RELEVANT ASSESSMENT AND PEDAGOGIES FOR INCLUSIVE DIGITAL EDUCATION

RAPIDE

IO2 TOOLKIT FOR ASSESSMENT OF STUDENTS IN FC AND WBL

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Abstract:	Overview of the work performed and the results achieved within the IO2 Toolkit for assessment of students in FC and WBL. The aim of this IO is to target HE teachers and to introduce learning material (chapter in project e-course) for teachers which will include assessment scenarios for the implementation of different assessment methods, mainly peer assessment and students' project assessment (that are related to both WBL and FCs) in different learning environments and within different HEIs. Further, within this output will be developed a tool (for an open source LMS) that supports peer assessment and project assessment to demonstrate and enable assessment as described in learning material.
Key words	IO2, RAPIDE, flipped classroom, work based learning, best practice examples, assessment

EXECUTIVE SUMMARY

This document includes the overview of the work performed and the results achieved within the IO2 Toolkit for assessment of students in FC and WBL. The development of this IO was be organized around the following questions:

- Q3: How to implement assessment methods in an online environment to be related to WBL and/or support FC to be relevant and reliable?
- Q4: What are preconditions to successfully implement project based assessment and peer-/self- assessment in an online environment?

CONTENTS

1. INTRODUCTION

Assessment is an essential part of learning. Meaningful assessment can lead student learning and positively influence the fulfillment of planned learning outcomes, but also vice versa.

In that respect, teachers have to use assessment methods directly related to the planned learning outcomes as advised by constructive alignment (Biggs & Tang, 2007). In the context of WBL, it is necessary to assess projects and the level of skills development, and in the context of FCs, where teacher and student interaction needs to be facilitated, peer evaluation should be especially ensured.

At the same time assessment has to support a deep approach to learning. Terms and concepts of deep and superficial learning were introduced and developed (Marton & Säljö, 1976), and appropriately developed for higher education (Entwistle & Ramsden, 2015).

Council conclusions on countering the COVID-19 crisis in education and training 2020/C 212 I/03 stated that one of the greatest challenges has been how to manage assessment and grading.

In pilot research performed as a part of needs analysis (FOI, SoM, Unizg2020) students pointed out that we should work even more to prevent cheating on exams. As a rule, assessment tasks that are relevant and interesting are more difficult to copy/cheat because students are also inclined to create such tasks independently. However, the teacher needs to put more effort into preparing and evaluating them. Assessment methods that can be reliably conducted online without extended additional teacher control over the situation when the assessment is conducted live are also those that are designed so that the tasks are focused on the essential, relevant, interesting and require an in-depth approach to learning.

When we conduct online assessment of some routine tasks, then it is necessary to introduce additional measures to prevent overwriting (use of AI), and tasks are generated for each individual student from the task database.

The aim of this IO is to target HE teachers and to introduce learning material (chapter in project e-course) for teachers which will include assessment scenarios for the implementation of different assessment methods, mainly peer assessment and students' project assessment (that are related to both WBL and FCs) in different learning environments and within different HEIs.

Further, within this output will be developed a tool (for an open source LMS) that supports peer assessment and project assessment to demonstrate and enable assessment as described in learning material.

Tasks leading to the production of the intellectual output include work by both researchers and technicians on the following:

- Literature review and collation of best practice examples on student assessment (peer and student's project assessment)
- Define pedagogical specification of student assessment (peer and student's project assessment) in an online environment
- Preparation of showcases on how to implement peer and project assessment in different subject areas and educational systems
- Define functional specifications and development of the tool for peer assessment and project assessment for an open source LMS
- Design and development of e-course chapter on student assessment to support FC and WBL
- Preparation of the quality feedback form on design, transferability and technical implementation of IO2
- Revision of toolkit and tool according to feedback from training participants.

2. LITERATURE REVIEW AND COLLATION OF BEST PRACTICE EXAMPLES ON STUDENT ASSESSMENT (PEER AND STUDENT'S PROJECT ASSESSMENT)

The literature review was performed in two separate activities.

First, systematic literature reviews on assessment in: (1) Work-Based and Project-Based Learning (conducted by B. Divjak, B. Rienties, V. Kirinić, M. Žižak, F. Iniesto, B. Svetec) and (2)Flipped Classroom approaches (conducted by B. Divjak, B. Rienties, V. Kirinić, M. Žižak, F. Iniesto, P. Vondra, B. Svetec) were carried out by the RAPIDE project team, coordinated by FOI. The literature review on assessment in Work-Based and Project-Based Learning included 58 articles, whereas the one on Flipped Classroom included 90 articles, identified in the Web of Science database.

Based on the literature reviews, two reports were prepared by B. Divjak and B. Svetec, as specified in section 3. Moreover, the project team has worked on two review articles: on assessment in Flipped Classroom (coordinated by B. Divjak) and on assessment in Work-Based and Project-Based Learning (coordinated by B. Rienties), as also explained in section 3. The article on assessment in Flipped Classroom (by B. Divjak, B. Rienties, B. Svetec, P. Vondra and M. Žižak), entitled *Reviewing assessment in online and blended flipped classroom,* has been submitted for review to a journal. Besides the literature review on the common features and challenges of assessment in online and blended Flipped Classrooms, the article also proposes a generic model of teaching, learning and assessment in online and blended Flipped Classrooms, as well as identifies areas for future research.

Next, TU Delft carried out a comprehensive literature review on digital Peer Assessment for us in Work-Based Learning and in Flipped Classroom Approaches. This umbrella review consisted of 14 review papers on the use of digital (peer) assessment in education provides a comprehensive overview of all design choices and their consequences open to educational practitioners wishing to implement digital Peer Assessment in their courses, the type of tooling available and the possible effects of these choices on the learning outcomes as well as potential pitfalls and challenges when implementing Peer Assessment. The review will inform and assist educators in finding or developing a tool that fits their needs.

The review paper titled: The Use of Digital Peer Assessment in Higher Education – an Umbrella Review of Literature by Gitte van Helden, Vivian van der Werf, Gillian N. Saunders-Smits, and Marcus M. Specht is currently under review for publication in the IEEE Access Journal and a pre-print version has been made available within the e-course.

3. PEDAGOGICAL SPECIFICATION OF STUDENT ASSESSMENT (PEER AND STUDENT'S PROJECT ASSESSMENT) IN AN ONLINE ENVIRONMENT

Based on the systematic literature review on assessment in Work-Based and Project-Based Learning and the systematic literature review on assessment in Flipped Classroom approaches mentioned in the

previous section, the pedagogical specifications of student assessment in an online and blended environment were reported in two separate reports as part of the Rapide project:

- Report on Assessment in Work-based and Project Based Learning by B. Divjak and B. Svetec
- Report on Assessment in Flipped Classroom approaches by B. Divjak and B. Svetec

Based on the systematic literature reviews, on assessment in Flipped Classroom, the preparation of review article entitled *Reviewing assessment in online and blended flipped classroom*
was coordinated by B. Divjak, with B. Rienties, B. Svetec, P. Vondra and M. Žižak, and the article submitted for review to a journal. The article analyzes the common features and challenges of assessment in online and blended Flipped Classrooms, and proposes a generic model of teaching, learning and assessment in online and blended Flipped Classrooms, as well as identifies areas for future research.

Based on the systematic literature review on assessment in Work-Based and Project-Based Learning, another article is in preparation, coordinated by B. Rienties.

4. SHOWCASES ON HOW TO IMPLEMENT PEER AND PROJECT ASSESSMENT IN DIFFERENT SUBJECT AREAS AND EDUCATIONAL SYSTEMS

During the LTT2 meeting in Delft in November 2021 a number of presentations were given on showcases of how to implement peer and project assessment and based on those a comprehensive overview of 10 showcases was compiled from many different subject areas and educational systems in a report by TU Delft with the title: "*Case Studies on Peer Review and Assessment*" based on best practices at all project partners.

In addition a paper was written on "*E-assessment in mathematics in higher education: a student perspective*" by Blaženka Divjak, Petra Žugec, Katarina Pažur Aničić, which is under review with the International Journal of Mathematical Education in Science and Technology.

5. FUNCTIONAL SPECIFICATIONS AND DEVELOPMENT OF THE TOOL FOR PEER ASSESSMENT AND PROJECT ASSESSMENT FOR AN OPEN SOURCE LMS

There are numerous advantages of using peer assessment in course delivery. Typical advantages listed in literature[1] are:

1. Logistical – it saves teacher's time
2. Pedagogical – judging the other students work is an additional opportunity for students to deepen their understanding about a topic
3. Metacognitive – grading can help to demystify assessment and students become more aware of their own strengths, progress and gaps in knowledge and skills

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[1] *Sadler, P., Good, E., "The impact of self-and peer grading on student learning", in Educ. Assess., vol. 11, no. 1, 2006, pp. 37–41.*

4. Affective – these types of assessment can make students more productive and cooperative, and thus can build a greater sense of shared ownership for the learning process
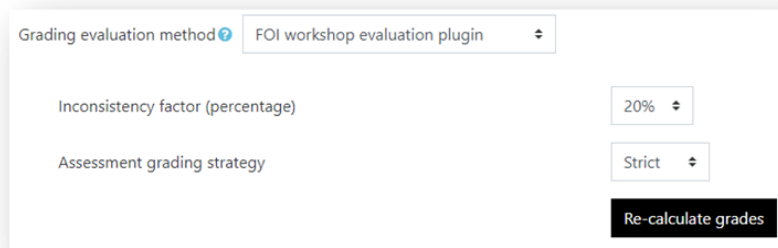
Besides advantages, there are several disadvantages that need to be considered and addressed appropriately[2]:

1. Logistical – students need additional briefing time and the teacher has to plan extra time for discussion of assessment criteria (validity!), goals, write some instructions in LMS, implement scoring rubrics etc
2. Reliability risk – students are assessing their own peers. Some of their peers can be their friends and others can be members of other cliques in the classroom. Therefore, teachers must be aware of it and if necessary, anonymize assessment tasks.
3. Equalizing –a tendency to award everyone the same mark. Learning analytics can aid the discovery of assessment patterns (especially in large groups)
4. Metacognitive – not all students are well equipped to undertake peer-assessment and they have not developed metacognitive skills so far. Therefore, teachers should start with the self assessment tasks that have lower stakes to train the students and use LA analysis to analyze reliability of peer-assessment whenever necessary (big groups, high stakes assessments).

In order to minimize the above mentioned disadvantages of peer assessment plugin for LMS Moodle was developed that is addressing the following:

- Inter-rater reliability
- Whose assessment is reliable?
- Who needs to be awarded for reliable assessment?
- How to calculate the final grades?
- How to automate the process?

Plugin is developed as a Workshop evaluation plugin that can be installed as a standard Moodle plugin. It changes standard Moodle Workshop final grade calculation, for the submission phase and assessment phase. It also simplifies the "grading evaluation" phase by helping teachers to focus on submission with unreliable assessments.

Submission grade calculation algorithm

[2] Divjak B., Maretić M. (2017) Learning Analytics for Peer-assessment: (Dis)advantages, Reliability and Implementation. JIOS. VOL. 41, NO. 1, 21-34.

- Case 1: Teacher and peer assessment
  - Submission points: arithmetic mean of lowest and highest points awarded for each criterion
    - Peer assessments are ignored
- Case 2: Only peer assessment
  - Submission points: weighted mean of all assessment points awarded for each criterion

Final submission grade: Awarded submission points scaled to max grade points

Inconsistent assessments detection
- Simplifies "Grading evaluation" phase by helping teacher to focus on smaller number of submissions where intervention is required
- Algorithm:
- For each of the submissions, Taxicab / Manhattan distance from each assessment is calculated
  S1 = (3, 0, 2, 2) #1 assessment (4 criteria rubrics)
  S2 = (1, 1, 3, 3) #2 assessment (4 criteria rubrics)
  d == |3 - 1| + |0 - 1| + |2 - 3| + |2 − 3 |
  d == 2 + 1 + 1 + 1 = 5
- Max distance for each submission is "returned"
- For x% (configurable) of all submissions with highest max assessment distance, submission grade is set to NULL indicating to the teacher that he must intervene
- Teacher assessments are ignored in this detection
- Submissions with teacher assessments are given grades based on Submission grade calculation algorithm

Assessment grade calculation algorithm
- $m > 1$ – number of assignments that student graded
- A – max number of points that can be awarded for assessment grade
- **A/m** – max number of points that student can receive for each of the assessments that he graded
- $r_1,…,r_n$ – max points for each rubric criteria
- $e > 0$ – acceptable error calculated as
- **d_i** – distance of student assessment grade of i-th submission to final i-th submission grade
- If **d_i** < e student is awarded grade according to $A\_i = A/me (e−d\_i)$
- If **d_i** >= e student is awarded 0 points for i-th assessment
- **Final assessment grade:**
  - Strict: sum of all points awarded to each of graded assessments
  - Lax: sum of all points awarded to each of graded assessments scaled to max grade points (highest sum gets max points)

Initial plugin version was tested in several different simulated scenarios and at later stages it was tested in already completed peer assessment activities in several courses. Based on the results it was concluded that plugin and corresponding algorithms work well for submission grade and assessment grade calculation, but that inconsistent assessment detection algorithm could be further approved.

Current version of the plugin is available for download on the project web site: https://rapide-project.eu/en/results

6. DESIGN AND DEVELOPMENT OF E-COURSE CHAPTER ON STUDENT ASSESSMENT TO SUPPORT FC AND WBL

6.1 E-COURSE 'LET'S GET FLIPPED'

The course was designed by the team from the Faculty of Organization and Informatics to host the following chapters to be developed within RAPIDE project:
1. Let's innovate teaching
2. Let's innovate assessment
3. Dashboard model that supports inclusive flipped classroom and work based learning and WBL
4. Impact analysis of innovative pedagogies.
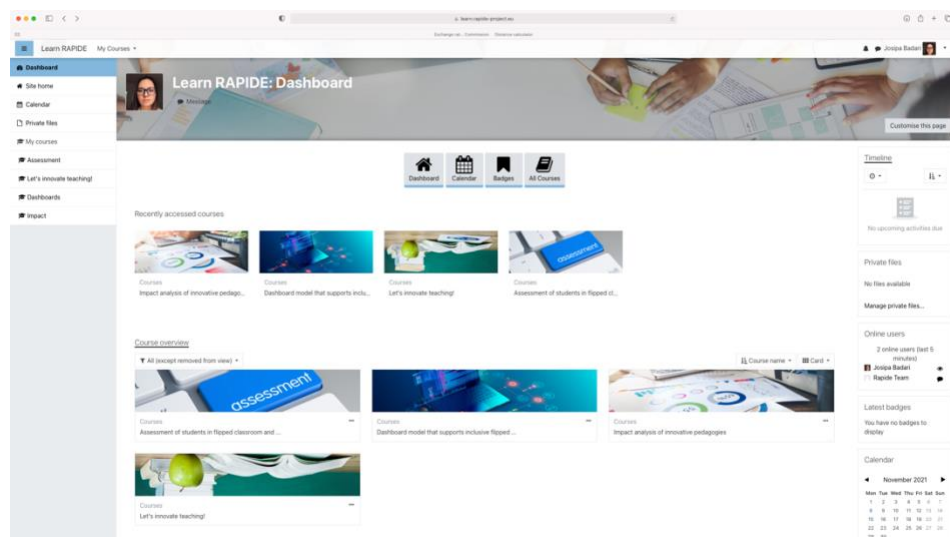
The e-course is available at: learn.rapide-project.eu

Figure 1 Print Screen of the RAPIDE online course home page

6.2 2ND CHAPTER - LET'S INNOVATE ASSESSMENT

The chapter was developed in coordination with TU Delft and the Faculty of Organization and Informatics as a result of the extensive literature review and in line with the project goal to enable education to the higher education teachers.

This second chapter of the e-course is aimed at assessment in FC and WBL approaches. Similar to Chapter 1 a course design was created using the BDP tool in line with the plan to provide 1 ECTS teacher-

participant workload (in submission process to UNIZG) using a similar build-up as used in Chapter 1 of the e-course to give participants a familiar look and feel.

Chapter 2 is designed such that it can be taken as part of the full e-course but can also be taken as a stand-alone module. In this chapter, learners will be submerged into Assessment in the context of Flipped Classroom and Work-Based Learning. The learning outcomes of this chapter are:

- To design and implement inclusive assessment methods related to FC and WBL in an online environment taking into account learning outcomes and students' backgrounds
- To analyse different academic subjects and align with appropriate assessment methods (constructive alignment)
- To design and implement assessment methods related to FC and WBL in an online environment considering study and subject field and student background and needs
- Implement peer assessment and student project assessment using a peer assessment tool (app or software)
- To encourage re-use all the materials available within this e-course have been prepared under the Creative Commons license (CC BY NC SA).
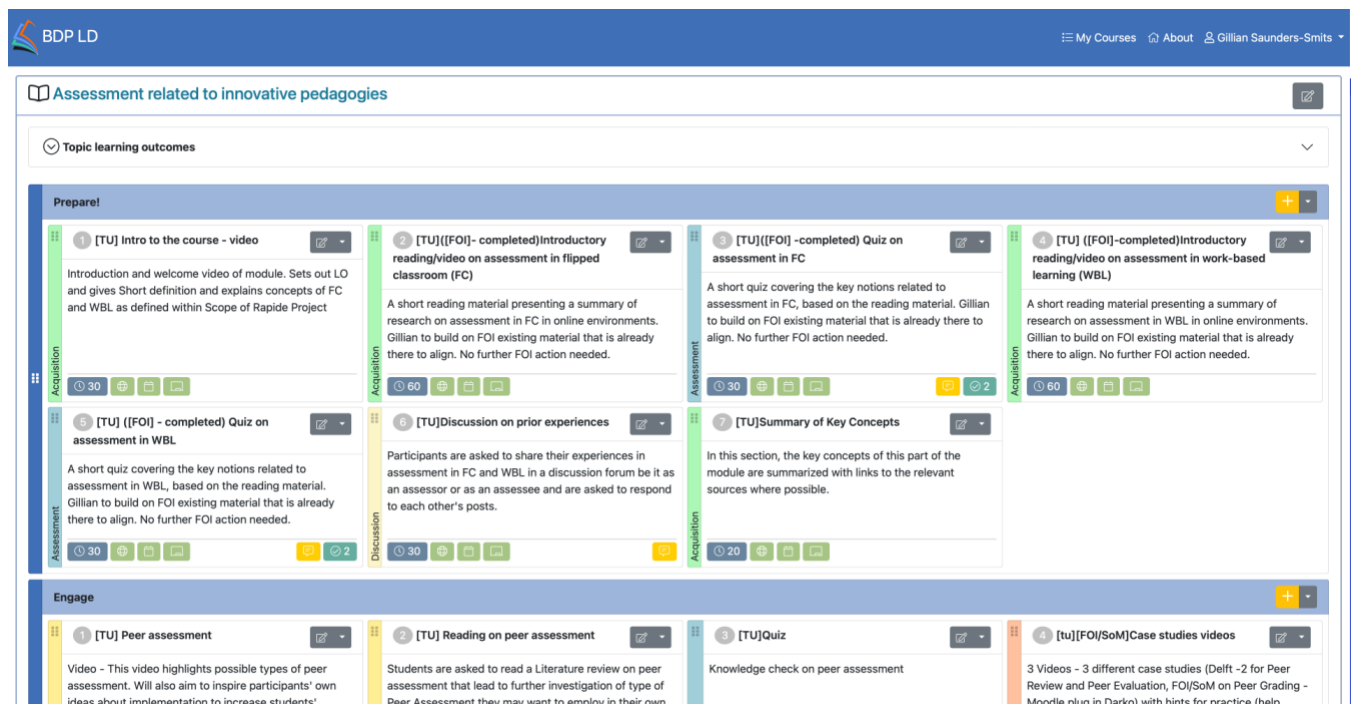

Figure 2: Screenshot of Chapter 2 Course design in BDP tool

The chapter again consists of three phases, which form the backbone of each of the 4 RAPIDE e-course modules in-line with the flipped classroom approach with use of many different active components to engage the learners:

PREPARE! – in this phase, learners are asked to do some initial reading to familiarize themselves with the terms and concepts used in the assessment as well as watch a few videos to further explain the challenges of assessment in the setting of the Flipped Classroom and Work-Based Learning as well as share your own (peer) assessment experiences so far.

ENGAGE! – in this phase, they go to the next step and introduce the different types of PA available to them and ask them to start thinking of how they would implement PA in their courses. They will of course also engage with PA by giving their fellow participants feedback on their PA plans.

EXTEND! – in this phase, we offer learners the opportunity to go beyond the basics and share more ideas and resources with you on how to engage students in their assessment and feedback processes. This part of the course is optional.

The chapter is designed to introduce learning material (chapter in project e-course) for teachers which will include assessment scenarios for the implementation of different assessment methods, mainly peer assessment and student's project assessment (that are related to both WBL and FCs) in different learning environments and within different HEIs. Many of the deliverables of IO2 have been used as teaching material in the e-course as well as other relevant research based educational resources.

The materials are available in chapter 2 at: learn.rapide-project.eu
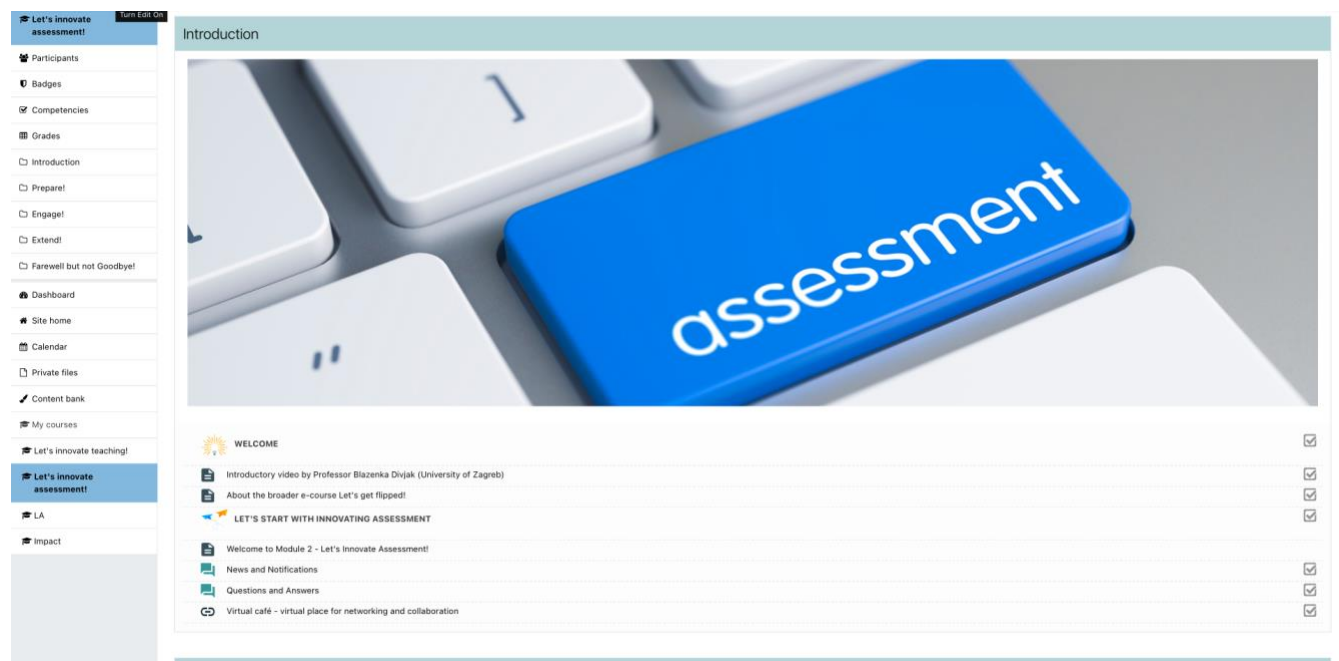

Figure 3 Print Screen of the RAPIDE on-line course chapter 2 - Let's innovate assessment.
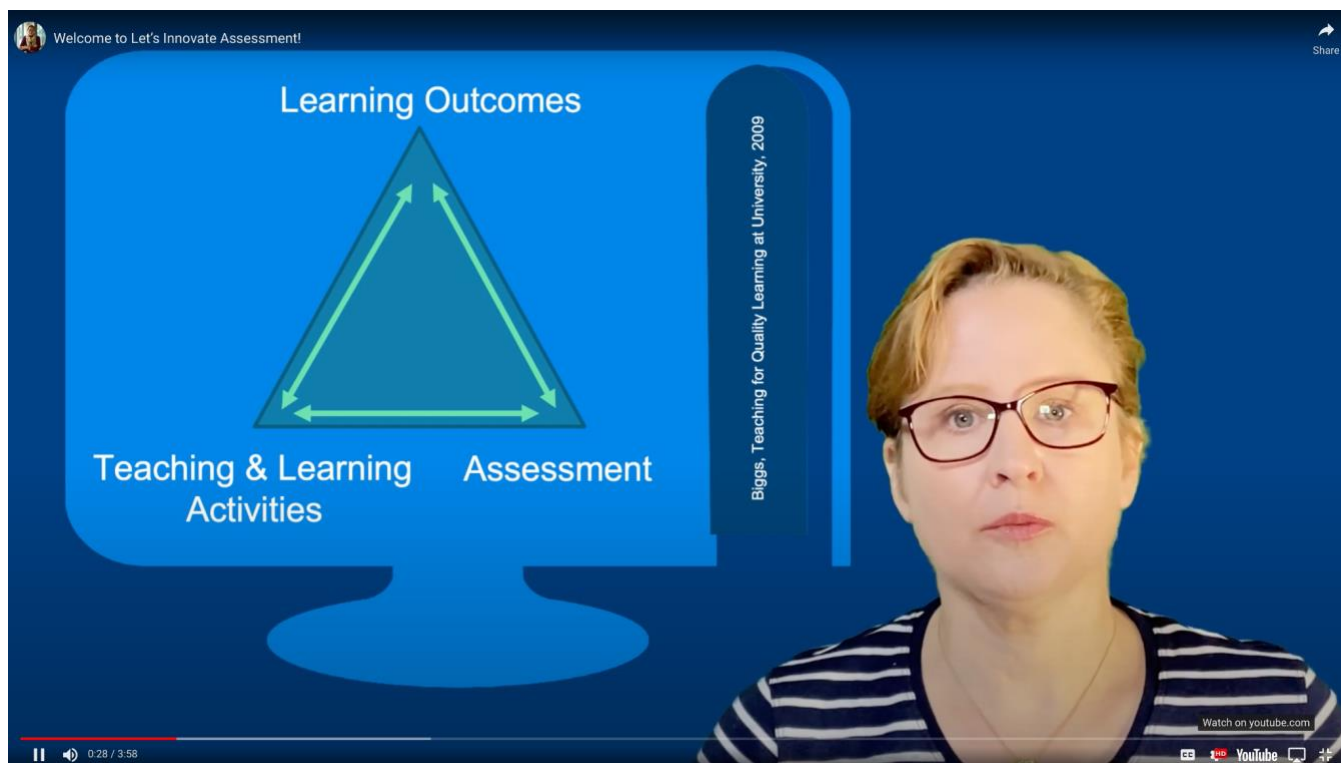
Figure 4 Screen shot of the Introduction to Assessment video in Chapter 2 - Let's innovate assessment.

After the LTT2 event the chapter was further developed as Module 2 of the RAPIDE e-Course to be piloted with 102 registered participants in July, 2022. The module was organised according to the principles of flipped classroom and the final feedback was gathered from participants to enable module creators further work on improvements. The Module 2 and the piloting process is described in more details in the document - RAPIDE e-course Let's get flipped.

7. LTT 2 EVENT

The second LTT activity - "Let's innovate assessment" was performed in M9 at TU Delft, following the 3rd project meeting. It is conceived as "train the trainers activity" for teachers from partner institutions. The plan was to have at least 20 participants (24 at most) in the LTT2 - 4 participants from every partner institution except from UNIZG 8 (4 from FOI and 4 from SoM). LTT2 activity was held for 3 days (November 16-18, 2021) with 23 participants. It is aligned with SO2 and contributes to its achievement. The goal of LTT2 was dual. The primary goal of LTT2 was to provide teachers with hands-on training on implementation of students' assessment that supports FC and WBL in an online environment. The second goal of this activity was to get feedback from teachers on design, transferability and technical implementation of IO2 and on training performance. Learning outcomes of LTT2 activity were the following: understand the concept of inclusive assessment methods analyze different academic subjects and align with appropriate assessment methods (constructive alignment)

design and implement assessment methods related to FC and WBL in online environment taking into account study and subject field and student background and needs implement peer assessment and student project assessment implement demonstration tool (peer assessment app for open LMS).

Means for LTT will include the toolkit for assessment of students in FC and WBL enriched with good practice examples about implementation of assessment methods related to FC and WBL and formative assessment for teachers participating in the training. The e-course designed in O1 (in Moodle) was upgraded with the toolkit material and will be used as a tool for LTT activities. It is prepared also as a self-paced e-course that can be used independently of f2f training.

Further, a demonstration tool for peer assessment for open LMS will be prepared and used in the post-training period. The materials are available at: https://learn.rapide-project.eu

8. QUALITY FEEDBACK

The quality feedback of the performed activity LTT2 was performed immediately after the end of the activity via google forms and reported to the project Quality Manager. The form consisted of 7 short questions which covered: Quality, content and duration of the training, Training methods, Acquired skills and knowledge, and Overall satisfaction with the training.
The final report is available to all project partners in the shared GDrive folder. The quality of the 2nd chapter Let's innovate teaching was performed during LTT 2 activity via questionnaire administered on GDrive. All LTT2 participants provided their feedback. The report is available to all project partners on GDrive.

9. INCLUSIVENESS

This result is created to support higher education teachers to improve their skills and transcultural experience which will enable them to be more competent in further delivering the education and assessment within a diverse student population.

In its Communication on achieving a European Education Area (EEA) (4) by 2025, the Commission outlines two key initiatives. These aim to address pressing educational challenges related to underachievement and early leaving from education and training within the EU. As one indicator of the need for education improvement, the level of underachievement, in the EU as a whole, has increased in science and reading, while remaining stable in mathematics. It is generally recognised that underachievement and early leaving are symptoms of more deeply rooted challenges in education. **These relate to a need for education providers to have access to approaches and competences enabling them to embrace student diversity; to offer secure and inspiring learning environments; and to motivate all learners regardless of their socioeconomic background, ethnic origin or disabilities.** (https://education.ec.europa.eu/et/news/inclusive-education-in-europe-learning-from-erasmus)

This result, therefore, is in line with the conclusions of the OECD Teaching and Learning International Survey (TALIS), particularly this that teachers and trainers need continuous opportunities for professional development. (https://read.oecd-ilibrary.org/education/talis-2018-results-volume-i_1d0bc92a-en#page7)

According to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions the higher education and VET systems need to adapt to strengthen their key role in supporting lifelong learning and reaching out to a more diverse student body. The need for more flexible and inclusive learning paths has increased as the student population is becoming more diverse and the learning needs more dynamic. (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0625&from=EN)

This result is in accordance with the basic principles of inclusive education such as: diversity enriches and strengthens all communities, society equally values, respects, and appreciates the diverse learning styles and achievements of all students and all participants are empowered to reach their potential, taking into account individual requirements and needs.

Regarding the assessment of students in online environment:

Within the Module 2 Let's innovate assessment of the RAPIDE e-Course the live event was held on September 12, 2022 under the inspiring leadership of host Naomi Wahls, RAPIDE own engineering education expert Gillian Saunders-Smits and guests John-Alan Pascoe, Assistant Professor Aerospace Engineering, TU Delft, Manouk van der Zwan, MSc student Aerospace Engineering, TU Delft and Teaching Assistant, and Angeniet Kam, Lecturer at the TU Delft Centre for Languages and Academic Skills that discussed their experiences with peer assessment and engaged with the live online audience to answer their question.
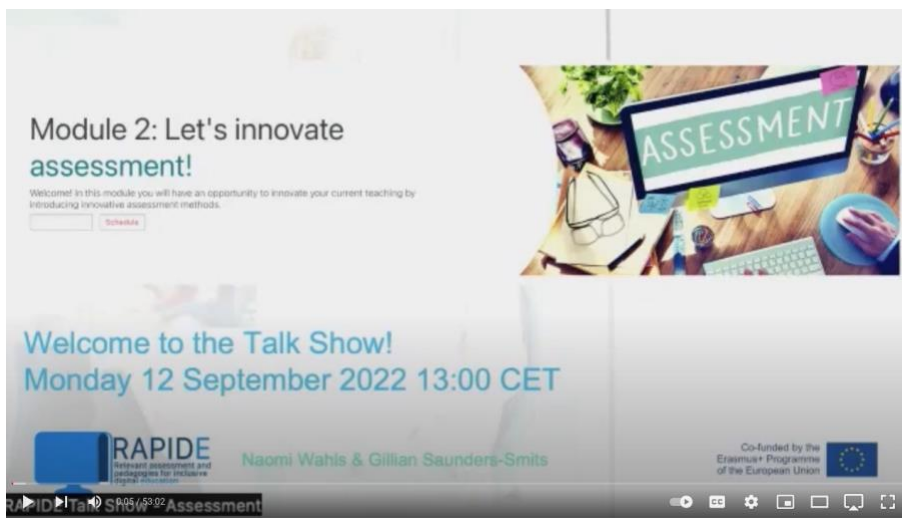
During the talk show, many valuable experiences and advice have been given to audience that included inclusive approach to giving feedback:

- Be clear, precise, positive
- Focus on how to improve and where the student should go next
- Involve peers in assessment process
- Make sure to use the appropriate form of the feedback (written, audio, video)
- Try to make feedback a two-way communication.