Grant agreement number: 779730

WP 5 – **Integration onto online e-learning platform**

D5.4 MOOC, demo course, degree course content and repository integration onto the LMS

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About TeacHy

As the FCHT industry gradually emerges into the markets, the need for trained staff becomes more pressing. TeacHy2020, or short TeacHy, specifically addresses the supply of undergraduate and graduate education (BEng/BSc, MEng/MSc, PhD etc.) in fuel cell and hydrogen technologies (FCHT) across Europe.

TeacHy2020 will take a lead in building a repository of university grade educational material, and design and run an MSc course in FCHT, accessible to students from all parts of Europe. To achieve this, the project has assembled a core group of highly experienced institutions working with a network of associate partners (universities, vocational training bodies, industry, and networks). TeacHy offers these partners access to its educational material and the use of the MSc course modules available on the TeacHy site. Any university being able to offer 20 to 30% of the course content locally, can draw on the other 80 to 70% to be supplied by the project (and its successor entity that will support the platform post-project).

This will allow any institution to participate in this European initiative with a minimised local investment. TeacHy will be developing solutions to accreditation and quality control of courses, and support student and industry staff mobility by giving access to placements. Schemes of Continuous Professional Development (CPD) will be integrated into the project activities. We expect a considerable leverage effect which will specifically enable countries with a notable lack of expertise, not only in Eastern Europe, to quickly be able to form a national body of experts.

TeacHy will offer some educational material for the general public (e.g. MOOC's), build a business model to continue operations post-project, and as such act as a single-stop shop and representative for all matters of European university and vocational training in FCHT. The project partnership covers the prevalent languages and educational systems in Europe. The associated network has over 70 partners, including two IPHE countries, and a strong link to IPHE activities in education.

Deliverables Abstract

This deliverable (in complementarity to Deliverable 5.3 on MOOC development on the NET-Tools platform) describes the setting up of the TeacHy educational content on the CANVAS LMS at the University of Birmingham.

The second part describes the transfer process to other LMS.

The implementation of MOOCs (see Deliverable 5.3), demo course, and repository, as originally intended for this deliverable, have become obsolete in the course of the project development and are not reported.

1 Deliverable content

This deliverable will report on how the educational material developed in TeacHy is set up on Learning Management Systems (LMS), specifically on CANVAS and MOODLE.

The original intentions of reporting on the implementation of MOOCs (via the NET-Tools platform), the demo course, and the repository are now defunct as

- the development of MOOCs stalled due to changes in DTU personnel,
- the demo course is identical with the material discussed here for the main TeacHy MSc programme implementation (a 'demo' did not take place due to the impact of Covid),
- the repository was implemented as the general repository on the TeacHy web site on the one hand, and the PPT-file repository of teaching content on the LMS pages.

2 Definitions

In order to understand the further descriptions in this deliverable, it will be useful to define key terms.

Learning Management Systems (LMS)

… are online platforms that organise and store e-learning content. Well-known examples are CANVAS (used at University of Birmingham), Moodle (a Google product), Blackboard, Thinkifik and about 20 others that are used throughout the globe. Their functionalities differ slightly but the main functionalities of including video content and downloadable data, guiding students through their studies, and allowing upload of student reports and exams, are common. Some of them are open source, others require handsome license fee payments, some are free to a certain level of usage and require per-user payments beyond this level.

Lectures

… are the smallest element of content. Lectures regularly take 45 to 90 minutes (double lecture) in the classroom. As recorded lectures it has become common to cut these lectures into sections of 20 to 45 minutes. Though it is possible for students to freely move forwards and backwards in the recordings, stop them, repeat or skip sections, the understanding is that there is an element of 'reward' in putting content 'behind them' for students when they have absolved shorter instalments. This partly contradicts the necessity to explain complex content in a longer delivery, the traditional delivery of 45-minute sessions in classroom lectures which students would normally follow, too. Cutting lectures into shorter sections caters to the belief that attention spans are limited – which may well be a self-fulfilling prophecy that is mainly connected to how online material is today consumed across social media and TV. After all, the length of feature-length films is also 90 minutes plus.

Teaching Units

… structure the e-learning content into topical groups that allow the students to understand the structure of content, and allow the lecturers to manage access of students to teaching material. Teaching Units also allow for a 'reward' feedback when students can monitor their progress in the content by completing one unit after the other. For the lecturers, structuring

in unites allows management of learning sequence by only allowing students to pass from one module to the next by passing an assessment, in this way imprinting a iinear work flow. This is important as students often feel overwhelmed and experience issues with time management when they have access to all content indiscriminatorily at the same time. Insofar not allowing them to move through the content ‘out of sequence’ will help to systematically build their knowledge levels.

Modules

… are the key elements of a degree programme (such as a BSc/BEng or MSc/Meng). A module typically will award students 5 ECTS points upon successful completion (equivalent to 10 credit points in the UK system). This corresponds to 100 hours of ‘student interaction’, defined as lecture attendance, reading, sitting exams and class tests, attending tutorials, and preaparing and submitting coursework. Usually, a module will consist of 15 to 20 90-minute lectures and tutorials, the maximum amount of teaching that could be fitted into one week. These could be sectioned into three to five Teaching Units, corresponding to days of the week. This gives the students some steer in the way of time management, seeing that one Unit would need to be completed within one day of studies (or the equivalent, depending on the period of time the moduleis delivered over).

Within WP 4 of the TeacHy project, university modules will also be offered outside of universities for Continuous Professional Development (CPD), i.e. professional upskilling. These might then be termed ‘courses’ as they are stand-alone offerings outside of the context of a degree programme. Confusion within universities might be caused by some calling modules ‘courses’ or ‘lectures’, referring to the traditional university delivery of ‘a lecture’ in two to four hours-per-week classroom delivery across a semester.

Degree Programmes

… are the taught, structured learning deliveries that students have to run through, including all teaching, student engagement, assessment, and student and research projects, in order to absolve a final exam or thesis submission that will – if successfully completed – be awarded by a formal degree, such as an BSc, MSc, or a number of degree certificates. In any case they are measured in the number of ECTS or credit points that need to be collected and the level of education they document. Degrees are official documents handed out by state-recognised institutions (normally universities) that are generally recognised globally.

Typically, an MSc degree will require 90 ECTS (180 UK credit) points, requiring the completion of 12 modules and a final research project of 30 ECTS (60 UK credit). Students on a degree programme need to enrol in a sufficient number of modules to achieve the benchmark number for entering their final research project or degree thesis, and on modules recognised for their specific degree.

3 Structuring online content

3.1 Modules

… will be the overarching structure of the content described here. A module is the building block of a degree programme, or alternatively for a CPD offering (where it may be called a course in order to adhere to colloquial use of terms). The module will be a complete unit on the LMS. Students and participants enrol on modules according to their nature as ‘core’ (obligatory, automatic enrolment) or ‘optional’ (selective, individual enrolment) in their studies.

A module will have an entry page that will give access to basic information on the module content, its way of delivery, a timetable, module structure and assessment. Fig. 1 gives an example of a typical module entry page.

The minimum information to be supplied via the module home or general page(s) are:

- module lecturers and their contact information,
- overview of module content and structure,
- timetable of all module activities (e.g. tutorials, exams, class tests etc.),
- type, content and timing of any assessment,
- a reading list.

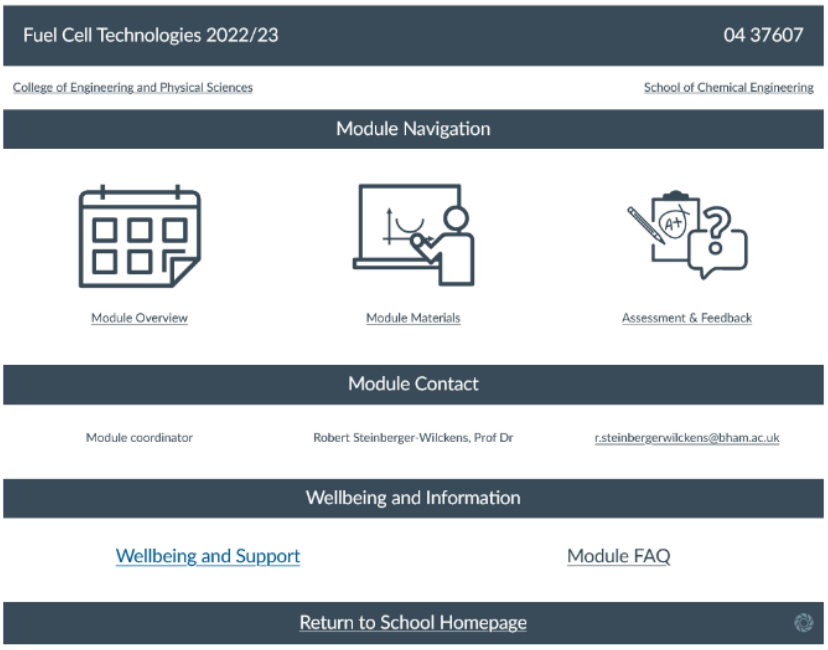

Fig. 1: Module entry page as programmed on CANVAS, giving access to three main groupings of information: Module Introduction (including timetables), Module content, and additional information, such as assessment, access to student support, feedback channels etc.

Further useful information can include:

- channels for student feedback (to lecturers and host institution),
- discussion fora and/or chat channels for interaction between students and between students and lecturers,
- links to further study information, wellbeing information, or general skills development programmes not directly linked to the module.

A useful sub-structure could be to separate the information into a basic introduction (inception) sections with an introductory lecture, overview of the module content and timetables (Fig. 2), a section with all the module content (Fig. 3), and a section with more general information on formalities (right icon in Fig. 1) that is not necessarily specific for a module but allows students and participants to access this information from any module while they are working on it, without having to switch to outside resources (this might be specifically useful for CPD courses where only this single module is accessible to participants).

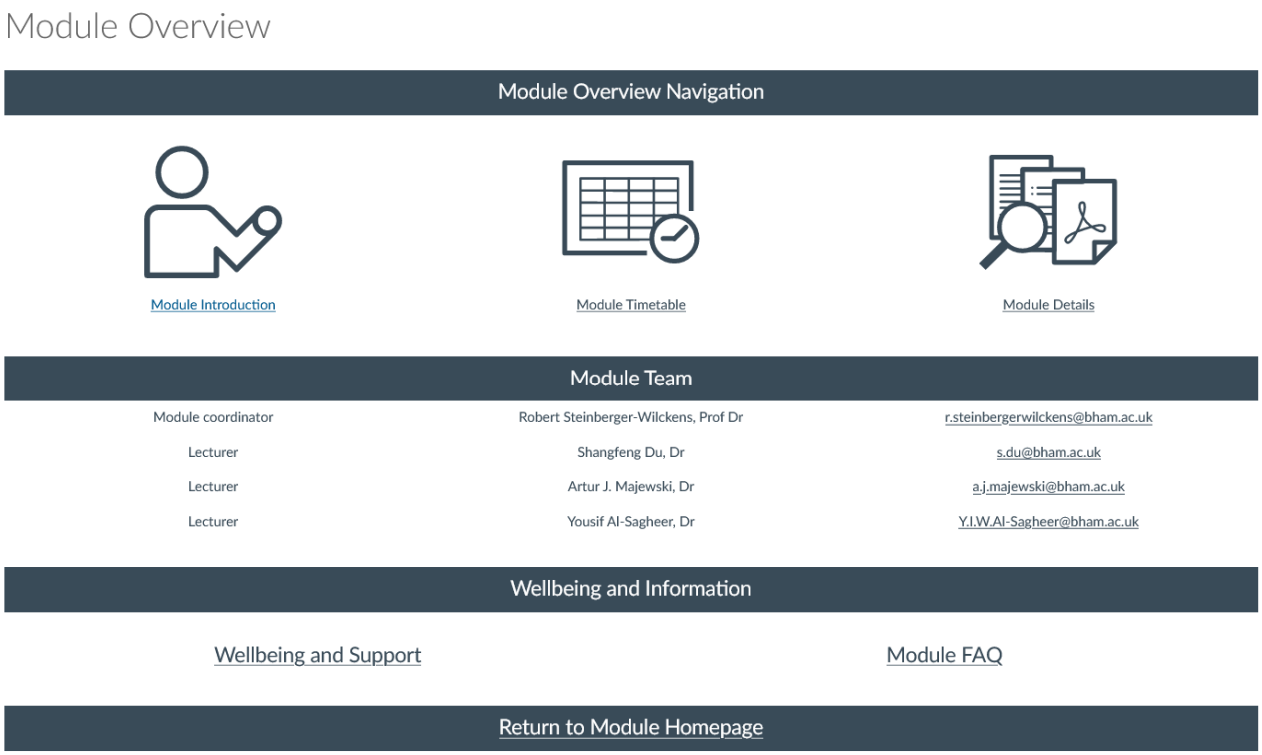

Fig. 2: Menue page (CANVAS example) reached using the left icon in Fig. 1; this page structures all basic information about the module and can be updated regularly as changes occur.

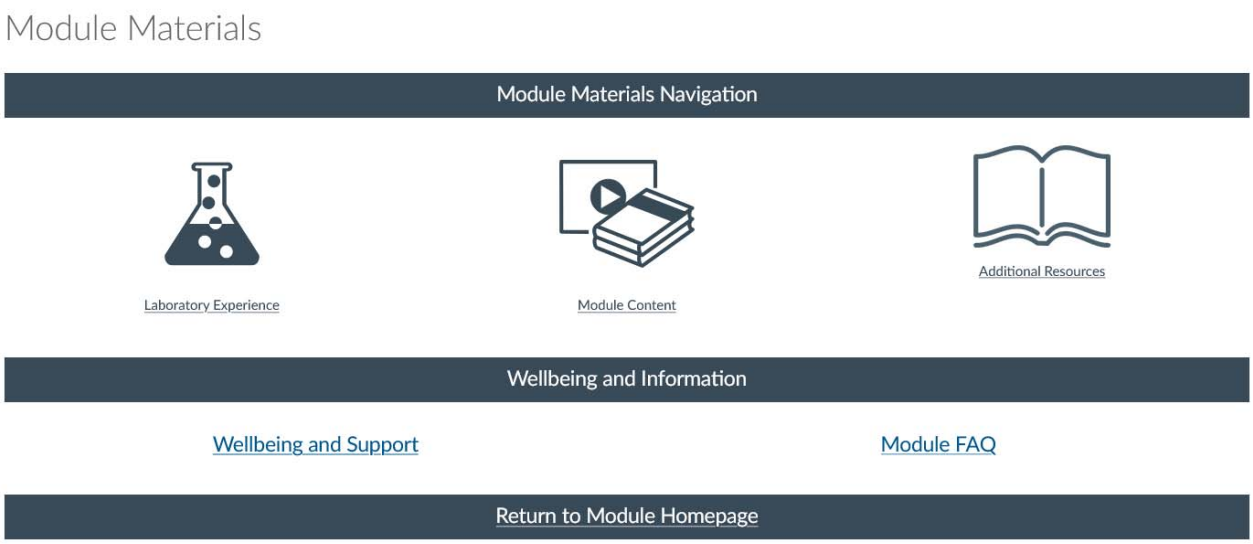

Fig. 3: Menue page (CANVAS example) giving access to the module learning content; the 'Laboratories' icon is only relevant to modules that run a practical element and is obsolete for most online content.

3.2 Teaching Units

… structure the learning content into units that allow for better time management for students, and give module coordinators and lecturers the means to monitor student progress. Moving from one Unit to the next can be restricted (e.g. by having to succeed in a small assessment, or simply by having completed all content of the previous Unit). Units can be arranged in a linear fashion (linear workflow) or be arranged in any other way with parallel access to Units, restricted or not. Fig. 4 gives an example of a module page giving access to several units, though in the case shown, students will only be able to access the ones they have already completed or are in the process of completing, before the links to the next modules will open.

Teaching Units can conclude with an assessment quiz that will open the next Unit. Alternatively, these quizzes can be attributed to single lectures (cf. 'Lectures' section).

Fig. 4: Module structured into 5 Teaching Units; links to the Units will only open once the previous Unit has been completed.

3.3 Lecture pages

… present the actual (recorded) lectures. An example is shown in Fig. 5.

Lecture pages as a minimum need to supply the following information:

- learning outcomes,

- the lecture recording(s),

- the lecture slide set.

Additional material can take the form of:

- a quiz (as shown in Fig. 5),

- additional reading material specific to this lecture,

- web links to relevant outside material, e.g. web sites or videos.

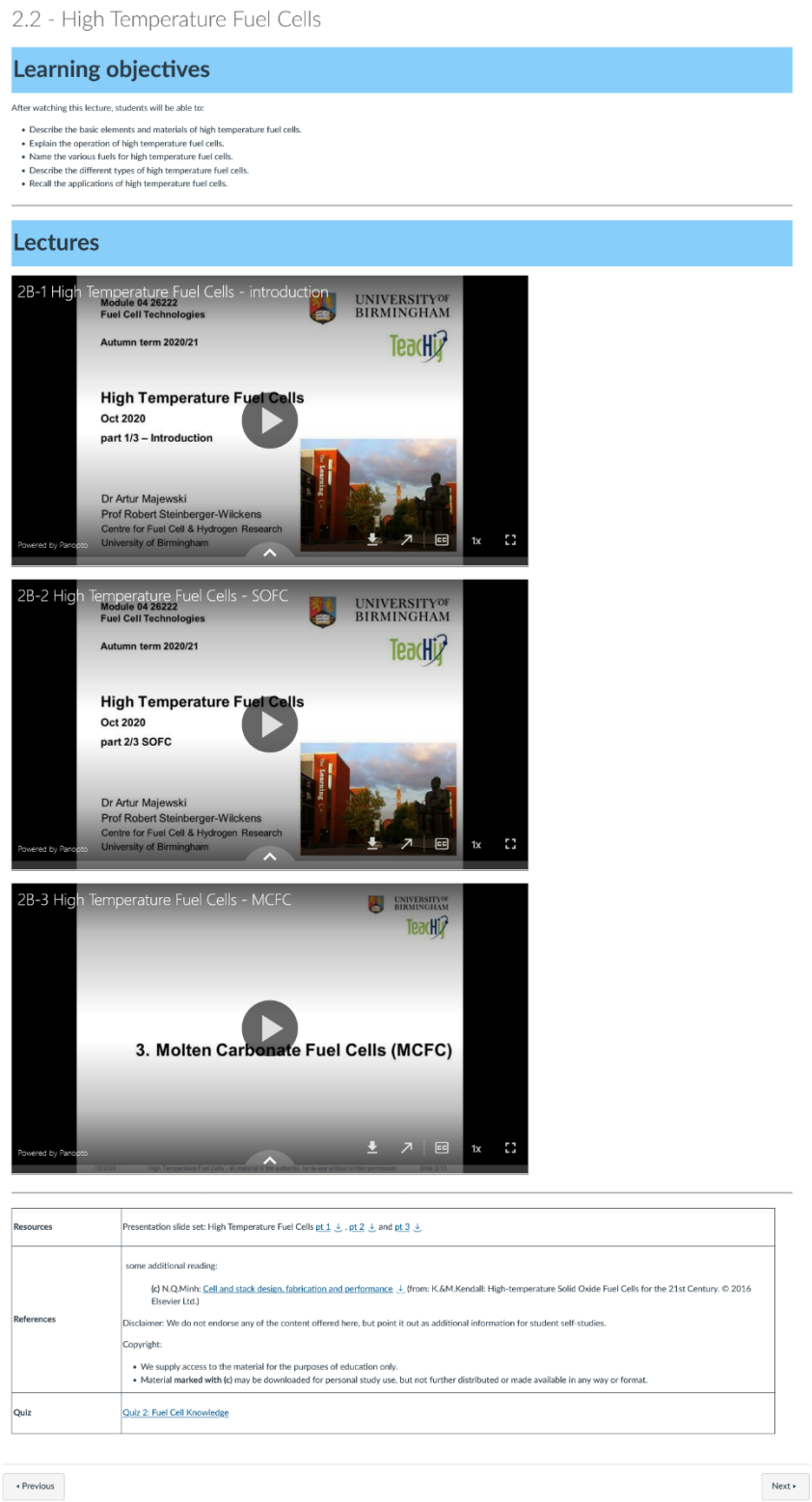

Fig. 5: Example lecture page as implemented on CANVAS.

The progression assessment between Teaching Units can be implemented as a summary quiz at the end of the Unit (cf. section Teaching Unit), or progressively, by completing all lecture-related quizzes in a Unit. The latter appears to be the preferred choice by participants.

Additional, downloadable material should be assessed for copyright issues (cf. Copyright section). Furthermore, pages should clearly point out the legal situation around this material and renounce any responsibility for external content, as the educational supplier will have no control of this content. This especially refers to web sites or web-sourced videos (e.g. YouTube) where content may change without notice (cf. Updating Information section) or may contain advertising.

3.4 Tutorials

… can be delivered online (via a Zoom, BigBlueButton, Teams or any other channel) or in-person. This will largely depend on how the teaching is organised and what the audience will be. A sufficient number of tutorials should be offered to give students sufficient time for live interaction with lecturers. Timing, length, and frequency of tutorials will again depend on the audience addressed and the structure of the module. in general, classroom-based lecturing will require slightly less tutorials, whereas Flipped Classroom delivery might call for more tutorial interaction opportunities.

CPD delivery of modules will require a different approach to spacing of tutorials and their role in the learning process (cf. Deliverable D4.3). Regularly it is found that modules need to be stretched out far longer for professional participants as they will typically follow outside of their regular work. Progress will therefore be slower. On the other hand, the discussion with professionals take a different turn to students, as they use their existing knowledge to pose completely different questions and sparking off a different type of discussion. From experience, a module taught at university within one week (called ‘short and fat’ in Birmingham) would need to be spread out to 4 to 6 weeks as CPD course, necessitating 5 to 6 tutorial sessions, organised at one per week.

Tutorials may or may not be recorded and added to the LMS module content. Recording might be limited as listening to a classroom discussion can be tedious (due to audio deficiencies) and working time for students busy solving classroom problems and exercises will need to be cut from the recording or the recording stopped. It might be more advisable to record a slide set with key content of the tutorial separately for documentation purposes. If there is a clearly defined exercise, problem, additional content section, recording this (live or separately) will be welcomed by students. The slide set should accordingly also be made available, potentially together with the solved problems.

3.5 Quizzes and assessment

Most LMS can implement ‘quizzes’. These can be programmed for self assessment, allowing students to make multiple attempts (formative). They can also be part of the module assessment (summative) which will make a marking process necessary. This can be automated or moderated, depending on how the questions are structured. Multiple choice, ranking, ‘fill in the blanks’, or calculations type questions can be automated, whereas ‘essay’ type answers will not.

Assessment in a module at university generally can occur by:

- class test(s),

- sat, written exams,

- online exams,

- oral exams,

- coursework,

- presentations,

- alternative forms of student assessments (interview type group work, online research etc.).

with the Covid experience, for instance, not allowing for more than 50% exam assessment at the University of Birmingham, mitigating the risk that due to a pandemic, the exam cannot be sat.

For the TeacHy modules, class tests (sat or online) and coursework appear to be the best choices, as these will allow for both university and CPD delivery, independent of university timetables. All modules should generally be designed to carry 5 ECTS / 10 UK credits, if offered by a university.

3.6 Interlinking content

… should allow students and participants to move freely between content, where logical and useful, without having to recur to the main menue(s).

This is especially important for the Timetable and Content Overview pages which should be reachable from all main overview pages. It can also be useful to offer direct links to other Teaching Units from TU overview pages (see below). Caveat: when updating or transferring content, updating a large number of links can be cumbersome.

3.7 Issues

3.7.1 External content

… can be linked from lecture pages or Reading Lists.

External content can change any time with no control of the module designer. It could therefore be useful to mention the last access date beside the link. In case students do not find the expected content, the date could give some indication of validity and allow retrieval of the relevant information from a web archive.

Using YouTube videos is a welcome diversification of lecture content, but also carries the unfortunate property of advertisements. It can be useful to mention this in the text accompanying the link. Again, the content may have changed (though less probable in this case, as the links are unique), or not be (freely) available any more.

All external links should be checked at least once a year, ideally shortly before the module goes live.

3.7.2 Copyright

In general, universities can distribute copies of copyrighted material to students enrolled on a module for the purpose of self-learning only. There are no further limitations to this, apart from needing to ensure that copyrighted information is not distributed outside of an official university module, i.e. that the information is not made public. Official enrolment as a student on the specific module is key, as this helps to discern a module lecture or seminar from a publicly accessible university event, where such distribution would be prohibited.

In all cases, copyrighted material should be declared as such, also pointing out that use and distribution of the shared material outside the university and for other purposes than self-study is not allowed. Even if no copyright is shown, authors and sources have a copyright according to the Bern Convention, whether or not the information, images, or data are publicly available.

All copyrighted or even external material should be declared with a statement to the effect of 'The material supplied here is copyright of third parties and may not be used for other purposes than self-studies or be further distributed in whatever format.'

For the sake of unambiguity, it is advisable to place an own copyright statement at the bottom of every slide.

3.7.3 Quality

The quality of videos, including their audio tracks, needs to be checked upon recording. ideally this should happen during the recording, but this would require a second person listening in and – if necessary – adjusting settings. This might strain resources beyond what is available in many cases.

The minimum approach is to record a short piece and listen back to check on settings and microphone placement.

3.7.4 Sub-titling

Many systems (such as the Panopto software in CANVAS, or Zoom recordings) allow for automatic generation of sub-titles (ST). The AI generating the ST, though, is inherently 'ignorant' of the content and will generally generate a large number of mistakes. The better and clearer the audio signal quality (cf. above), the better the ST. Zoom is generally by far better than Panopto, which generally has a very low quality of ST.

In order to allow students and participants who are not familiar with the language of the audio track to follow the lectures, correct ST's are essential. It is therefore necessary to review the ST and use a software feature to correct them (e.g. available in Panopto). Not checking on ST can result in both comical and useless ST's.

The ST editing features in Panopto, for instance, will allow downloading of all ST as a text file – which allows easier editing, but also enables translation and thus creating content in different (ST) languages.

3.7.5 Updating information

External links

… need to be regularly checked, ideally just before a module goes live. If the link does not show the intended context, either search for the correct link, or alternative content that can be linked. If none of this is available, remove the link, or temporarily disable, leaving an adequate message on the lecture page (e.g. if the link will be re-enabled at a later time).

Recorded lectures

Students have the habit of demanding 'fresh' content, frowning on recorded lectures that show dates two or even three years in the past. A basic lecture on thermodynamics and electrochemistry will of course not change over the years, but try explaining that to these little sneaky bastards … Nevertheless, there are lectures on technology applications and topics that are closer to ongoing research that should be re-recorded at regular intervals. Overall, also in view of keeping peace in the classroom (tutorials!), it is advisable to re-record lectures every three years minimum.

Alternatives are

- to edit the lecture and re-record the first few slides, then splicing this with the 'old' lecture body, or

- to not mention any dates on lecture slides (e.g. title slide).

In the second case, though, it is advisable to use version numbers on the first or last slide, in order to be able to determine when the recording was made and which update status it carries.

3.7.6 Definition of Minimum Standard

1. Structure

   a. entry page ('home' page, 'landing' page, 'main menue' page) with links to

      (i) module introduction, timetable, module overview page, and

      (ii) module content page.

   b. module content page with full overview of lectures in the module

   c. teaching units or main headlines of module (if no TU defined) linked from an overview page or the module

      content page.

   d. every lecture has its own page.

   e. channels for student feedback are defined.

2. Content

a. all lectures are recorded and available via an LMS.

b. every lecture page includes

(i) defined learning outcomes,

(ii) recorded lecture material,

(iii) downloadable slide set identical with the lecture material,

(iv) an automated quiz about the lecture content for self-assessment the participants can repeat ad infinitum .

c. an introductory page and lecture are provided that explain the content and structure of the module.

d. assessment is provided (consisting to a maximum of 50% of a sat exam) to qualify students for 5 ECTS

points / 10 UK credit as a standard

e. a Reading List is provided.

f. information on the assessment method is provided.

g. live tutorials are offered, whether in-person or online.

h. quizzes should offer a mix of question types and use question banks, so that different students see

different versions of any quiz or class test.

3. Quality

a. all recordings are checked for video, audio, and subtitle quality.

b. prior to every launch of a module, all external links are checked.

4. Documentation

a. all original lecture files are archived on the LMS pages together with the recorded content, though hidden

from student view, for corrections or future updates .

3.8 Example of Good Practice

Fig. 6 shows the work flow of the University of Bimringham CANVAS modules. Further page screenshots have been documented in Figs. 1 through 5.

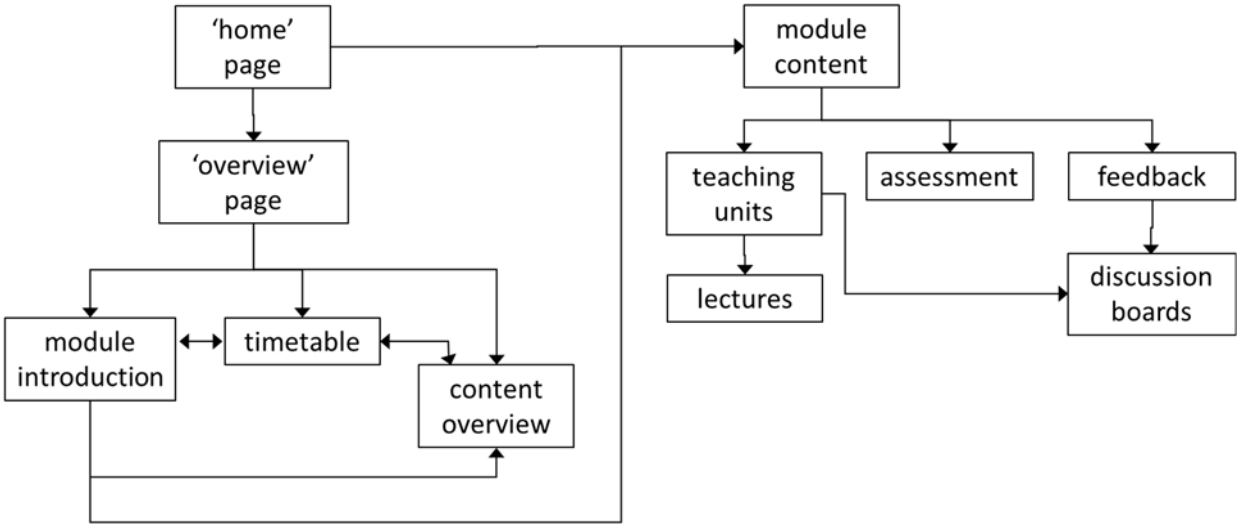

Fig. 6: Menue structure of modules implemented on the University of Birmingham CANVAS LMS.

4 Transferring programme materials to other LMS

One aim of the TeacHy project was to share online educational content across a network of universities. In order to do so, the transfer of TeacHy e-learning materials between various e-learning platforms (Learning Management Systems, LMS) needed to be mastered. Solving the issue of transfer of digital material is crucial for offering the programme content to third parties. The full control over study materials is one of the crucial conditions for programme and module accreditation at most of universities. The whole TeacHy programme was originally designed for the Canvas learning management system at UBHAM but various other systems are used at other universities. Thus, conversion to MOODLE as open source software was realised at UCTP.

Each individual lecture within a module consists of one or several video lecture(s), the lecture slide set (PDF-file), supplementary materials (if available) and a quiz (if available) (Figure7). Based on university request to have all materials located on their own system the placement of all core materials should be under university domain. But video-lectures generally represents large files not suited to space usually available for one module. Thus, file repository is used outside the main module page in learning manager system (LMS) and corresponding link is used. Other materials can be located in repository or in the module pages. Quizzes are located directly in the LSM module pages. Location of individual materials are crucial for possible module transfer.

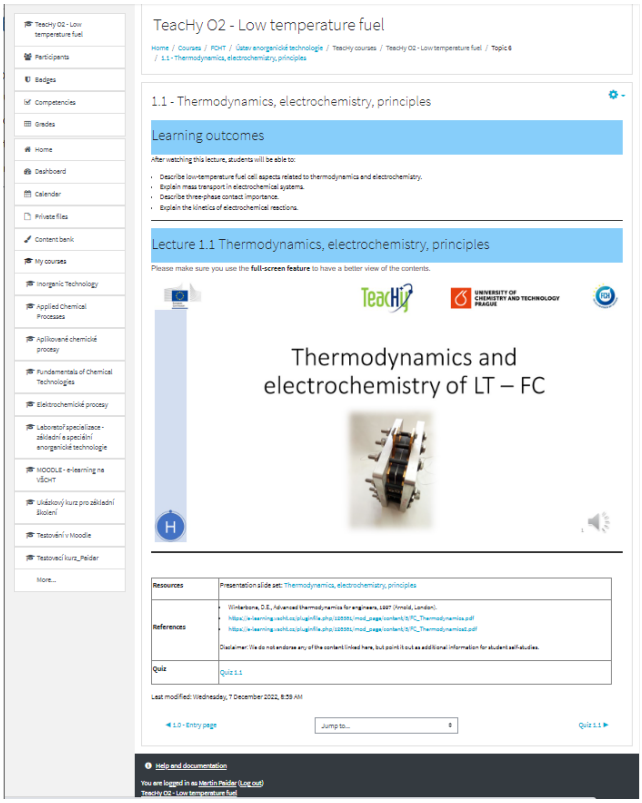

Figure 7: Lecture page containing lecture description, links to video-lecture, supporting material and final quiz.

4.1 CANVAS LMS

Canvas is the commercial LMS used at UBHAM. It uses a layered structure (

Figure 8) comparable to webpages structure. Each module retains the same structure, having separate pages for introduction, module content, etc. Large files such as video-lectures are stored on a repository (Panopto recording software platform) and hypertext links are used to connect these to the lecture pages.

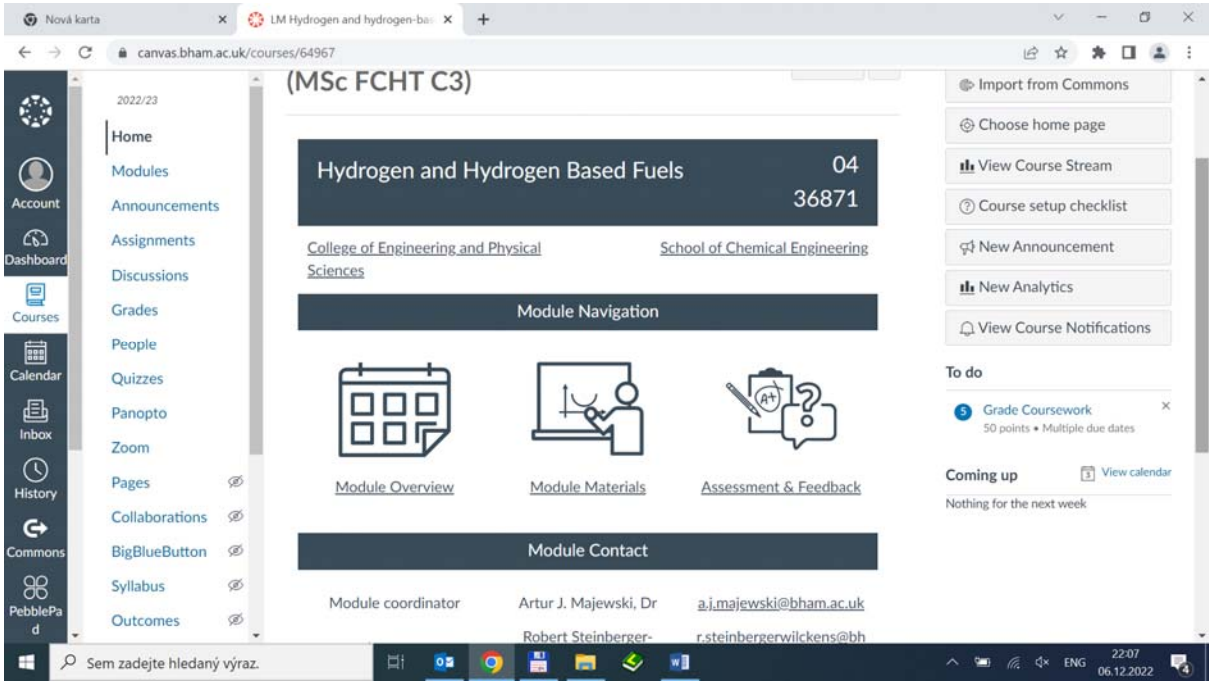

Figure 8: Module home page created in the CANVAS system. Hypertext links connect to other pages.

4.2 Moodle LMS

Moodle is a free and open-source learning management system written in PHP and distributed under the GNU General Public License. Despite free availability several private companies provide paid support for this LMS and extensions reflecting individual customer needs. Also, it depends on university IT administrators which parts of the whole Moodle system will be installed and made available to teachers for e-learning course preparation. This means that Moodle will have a variety of options installed at different universities. UCTP uses Moodle as e-learning support to regular courses, but full e-learning modules can also be hosted.

The Moodle module structure is built as one web page where all lectures are available (9). The teacher can set some parts as hidden to students until some condition (e.g. mastering a quiz) is completed. For students it looks similar to CANVAS but the inner architecture is different.

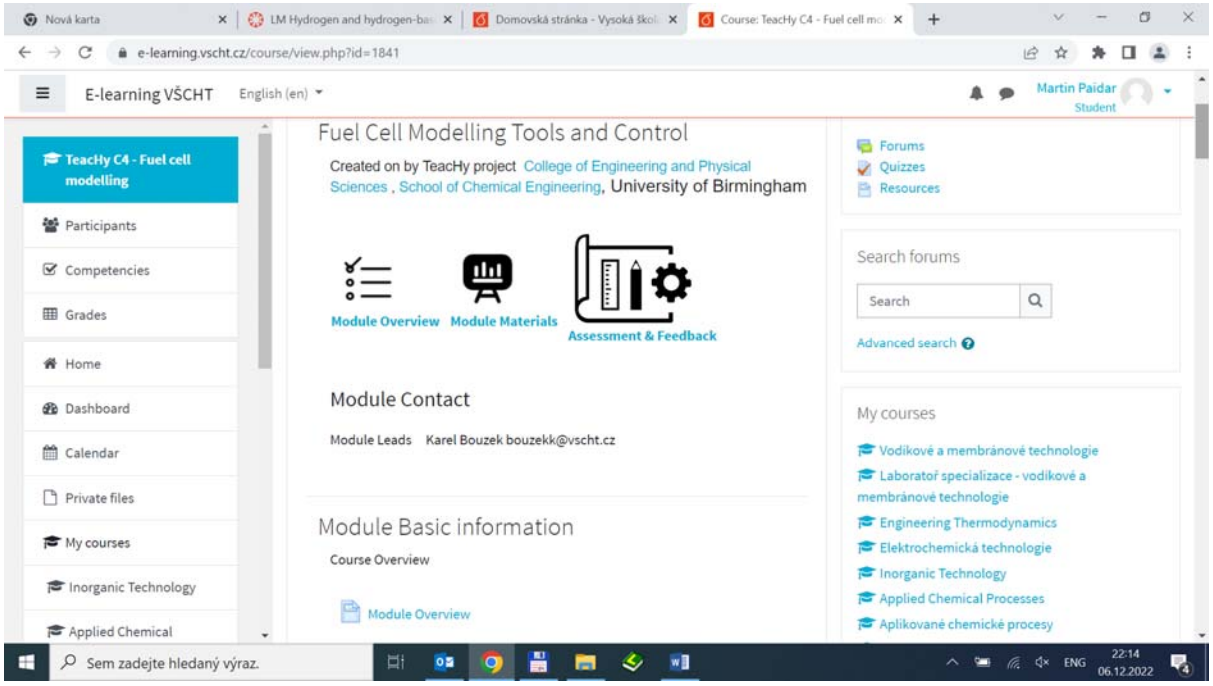

Figure 9: Module home page created in the Moodle system. Hypertext links addressing other positions in the same page.

4.3 Course transfer

CANVAS allows to export whole modules/courses as a compressed file *.imscc using the standard zip compression algorithm. Nevertheless, external files are not included. All files from the video and files repositories must be downloaded separately.

Moodle has the option for course export and import, but imports from other systems than Moodle are problematic. All external links including to the repository of videos remain unchanged. Lecture structure and texts are faithfully transferred, as are quizzes. In principle, a significant number of person hours are needed to check and correct the transferred course. This means that already an established e-learning course running on some university can be used as good practice example, but the course transfer requires significant changes if a different LMS is used. The main work lies in the modification of hypertext links to new file locations.

For the implementation of a whole course or degree programme at a new university, the full understanding of programme, teaching unit, module, and lectures structure is necessary, including the location of individual files in folders/repositories. To create a mirror of a programme the receiving university ideally requires the same version of the LMS and also the same structure of file repository.

5 Summary

The TeacHy MSc degree programme teaching content has been fully implemented at UBHAM on the CANVAS LMS system.

The whole content has been transferred to the Moodle LMS at UCPT.

Both systems are fully functional and are being used for student qualification to the degree of MSc in Fuel Cell and Hydrogen Technologies.