can be found elsewhere in this report. Therefore, we only discuss self-assessments specifically for interactive modules here.

Self-assessments, even on learning management systems, can enhance students' learning. One study compared students learning with interactive e-learning modules vs. learning with only video lectures and found that the former led to a better learning performance [82].

At UM, interactive e-modules have been practiced, even prior to the pandemic [UM]. The modules were aimed at providing theoretical knowledge prior to practical training, so the students know what and why they have to perform a skill, in what context, and the level of mastery expected by the end of the course. This then activates and acts as the students' prior knowledge, before they physically perform the skill. Some educators even require students to pass a quiz before classroom contact [ext.]. Having interactive e-modules engages students in the learning material for longer, which aligns with a previous meta-analysis that proposes the longer time spent with blended education improves learning outcomes [32].

Interactive modules can be created via Storyline, transferred with a SCORM package, and adapted into Canvas [UM]. Some parts of UM have introduced interactive e-modules created by other parties, such as the Topic Oriented Open Learning (TOOL) platform for Anatomy (Leiden-Maastricht partnership) and Data Camp [UM].

## 3.  Collaborating on learning management systems

Collaborative learning through a learning management system is possible and preferred by students, but learning performance would not be any different from face-to-face collaborative learning, according to research. One study compared groups of 3-4 students who learnt collaboratively using an online platform called PIVOT (Practice Improvement using Virtual Online Training) and groups who learnt collaboratively on their own [48]. With PIVOT, the students gather, assess, and respond to case information independently, before proceeding to view, comment, and possibly like other students' responses. In class, the educator would present the webpage with the responses with the number of likes. This webpage would be used for discussions between the students. However, the use of PIVOT to learn collaboratively did not lead to better learning performance (specifically on reasoning skills), compared with students who used a more traditional means of collaborating (i.e., collaborating before class (e.g., use of Google Docs) then having one group lead group discussions in class). Nonetheless, the students reported having a preference for PIVOT, compared to the traditional method for collaboration [48].

## 4. Learning analytics - information on learning progress of students 🖥

Learning analytics may sound like a far-off concept that is detached from the educator, but an external educator reassures us that it is a much simpler concept [ext.]. What it essentially means is the use of student data to quickly understand and assist students in their learning. It is especially useful when confronted with large student populations [ext.]. At certain UM faculties and other institutions, progress in learning analytics has been made [UM, ext.].

Studies that had success in improving student learning included many practices, including the use of learning analytics [30], [49], [52], [76], [78], [79], which provided input and awareness regarding the students' learning process for both students and teaching staff.

Nonetheless, with every innovation comes considerations, especially concerning its influence on education. Learning analytics should not negatively interfere with the students' self-directed learning, collaborative learning, motivation, and the teacher's understanding of the students' learning progress. These concerns and more considerations for artificial intelligence and education at UM have been elaborated by Wasenitz and Jansen [83].

### 4.1 Adaptive learning paths 🖥

Collected student data can be used to provide insights to students and staff on students' learning progress, and if desired, to adapt the students' learning paths according to the insights. Data can be collected from various sources, for example, the students' responses on interactive self-assessments, changes in responses between multiple self-assessments, performance scores, time spent on questions, sequences of reading pages, reading time, etc. [10], [76], [78], [79]. As the student progresses through (and sometimes repeat) the module, it is possible to have the learning management system adapt according to the students' learning progress (e.g., if-then statements [78]), if the student passes this quiz, then share further information). At another university, it is possible to find out how frequent students log into the learning management system, how active the students are with each module, how much time students spend watching recorded lectures, whether or not they have completed their assignments, etc. It is also possible to track student progress based on the educator's feedback across time [ext.].

Studies have described using fuzzy logic to estimate the level of prior knowledge [79] and Bayesian estimation procedures to approximate the students' learning progress [76], [79]. Educators from other universities describe the algorithm similar to a decision tree, where, if the students have mastered certain elements, then they receive different tasks that are more challenging and follow diversified learning paths [ext.]. The learning management system identifies what is known and what is not yet mastered, then provides tailored content, hints, feedback, or different versions of questions, depending on the students' needs and mastery (e.g., beginner, intermediate, and advanced [78]). This self-paced learning empowers students with a sense of autonomy, allowing them to progress at their own pace and revise materials as necessary, in order to achieve the intended learning outcomes [76], [79].

Nonetheless, one study did find that as long as active learning is present, the contribution of learning analytics would be marginal [12]. This study compared flipped classroom with adaptive learning, flipped classroom without adaptive learning, and groups that had blended education supplemented with regular quizzes, and did not find a difference between the three conditions, suggesting that all three active learning methodologies are just as effective for student learning [12].

### 4.2 Access to information 🖥

The data collected can be adjusted so that it is available just for the individual student, shared with the educator, or shared (anonymously) with their classmates. For example, if the educator is aware of how the students are performing, then learning activities can be adjusted to accommodate the students' learning progress. The additional benefit of this is that it builds a support system for students who are at risk of falling behind, failing,

or dropping out, because learning analytics (e.g., the use of regression techniques) help educators identify students who are struggling [78].

Nonetheless, learning analytics should be carefully implemented. The data collected on students should only serve as one data point in the larger picture of their learning. Learning analytics is output-driven and do not take into account student motivation or the students' learning process (e.g., in the face of life's challenges). Furthermore, learning analytics should not be promoted in such a way that undermines larger educational goals, such as achieving intended learning outcomes, self-directed learning, and collaborative learning. These concerns and more considerations for artificial intelligence and education at UM have been elaborated by Wasenitz and Jansen [83]. Finally, we highlight that any data collected has to adhere by the General Data Protection Regulation (GDPR), protecting rights that students and staff members have, including but not limited to:

- Right to be informed of how one's data is being processed
- Right to access this data
- Right to erase data
- Right to restrict processing of personal data
- Right to object to one's data being processed
- Rights relating to automated decision making, including processing

### *4.3 Group awareness through data* 💻

The quality of online interactions can be improved when students are aware of the group's performance. One flipped-classroom-study provided students and tutors information on the group's learning status using charts and diagrams [49]. Information was collected from the learning management system. Next, a map of group knowledge was produced to illustrate the learning progress of the group. Then, the map was shared with the students, to which the students can comment and supply information to other members, thus creating a sense of community. The students were aware of their individual learning progress and the group's learning progress. The researchers found that the quality of interactions over forum discussions, mediated by an educator, improved as a result of having group awareness [49].

## 5. Overview of Canvas functions 💻

In the previous sections, we covered some functions of Canvas, including self-paced modules, interactive modules, and learning analytics. Here, we cover some more functions that have been appreciated by educators:

**1**. Structuring education
   a. Intended learning outcomes can be highlighted on the front page [UM].
   b. Announcements help grab the attention of students [UM].
   c. Modules – The course overview is easily seen with the list of modules. Study materials are easily organized, with the module tabs to place resources, knowledge clips, links to recorded lectures and so forth. Educators like organizing the materials in a chronological order
   d. Blueprints are available for designing a course [UM].

**2**. Contact/Communication
   a. Synchronous discussions possible through Canvas Conference [UM]
   b. Asynchronous discussions
      i. Forum discussions – Many UM educators had used the forum discussions for brainstorming, monitored by an educator and with summaries created by students (and sometimes re-uploaded to the forum) [UM].
      ii. Subgroups pages can be created for students to organize their discussions [UM].
      iii. Email notifications to inform students of happenings on Canvas [UM].

c. Yet, some educators have expressed finding it difficult to communicate with students through Canvas. Therefore, when trying to reach the individual student, emails are still preferred [UM].

3. Assessment
   a. Exams, including take-home exams, are possible, with plagiarism checks available [UM].
   b. Speed grader – Rubrics can be added to help with grading. Direct feedback can be given on the assignment as well. The speed grader allows an overview of all students who have submitted their assignments [UM]. Furthermore, tutorial group can be assigned to tutors [UM].

4. Support from Canvas
   a. Educators can get help either from the Help Menu or contact Canvas directly [UM].

Nonetheless, Canvas could still be improved by including the following requested functions [UM, ext.]:

1. Assessment
   a. Possibility for follow-up grading/interaction between educator and student on the same assignment or portfolio.
   b. An easier way to transfer grades to the exam office.

2. Skills
   a. To be able to add skills training, such as virtual reality.

3. Applications
   a. A more flexible application programming interface (API), allowing educators to use plugins, apps, and interactive tools such as Miro and WooClap.

4. Communication
   a. Semi-synchronous discussions similar to WhatsApp. For example, when someone is typing, we are able to see that activity, allowing us a sense that we are not alone.
   b. Possibility for students of different disciplines and years to collaborate.
   c. Collaboration between teachers.
   d. One institution highlighted that students opted for other platforms to connect with one another (see sense of community and co-creation in small group collaborative learning). Another institution high-lighted the need for Microsoft Team's features, such as planning and co-editing of documents. These features should be added to Canvas, as it is important for educators to support students in their learning.

5. Accessibility
   a. Canvas should be made accessible on different devices and different browsers (on the devices).

# Assessment in blended education: Some relevant aspects 💻

UM educators are aware of the function of assessments – assessment is of, for, and as learning [84]–[86]. As such, assessment should be designed such that feedback from one assignment is input for the next assignment, in other words, a feedback loop [UM, ext.].

**"You can do group-based learning, assignment-based learning, you can do flipped classrooms, whatever, if everybody is going to get exactly the same exam, then the question is what is going to be in the exam"** - *UM educator [UM]*. In other words, the design and delivery of education is often seen as separate from assessment. Yet, education should always be designed in a manner that is constructively aligned; starting from the intended learning outcomes, to the transfer of knowledge, to the assessment of knowledge [UM].

Accordingly, the method of assessment should be adjusted to the intended learning outcomes. If the intended learning outcome is to develop legal opinions and give legal advice, then case assignments that evaluate how well students formulate legal opinions and advice is better than having students write down everything that they know about a topic. If the intended learning outcome is to be able to think critically, analyze data, and conduct research, then a research project with a final research paper would be a suitable assessment method [UM].

There has been a lot of attention given to the development of assessment in the past years, both within UM and at other universities. **"One thing on my wish list, and I think we are going in that direction, is to have more attention on formative assessments or having longer projects in which you can show progress as a student. Another thing is more on application, for students to learn to apply knowledge,"** – *Dr. Bjorn de Koning, Erasmus University Rotterdam [ext.]*. We discuss these developments in detail below.

In the present paragraphs, some aspects of assessment where relevant in the context of this report are discussed. Please note that the following text is not intended as a full overview of possible assessment methods for UM or blended PBL in general.

## 1. Programmatic assessment 🔌

Programmatic assessment is defined as **"an approach in which routine information about the learner's competence and progress is continually collected, analyzed and, where needed, complemented with purposively collected additional assessment information, with the intent to both maximally inform the learner and their mentor and allow for high-stakes decisions at the end of a training phase"** [87].

It is important to design education at the program level and assess education at the program level [UM]. Programmatic design and assessment ensures that intended learning outcomes are thoughtfully planned and achieved by the end of a bachelor or master program [UM]. Specifically, there is structure and scaffolding to the students' learning, with the learning curve that is explicitly designed [UM]. Then, the design of assessments can be made according to the intended learning outcomes across the program [UM].

Some UM educators have pointed out that a period of eight weeks (or even fewer) is too short to guide students in their learning. Instead, feedback should be given across a year or even an entire program. This has been carried out at other institutions, for example, where students are regularly accessed in their development of CCCS in the first year [ext.].

Continuous feedback, especially on skills, can be given through a portfolio that students build up [UM, ext.]. This portfolio may consist of learning tasks and competencies, to which students receive narrative feedback on, guided by rubrics [UM, ext.]. Canvas is still lacking a function that allows continuous grading across courses [UM].

## 2.  Regular assessment and feedback

Educators argue that although the intended learning outcomes are important, it is too easy to overlook the steps that we need to take to achieve those intended learning outcomes [UM, ext.]. Instead, we should pay attention to the students' growth over time, so we can provide just-in-time feedback to highlight strengths and remediate deficiencies [ext.]. Therefore, regular assessment and feedback should be given to students - to evaluate the achievement of intended learning outcomes and to stimulate further learning.

### 2.1 Benefits of regular assessment and feedback

"I want my students to know that I have their back. Once you establish this trust, it gives you more room to give them critical feedback, to say "Hey, this wasn't as good as it could be. You and I both know you can do better. What do you need to get there?" I'm that kind of teacher. I think my students understand that I'm their champion, that I want them not only to rise but to soar. But I also want them to be good people, moral leaders who have a positive impact on the world."
– *Prof. Dr. Timothy Patrick McCarthy, Harvard University.*

Regular assessment and feedback can be a low threshold yet active manner for students to gauge their understanding and learn some more. There is plenty of evidence from literature showing that regular feedback can help students to learn:

- In one study, student learning was improved with regular feedback, where students had to develop interview skills [88]. The feedback focused on the outcome of the interview and the quality of questions asked, for example, how certain questions affected the answers given.
- In another study, educators would ask questions, and students could answer either by raising their hands or by using digital devices (e.g., WooClap). This was compared against another condition where no questions were asked from the lecturer (with or without the students using their digital devices). The former, where lecturers asked 3 questions in their 2-hour lectures, led to better academic results [89]. In other words, simply asking questions assists students with their learning.
- In one study, providing regular quizzes was found to be just as effective as flipped classroom for student learning [12].
- In another study, students were given regular tests, including home assignments and sample questions to exams. These students had better academic achievement, compared to those who just attended lectures and tutorials [90].

The benefits of regular feedback have been experienced in practice too. Educators explained that regular assessments help students learn better and keep students engaged with the topic [UM, ext.]. Furthermore, regular assessment also gives educators confidence that students are progressing with the intended learning outcomes [UM]. Students also appreciate regular assessment moments because it helps motivate them to engage with their course [UM].

In terms of workload, both UM educators and students state that by having regular graded light-weight assessment, the burden on students is lightened per assessment (especially reducing the burden of the final assessment). Furthermore, educators argue that more students are able to handle the light-weight assessments, compared to a one-off final exam [UM]. In this manner, without changing the intended learning outcomes or assessment criteria, more students are able to show that they have achieved the intended learning outcomes.

### 2.2 Regular assessment activities: Grading

Both non-graded and graded forms of assessment have a place in education. For many educators, grades are seen to be unhelpful for learning [UM, ext.]. The most valuable assessment and feedback are argued to be from peer and educator-student exchanges, which are non-graded. Furthermore, regular graded assessments may not be conducive to student well-being and can lead to a higher burden for educators in terms of

workload and financial investment [UM, ext.]. Interestingly, one educator experimented with not giving grades. This educator did not receive any complaints from students. Instead, according to this educator, the students focused on improving through the feedback given and outperformed previous years in terms of achieving the intended learning goals [ext.].

Still, grades serve as a means to validate achievement of intended learning outcomes, which can be important for many professions (e.g., law, medicine) [UM]. Grades can also have a motivational purpose for students. For example, one study found that when students complete regular assessments in a summative rather than formative manner, this resulted in better academic performance [76]. In this study, assessments were given for each module via a learning management system that is enhanced with learning analytics. The study found that using these assessments summatively led to better performance in the students' final exam. The reasons behind this may be because: one, formative assessments on a learning management system may lead to excessive academic load, leading to worse student performance; two, the voluntary nature of formative assessments may lead students to not participate in these assessments at all.

In light of the need to validate achievement of intended learning outcomes, all while having a focus on student learning, one educator suggested to only give a "pass or fail" grade [ext.]. This solution can be demotivating for students who strive towards high grades [ext.]. However, we are reminded that education's focus should be on learning and achieving intended learning outcomes, rather attaining high grades [ext.].

With the arguments thus far, it may be tempting to hand out multiple non-graded assessments, as it supposedly has the potential to benefit student learning. Yet, student workload is also one factor to consider. Students have pointed out that it can be too easy for educators to give out regular mini-assignments that are not graded, which can lead to a high workload.

In the end, educators prioritize student learning, but recognize that grades are necessary to validate achievement of intended learning outcomes. With each assessment that is given, there needs to be a clear purpose and value, so that these assessments help achieve and validate the achievement of intended learning outcomes, while falling within the allocated ECTS.

## 2.3 Students as individuals

Many educators have advocated to tailor assessments and feedback to each student [UM, ext]. This means that the individual student's transfer of learning should be evaluated, given feedback, and re-evaluated after more transfer of learning.

Educators are encouraged to have at least a one-on-one evaluation with the students halfway through the course, to check in on their well-being, evaluate their academic progress, and to provide formative feedback on their PBL process and CCCS-learning [ext.].

To ease the workload of educators, feedback can also be given online. Giving regular feedback via the web or mobile application (e.g., written, verbal, or with supplementary materials) results in just the same learning performance as giving in-person feedback [91].

### 2.3.1 Self-assessment

Self-assessments can keep students engaged in their independent learning [ext.] and improve learning as well [25], [76], [82]. In fact, performing self-assessment just once have been found to improve learning just as effectively as performing multiple self-assessments [92]. There are many types of self-assessments [25], [30], [35], [52], [67], [75]–[79], [82]:

- multiple choice [25], [75], [79], [82]
- fill-in-the-blanks [30]
- short answers [75]
- sequences [75]

- hotspot [75]
- true/false [75]
- drag-and-drop [30], [75]
- taking photos/making images as answers [30]
- gamification - when questions are answered correctly, the students obtain points, which are scored based on the complexity of the question solved. The point system is argued to stimulate a sense of achievement, and allows students to see where they stand in comparison to their peers. Compared to students who completed exercises with pencil and paper, this gamification of exercises led to improvements on the exercise performance [61].

These self-assessments can come with immediate (visual and/or auditory) feedback [52], [67], [75], [77], [79], [82] and can be repeated as many times as needed by the students. These self-assessments do not need to count into the students' final grades. An external educator insists on having these done voluntarily by students. Yet, in literature, it is recommended to have self-assessments count towards the final grades, because completing these questions summatively rather than formatively led to better overall academic performance [76]. In this study, the self-assessments contributed to 30-35% of the students' final grade. Some studies have given students the option to repeat the self-assessments up to three times, with the highest score taken into the final grade [12], [35], [77]. Nonetheless, whether these self-assessments count into the final grade or not, just completing self-assessments itself led to better learning, compared to those who did not use self-assessment at all [76].

Furthermore, when students are aware of what is expected of them, they can perform significantly better in the overall course. One study found that when students are given rubrics alongside their course assignment, they perform significantly better in their overall course assessment compared to if no rubrics were given at all [93]. The course assignment was a discussion on an online forum with instructor-, peer- and self-feedback. The course assignment was conducted after learning activities such as guided research, reading resources, and face-to-face case discussions. After the course assignment, students completed a course assessment in the form of a quiz, and those who had the rubrics during their course assignment performed better on this quiz. The authors explain that administering rubrics is an effective form of explicit guidance for online discussions to facilitate learning [93].

Educators have also recommended using more formative elements via the learning management systems, Canvas [UM, ext.]. Self-assessments can be arranged before and after transfer of knowledge [UM, ext.]. Self-assessments make learning modules more interactive and have been found among the practices that improve student learning. Interactive modules via learning management systems have been documented elsewhere in this report.

### *2.4 Students as a group: Collaborative learning*

When it comes to collaborative learning, the process can be just as important as the outcome. In the following sections, we cover a few ways to receive feedback from group discussions and how to conduct assessment and feedback in group assignments.

### 2.4.1 Feedback from group discussions

Some UM educators find that the formative feedback naturally given in peer-to-peer collaborative learning discussions is one of the best forms of regular feedback and can contribute to students' learning [UM, ext.]. **"The real quality of education is in the teacher and in discussing with students. The quality of education is in the interaction."** *– UM educator.*

At some parts of UM, students complete a quiz before they come together as a group. Then, the same quiz is given to the students again during the group discussions, so they learn from each other [UM].

At another university, the PBL process is graded by tutors on a weekly basis. In tutorial meetings, tutors grade students using rubrics, based on how they present, participate, and collaborate with classmates [ext.].

### 2.4.2 Assessment and feedback in group assignments 💻

In group assignments, peer-to-peer feedback can be especially important for group work. For example, by reflecting on the students' roles in the group, on how they will work together as a team, and to provide feedback to each other [UM]. Students have expressed wanting reflection sessions to evaluate group processes, to find solutions for when the group is not working [UM].

To improve collaborative learning, some UM educators arrange so that students perform intervision/peer review, i.e., giving each other feedback, without the presence of the educator. At least once throughout the course, intervision groups discuss the collaborative learning process and also content of their group assignments. To encourage unbiased feedback, intervision group members are different than those of the students' actual collaborative learning groups [UM].

One way of giving peer-to-peer feedback is via FeedbackFruits [UM]. Furthermore, when students are given feedback on a certain skill to improve on, it is important that the students are directed to a resource online (e.g., GoodHabitz) to improve on that skill [UM].

### *2.5 Regular (graded/non-graded) assessment activities* 💻

Here, we share some ideas on how to carry out regular assessment activities in the general student population.

### 2.5.1 Learning activities 💻

### Asking regular questions 💻

One way of giving regular feedback is by regularly asking students questions, whether verbally or via digital devices. Interestingly, using digital questions in classrooms have led to better academic performance, compared to verbal questions and answers [89]. In another study, the use of Kahoot and Mentimeter applications positively influenced the students' perceptions of e-learning [94].

In practice, educators have also incorporated polls with the use of Kahoot, WooClap, and Mentimeter, finding these short quizzes to motivate and engage the students in their learning [UM, ext.]. Specifically, one external institution introduced multiple choice conceptual quizzes at the beginning of class, then have the students discuss their answers, and then introduce the same quiz after the discussion, which usually leads to 70% of the students getting the right answer [ext.].

UM students also like it when their educators conduct interactive sessions, because it can help them in connecting the dots in the course. **"WooClap was something that I liked... it helps you to don't lose thread of class and... they asked you questions and everybody has to pay attention"** – *UM student*.

### Concept maps 🔌

Using concept maps as a form of formative assessment has been found to be beneficial for student learning and (cognitive and emotional) engagement, compared to when multiple choice questions were used as formative assessment [95]. In the study, students learn programming via a learning management system, where reading materials and videos are presented on multiple modules. At the end of each module, the students were given formative assessments. The researchers explain that concept maps help students to find relevant and important information when going through academic material. Furthermore, concept maps also help students to find the main gist of the articles they read.

### Quizzes 🖥️

In literature, many studies assign weekly (approximately 10 to 15 minutes) quizzes to students [6,10,20]. In one study, animated characters that were used in knowledge clips were brought back to the quizzes, to make the quizzes an even more fun experience and to integrate learning with assessment [52]. These quizzes include interactive games, such as puzzles, word game, pick and drag, drag and match, matching, fill in the blank, rank based on priority, find database, true or false, and so on [52]. Should these quizzes be graded, some studies have given students the option to repeat the quizzes up to three times, with the highest score taken into the final grade [12], [35], [77].

Some educators use Zoom polls or quizzes on Canvas in the pre-discussion to activate the prior knowledge of students [ext.]. Some educators even require students to pass a quiz before being able to access the pre-discussion [ext.]. Another way of quizzing would be for the teacher to ask prompting questions, for the students to answer the questions individually (e.g., in a poll), discuss it in a group, and then re-answer the questions, before receiving the correct answer and feedback from the teacher.

### Gamification 🖥️

Gamification is one way to provide regular and engaging feedback, although more research on validity is needed. We elaborate on gamification elsewhere in this report.

### 2.5.2 Assignments 🖥️

### Confetti principle 🔌

At some parts of UM, the educators designed a "confetti principle" when it comes to assessment, where students are given feedback on whether they have achieved the intended learning outcomes at multiple (4-5) time points from multiple sources. The students can also be working on a multicourse case, where one project that lasts a semester is graded on multiple courses at multiple times [UM].

### Feedback on assignment 🖥️

UM educators have expressed liking assignments that are uploaded onto Canvas, which they then bring into the tutorial meetings to discuss [UM].

After students have handed in (a preliminary version of) their assignment, educators can arrange a Q&A session, where general feedback is given about what went well and what can be improved, so students can learn from the mistakes of one another. This can be done online, because it may be easier to share detailed examples via shared screens. This practice has been carried out at UM and at other institutions as well, and students have expressed liking this practice [UM, ext.].

### 2.5.3 Skills 🖥️

### Remote assessment of skills 🖥️

Students who learn skills on their own (e.g., of a laboratory skill or communication skill) can also film themselves to receive feedback, either from a teacher or from their peers [UM]. This can also be done via a program called TrainTool. This manner of feedback works because students are confronted with their own mastery of skills, allowing them to learn their strengths, their weaknesses, and how to improve their skills.

### Portfolios 🖥️

> "What's important is students get control of their learning, which means the use of portfolios will be more and more important, where students can reflect and faculty can see how students develop and learn." - *Prof. dr. Martin Wetzels, previous Vice Dean of Education, School of Business and Economics [UM].*

Some UM educators have pointed out that a period of eight weeks (or even less) can be too short to guide students in their learning. Instead, feedback should be given across a year or even an entire program (see programmatic assessment) [UM]. A product, such as a portfolio, can be continuously developed, where students receive regular feedback on [UM]. Portfolios are also used to check that the students demonstrate attaining a certain level on a regular basis [ext.]. Portfolios may consist of learning tasks (e.g., written pieces) and competencies, to which students receive narrative feedback on, guided by rubrics [UM]. Although reflections are regularly used in portfolios, one external educator commented that it is difficult to judge whether certain reflections are genuine or not. Instead of reflections, students should work on *refractions*, to bring about change, to demonstrate learning [ext.].

At some parts of UM, after receiving theoretical knowledge via interactive online modules, students develop self-selected learning goals on skills, where they describe their goals and action plans on an online portfolio called ePass [UM]. Their coach would give feedback on their goals. Then, during the practical training, the students would work on their goals, reflect on what they have learnt, whether they have achieved their learning goals, and their further action plans, to which they would once again receive feedback. Then finally, the students would perform their acquired skills through an assignment.

### 2.5.4 Other feedback activities

There are many creative ways to stimulate moments of feedback. For example,

- Questions/polls
- Q&A activities
- Assignments/projects
- Pair & share (PS) activities, including rapid PS, reflective PS, and proactive PS
- Presentation and discussions
- Paired quizzes
- Role playing
- Mind mapping
- Debates
- Fishbowls

These activities are covered in detail in the discussion of classroom contact of flipped classroom.

### 2.5.5 Type of feedback

#### Content of feedback

The type of feedback provided to students may be important. Students who were given feedback about their weekly study plan, specifically time spent studying and their progress towards self-selected goals, did not perform any better than students who were not given this visual information [96]. Therefore, feedback on scheduling does not appear to assist the students in their learning.

#### Manner of delivering feedback

Prompting students in a certain manner may be detrimental to their participation in future discussions [93]. Specifically, one study had educators prompt students by first providing positive feedback, then provide a guiding question that invited all students to respond. For example, **"That's a great point you bring up about X. How could we apply/evaluate X in a real world situation? Anyone?"** Although prompting students in this manner led to more in-depth responses, it also led to less frequent responses. Providing both a prompt and a rubrics of their discussion performance led to the worst result, where students had more shallow and less frequent discussions. The researchers explain that providing both prompts and rubrics could have led to an overload of information (cognitive load), leading to worse discussions [93].

At other institutions, educators have suggested using audio or video feedback, because it brings in more dimension to the feedback. Compared to textual feedback on the students' written work, audio or video feedback may be more effective in explaining how the students can improve their work [ext.].

## 3. Summative assessment in blended education

### *3.1 Designing summative assessment*

Keeping in mind that assessment is of, for, and as learning [84]–[86], then assessments need to be well-designed. Here, we discuss a few considerations when designing summative assessments.

### 3.1.1 Applying knowledge

As with the intended learning outcomes, a large number of educators have emphasized that assessments should be applicable and insightful, where students go beyond reproduction of knowledge [UM, ext.]. Students also appreciate testing their application of knowledge, because it is an **"enriching and vigorous way of testing someone's knowledge"** - *UM student*. Applicable assessments can have more validity than theoretical assessments, i.e., actually measuring what assessments are meant to measure. In this manner, assessments are aligned with the intended learning outcomes and the students' future careers, which is motivating for students and educators [UM].

When questions are applicable, students have to defend their arguments. Thus, the answers to applicable questions are difficult to search for on the internet [ext.]. Some assessments do not even have a correct or incorrect answer [UM, ext.]. One UM educator explained, **"the cases were described in such a way, sometimes there was also no correct or incorrect answer. You could say yes or no, but then the elaboration, so the interpretation would determine how many points they would get for the question"** [UM]. At one university, some have named applicable assignments as "argumentative", because students have to justify their answers [ext.]. Another university administers NOCATs, or *No Correct Answer Test*, where students have weekly assignments to solve a problem and the answer or solution to the problem depends on the resources and methodologies used to search up the solution [ext.].

In the next sections, we cover the types of assessments that enable application of knowledge.

### Assignments

Some students have requested for assignments in place of exams, because that can motivate students to engage throughout their course [UM]. We elaborate on how to design assignments according to real-world problems elsewhere in this report.

### Open questions

Open questions to allow students to show what they have learnt [UM, ext.].

### Open book/Take home exams

Supporting arguments

- When intended learning outcomes are *applicable*, then take-home exams are a possibility, where students have to link real-world situations to their theoretical knowledge [UM]. This type of assessment would align well with flipped classroom, which focus on application of knowledge.
- Some UM educators commented that there is no need for proctoring and dishonest behavior can be detected with plagiarism software [UM, ext.].

Opposing arguments

- However, others still think that we cannot guarantee honest behavior in take home exams, because another person could have completed the assessment on behalf of the intended student [UM].
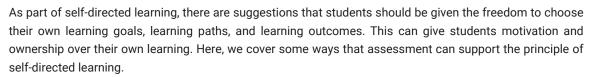
**Multiple choice question (MCQ)** 🖥️

Supporting arguments

- Some courses still require MCQ, e.g., statistics or more basic courses with only theoretical information [UM]

- Reduces grading workload [UM, ext.]

- **"If you think multiple choice doesn't really test anything, then you are doing it wrong",** *explains one UM educator [UM].* MCQs should not be discouraged as a method, instead the questioning of factual knowledge should be discouraged. Applicable and insightful questions are still possible with MCQs. By designing good MCQs, this can reduce the workload of grading as well because MCQs can be easily graded by computers. Another UM educator assesses knowledge with MCQ paired with requesting that students elaborate on why they chose their answers [UM].

Opposing arguments

- Many educators at UM strongly oppose the use of MCQs [UM]. "Life is not multiple choice", explains one UM educator [UM].

### 3.1.2 Self-directed learning in assessment 🖥️

As part of self-directed learning, there are suggestions that students should be given the freedom to choose their own learning goals, learning paths, and learning outcomes. This can give students motivation and ownership over their own learning. Here, we cover some ways that assessment can support the principle of self-directed learning.

**Choice of questions** 🔌

In standard exams, educators can design two parts:

1. A number of mandatory questions, to ensure the learning requirements have been met

2. A number of questions that students can choose to answer, based on their self-selected learning goals across the course [UM].

This form of assessment has been well-received by other UM educators [UM].

**Freedom of format** 🖥️

With regard to individual or group assignments, UM educators have suggested to give students freedom in expressing their findings. For example, through PowerPoint presentation, poster, podcast, video, poetry, write a story, composing music, paint, make a performance, even make a quiz [UM].

The findings can be presented at an organized symposium. Streaming online with chat forums allows the possibility for students of all years, educators, and external clients to attend this symposium, giving further opportunities for exchange and connection. Programs that support online symposiums include Remo [UM].

**Portfolio** 🖥️

Students can be given freedom to design their portfolio, which they receive regular feedback on to continuously develop their learning [UM, ext.]. Portfolios can be used to demonstrate that students have reached a certain level on a regular basis [ext.]. Portfolios can be developed across one course, but some educators suggest that feedback should be given across at least a year or even an entire program (see programmatic assessment) [UM].

A portfolio may consist of learning tasks (e.g., written pieces) and competencies. Students receive narrative feedback on their portfolio, which is guided by rubrics [UM]. Although reflections are regularly used in portfolios, one external educator commented that it is difficult to judge whether certain reflections are genuine

or not. Instead of reflections, students should work on refractions, to bring about change, to demonstrate learning [ext.].

At some parts of UM, students can choose the skills that they would like to develop [UM]. Using an online portfolio called ePass, the students describe their goals and action plans to develop the chosen skills. Their coach would give feedback on their goals. Then, during the practical training, the students would work on their goals, reflect on what they have learnt, whether they have achieved their learning goals, and their further action plans, to which they would once again receive feedback. Then, the students would have their learnt skills assessed through an assignment.

### 3.1.3 Collaborative learning 🖥

The grading of collaborative learning is most commonly seen in group assignments. The process of collaborative learning within tutorial meetings tends to be in formative feedback formats [ext.]. Conventionally, graders are educators. However, it is also possible and becoming more acceptable to have peer-review, where students are given trust and training to assess and give feedback on each other's work - a sign of true collaborative learning.

In the following sections we cover the grading of group assignments, before delving into peer review.

### Group assignments 🖥

At some UM faculties, assignments are distributed between individual (70%) and group assignments (30%) [UM]. Examples of group assignments include products that are co-created by the group, such as creating a blog, a Wiki page, or a group portfolio. As emphasized by the self-directed learning principle, some educators propose that students should be given freedom to express their learning in their assessment [UM]. For example, by letting students share their learning in their preferred format - PowerPoint presentation, poster, podcast, video, poetry, write a story, composing music, painting, making a performance, or even making a quiz.

When grading group assignments, many UM students have requested that individual contribution needs to be made clear. Students have brought up non-participation as a factor that affects their motivation and mental well-being. This request for ensuring individual contribution is supported by another institution, because grading is then fair [ext.]. UM students have suggested the following ways to encourage equal contribution:

- Ensure that each student completes their assigned tasks
- Check that each student makes a submission
- Have a scoring system for individual work
- Declare individual contribution for each part of the assignment, similar to how author contributions are required in scientific journals

However, at another university, individual contribution is not graded on purpose [ext.]. The involved educator explained that, similar to self-regulated learning, groups should regulate learning as a group, which also includes the regulation of emotions and motivation. So a team member who notices that the other is not contributing as much, this is part of the learning process as well, to address and find solutions to improve the group processes. By having individual contribution, students may start focusing on the grades of individual contribution, rather than focusing on actually learning as a group. At the same time, this educator also acknowledges that there is not much research on individual grades on group assignments, so this remains one possibility for future research.

In a collaborative learning design-based research [46], the researchers identified practices to stimulate knowledge co-creation in a multidisciplinary, virtual group:

1. When submitting a group assignment, **each member had to manually indicate their approval** to the submission on the learning management system, and then send in a **statement of participation** to the educator.

2. After that, the groups were asked to **peer-review other groups assignments**, so that they can learn academic content from each other. All tasks had a 2-week deadline.

3. To foster reflection, a **group-level written reflection** was required every two weeks to encourage group members to express their thoughts on how they were doing and how to do better. Instructions on how to carry out a group-level written reflection was provided on the learning management system.

4. The final group assignment encompassed all academic content from the entire course, where the groups had to **utilize given feedback from previous assignments** to demonstrate their learning [46].

For this study, these practices led to a better overall course experience and multidisciplinary collaborative learning. The students were made aware of each other's strengths, so they were able to learn from each other. These practices also made students realize that multidisciplinary and remote collaboration meetings are part of their future work life. The course structure of intermittent assignments and teaching allowed students to distribute their time more evenly. Nonetheless, comments were still made on limited face-to-face interaction, suggesting that virtual collaboration may not be optimal [46].

### Peer review 💻

There are a few ways to conduct peer review. The simplest example occurs in PBL group discussions, where the utterances of students are checked by their peers. Another way to stimulate group discussions would be to have students share anonymous pieces of work for group review [ext.].

At UM and other universities, students are trusted with the responsibility to grade each others' work, for example, on FeedbackFruits. Just like teachers, students have to be trained to give and receive critical feedback [UM, ext.]. When grading, rubrics are provided to provide structure and promote fair grading [UM]. Further supporting arguments for peer-reviewing include:

- It can be an intended learning outcome, for students to learn collaboratively, which means that they have to be able to give and receive feedback [ext.].

- Reduces teacher workload [ext.].

- It is likely that students are more detailed than an educator [UM].

- UM educators who advocate for peer review argue that when students give each other feedback on their written work, they learn by receiving feedback, but also by giving feedback [UM].

- With the use of rubrics, there is discussion and learning about why certain grades are given and why certain choices are justified. This is a learning activity that the students can take along with them to the next learning activity [UM, ext.].

### 3.1.4 How to ask questions? 🔌

Questions in assessments may use the same frameworks recommended to students when self-direct their learning. This has been elaborated elsewhere in this report.

### 3.1.4 Feedback given 🔌

Students have expressed that **"There needs to be feedback given on final assignments/exams, even if it is just one positive and one constructive suggestion. Without feedback, the grades become not only confusing but even meaningless, and demotivating."** [UM].

### 3.1.5 Transparency in grading 🔌

Students have requested for transparency in grading, for example, by providing them with the used rubrics. Students have also requested that assessors have the same grading system, instead of having assessors who are more lenient vs. assessors who are more strict in grading. Educators within and external to UM have also explained that with the use of rubrics, there is discussion and learning about why certain grades are given

and why certain choices are justified. This is a learning activity that the students can take along with them to the next learning activity [UM, ext.].

### 3.1.6 Proportion of assessments graded

We do not have a recommended proportion of how many assessments should or should not be graded. Once again, this all depends on how the assessments are constructively aligned with the intended learning outcomes. Nonetheless, we provide examples of various weightages that have been given out:

- Assignment 25%, final assessment 75% [UM]
- Regular assessment amounting to 30%, final assessment 70% [35]
- Regular assessment amounting to 30-35%, final assessment 65-70% [76]
- Three assessments of 30% each, with a participation score of 10% [ext.]
- Regular assessment amounting to 40%, final assessment 60% [UM]
- Regular assessment amounting to 50%, final assessment 50% [4]
- Regular assessment amounting to 67.7%, final assessment 32.3% [6]

With these figures, we remind the reader to not use a certain proportion for the sake of doing so. These figures can only demonstrate what others have been doing.

### *3.2 Setting*

During the pandemic, assessments were moved online and conducted remotely. Looking towards the future, there are questions about whether assessments should be digital and whether assessments should be on-site or remote. As usual, the answer lies in the intended learning outcomes.

A recent systematic review of online examinations reported that student performance was not influenced by whether exams were conducted on paper or online [97]. Yet, the majority of students prefer online exams, rather than paper exams. Below, we provide the pros and cons of each setting, according to our interviewees and the systematic review [97]:

### 3.2.1 Paper and pencil, on-site

Supporting arguments

- No need to use TestVision [UM]
- Easier to ensure fair assessment [UM]
- Have more control over the assessment procedure [ext.]

Opposing arguments

- Issues with handwriting [UM]

### 3.2.2 Remote

Opposing arguments

- TestVision not compatible with proctoring software [UM]
- Difficult experience with proctoring [UM]
- Concern for unfair assessment (e.g., someone else taking the assessment on behalf of the intended student) [UM]

### 3.2.3 Digital

Supporting arguments

- Students prefer to type rather than to write. Typing is faster and easier for editing too [97].

- Digital exams are more economical [97].
- Digital exams are more accessible for remote students [97].
- Students believe that online assessments align better with their future real-world environment [97].
- Students believe that online assessment contribute to improved learning and feedback [97].
- Students trust the results of online exams over paper-based exams [97].
- Easier grading
  - Typed words and other visuals (tables, mind maps) are tidier than handwritten words [UM, ext.]
  - Direct feedback can be given in a transparent manner via Canvas, which has been positively experienced by educators [UM, ext.]
  - Possibility to have assessments easily graded by multiple graders [ext.]
  - Learning analytics quickly aggregates data to produce insight on student performance [ext.]
- Possibility of using plagiarism detection software. No need to use TestVision ensure fair assessment [UM, ext.]
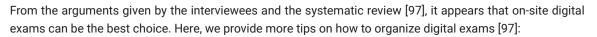
Opposing arguments

- (Institutional or student) investment in computers [ext.]
- The majority of students perceive online exams as being easier for dishonest behaviors [97]

Mixed arguments

- The effect of online exams on anxiety levels were nuanced. Online exams typically raise anxiety levels in students, but for those who typically experience high anxiety in traditional exam environments, online examinations lowered their anxiety levels. Strategies to manage anxiety include having students reflect and report on their anxiety levels [97].

### 3.2.4 Recommendations on exam settings 💻

From the arguments given by the interviewees and the systematic review [97], it appears that on-site digital exams can be the best choice. Here, we provide more tips on how to organize digital exams [97]:

- The Arial font was preferred by almost ¼ of the sampled students
- Black text on white font was preferred
- Countdown timer was preferred to analogue clocks or ascending counters
- Allow students to set their own reminders for remaining time

Educators have also voiced out preferring the use of university computers instead of the students' own computers, to reduce the risks of technical problems (e.g., data loss, incompatible operating systems, firewalls) [97]. Nonetheless, when students use their own devices, the following steps have been suggested:

- Having students transfer digital examination to their device via USB
- Use of software to control access to certain applications
- Prevent USB keyboard hacks for easy access to other documents
- Prevent modification of exam software
- Prevent a cold boot attack (i.e., physically accessing the device where the default copy of the exam questions are stored)

### *3.3 Fraud prevention in blended education* 💻

Fraud prevention is necessary because educators need to confirm that students have acquired certain knowledge in their program [UM].

Here, we highlight an argument given by a UM educator: collaboration does not need to interpreted as fraud, especially if it is made clear by the examination rules. This educator explicitly informed students that they can

discuss the questions, should they want to, in an exam with open questions and limited time. The explanation given was, **"assessment is supposed to be a learning experience and not just, you know, ticking the box and you pass the course. I wanted it to be a learning experience, so then you also collaborate a lot… but then also because the cases were described in such a way, sometimes there was also no correct or incorrect answer. You could say yes or no, but then the elaboration, so the interpretation would determine how many points they would get for the question"** [UM].

For other means of fraud, we provide some recommendations on prevention below.

### 3.3.1 Having applicable, argumentative questions

Supporting arguments

- When questions are applicable, students have to defend their arguments. These questions tend to be open questions [UM, ext.], but can also be multiple-choice questions [UM]. Hence, it makes it difficult to just search their answers on the internet [ext.].

Opposing arguments

- Open-ended/essay questions tend to come with a heavy workload [UM].

### 3.3.2 Cheating prevention

According to a systematic review on online assessments, although **cheating should be targeted from an ethical and social standpoint**, the reviewers also provide the following from literature to counteract cheating:

- Identifying the test taker
- Prevent theft of exam questions
- Prevent unauthorized use of resources
- Prepare setup of online assessments
- Prevent the use of unauthorized devices
- Avoid "bring your own device" methods
- Limit access to other people during exams
- Equitable access to equipment
- Identifying computer crashes
- Provide randomized questions from a larger pool of questions
- Continuous question development
- Multiple examination versions
- Open book options
- Time stamps
- Diversity in question formats, sequences, types, and frequency
- Check for nearby devices using Bluetooth neighborhood logging
- Random device swap

### 3.3.3 Authentication

According to a systematic review, although online assessments should be designed along the same principles of open book exams, the reviewers still provide the following from literature to support authentication [97]:

- Fingerprint reading
- Streaming
- Follow-up identification

- Post-hoc search for cheating
- Subsidiary products on learning management systems (e.g., Weaver)
- Biometric software
- Have students and examiners authenticate at pre-, intra-, and post-exam periods
- Use of continuous tracking apps
- Use of login function
- Use of visual passwords
- ID check
- Digitally signed applications

### 3.3.4 Proctoring

Supporting arguments

- Proctoring is useful when students are abroad [UM].
- Has successfully detected some dishonest behaviors [UM, ext.].

Opposing arguments

- Despite proctoring put in place for online, remote exams, a quarter of students still copy text from websites and their notes [UM].
- Causes a lot of discomfort and stress with being video-recorded [UM].
- Software not compatible with TestVision [UM].
- Regular technical issues [UM].

### 3.3.5 Quizzes with randomized questions from a larger pool of questions

Supporting arguments

- Encourage student learning if quizzes can be repeated (e.g., self-assessment in an interactive module. If these self-assessments were to be graded, some studies have given students the option to repeat the self-assessments up to three times, with the highest score taken into the final grade [12], [35], [77]
- The use of randomized questions from a larger pool of questions has been commonly used [4] [35][ext.]. It is especially effective in preventing cheating when paired together with time pressure [UM].

Opposing arguments

- High workload and likely impossible to create a bank of questions within the same topic [ext.].
- If carried out remotely, there is still concern for unfair assessment (e.g., someone else taking the assessment on behalf of the intended student) [UM].

### 3.3.6 Time pressure

Supporting arguments

- Time pressure in assessments allows for remote and open book assessments, minimizing the chances that students can collaborate on their assessments [UM, ext.]

Opposing arguments

- Having flexibility time-wise (especially for assignments) have helped with students' well-being, according to educators [UM]

### 3.3.7 Oral exams

Some institutions have used oral assessments, which can be conducted face-to-face or online [ext.]. The questions given in oral exams have to be applicable as well, where students have to give argumentative answers (i.e., elaborate to defend their answers).

Supporting arguments

- When conducted online, it is apparently possible to tell if someone is cheating by reading a piece of text (e.g., eye movements and intonation) [ext.].

Opposing arguments

- Time investment is quite high, compared to having hundreds of students take a written exam in a few hours [ext.].

### 3.3.8 Linear questions

Linear questions are assessments where students cannot go back to a previous question after having answered them [UM, ext.].

Supporting arguments

- This adds a barrier so that students cannot collaborate on their exams. This practice is usually paired with time pressure [UM, ext.].

Opposing arguments

- It introduces rigidity in answering exam questions. Students may think of a different answer later, but would not have the chance to fix their answers [UM].

# Role of the educator 💻

The quality of education rises and falls with the educator [UM]. An educator can wear many hats – a teacher, an education designer, a mentor, a coach, someone that checks in on students' well-being etc. It is important for them to be engaged and committed, because their energy projects onto the students. [UM, Ext]. The increasingly blended form of education requires adjustments from the educator to make use of opportunities that arise when learning is not solely classroom-based anymore. UM students noticed that **"the role of the tutor has intensified and is decisive for the success of the tutorial".** Many aspects of UM educators' existing roles and skills have received praise from the UM community, even while working towards a more blended educational format [UM]. The roles discussed below are not exhaustive, but are ones indicated by the UM community.

## 1.  Achieving intended learning outcomes 🔌

One of the most important responsibilities of an educator is to guide students in achieving intended learning outcomes. Educators should remain vigilant to detect gaps in knowledge and point it out for the students [UM]. When education is completely online, the role of the educator becomes more important. Some UM educators pointed out that it is necessary to be more directive in online tutorials, as the lack of social cues obstructs the natural flow of group discussions [UM]. During group discussions, educators can help students make connections from one topic to another, should they forget [UM]. Educators can also keep a group discussion going by asking, pushing, and pulling [UM].

Students have also expressed preferring the tutor to be present during the entire group meeting, or at least during the post-discussions. Other students explain that tutor presence is especially important in larger groups, because students tend to go off-topic in their conversations.

## 2.  Awarding students' successes 🔌

Recognition and awarding can be very important for students, keeping them motivated in their learning. With the recent changes in education, UM educators have praised the students for having the quality and capability to be independent learners. One way of giving recognition to students is to celebrate their successes and milestones, such as having mid-term and end-of-term celebrations, because doing so drives students to keep on going [UM]. Additionally, vocalizing praises on their contribution and being specific on what went well will enhance their motivation [UM].

## 3.  Helping students learn to learn 🔌

**"Good education is always about the individual… helping them discover themselves, not only in terms of content development and becoming experts in the field, but also personal development"** – *UM educator [UM]*. A UM educator explains that by spending a fraction of time helping students learn meta-cognition, to be aware of what they know, what they do not know, and how they learn, students can develop better study methods, which then aids them in learning other future content [UM]. This practice resonates with an external educator, who further elaborates that PBL should also assess the students' self-directed learning, whether the students know how to find the right information, where to find the right information, and whether they are able to evaluate the information [ext.]. As elaborated elsewhere, self-directed learning motivates students, whereas the explicit articulation of instructor expectations for academic success does not have an effect on students' learning [45].

## 4.  Just-in-time teaching 💻

Studies that had either improved [45], [67] or had a neutral effect [47] on student learning have been incorporating many practices, including just-in-time (JIT) feedback. This means to provide regular feedback as the

students are learning, and not wait until certain milestones are achieved. For example, some studies have students work on an online document, and the educator is able to provide feedback in real-time [45], [47].

## 4.1 Guiding the process

Educators are able to directly influence the way students work together. For example, a UM educator would assign students to a group in the first meeting, later on they would let students assign groups themselves. They also provide their students with optional steps to take in the group work process. Once a student is familiar with the content, the support can be reduced.

## 4.2 Guiding content knowledge

What is interesting about the role of the tutor is that they are in the position to steer the students just-in-time [ext.]. Educators know which topics in are difficult for the students, which gives them the opportunity to anticipate and prepare additional just-in-time information to provide the students with, for example, with a knowledge clip. Furthermore, educators play a role in ensuring that students are searching up information from reliable resources, elaborated elsewhere in this report.

## 4.3 Communication online

Canvas can provide educators with many asynchronous opportunities to keep in contact with the students. Many UM educators make sure that their presence is still visible, through announcements, videos, responding to comments on discussion threads. In a completely online environment, UM educators have suggested to check and respond on the students' discussion forums regularly (e.g. every 1-2 days). This manages expectations as well, to let students know that the educator is available, but not 24/7.

Other ways of keeping in contact with the students include using social media, such as WhatsApp, Microsoft Teams, Discord, and so on, elaborated elsewhere in this report.

## 4.4 Q&A sessions

One study found that student learning outcomes were maintained despite the emergency move online during the COVID-19 pandemic [31]. Their institution used many practices, including having asynchronous discussions via the Q&A platform called *Piazza* and synchronous feedback through office hours held via video conferencing.

### How to organize Q&A's?

Attendance has not been mandatory for Q&A's sessions at UM. Q&A's have an ad-hoc purpose, where only students who have questions attend. Both group and one-on-one Q&A's have been organized at UM, with the latter being a preference for some students who find it difficult to ask questions in a larger group.

In these Q&A's, students discuss materials that they have learnt, specifically on unclear content where they still have questions or where they are curious about. One UM educator used time slots allocated for lectures to have a quiz about the topic (based on content of self-study) in the first hour and a Q&A session in the second hour. These Q&A sessions serve as an add-on, rather than an avenue to provide information that students could have gotten on their own. **"If they have questions, then I become important and then I need to be there, so that's why I have that interaction where we do that"**, explained one UM educator.

Q&A's are more popular when students are actively producing something, such as an assignment or project. Therefore, educators tend to organize Q&A's after students have handed in (a preliminary version of) their assignment. This is where general (anonymous) feedback can be given about what went well and what can be improved, so students can learn from the mistakes of their peers [UM, ext.]. Peer review and feedback can also be encouraged within these sessions.

**Face-to-face or online?**

Online Q&A's have been preferred at UM for several reasons:

- Q&A's tend to be shorter meetings, so having it online is more convenient for both educators and students
- Online Q&A's give educators more flexibility in scheduling
- It is easier to share detailed explanations of worked examples or common mistakes via shared screens to a larger audience.
- Online Q&A's encourage attendance due to its convenience
- Online Q&A's help avoid needless room-bookings.

**When to organize Q&A's?**

Q&A's can be organized when students need it the most. For example, after a lecture, a skills training, at the end of the week, or at the end of the course. For example, at UM, some educators incorporate knowledge clips at the beginning of the week, organize tutorial meetings or flipped classrooms throughout the week, and end the week with a Q&A wrap-up session. An external educator introduced "Ask professor anything" sessions every Friday, where discussions can be academic or about anything at all.

## 5. Taking attendance

Some UM educators do not support attendance requirements. They explain that students should not attend classes just because there are attendance requirements, they should attend classes because they are motivated to learn, because the educators give great education [UM].

Yet, some students and educators support having attendance, because with fewer students, motivation drops, and discussions become less engaging [UM]. Perhaps then the issue is not about attendance, rather, it is about having students being motivated to attend the learning activities.

Still, attendance can also be one way of checking that the students are doing okay, especially in online education, without the attendance counting towards the students' final grades [UM]. Thus, the role of attendance is student-centered and serves to help the student, rather than to control the student.

## 6. Checking-in and reaching out

Educators can also connect with students on a more personal level. Checking in and reaching out is also important for student well-being, elaborated elsewhere in this report.

## 7. Mentality of an educator

Educators should be enthusiastic about student learning. Students have complained that having non-passionate tutors affects their well-being. **"Some tutors don't seem to like to be a tutor, which is very demotivating"**. As we have explained elsewhere, it is important for educators to be able to self-direct their teaching and be rewarded and recognized for a career trajectory in teaching.

Furthermore, educators should also have a mentality of continuous learning. Educators are students themselves, especially when education development is rapidly ongoing. We discuss trainings for educators here.

## 8. Provide expertise

A number of educators and course designers have been suggested to be experts with real-world experience, allowing them to design education around real problems that expose students to the industry. Experienced educators may also be able to bring in contacts, connecting education with the real world [UM, Ext]. If tutors are not experts, then they should at least be guided by an expert who is responsible for designing the intended learning outcomes, designing the assessment of the intended learning outcomes, and preparing all the other tutors [UM].

Expert or not, tutors should be well-versed in the students' recommended reading list, so they are able to guide students in tutorials [ext.]. When educators are passionate and enthusiastic about the topic, this motivates students and gives them confidence in their learning. One UM educator explained that, **"If they (students) have questions, then I become important and then I need to be there"** [UM]. Additionally, it's important that the tutor knows the role of the course in the curriculum, to be able to address this during tutorial meetings [ext.].

> **"The role of the tutor, since they have such intensive contact with the students, are able to guide, facilitate and provoke discussion among the students, but it is their interaction, their engagement that is the center of the whole learning process, their active involvement".**
> – *UM educator [UM].*

## 9. Personal and professional development 🔌

Education is more than just academic content, it is also about the students' personal and professional development. We elaborate on these elsewhere in this report.

## 10. Regularly asking for student feedback 🔌

Feedback does not need to be formal and scheduled. Teachers can learn a lot by just chit-chatting with the students. In order to receive good feedback, the teacher has to

- Create an open and safe atmosphere
- Build a good community where students and teacher do things together
- Show appreciation for what the students say

## 11. Training 🔌

Educators are students too. Just as we advocate for lifelong learning to the students, educators need to continuously develop themselves, personally and professionally. With the fifth industrial revolution knocking on our doors, educators should continue to educate themselves on good educational practices and opportunities. More information is provided in the sections 'On demand - didactical support' and 'Training for teachers'.

## 12. Communities of practice 🔌

A community of practice is where educators can come together as a group, with the aim to enhance each other's education practices. A community of practice can serve as a platform to connect educators, where they can share and disseminate knowledge. By setting educational goals, each member of the community strives to better the education that they design, deliver, and assess. For example, by sharing creative ways to better education in a CCCS manner.

The Vice Deans of Education have set an example of forming communities of practice. During the beginning of the pandemic, Vice Deans of Education would have 2-hour meetings once or twice a week with the education management team, the faculty boards, the faculty councils, the education office, the board of examiners, innovative educators, technology pioneers, and students as well. These meetings were meant for the Vice Deans of Education to learn from others and to share and disseminate information, with the end goal of providing quality education.

Having a network to learn from can be valuable, especially during moments of rapid education development. The members of the network may be educators from the same course, faculty, and institution. At the same time, it is highly beneficial to form national and international networks, to bring a broader perspective when focusing on developing education. UM educators with national and international networks were introduced to innovative practices such as having remote assessments of skills, virtual reality, serious games, and so on – just as we have benefited at EDvance from our external partners.

In the next sections, we cover ways of organizing communities of practice.

## 12.1 Programmatic design

As we have explained in the design of education, programmatic design can bring educators together to collaborate on delivering intended learning outcomes that are aligned across the program, with learning curves explicitly thought out for the students. This presents a good opportunity for educators to connect, work together, and exchange information, naturally forming communities of practice.

## 12.2 Staff meetings

Monthly staff meetings are great for forming communities of practice [UM]. In these meetings, the progress of education can be discussed, including delivery and assessment. Here, educators can make the best use of the contact time by taking stock of every educational activity, novelties, and good practices. For example, by sharing interesting findings whether through articles or experience. Minutes of these meetings are then shared where the distilled information is structured thematically [UM].

## 12.3 Small group collaborative learning

Although staff meetings provide a good opportunity for forming communities of practice, these meetings tend to be made up of large groups (e.g., 25-30 educators). Similar to how it is advocated for student learning, smaller groups are better for learning as it encourages active participation and more intimate connections.

There are many ways to form smaller groups. For example, by having the staff meeting break up into smaller group. Yet, educators can come together in informal sessions as well.

## 12.4 Diversity and inclusivity

As elaborated elsewhere, diversity is important in an education design team. The same advice is given when educators need to learn good educational practices from each other. Therefore, we recommend to include diverse expertise and backgrounds into communities of practices and to join various (more than one) communities of practice.

At some parts of UM and at another university, there is a buddy system/mentorship program, where early career educators are paired with an experienced educator, so information exchange can occur [UM, ext.]. On the one hand, the experienced educator can show the ropes and share established good practices; on the other hand, the early career educator can share novel experiences and recent findings.

## 12.5 Online platforms

Online platforms allow for educators to share information and learn from each other. At some parts of UM, educators have set up Canvas courses for educators, to share valuable information on good educational practices and to discuss practices with each other [UM]. Some UM educators also come together on Microsoft Teams to share good practices as well, where information is disseminated through posts, files, chats, and more. At other universities, blogs and databases have been set up to create an archive of good practices [ext.].

## 12.6 Learning initiatives

Both at UM and at other universities, we have seen learning initiatives set up to encourage open dialogue and discussion. For example, the Teach Meets at EDLAB and CPD co-creation workshops. More concrete examples of these sessions include "The good, the bad and the embarrassing", where educators share good and bad practices, while being vulnerable with revealing embarrassing occurrences in education. This allows educators to realize that they are not alone in their teaching and opens up opportunities for genuine connection between educators.

**Part 2**

# At the curriculum level

## Management 🔌

### Visions on education

UM's vision on education focuses on offering innovative and high-quality education that promotes active learning to construct academic and professional knowledge, skills, and attitudes, which prepares students for the global labor market.

Alongside this vision by the university, our educators also hold more visions on education. **"We want to educate our students to become lifelong learners"** – *Prof. dr. Mirjam oude Egbrink, Vice Dean of Education, FHML [UM]*. To achieve this aim, PBL's CCCS principles (i.e., constructively, contextual, collaborative, and self-directed learning) pave the way for students to learn continuously even after graduation, by ensuring that students are able to learn both independently and collaboratively with others.

Furthermore, educators aim to deliver student-centered education. **"Do whatever it takes to make it happen for our students"** – *Dr. Hanne Diliën, Vice Den of Education, FSE [UM]*. This has been echoed by colleagues from another university: **"Placing the student at the center is the most basic thing."** – *Dr. Esmeralda Campos, Tecnologico de Monterrey, Mexico [ext.]*.

In the past year, there has been an increasing blend of face-to-face and online educational components. One UM educator adds that there should also be harmonious integration of both face-to-face learning and ICT components, with an emphasis on inclusion [UM].

Overall, it is clear that many educators have ambitious goals for education. With EDvance, we hope our findings and recommendations will help advance these goals.
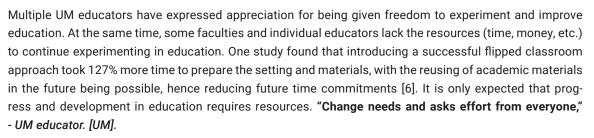
# Implementation of good practices 💻

Prior investments have fueled the implementation of good practices in design, delivery, and assessment at UM. The literature and interviews of EDvance provide a variety of foci of investment, from technological investments, areas of educational experimentation, and institutional collaboration.

## 1. Investment in educational technology 💻

Many of the successes in UM's education have been made possible through technology, an important part of education at UM, even prior to the pandemic. Investment examples include adopting Canvas as a learning management system, creating digital taskforces at many faculties, and so on [UM]. Studies that have successfully implemented blended education have also reported institutional investment in regularly-updated resources, software, cloud storage, staff, and a renewed and committed management structure [26]. Many UM educators indicate that, in order to execute quality online education, basic infrastructure needs to be covered, such as having a good internet connection, equipment, and software. When education incorporates more digital elements, it is also important to ensure that education remains inclusive and open to everyone [UM].

The UM community has requested for continuous investment in technology. For example, by providing licenses for useful software, such as Zoom, Microsoft Teams, Camtasia [UM]. When creating content for students, software programs are needed for authoring, illustration, and audio development [25], [26] Educators may encourage digital participation through laptops or mobile phones [89], but that would also require that either the student or the institution invest in digital devices. For example, installing quality microphones in all tutorial rooms [UM]. Other institutions, for example, prepare (Wacom) tablets for their educators and students so that they can visualize complex theories (e.g., mathematical models) [Ext.].

## 2. Providing time and resources to educators 💻

Multiple UM educators have expressed appreciation for being given freedom to experiment and improve education. At the same time, some faculties and individual educators lack the resources (time, money, etc.) to continue experimenting in education. One study found that introducing a successful flipped classroom approach took 127% more time to prepare the setting and materials, with the reusing of academic materials in the future being possible, hence reducing future time commitments [6]. It is only expected that progress and development in education requires resources. **"Change needs and asks effort from everyone,"** *- UM educator. [UM].*

Currently, UM educators can and have enjoyed developing education, but these efforts are not sustainable [UM]. When the workload of educators is high, they focus on executing the course, leaving them with no time to work on improving education, for example, by joining a community of practice to learn and develop their educational knowledge and skills [UM]. This is shown in the reduced attendance numbers of lunch lectures for staff, for example. As a consequence, educational activities are then adjusted to a less innovative and/or interesting format. Resources, whether time, money, people, and so on, are needed to support education development and innovative teaching methods [UM].

Every teacher is given norm hours, i.e., the hours given to staff members for performing educational tasks. These norm hours have not reflected the real hours invested by educators [UM]. Time is needed to update the ever-changing course materials to ensure that it is still contextually relevant to today's society. Furthermore, administrative tasks, such as filling out forms with students' exam grades then sending these grades to the exam office is time-consuming [UM. Furthermore, the increasing number of students have also been demanding in terms of workload [UM].One way of recognizing and rewarding educators is to allocate more time for education development and innovation [UM].

Time can be saved through a variety of clever methods. First and foremost is to always design quality education that is future-proof. Another way to increase time is to introduce more automatization of manual work, for example, in terms of planning, processing grades, in terms of feedback [UM].

Educators have indicated what they would like to use time for:

- Creating quizzes or online sample tests in Canvas [UM]
- Creating an interactive modules in Canvas [UM]
- Developing and recording knowledge clips [UM]
- Structuring a lecture [UM]
- Developing "active learning". This takes double the amount of time compared to lectures [ext.]
- Creating and grading exams that are sufficiently individualized for students [UM]
- Designing a way to do peer assessment well, to deal with increasing student numbers [UM]
- Improving current assessment material for sustainability [UM]

When time remains a challenge for educators, there are other opportunities for education development. For example, the UM Honors program has always been a place for education innovation, where good practices developed meant to be rolled out to regular education [UM]. Similarly, at other universities, a central body is funded for the development of innovative education, allowing them to run independently without the constraints of needing to justify every decision [UM].

## 3. Investing in our students 🖥

UM students have requested to have more study spaces. One UM student explains, **"Promote physical locations and options more. Students are stuck in their tiny rooms and the barriers between private life and uni are fading. Their (bed)room is also an office and classroom,".** This is especially important during the COVID-19 pandemic.

Furthermore, organizing more online education requires online resources. Students require access to online resources, such as journals and electronic book copies [UM, ext.]. To promote self-directed learning, a UM educator has also suggested allowing students to take courses from other faculties, which then requires investment in open-access education [UM].

## 4. Faculty-specific needs 🖥

Different faculties can have different needs, requiring different funding in their educational activities [UM]. For example:

- Some programs involve more skills training than others.
- Some programs have to adhere to national qualification rules in order to issue diplomas to students.
- Some programs require assessment to be done in person or with proctoring, due to the nature of the academic content (e.g., mathematics), whereas other faculties are more flexible in assessing their students on writing, speaking, and research skills.
- Some faculties are growing at a fast pace, requiring larger facilities to accommodate the students.
- Some programs have an increasing need for internationalization, where students collaborate with others around the globe
- Some programs require students to attend courses from other universities, while other programs provide courses to students from other universities
- Furthermore, every faculty has its own culture, with different expectations of how far the educators are willing to go above and beyond [UM]

## 5. Institutional collaboration 💻

UM faculty members have encouraged further national and international collaboration [UM]. Institutions need each other to efficiently develop educational materials, for example, to develop an e-module, a serious game, a virtual patient, virtual reality content, and so on. For some skills (e.g., clinical, debate, etc.), it is important for students to access different resources [UM].

One possibility is to work together with commercial organizations, for example, YouTube or Coursera, since they have more experience in developing educational videos [ext.]. These providers are apparently active in reaching out to other higher educational institutions in Europe to take on the role of providing content [ext.].

# Educational support services

In times where education is rapidly developing, both educators and students can benefit from education support services. Various types of support can be provided, from top management, to didactical and technological support on request, to providing training for both educators and students.

## 1.    (De)centralized support

As emphasized elsewhere, a diverse team is needed when designing education, where educators provide content knowledge, while receiving didactical and technological support from instructional designers and from instructional technologists [ext.]. UM educators have requested for both centralized and decentralized support centers, which also exist at other institutions [ext.]. At another institution, 80% of educators were found to have used their centralized support, serving as a one-stop support center where educators can receive advice on all types of support [ext.]. On the other hand, decentralized support centers can give more specialized support.

## 2.    On demand - Didactical support

Didactical knowledge can serve as the starting point when designing education. The extent of support needed differs from case-to-case [UM]. Some educators request quick and easy guides or videos, some educators request course blueprints, others request for help where an educationalist or technologist holds their hand through the design of courses [UM].

### *2.1 Support material*

A systematic review by Stefaniak (2020) describes the instructional support needed for online education [98]:

**1. Perception of utility**

   a.  Support in helping educational activities align with the competencies of students
   b.  Support in making educational activities flexible to stimulate a sense of autonomy in students.

**2. Perceived resources**

   a.  Support in learning management systems
   b.  Support educators in having accessible communication with their colleagues and other stakeholders

**3. Transfer coping strategies**

   a.  Providing tools needed for managing educational activities
   b.  Providing discussions that align educational activities with intended learning outcomes.

**4. Social support**

   a.  Helping educators and students build a sense of community through virtual team meetings or forums.

Other types of support have been given by educators as well [UM, Ext]:

• Quick and easy guides/modules/knowledge clips on various aspects of course design, delivery, and assessment [UM].
• Checklists on education design that upholds the CCCS principles [UM].
• Blueprints on education design. Although Canvas does provide a blueprint for courses [UM], UM educators have requested for more practical guidelines for designing a good course [UM]. This has been provided at other institutions [ext.].
• Sharing best practices. For example, online teacher communities, blog posts (by staff for staff), or Canvas courses were made to share good practices in education [UM, ext.].
• A simple FAQ (frequently asked questions) directory [ext.].
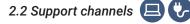
- ECTS calculation. At other institutions, simple Excel files are provided for the calculation of ECTS [ext.].
- UM educators have requested a place to experiment with educational practices [UM]. One way of doing so is through the Honors program.

### *2.2 Support channels*

There are many ways that didactical support can be provided to educators.

### 2.2.1 Consultation

Consultation meetings with didactical experts can be provided to educators. At another institution, three types of services are provided that can exemplify consultation services:

- Detailed consultations, where 45-minute chats are provided with support services.
- Quick wins, where the teacher comes in with the intention of redesigning and developing one part of their course (e.g., assessment, assignment, etc.).
- Design sprints, which are 1½-day interventions to go through the whole design process for a course.

### 2.2.2 Hotlines

A 'teachers' hotline can be very helpful, where educators can ask educationalists or students for help via phone or email [UM, ext.]. Where necessary, the educators can be directed to more specialized support, such as logistics support, ICT support, assessment support, and educational support. These hotlines have been used for general purposes *and* in moments of education emergencies.

### 2.3.3 Didactic training

Didactic training or teacher training is provided at UM through introduction to PBL, tutor training, the University Teaching Qualification (UTQ) training, Continuing Professional Development (CPD) training, and so on. At other universities, training is also provided to educators on didactical skills, both in terms of content and the use of technology [ext.].

Didactic support task forces within each faculty have also been giving presentations and symposia, to share their knowledge with educators [UM]. This manner of continuous teacher training has also been conducted at another university, where informative educational sessions are organized each semester to share the ins and outs of education [ext.].

### 2.3.4 Faculty-specific assistance

At an external institution, learning and innovation support teams were set up within each faculty, which provides practical educational support by answering questions [ext.]. At UM, faculty-specific support has been useful during times of dynamic education development. A UM educator explained that having an assessment specialist at the **faculty** has been very helpful to rapidly implement necessary changes [UM]. For faculties that currently do not have large faculty-specific didactical support, building those support is expected to help with their growth and optimization of education [UM].

### 2.3.5 Information dissemination

With rapid developments in education arising in recent years, we need to continuously update educators on latest findings and how to execute good education practices. Other universities have provided an accessible database for learning activities, active learning, learning activities [ext.], while the support centers regularly send out newsletters containing bite-sized information on good practices [ext.]. On a more personal level, tutors can also be informed or reminded of various teaching methods through their tutor instructions for each course [UM].

### 3.   On demand - Technical and technological support 💻

With the fifth industrial revolution on the horizon, educators may need support with various new and existing technologies. A recent example at UM was how the Canvas support team has helped educators immensely during UM's transition from Blackboard to Canvas as a learning management system [UM].

Similar to the support channels suggested for didactic support, technical support can come in the forms of consultation, hotlines, training, faculty-specific support, and information dissemination. At UM, a technical help desk for students and educators has been set up to support acute technical problems [UM]. At another university, a centralized support body provides information on the available technologies and detailed support on how to use these technologies (e.g., "what buttons to press")[ext.].

#### *3.1 Video-making* 💻

These days, the skill of video-making is increasingly expected of educators [UM]. Some UM educators have even been venturing into virtual reality. However, most educators are not experts (yet) in making short, attractive, and informative content clips, as the experience of preparing these clips is very different from preparing a lecture [UM]. Many UM educators have indicated needing professional support in video-making [UM].

Several external institutions have set up dedicated professional teams to support teachers in video-making. Advice is given on how to create short clips. The educator submits a script of a certain length. The team of graphic designers (mainly made up of students who are trained and paid) then create the graphics for the videos and add text to it. A professional narrator narrates the audio, while AI transcribes the voiceover to create subtitles. The purpose of this is to create professional products that are future-proof [ext.].

#### *3.2 Live event moderator* 💻

With the increasing use of live lectures and video conferencing, the role of a moderator can contribute to a smoother experience for the audience [UM, ext.]. The lecturer can focus on their presentation and information transfer, while the moderator manages the incoming questions via chat, logistics, security, connection, and the presentation slides where necessary. Although moderators can easily be another educator or even a student, a trained moderator can provide guaranteed support, especially when dealing with large audiences.

### 4.   Training for Educators 💻

Lifelong learning is not only meant for students, but for educators as well. Importantly, the quality of education rises and falls with the educator [UM]. Teacher training is available both at UM and at other universities. An external institution even provides their educators with yearly training, to regularly update their knowledge as educators [ext.].

#### *4.1 Teacher training at UM* 🔌

UM offers various teacher training, starting from the introduction to PBL, to tutor training, to teaching trajectories such as UTQ (University Teaching Qualification) and CPD (Continuous Professional Development). Still, these trainings are only one step into maintaining teaching standards at UM. Further training includes regular informal meetings such as teach-meets and having communities of practice to provide opportunities where educators can learn from each other [UM].

These days, faculty development workshops are more interactive, focus on application, and encourage the discussion of cases. Other than sharing best practices through cases, individual educators can also bring in examples from their teaching to share and garner advice from the others. Activities include role-playing, discussing critical incidents, sharing experiences, going in depth on a specific topic that a participant brings up, and so on. Similar to education provided for our students, these teacher training also promote the CCCS principles.
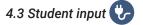
### 4.2 Peer coaching

At some parts of UM, educators pair up to share and improve on their educational practices. They may ask each other, for example, **"how do you design your education?"**, **"how do you deliver it?"**, **"how does your assessment look like?"** and **"why was it a struggle designing it?"** [UM]. This way, educators are not alone and keep each other accountable to always strive for growth and improvement.

### 4.3 Student input

> **"Their input is really input that helps the group forward"**
> *– UM educator.*

There are various ways to gather student input to improve education. The simplest among them is to just have a chat with the students, whether in the classroom or not [UM]. Other ways include to appoint a student representative and make time in a dedicated meeting to ask them for feedback. Student feedback may be gathered through anonymously on a regular basis, and not necessarily scheduled at the end of the course. Students have suggested to provide an online box of suggestions. Another innovative way to understand the student's educational experience is to "shadow a student", where an educator walks along with a student for a day, to get a sense of what it's like to be a student.

### 4.4 Content of teacher training

Topics for teacher training that have been suggested by the UM community include:

- PBL training
  - CCCS principles
  - Education design
  - Tutor instruction, including how to activate prior knowledge, structure group discussions, keep discussions on track, and ask challenging questions
- How to give an online lecture
- Assessment
  - How to ensure fair assessment
- How to design good multiple choice questions
- Student contact
  - Soft skills (e.g., how to be approachable to students)
  - Well-being training - identifying red flags and how to approach student well-being
- Technical and technological knowledge
  - Software and program use, such as Zoom and TestVision
  - Video-making

### 4.5 Communities of practice

Coming together as a community helps educators learn from each other in a more structured and social manner. We elaborated about communities of practice elsewhere in this report.

## 5. Training for Students

Education can be so much more than just content knowledge. Students also need personal and professional development, such as training on professional skills and navigating careers, among many other skills.

> **"I think my students understand that I'm their champion, that I want them not only to rise but to soar. But I also want them to be good people, moral leaders who have a positive impact on the world."**
> *– Prof. Dr. Timothy Patrick McCarthy, Harvard University.*

## 5.1 PBL training

Considering the fact that PBL is a huge part of UM, students have expressed appreciation for the PBL training that is given to them, to acquaint them with the PBL process. Previous studies that successfully implemented new pedagogical models also assisted the students' transition by providing guidelines on tips for success in the course and in group work [6]. Although we did not find studies that compared training vs. no training, our students, especially the Masters students, have expressed their need to be trained in PBL skills. For example, one student praised their professor, **"the professor for my first course... he did an introduction to PBL for all students. And I think he did it really well, so the first lecture before we did anything, was on PBL... (for those new to PBL). He would make us start tutorial 40 minutes earlier already, do the discussion beforehand, before you bring it to the big group, because he said,** *'oh okay, you don't know PBL in person and online it's even more difficult than PBL in person.'* **So he said** *'I want you guys to get more comfortable with each other and kind of develop how you want to have the discussion, who speaks or when'.* **Definitely not perfect, but I think for him, that was a really good way to get into PBL".**

## 5.2 Collaborative learning

It is important to teach collaborative learning, if it is expected of students and assessed [UM]. The types of collaborative learning training include social skills, learning to be accountable and to be able to address peers on accountability, learning to have a collaborative responsibility to finish group products successfully, learning to handle a conflict with peers, learning to hold different group roles [UM, ext.].

When students are expected to lead the discussions, they can be given training on how to lead as well. At an external institution, the student(s) who will chair the meeting meets with the educator a day or two before the class to discuss their plan of leading the class, or "choreographing the class". Topics that are discussed include how to navigate the discussions, how to design conversations, what is the opening prompt, how to provoke questions, challenges, or problems, and how to reach the end goal. The educator can then give guidance or advice on best practices and common pitfalls [ext.].

## 5.3 Creativity

One UM educator highlighted the need to provide training on creativity and how to brainstorm efficiently. This is because the educator sees "solving problems" as an essential skill in everyone's careers, a skill that has to be taught at university. **"Creativity is very important in a very complex world because all the problems we are facing are wicked problems, problems without a clear solution".**

## 5.4 Professional behavior and career services

Students should be equipped with skills to prepare them for the labor market. For example, skills on managing emails and other means of communication, time management, and so on.

With regard to the valuable support provided at the career services, students have requested to have more than the current three meetings limit. Students expressed that they need support in the job-search process and appropriate support for non-EU students to cope with the overwhelming regulations that they face.

## 5.5 University matters

Students have also requested simple explanations on how to submit general complaints, appeals, and objections (including grades, course design, university decision, etc.) at UM.

## 5.6 Peer support

Students have requested training to support their peers. A student explained, **"Training students so that they can offer low threshold (support)... It breaks that initial barrier of recognizing that you need to actually seek help".** For more information on well-being, see elsewhere in this report.

# Socialization and well-being in education: Recent experience at UM 💻

Times of uncertainty such as COVID-19 have emphasized the importance of socialization and well-being in education. Through times of social-distancing, we have learnt to intentionally create a sense of community even in an online setting. In difficult times, students can receive support from many sources - fellow peers, mentors/coaches, study advisors, educators, study associations, and psychologists. The visibility of these sources of support are important (e.g., via Canvas, student emails, student associations, social media marketing), so students have a variety of options to reach out whenever they face problems [UM, ext.]. Whereas some recommendations are given, we acknowledge that the evidence in the following paragraph is mainly based on anecdotic evidence. However, the lessons from the recent period with regard to well-being should not be forgotten.

## 1. A sense of community 💻

Building a sense of community contributes to student well-being, which then enhances the students' university experience. Here, we cover a few ways to create a sense of community.

> **"Good teaching is about connection. It's about making a connection between yourself as a teacher and your students but also between students themselves with a group."**
> *– UM educator*

### 1.1 Meeting face-to-face 🔌

Although there has been a heated debate on face-to-face vs. online meetings, here we emphasize that in-person meetings are important when creating a sense of community [UM]. According to UM educators, students themselves want to meet up in a physical environment as well, for example, over coffee or simply meeting in the corridors between classes [UM]. Indeed, the interviewed students have expressed that physical contact is important when building friendships and networks. Meeting on-site created **"the opportunity to ask extra questions and see students, to know your tutorial group better"**, explains a UM student [UM].

> **"One of the perks of being in the Law faculty, that in our city is a very nice building that certainly for international students serves as a home almost. The building is a big part of the community at the Law Faculty."** *– Dr. Sjoerd Claessens, Vice Dean of Education, Law Faculty [UM].*

### 1.2 Small groups 🔌

Multiple UM educators have emphasized the importance of small group learning for student well-being [UM]. At some parts of UM, first year students are kept together as a tutorial group for more than one course period (20 weeks), so they get to know each other very well and experience different tutors together. This is combined with a training in professional development, where students learn, for example, to have difficult conversations about values and expectations [UM]. This practice creates a tight-knit group that learns together. Other ideas on small group collaborative learning have been elaborated elsewhere in this report.

### 1.3 Social media 💻

When face-to-face communication is not possible, students made use of online discussion forums more frequently [35]. When it comes to forming friendships, a UM educator suggests creating an exchange platform that offers opportunities meeting people, where students can make requests, for example, to find a study mate or to meet up over the weekend [UM]. Yet, students hardly made use of social media apps that were offered by the university (e.g., forum discussions or Microsoft Teams). Rather, they would go for more popular apps such as WhatsApp, Google Hangouts, Instagram, Facebook, Discord, or Slack to collaborate, because they prefer to have a more immediate contact, compared with asynchronous question and answer forums on Canvas. Some educators have tried to bridge the gap by connecting with students through popular social media platforms, such as Discord, so they are more aware of the students' well-being and learning progress

[UM, ext.]. Outside the classroom, students tend to remain connected with each other through WhatsApp groups. **"It was helpful to ask others in the class about how they are dealing with problems"**, explained one UM student.

### 1.4 Social activities

It is important to promote social activities at the start of the academic year, explained by UM students. When students are not integrated from the start, the barrier for integration gets higher and higher. Students have expressed wanting more information on monthly social activities. **"Let students know what social activities take place every month"**, one student requested.

One strong request by students was to have UM help in sharing social events, specifically through Canvas. **"Canvas is usually the most effective manner to reach students directly for social activities. However, UM prefers not to use it as much. However other alternatives like newsletters have much lower click rates"** – explained one student. Through Canvas, student associations are able to reach every student, so they can invite students to meet and connect with other students. Furthermore, student associations should be kept in the loop of current (pandemic) regulations, so they are able to align their events accordingly.

## 2. Support from peers

### 2.1 Peer supporters

UM students have suggested creating groups of peer supporters in all facilities to lower the threshold for seeking psychological help. This can be done by providing students with training to support each other on their mental well-being. At some parts of UM, mentor systems are used, where a first-year student is coupled with a second or third year student, so the students can bond and the first-year student receives information on where and how to receive further support [UM].

### 2.2 Student associations

**"Empower social organizations"**, requested a UM student. Students have expressed that student associations should be given more support and funding, because student associations keep students connected with each other, thus protecting the students' well-being. Many social events organized by student associations are easy-going (e.g., quiz nights, park hangouts, etc.), thus lowering the barrier for students to connect. As emphasized elsewhere in this report, student associations have requested access to reach students through Canvas,

## 3. From educators

These days, educators can also play a role in supporting students' well-being [ext.]. Although many educators do want to support their students, the workload that they face, especially over the pandemic, has limited the support that they were able to provide. Hence, once again, we emphasize that there are many sources of support for the students, which busy educators may refer their students to. Nonetheless, we provide some recommendations below on how educators can still support students.

### 3.1 Training

Students have expressed wanting educators to invest in their well-being, for example, by identifying red flags and being able to approach them with regard to their well-being. Students have suggested providing educators with training to increase their skills and awareness on well-being. Furthermore, educators should be aware of the type of support provided by the university, so that they can refer students to the necessary support bodies [ext.].

### 3.2 Checking in 💻

**"A good tutorial stands and falls with having a good learning environment,"** explains one UM educator. By regularly showing compassion and checking in with the students, educators can create a safe environment for students to express and learn collaboratively. Checking in with students pays off in engagement throughout the course, explains a UM educator. One study compared students who only interacted with their educators on content-related matters with students who received interpersonal and social feedback from the educator, all via a learning management system. The students with more personal contact with their educator had better academic achievements and showed a higher level of participation in the forum discussions [41].

Tutors can check in with students by asking how the students are doing at the beginning of the tutorial, during the break in the tutorial, and/or at the end of the tutorial [UM]. During online conferencing, it may be all too easy to leave the call and move on to the next meeting. However, some UM educators advise tutors to stay behind for a bit, just as tutors would in a physical setting. Then, this may strike up the opportunity for students to approach the tutors [UM].

When online, it may be more difficult to detect social cues due to the limited non-verbal communication [UM]. Hence, tutors are encouraged to set ground rules from the beginning of the course, for example, by requesting to be able to see and hear every student (i.e., cameras and microphones turned on). More on (n)etiquette elsewhere in this report.

UM students have also expressed appreciating when educators check in on them. One student explains, **"it creates room and you do see this room, like someone is interested in you, someone does care about your mental health, your struggles, your anxiety"**. The student goes on to explain that, if students are not comfortable sharing, that is fine, we can just move on to the next student. The important point is to create a safe and comfortable space to come forward with their whole self. This can also lead to more private one-on-one conversations, to tackle heavier issues.

Other practical tips include:

- Having a one-on-one evaluation with the students halfway through the course, to check in with them, but also to provide formative feedback on their PBL process and CCCS-learning.
- Connecting with students beyond the classroom (e.g., via email, Canvas, or social media). It is important for educators to be visible, so students are able to reach them for questions or in times of emergency. Feeling connected with the educator may motivate students to continue being active in their group participation too [UM].
- Get to know students on a personal level. For example, knowing what their hobbies and interests are so that educators can relate the academic content to their personal interests. Although these can be done through checking in with the students, some educators have also administered surveys [UM].

### 3.3 Reaching out 💻

Students appreciate it when educators make time for them. At UM, many educators have thought of creative ways to reach out to students. For example, in order to make themself visible so students can connect, one UM course coordinator regularly showed up in tutorials to ask how the students were doing [UM].

Small gestures can go a long way in supporting students in their well-being. As an educator, what helps is to place oneself in the situation of the student and think about what they would need. Then, we may notice issues that we usually take for granted, e.g., feelings of social exclusion and loneliness [UM]. Educators can also make their presence more visible by regularly relaying messages (whether face-to-face or via short videos announcements) such as **"How are you doing? This week, we will cover the topic of XYZ. I hope you still remember ABC from last week! Watch this knowledge clip/Read this article for an overview."** [UM]. At universities, educators administer regular online surveys through their learning management system to check in and intervene should students report that they are not feeling well [ext.].

During the pandemic, some educators sent students seeds to plant, with the intention that planting seeds would be therapeutic for the students [UM]. Some educators also took notice that some students were in a different time zone and adjusted the timing of the tutorial to a more appropriate one [UM].

Students have expressed wanting to spend time with their educators. Some students even requested for weekly coffee breaks or breakfast (possibly via video conferencing) with their educators. In order to connect and understand students, some UM educators have initiated outdoor walks, for example, during the mentor sessions, and some even go to the extent of inviting students to their homes for a chat, with cookies and tea. Of course, this is not to say that every educator needs to do the same. The main point is to make an effort in connecting with the students.

### 3.4 Education activities

Well-designed education can serve as a source of well-being as well. Education should be about meaningful learning activities, learning progress, and learning experiences, and not about grades [UM]. Students should be given a larger perspective of the academic world that they are in, that there are some things that are more important than others, so they can set priorities straight [ext.].

Among the many possibilities, well-designed education can contribute in the following ways:

- In line with the self-determination theory, some external educators have suggested removing deadlines and giving students more flexibility in handing in their assignments [ext.]. This idea also aligns with self-directed learning, which has been argued elsewhere to enhance student motivation.
- For more mature students (i.e., those who have years of work experience), online sessions have been reported to help with their reintegration into the classrooms [ext.].
- Structure helps students to manage their expectations, so they can plan their lives accordingly. See elsewhere in this report for an elaboration on structure in education design.
- Small group collaborative learning is also important to stimulate a sense of community, elaborated elsewhere in this report.

## 4. From mentors/coaches/study advisors

Although there are different definitions used for mentoring, coaching and study advising, we found that these terms were used interchangeably in our interviews. Therefore, from here onward, we use the term "mentoring".

Mentoring can provide students with a trusted person, with the topic of discussion and frequency of meetings depending on the students' needs. Mentoring allows students to develop themselves personally and professionally [UM]. The topics covered in mentoring include study-related issues, building personal networks, professional development, career progression and so on. Having a mentor can help with group processes as well, for example, on how to collaborate, the roles taken up, and how to manage with diversity in the group. Students can also confide in their mentor when they face problems. Mentoring helps detect problems early on [UM]. For example, mentors can help students find ways to avoid stress or homesickness, before a problem actually prevails. Interestingly, alumni students can be very well used as mentors, to bridge the gap between the study program and the job market.

According to students, having small, informal mentor groups of 4-5 students worked well to discuss their issues. At the same time, students want to be seen as individuals as well. Some educators highlight that first-year bachelor or master students are especially in need of mentoring, to help them integrate into university life [UM, ext.]. However, at some parts of UM, there is a continuous presence of a mentor throughout the program, especially when education is mainly delivered online.

However, a recent study did find that mentoring during the pandemic did not change students' perceptions of online education nor their well-being [99]. Therefore, other sources of support may still be needed to assist students through these harsh times.

### 5.    From UM psychologists 💻

The UM psychologists have been a valuable source of support for students, which is highly recommended by educators as well [UM]. However, UM students have also expressed needing more psychologists, more free sessions, and better quality support. One student explained, **"UM psychologists are always overwhelmed. It is too difficult to get appointments and appointments are canceled without notice. They don't respond to emails for follow-up"**. At other universities, one way of alleviating the burden on UM psychologists was to set up a phone line to provide emotional support through calls and chats [ext.]. At some parts of UM, WhatsApp groups were created between students to share problems that they face among peers [UM].

### 6.    Well-being initiatives 💻

At UM, the **Well-being Movement** offers a wide variety of activities and workshops, available for students and educators [UM]. Other institutions have also provided similar support within their organization, such as rolling out online sports activities, painting classes, etc. [ext.].

# Well-being support for UM's educators 🔌

In order to provide quality education to students, it is also important to care for the well-being of our educators.

> **"I think that usually when the professor lives a healthy life, then it is more prone to let students be relaxed, and to understand students, and to be more empathic. So, I think that focusing on the well-being of professors will eventually lead to the well-being of students."**
> *Dr. Esmeralda Campos, Tecnologico de Monterrey, Mexico [ext.].*

## 1. Work-life balance 🔌

In these dynamic times with vast socio-economic changes, many educators go the extra mile in an attempt to deliver the best for their students. Although the intentions are good, this can create two problems: one, it becomes harder for the educators themselves to maintain a healthy work-life balance; and two, it unintentionally creates the culture for other educators to work unnecessarily long hours as well. For the latter, an external educator has advised that long hours do not equate to quality work. Rest and relaxation is just as important when the aim is to deliver quality education. **"We don't work 24/7, we work 9 to 5. We work hard and we play hard,"** explains the educator [ext.], **"It is important to make clear, yes, we like a challenge, we're ambitious, we really want to give it our all. But once we have done that then we go home, enjoy cooking, go for a walk, relax then the next day we get back to it."**

In terms of educational tasks, educators can receive support from various parties. From the UM central level, it is important to communicate expectations of staff members clearly (i.e., that they are not available 24/7), both to students and staff [UM]. Furthermore, program and course coordinators should be supportive in listening and addressing issues brought up by the teaching staff, whether it is about the students, the work, or themselves as individuals [ext.].

In terms of delivering education, educators can also be given freedom and ownership in their teaching [UM]. Just like how students are encouraged to self-direct their learning, educators should also be encouraged to self-direct their teaching, as long as the intended outcomes are achieved [UM].

Finally, educators can benefit from many of the advice given to students, including:
- Finding support from peers.
  - Creating communities of practice. Here, educators can share problems that they face, where they can receive support and solutions [UM].
  - Checking in. During staff online meetings, do not forget to check in with each other in a genuine manner [ext.].
- Reaching out. Similar to how students benefit from being in contact with educators, educators have also expressed liking meeting with students for the sake of their well-being [UM].
- Joining well-being initiatives.
  - Well-being workshops have also been provided to educators, for example, on the topic of mindfulness, exercising at home, and managing emotions [UM, ext.].
  - Just like students, educators are encouraged to speak to an advisor whenever they are faced with problems. Furthermore, it is also important to cultivate a private support network to fall back on [UM].

## 2. Self-directed teaching 🔌

> **"As much as possible you want to give ownership and freedom to the particular instructors. Everyone has their own teaching style and you want to give room to an instructor to teach that course in their way. As much as possible, I like to leave that open."**
> *– Aart van Gils, TU Delft [ext.].*

Although there has been ongoing discussions about teaching hours, there is still a lack of attention given to the tasks of educators. Educators should enjoy teaching. Educators should feel empowered to adapt their course [UM]. Self-directed teaching is done by giving educators the freedom, responsibility, and faculty support to design, adjust, and experiment within a course. Notably, when an innovation is introduced, a buffer time is needed for students and teachers to get over the novelty effect, the initial hurdle, before its effects can be truly evaluated [UM]. On a micro level, tutors can be encouraged to innovate as well. For example, at one UM faculty, various teaching methods were provided in the tutor instruction, so tutors get an idea of how diverse teaching can be [UM].

Yet, a few factors have to be taken into consideration when educators are encouraged to innovate. One, educators have to manage their own expectations, as students may sometimes be less enthusiastic about these innovations [UM]. And two, management should realize that innovators tend to exceed their working hours, therefore they should be reminded to take care of themselves too [UM, ext.].

### 3. Recognition and reward

Often, educators have to balance their teaching with their research work [UM, ext.]. In many instances, teaching activities can be undervalued. Awarding teaching can help make educational activities become more of a priority and improve the well-being of educators [UM]. One example would be to create career trajectories for teaching [ext.]. Another example is to give out teaching grants, which would also help educators build their careers [UM]. This way, investing time in well-designed and executed education would be better appreciated, stimulating educators to commit to delivering quality education and to innovate and develop education further [UM].

> **"You need to see the individual, the people who do the work, not the course that's the outcome, but you need to see the people and the hard work they've been doing"**
> *– UM educator.*

Recognition can come in the forms of monetary incentives, awards, and time. However, short-term incentives have argued to not be sufficient [UM]. The endeavors of educators have to be genuinely recognized for each individual. According to one UM educator, recognition means that managers vocalize, or give words, to the work that educators are doing. The more specific the recognition is, the better. For example: **"I really admire how you were able to bring XYZ together for the students".** Preferably, the vocalized recognition is registered in the employees file with a letter or email, because then it symbolizes that the manager *and* the organization values the educator [UM].

# Conclusion and next steps

From the rapid review and interviews conducted at EDvance, we presented many good practices in blended education to support students and educators. Although the learning and teaching experience can be enhanced by technological innovations, non-digital practices remain a core part of education. With regard to the advances in blended education that are enhanced by technology, we learnt to use subgroups, to blend static media with knowledge clips, and to adapt our meetings flexibility to either an online or an offline format. We introduced the flipped classroom concept, new opportunities in collaborative learning, and real world problems. Canvas as an interactive learning management system can assist in structuring student learning. With regard to summative assessments, we recommend digital, on-site assessments for the convenience it brings to students and educators. With more digital elements in education, the role of the educator grows bigger. Finally, at the curriculum level, investment, support, and flexibility are needed to support the implementation of good blended educational practices and the well-being of students and educators. In the end, good practices in blended education start from having intended learning outcomes constructively aligned with the design, delivery, and assessment of education, with the CCCS principles in PBL serving as our foundation.

This report serves as the first step in a larger plan for knowledge dissemination and further evidence-based studies. The next step would be to share the findings through a website that is accessible to the public. Through the website, educators can retrieve applicable information just-in-time, while those more intrigued with the research have the opportunity to have a thorough read. This website would be a living website, where good educational practices are continuously updated and shared with the wider public. We hope that our findings will also inform the University Teaching Qualification (UTQ) and Continuing Professional Development (CPD) activities at UM.

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# Appendix A: Interview structure for Vice Deans of Education

Preamble:

Thank you for agreeing to talk with us. Please allow us to introduce ourselves again. We are the EDvance team, from EDLAB. Our aim is to collect good practices in blended education that aligns with the PBL principles of constructive, contextual, collaborative and self-directed learning (CCCS). Last year, we had to deal with the sudden changes brought about by COVID-19. After an adjustment period, we are now designing, delivering, and assessing education at UM with a more thoughtful process. We believe there are some good practices that we, as an entire university, can learn from. We are interviewing you today, to find some good practices in the Faculty of Health, Medicine, and Life Sciences. We are specifically interested in your experiences and thoughts about the period from September 2020 onwards.

Do you have any questions for us before we start the interview?

If, at any point, you would like to go off the record, please do let us know.

Start of interview:

1. What is your idea of blended education and in what form is it executed within your faculty?
   a. How are the CCCS principles promoted within your faculty?

2. Now, we would like to talk about the **leadership and management** of education at FHML. From your position as vice-dean of education, what is the **educational vision** at FHML regarding blended or technology-assisted PBL for the future?
   a. What defines FHML with regard to the educational process (compared with other faculties/study programs)?
   b. Do you think blended or technology-assisted PBL can increase educational quality?
   c. Do you foresee future opportunities for UM with implementation of blended or technology-assisted PBL (e.g., international collaboration, etc.)?

3. From a management point of view, what do you think worked well in **managing blended or technology-assisted PBL** in your faculty?
   a. What are the major changes made to accommodate new needs, after Period 5/6 of 2019/2020?
   b. Which support do you think is most crucial to ensure the success of blended or technology-assisted CCCS for the staff and students? (collegial / expert / knowledge / technical and practical support)
   c. Is there specific support for the design / delivery / assessment of blended education within FHML?
   d. Does FHML require specific support that other faculties may not require?
      i. **E.g., Educational activities**
   e. How often do you connect with educational experts outside FHML?
      i. What about contact with experts outside the UM?

4. Since September 2020, what **practical elements have contributed to the success of implementing blended or technology-assisted PBL** at the FHML? And why?
   a. Are there any factors specific to the design / delivery / assessment of education?
   b. What lessons can we derive from the experiences regarding blended or technology-assisted PBL during the past period to inform the future?

5. Do you think that blended or technology-assisted PBL can improve **constructive alignment** at the faculty?
   a. For example, the alignment of intended learning outcomes with the design, delivery, and assessment?
   b. Alignment of courses with the program and the faculty?

6. Which technology is most crucial **to support blended PBL**?

    a. Which tools did you think were most valuable? What would you certainly want to keep for the future?

    b. Strengths / Challenges

7. The UM.online research and other research has shown that engagement and well-being are of great concern in the context of blended education, at least during the COVID-19 pandemic. From your faculty,

    a. Do you have any practical recommendations to promote **student engagement**?

    b. Do you have any practical recommendations to promote **student and teacher well-being**?

8. Thinking about current and future education at FHML, what are the opportunities or challenges for blended or technology-assisted PBL?

    a. What is on your educational wish list for your faculty?

    b. Where do you see the education in your faculty in 5 years?

9. Finally, off-the-record, we are looking for **education innovations** that promote the CCCS principles in a blended or technology-assisted PBL setting?

    a. Do you have any recommendations for courses, staff members or projects that are innovative and also promote blended or technology-assisted PBL?

    b. Or, are there any (irregular) programs that we don't come across in our evaluations that might be useful for us to look at? (e.g., MHPE master, mainly done online so very important to get students engaged and connected)

Okay, that is all. Thank you very much for your time! We really appreciate your help. We will keep you updated on the results.

# Appendix B: Interview structure for Educators and Educationalists

EDcafé – Interview - EDUCATIONALISTS

*(can be program directors; course coordinators; teachers)*

## Logistics

**Date and time:**

**Location:**

**Moderator:**

**Observer/note taker:**

**Participant name/faculty/position:**

## Introduction

**Introduce EDvance project:** Thank you for agreeing to contribute to this interview. Please allow us to introduce the EDvance project again. The aim of EDvance is to collect good practices in blended education that align with the PBL principles of constructive, contextual, collaborative and self-directed learning (CCCS). Last year, we had to deal with the sudden changes brought about by COVID-19. After an adjustment period, we are now designing, delivering, and assessing education at UM with a more thoughtful process. We believe there are some good practices that we, as an entire university, can learn from.

**Goal of this interview:** The purpose of today's interview is to find some good practices in your faculty . We are specifically interested in your experiences and thoughts about the education period from September 2020 onwards.

**Plans for reporting/giving back:** We will compile a report on the good educational practices, both from scientific literature and from the community. This report will be disseminated UM-wide. Furthermore, we will organize a symposium, with various workshops tailored for each stakeholder group.

## Instruction

- Moderator / Note-taker
- Recording video/audio
- Informed Consent (signed?)
- Off the record comments
- Any questions so far ?

## Interview topics

1. First, can you please tell us about your role in education?
2. Can you describe how education is executed within your faculty since September 2020?
   a. Specifically, how are delivery and assessment carried out?
   b. How are the PBL principles of constructive, contextual, collaborative and self-directed learning (CCCS) promoted within your faculty?
3. What do you think worked well in **blended or technology-assisted PBL**?

    a. Do you think blended or technology-assisted PBL can increase educational quality?

    b. Do you foresee future opportunities for UM with implementation of blended or technology-assisted PBL?

    c. What are the major changes made to accommodate new needs, after Period 5/6 of 2019/2020?

4. Since September 2020, what **practical elements have contributed to the success of implementing blended or technology-assisted PBL** at your faculty? And why?

    a. Are there any factors specific to the design / delivery / **assessment** of education?

    b. What lessons can we derive from the experiences regarding blended or technology-assisted PBL during the past period to inform the future?

5. Do you think that blended or technology-assisted PBL can improve **constructive alignment** at the faculty?

    a. For example, the alignment of intended learning outcomes with the design, delivery, and assessment?

    b. Alignment of courses with the program and the faculty?

6. Which technology is most crucial **to support blended PBL**?

    a. Which tools did you think were most valuable? What would you certainly want to keep for the future?

    b. Strengths / Challenges

7. Which **support for staff and students** do you think is most crucial to ensure the success of blended or technology-assisted CCCS ? (collegial / expert / knowledge / technical and practical support)

    a. Is there specific support for the design / delivery / assessment of blended education within your faculty?

    b. Does your faculty require specific support that other faculties may not require? (Maybe in terms of specific educational activities)

    c. How often do you consult with educational experts outside your faculty?

    d. What about consulting with experts outside the UM?

8. The UM.online research and other research has shown that engagement and well-being are of great concern in the context of blended education, at least during the COVID-19 pandemic. From your faculty,

    a. Do you have any practical recommendations to promote **student engagement**?

    b. Do you have any practical recommendations to promote **student and teacher well-being**?

## Concluding remarks

Thinking about current and future education at your faculty,

1. What are the opportunities or challenges for blended or technology-assisted PBL?

2. What is on your educational wish list for your faculty?

3. Where do you see the education in your faculty in 5 years?

Finally, off-the-record, we are looking to interview more people who promote the CCCS principles in their education. These can be educationalists, who were highly involved in blended education, or innovators, who have innovative ideas in education. Do you have any recommendations to share?

## Closing off

Alright, that is all. Thank you for making time to have a chat at EDcafé! We really appreciate your help. We will keep you updated on the results.

# Appendix C: Interview structure for External Contact

## Logistics

**Date and time:**

**Location:**

**Moderator:**

**Observer/note taker:**

**Participant name/faculty/position:**

## Introduction

- Introduce EDvance
- Moderator / Note-taker
- Recording video
- Informed Consent
- Off the record comments
- Questions

## Interview topics

1. Can you please tell us about your role in education?
2. With blended education, we refer to the mix of in-person and online education, where education could be assisted by technology. What are good practices in blended education that are being carried out at your university?
   a. (If not answered already) What are practices that contribute to
      - constructive learning
      - contextual learning
      - collaborative learning
      - self-directed learning?
   b. (if not answered already) What are good practices in assessment?
3. What **practical elements** contributed to the success of implementing these good practices?
   a. (If not answered already) Technology
   b. (If not answered already) Support – collegial / expert / knowledge / technical / practical
4. What choices do you make when designing blended education (compared to traditional education)?
   a. (If not answered already) How do you align teaching and assessment to the intended learning outcomes?
5. Do you have any practical recommendations to promote **student and staff well-being and motivation** in blended education?

## Concluding remarks

Thinking about current and future education at your university,

1. What is on your educational wish list for your faculty?
2. Where do you see the education in your faculty in 5 years?

# Appendix D: Focus group discussion moderation guide

EDcafé – the place to discuss **C**urrent **A**nd **F**uture **E**ducation

*Focus Group - Moderation Guide*

*Student Panel*

| General | |
| --- | --- |
| *Date / Time* | |
| *Duration* | |
| *Location* | |
| *Moderator* | |
| *Observer / note taker* | |
| *Recorded* | Audio & Video recorded |

| Number of students per faculty | |
| --- | --- |
| FPN | |
| FASoS | |
| FPN | |
| FHML | |
| LAW | |
| SBE | |

## Participant profile

Current UM students; familiar with the PBL/CCCS educational system at UM; enrolled in coursework in period 1, 2, 3 or 4 of academic year 2020-2021. Excluded are students who were doing internships in the first semester of 2020-2021 academic year.

## Objective/Purpose of this Focus Group

According to the student, what are experiences of good practices of the Problem-Based Learning (PBL) in the context of blended education?

What worked well and what did not work well with respect to Educational Activities (Tutorials, Lectures, Practicals, Skills); Use of Technology (Which tools were used, what are the pros and cons; Motivation; Well-being.

EDcafé agenda (total: 90 mins)

- Introduction project & framework (10 min)
- 1st CASE STUDY
    - Introduction (5 min)
    - Breakout Room discussion (10min)
    - Plenary (20min)
- 2nd CASE STUDY
    - Introduction (5 min)
    - Breakout Room discussion (10min)
    - Plenary (20min)
- Plenary recap + Closing (10 min)

## When the students come in - Before we start

- Welcome, good afternoon, how are you doing?
- At first we want to thank you for your participation, we hope to make it a nice interactive session today. Feel free to raise your hand for a question/request at any time.
- Make sure everybody can see and hear each other
- Change name in Zoom ➔ add faculty (Anne and HQ change name to EDvance - …)
- Any other general notes on your home situation (any packages that are going to arrive?)
- Mention that we will record the plenary sessions ➔ Start the recording
- Did everybody have the time to answer the questions from the PDF?

## Verbal *short* Introduction of EDvance project

We are EDvance, based at EDLAB. Our aim is to collect and synthesize good practices in education to optimize the design, delivery, and assessment of PBL in a digital age. The PBL model is characteristic of the UM is constantly evaluated on its performance and usefulness for each faculty. At its very core, the learning principles of PBL are constructive, collaborative, contextual, and self-directed learning (CCCS). In the past year, we have been mixing face-to-face and online learning, calling it 'blended education'.

Of course, we need the voice of the students, and that is why we are very happy that you could join this meeting with us today!

## CASE-study #1

From your experience with the education at UM in period 1,2,3,4 of this academic year:

- Which **educational activities** have worked well for you?
    - How were these activities executed (which face-to-face or online tools were used) and why did these work for you?
    - Have you been using common media platforms such as whats-app in their communication in the learning process? What are your experiences?
    - Which online or onsite educational activities would you definitely keep, even when we are allowed to have education face-to-face?
    - What is on your educational wish list and how do you envision education at UM 5-years from now?

**Delivery: Mind-map with educational activities**

**Instructions for students before breakout room**

1. Wait for the instructor to join your breakout room and share a link
2. Open the JamBoard Link
3. Discuss the sub-questions
4. Use Post-It/Sticky notes on Jamboard

**Moderators during breakout room #1**

**HQ:** joins rooms 1 and 2 to provide the following links and text in the chat

(In each break out room, provide these links + text below)

- First break out room 1:
  https://jamboard.google.com/d/1FXG3_voBL_DH6Bq1Y5gksc7msA7Y0CcvwnMGZGtVP78/edit?usp=sharing
- First break out room 2:
  https://jamboard.google.com/d/1tOq5Rpt0YuB6BRKYp4s_RgUigrp2W0blNl8sjTlgvWE/edit?usp=sharing

**Anne:** joins rooms 3 and 4 to provide the following links and text in the chat

(In each break out room, provide these links + text below)

- First break out room 3:
  https://jamboard.google.com/d/1bfrkfmsCyJCvSqnhmPmuYm1xaFkGAkwCCzfEMbMVyeA/edit?usp=sharing
- First break out room 4:
  https://jamboard.google.com/d/1IFgBWhA1ff8OskRcrsFaEAdGN-NrqdOqx4rrGourE0w/edit?usp=sharing
- Open all jamboards in tabs in webbrowser and see how the students are doing
- Regularly join the breakout rooms to provide help

**Plenary recap of Case Study #**

- Welcome back to the main room of our meeting
- Mention that we will record the plenary sessions ➔ Start the recording
- In the next 20 minutes, we are going to discuss your main points from the breakout rooms
- We will do this by going through the sub questions and ask you to bring forward the points that you have discussed in your separate breakout rooms
- We will show you the JamBoard you have created

Breakout room session#1:

*Which educational activities have worked well for you?*

Sub questions:

- How were these activities executed (which face-to-face or online tools were used) and why did these work for you?
- What challenges have you faced, and what are the solutions to overcome these challenges?
- Which educational activities would you definitely keep, even when we are allowed back into classroom education?"
- What is on your educational wish list and how do you envision education at UM 5-years from now?

## CASE-study #2 (HQ)

"Our previous research has found student well-being and engagement suffered last year. What can the university do:

- To protect student well-being in a blended setting?
  - What have you found useful/helpful for your well-being?
  - Can you elaborate on this, and explain which elements were specifically helpful?
  - What is still missing that you wish for in the future?
- To motivate students to engage in their course within the blended setting
- To keep students connected with each other in blended education?
- To keep students connected with the teaching staff in blended education? This could include your tutor, course coordinator, study advisor, exam committee etc.

### Delivery: mind-map with support practices

### MODERATORS DURING BREAKOUT ROOM #2

**HQ:** joins rooms 1 and 2 to provide the following links and text in the chat

- Second break out room 1:
  https://jamboard.google.com/d/1dKQ01jbZxaj5BE17Q1NdaE77IvApf3E8M19NeydOE0I/edit?usp=sharing
- Second break out room 2:
  https://jamboard.google.com/d/1zLFLqVVc4nltPszjmJeb0fD4zALH4_WsS1Sf6Jtb_XI/edit?usp=sharing

**Anne:** joins rooms 3 and 4 to provide the following links and text in the chat

- Second break out room 3:
  https://jamboard.google.com/d/1qlIpEuCLiWof1Sr-wVCb065hhnEpen1vGWaC2JNkU9E/edit?usp=sharing
- Second break out room 4:
  https://jamboard.google.com/d/18j5HKagqh26-89_7SMtjTVi5wCSUrYdYDazLH6RTZ4c/edit?usp=sharing

### PLENARY RECAP CASE-STUDY #2

- Welcome back to the main room of our meeting
- In the next 20 minutes, we are going to discuss your main points from the breakout rooms
- We will do this by going through the sub questions and ask you to bring forward the points that you have discussed in your separate breakout rooms
- We will show you the JamBoards you have created ➜ quickly go

*What can the university do:*

- To protect student well-being in a blended setting?
- To motivate students to engage in their course within the blended setting
- To keep students connected with each other in blended education?
- To keep students connected with the teaching staff in blended education?
  This could include your tutor, course coordinator, study advisor, exam committee etc.

### OVERALL PLENARY RECAP

- Ask for main additional comments
- Thank you for today
- Your comments are very much appreciated
- For feedback or additional comments, Feel free to email us (email address in chat).
- Have a nice day!

Since its establishment, Maastricht University (UM) is known for its problem-based learning (PBL) education model. During the COVID-19 crisis, education at UM was offered in a variety of fully online and blended formats to ensure continuation of education for all students. In this book, EDLAB, the Maastricht University Institute for Education Innovation, takes stock of new and updated educational practices and experiences. EDvance compiles good practices in blended education, which support important PBL learning principles: constructive, contextual, collaborative, and self-directed learning. The book furthermore provides potential strategies to support students and educators, focusing on the entire educational process, including such themes as well-being and community building. Although many of the practices discussed within this report are innovations enhanced by technology, non-digital practices are also addressed.