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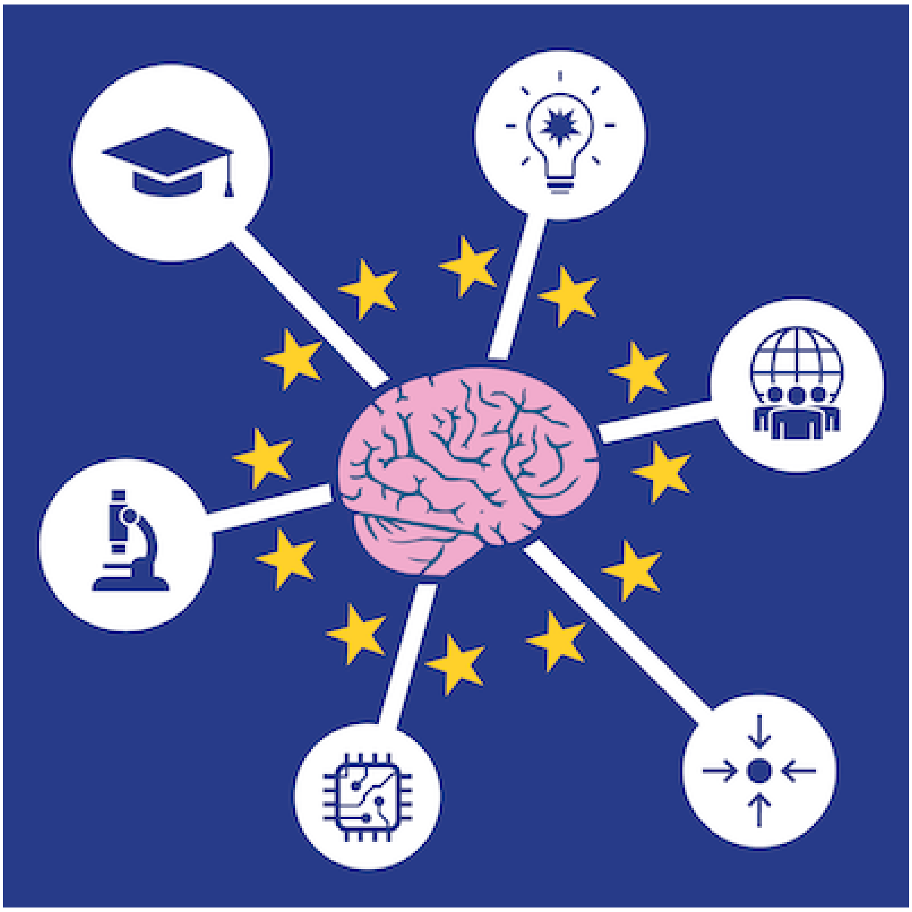
INNOVATIVE PEDAGOGY HANDBOOK

Workpackage 4
EDUCATION AND RESEARCH

Task Force
INNOVATIVE PEDAGOGY HANDBOOK

NeurotechEU



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INNOVATIVE PEDAGOGY HANDBOOK

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This Innovative Pedagogy Handbook was developed by faculty and administrative staff from the founding universities of NeurotechEU - the European University of Brain and Technology, an initiative that aims to build a trans-European network of excellence in brain research and technologies to increase the competitiveness of European education, research, economy, and society. NeurotechEU Alliance partners are listed below in the order of their assignment to project work packages:

- Radboud Universiteit (The Netherlands)
- Universidad Miguel Hernández de Elche (Spain)
- Karolinska Institutet (Sweden)
- Rheinische Friedrich-Wilhelms-Universität Bonn (Germany)
- Boğaziçi Üniversitesi (Turkey)
- University of Oxford (The United Kingdom)
- Universitatea de Medicină și Farmacie din Cluj-Napoca (Romania)
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1 Introduction

1.1 Purpose of this document

One goal of the NeurotechEU Alliance (NTEU) is to develop and establish suitable and innovative pedagogical practices. An important area of development is finding ways to increase the efficiency of learning on virtual platforms and paving the way for expanded virtual mobility. NTEU supports its partners to share and jointly optimize their teaching methods and to strengthen the links between teaching, research and innovation. By considering challenges, practices and required skills, we aim to show that digital approaches to teaching are both relevant to educator's everyday problems and easy to implement. We hope that these insights will encourage readers to adopt a more structured and relaxed approach to trying out digital teaching.

This document is intended to be a continuously expanded source of innovative teaching methods that can be useful for NTEU members. It reflects our past and future activities in the NTEU Pedagogy field-lab (PFL), in which we develop and test suitable approaches for teaching within NTEU.

After a brief introduction, it will provide examples of teaching innovations by NTEU members, which are suitable for delivering NTEU content such as learning modules to NTEU students or other NTEU target groups. By clearly stating the purpose, advantages and limitations of tools and platforms the handbook will help the reader with selecting the most appropriate tool to achieve their goals. It will be continuously updated as new tools and approaches are being developed, tested, and rolled out.

1.2 Teaching in NeurotechEU

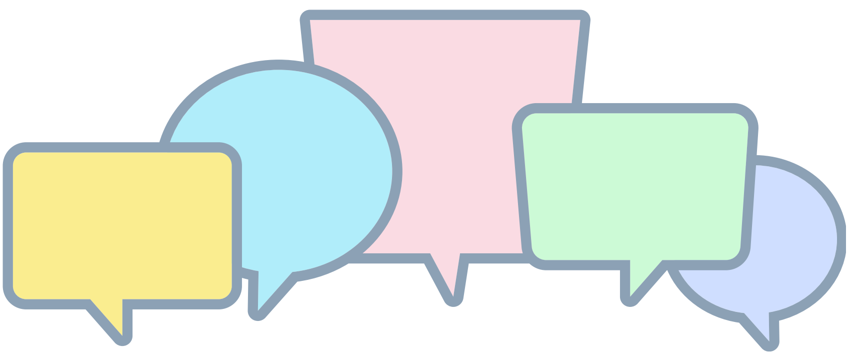
The field of higher education is crucial to the social and economic development of any country. Against the backdrop of rapidly changing socioeconomic conditions (e.g., recent Covid-19 pandemic), the need to ensure access to education is critical for the continued pursuit of technological innovation and the prosperity of society at large.

NTEU programs are being designed to bridge disciplinary boundaries and borders between participating universities, creating a unique organization that is not constrained by faculty, institutional and geographical limits. NTEU students will receive comprehensive multidisciplinary, international, and cross-sectoral training at all education levels (bachelor's, master's, and doctoral) to develop a common European identity with educational and research opportunities in a multicultural, multilingual environment across the continent. In addition, NTEU actively promotes lifelong learning via structured yet flexible, scalable, and personalized programs to remove obstacles to accessing education, bridge employment disparities, and maximize human potential in an atmosphere that promotes inclusion and diversity. The goal is also that the next generation of multidisciplinary scientists and engineers will have access to state-of-the-art infrastructure for basic, translational, and applied research across a wide range of disciplines to help them become the transformative future leaders of society, industry, and academia.

Beyond its educational mission, NTEU research also fosters technological and societal innovation by bringing together partner organizations to create an innovative ecosystem and help Europe become a global leader in brain research and technology. Outstanding universities of the future will be more than educational and research institutions. As the backbone of the Knowledge Triangle (education, research, and innovation), higher education, research, and business will join forces in the Universities of the Future to develop cutting-edge technology and push the frontiers of knowledge. In NTEU students and staff work together to develop integrated and open curricula that combine study periods in different countries and settings across sectors. Mobility, physical and virtual, will be a key component in all programs shared. In this way, NTEU will contribute to the emergence of European university degrees. By pooling educational and training capabilities of the participating partner universities, leveraging next-generation virtual exchange and mobility platforms, and intensifying collaboration between students and researchers, the mobility rate is expected to increase substantially. Furthermore, information and communication technologies will enable a new interactive virtual mobility platform that increases accessibility and inclusivity while providing a scalable, economical and modular alternative to physical mobility.

To achieve its broad goals and to adapt to continuously changing requirements in teaching and learning, NTEU must develop and implement innovative teaching methods and throughout. Traditional classroom or lecture hall instruction are still commonly used by teachers and lecturers to impart knowledge to their students. However, especially the Covid-19 pandemic has taught us that it is increasingly important to support and further develop asynchronous distance learning. It is essential that online learning materials take advantage of all the media formats available. These range from short video podcasts to longer recorded lectures and can be complemented by online toolboxes for self-study and materials and tools to promote interactive and group learning, as well as in-person events such as internships and summer schools to promote hands-on experiences. Finding ways for automatic recognition of learning periods, internships, and degrees between the partners is another practical necessity. Above all, NTEU aims to support active learning as this is considered most effective.

Currently, the handbook focusses on teaching methods. The material presented here is intended to first provide an overview of teaching practices in chapter Innovative teaching methods. These are not meant to be comprehensive but to serve as an overview of concepts that will be useful for content creation and refinement in NTEU. This is followed by a short overview of distance learning concept in chapter Implementing distance teaching and learning and innovative examples from NTEU partners in chapter Innovative implementations in NTEU. For other aspects of learning such as assessment we provide a glossary (chapter Appendix/Annex/Glossary).



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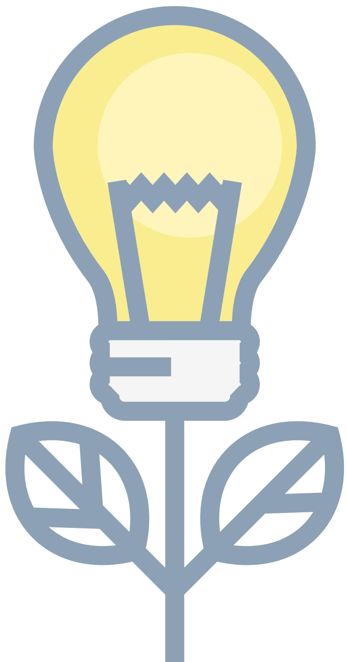
2 Innovative teaching methods

For discussing more recently developed teaching methods, it is helpful to keep in mind some of the basic terminology and concepts. An important step during the design of new content is choosing suitable formats. They define for instance the available types of interactions between students and teachers, the usable course material, the number of participants and they narrow down which media can be used and to what extent it can be performed online. An overview of typical formats can be found in chapter Teaching formats and course types (glossary). It is also essential to clearly define learning outcomes, expectations, and goals when designing courses and lessons. In creating programs these should transform into a set of concrete learning objectives. An assessment of learning outcomes is necessary in many cases. There the goal is to set standards that allow to measure fairly and as objectively as possible whether a student's or participant's work has met the declared learning outcomes of the course. Assessments also serve students to monitor their progress during the course, the latter can be incorporated as formative assessments. As the demand for online learning environments in higher education grows, so does the need for systematic application of learning and educational theories to the design, development, refinement, and implementation of assessment strategies. The main concepts and terminology are summarized in section Assignments and assessments (glossary).

When discussing innovative teaching methods, we should first clarify what we mean by 'innovative'. The basic idea behind the term is that it defines a new or novel way of doing things. In the pursuit of innovation in teaching, teaching strategies must be different from what has been common practice in the past and teachers likely need to abandon traditional approaches to some extent to come up with truly innovative teaching methods. This is also captured by the term 'disruptive'. It too can refer to teachers breaking with traditional approaches, but it can also mean that new technologies have a disruptive effect on the way we teach and think about teaching. A very recent example is the impact of chatGPT on essay writing. Teaching methods are also called teaching strategies or instructional strategies. This term has been defined differently by several authors. Some state for instance that teaching methods are processes that are primarily descriptions of objective-orientated activities and of the flow of information between teachers and students (Kizlik 2016).

In the traditional 'chalk and talk' method or textbook method, the teacher is almost always the only active person in class. While some teachers still use a blackboard, whiteboards and markers, smart boards and, in blended-learning methods, lightboards are supplanting the earlier tools. Regardless of the tools used, the key characteristic of this approach is that the instructor lectures while simultaneously creating notes on a medium visible to the students. There is evidence suggesting that oral presentations to large groups of passive students contribute little to actual learning (Raupach et al., 2015). Therefore, it is important that students are actively involved in the learning process. Conversely,



it should be noted that the format as such (e.g. 'chalk and talk') does not necessarily define the level of interaction, as those formats can also be designed to be highly interactive and collaborative. There are already many alternatives to traditional teaching methods. For instance, Experiential Learning (also called Learning-by-Doing) can be an important component of course design. The goal is for students to actively engage in carefully designed activities (opportunities for Learning-by-Doing), and then to reflect on those activities. It is believed that this will empower them to use their theoretical knowledge in practical or applied work. Another approach to education is the Competency-Based Learning. Here, the focus is on the demonstration of desired learning outcomes by the student as a central element of the learning process. It typically begins by identifying specific competencies or skills. Students are then given the opportunity to acquire and master those skills or competencies at their own pace. Sometimes, when learners can demonstrate that they have already achieved a certain level through a test or assessment, they can then be allowed to progress to the next level of competency. This enables students to skip through content in which they already have expertise. In principle, this allows educators to break away from the model of regularly scheduled classes, in which students learn the same material at the same speed and time as their fellow students. The main value of the approach is the direct development of skill and competencies, but it is also used for abstract or academic skill development.

In the following, we briefly highlight some pedagogical concepts and approaches that could be useful for content development in NTEU.

2.1 Inquiry-based learning

Inquiry-based learning (IBL) describes pedagogical strategies such as problem-based learning and case-based learning that focus on students exploring, thinking, asking, and answering questions together with peers to acquire new knowledge through a carefully designed activity. These provide students with the opportunity to engage with and apply the scientific process as scientists, rather than following a predetermined protocol (Yew and Goh, 2016; Laforce et al., 2017).

Problem-based learning (PBL) uses specific problems (e.g. clinical cases) to stimulate inquiry, critical thinking and application of knowledge (Barrows and Mitchell, 1975). It can be applied to many fields but is often found in medicine. Defining the problem by the student is a part of the process. Research inside and outside of class and arriving at a final response in an iterative fashion are common features (Nilson, 2016). The goal is for students to gain a deeper understanding of the content taught and, more importantly, acquire the skills necessary for lifelong learning through this active and collaborative learning process using concrete cases.

Case-based learning is similar to PBL, because students develop skills in analytical thinking and reflective judgment by reading and discussing complex, real-life scenarios. Like PBL, case-based learning uses a guided inquiry method, but it typically requires students to have substantial prior knowledge for analysing the case. The case-based learning approach is particularly popular in business education, law schools and clinical education in medicine, but it can be used in many other disciplines as well. For examples and further reading see (Irby, 1994).

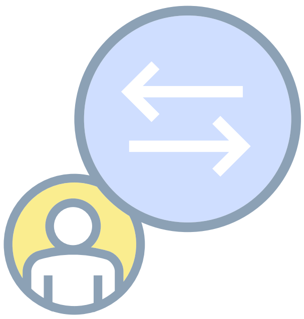
Project-based learning is again similar to case and problem-based learning but tends to come in longer learning units, which are also broader and more varied in terms of learning content. It expects students to have even more autonomy and responsibility when choosing sub-topics, organising their work, and choosing methods for conducting the project. Projects are usually based around real-world problems and give students a sense of responsibility and ownership. This method It can be used to promote interdisciplinary conversations and group work. For examples and further reading see (Larmer and Mergendoller, 2010).

Challenge-based learning (CBL) is a pedagogical method that builds on PBL, in which students learn in real and relevant context. The aim is to identify and analyse a problem (e.g. sociotechnical) and to come up with a real-world solution that is socially, economically, and environmentally sustainable and therefore often interdisciplinary in nature. For further information see (Challenge based learning, 2021) and (Kohn Rådberg et al., 2020).

For further reading on inquiry/problem-based learning please see (Davis, 1999).

2.2 Flipped classroom

A flipped classroom is a teaching approach where students are first exposed to content before coming to a class. In class, they then spend time on engaging more deeply with the ideas and concepts. This encourages the use of active learning to allow students to explore concepts, solve problems, and discuss ideas with each other and the teacher/instructor. The group sessions are usually done in a classroom or lab setting. However, students can also conduct research and information gathering by accessing resources online, by using online multimedia resources to create reports or presentations, and by collaborating online through group project work or through critique and evaluation of each other's work. Therefore, the flipped classroom method can also be used in a blended learning setting. For an example in NTEU see Statistics course using flipped classroom on eCampus.



Team-based learning (TBL) (Haidet et al., 2012) is one specific implementation of a flipped classroom. A potential implementation could look like this: Students are split in teams of 5-7 students who work together. Before each unit of a course, they prepare by reading material related to the course work (typically selected by the teacher). In the beginning of the class, students complete individually a short multiple-choice test based on the readings and then the same test is retaken by the entire team. Then the teacher/instructor encourages teams to identify questions where they have disagreed with the answer given by the teacher/instructor. They then review the material, evaluate their understanding, and defend the choice they made. The class is concluded by a mini-lecture that focusses on the concepts that students struggled the most with. As such, TBL incorporates not only a flipped classroom, but also collaborative learning (2.4) and peer teaching (2.5).

2.3 Simulation-based learning

In simulation-based learning (SBL), simulation(s) are used for learning purposes. This training is done in a realistic environment utilizing simulation equipment. To create a realistic environment, the setting must include faculty members who have been formally trained in simulation pedagogy. In medical education, SBL is used to recreate clinical scenarios for developing knowledge, skills, and attitudes of healthcare professionals while protecting patients from unnecessary risks. In biology, chemistry and physics education SBL is used to recreate scenarios of complex machine operation, or requiring e.g., animal testing.

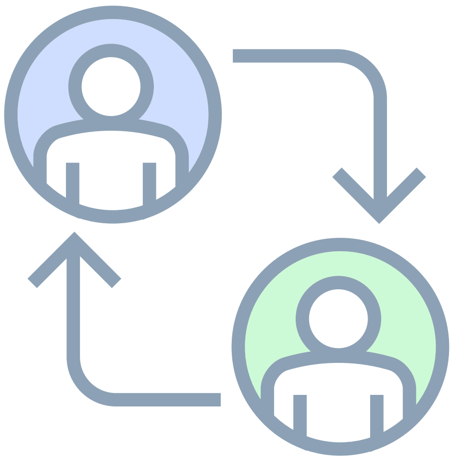
2.4 Learning through collaborative argumentation

Argumentation in science (i.e., the interactive coordination of evidence and theory to support or refute an explanatory conclusion, model, or prediction) helps to absorb and construct scientific knowledge. Argumentative learning practices are defined as activities in which participants cooperate to solve/explore a particular problem, for which a set of hypothesis or solutions are proposed, by engaging in argument (Muller Mirza, 2012). Both consensus and challenge contribute to learning.

Students can deepen their understanding of contested topics in science, history or arts by arguing in ways similar to professional scientists and academics. Argumentation also helps students to appreciate the value of opposing ideas and of evidence. Together they refine ideas with others, so they learn how scientists work together to establish or refute claims. In this way, argumentation pedagogy prepares students for a world where the consequences of science, technology and public policy affect many and are publicly debated (Sharples, 2019) and prepares for peer teaching (Peer teaching (learners become teachers)).

2.5 Peer teaching (learners become teachers)

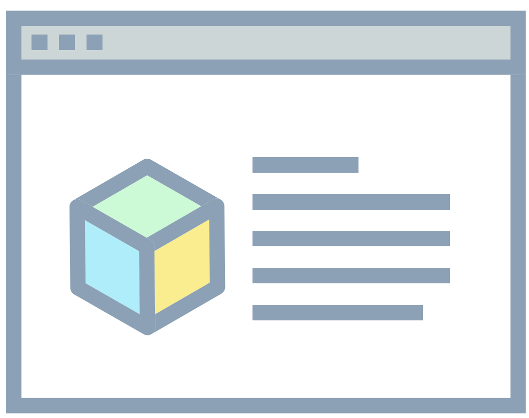
In peer teaching, students act as teachers. It is widely used in primary and secondary education, many universities, and increasingly in medical schools. Peer teachers can give lectures on assigned topics, lead problem-based learning, or act as tutors for their classmates (Benè and Bergus, 2014). The model can also be attractive to study programmes because it enables students to act as teachers elsewhere (e.g., in tutorials, Tutorials). When working with well-defined rubrics, peer teaching can also incorporate peer assessment where students assess the product of other students. Example of such products are reports, essays, poster presentations and oral presentations. Peer assessment helps students to actively think about assessment criteria, thereby improving the quality of their own product.



2.6 Space-oriented learning

Another active learning approach pursues the unifying hypothesis that physical space can play a critical role in in human memory and experience, or space as a frame for memory formation and a source of authentication, i.e., space-oriented learning. An example is the Future Memory Project, which applies this method to Historical and Cultural Learning (HCL). Future Memory is based on this unifying hypothesis and has implemented it for authentication and education of singular historical events in a concrete HCL paradigm using mobile and mixed reality technologies. In a recent study, these technologies have been used to facilitate understanding in the form of individualized mixed reality audio-visual narratives through the active and embodied exploration of digitally enhanced physical sites implicated in the Holocaust and Nazi crimes (Verschure and Wierenga, 2022).

The open access co-creation platform Gala (see section The NTEU Case Library on the Gala Platform for further explanation) has implemented space-oriented learning in one of its course modules by recreating a digital map of a natural reserve with focus points, or site visits, the students can visit. By cycling through the different site visits in subsequent sessions, or walks, students approach the learning objectives in an innovative and active manner to learn more about the natural reserve while memorizing the map, hereby forming memory in a context, space-driven orientation.



3 Implementing distance teaching and learning

Distance education has gained immense popularity in a short span of time as it allows individuals to pursue their studies despite potential obstacles (e.g. long/expensive commuting, access restrictions to the university during a pandemic). In this context, however, it should not go unmentioned that limited access to the internet remains a challenge in implementing distance teaching and learning. Furthermore, the Covid-19 pandemic has taught us that social, in person, interactions between students, and students and teachers is important for the social and emotional wellbeing of students. The field of distance education is very broad and therefore only some implementations of distance/online learning will be briefly presented below.

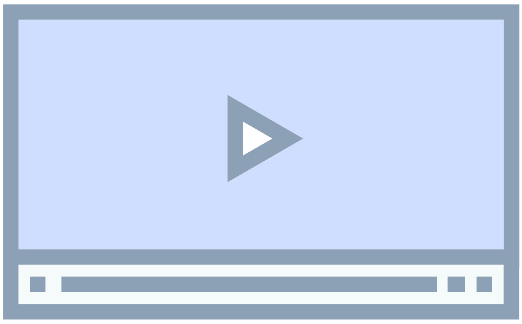
Blended learning combines tools of distance learning, e.g., the examples given below and other online technology-mediated types of content presentation with physical classroom-based methods. A common example is the flipped classroom concept (see Flipped classroom), in which a lecture or other material is made available before an in-class session, which is then held as a seminar that the participants physically attend. Similar separation of content is a practical training, where the theoretical concepts can be obtained by online content or via distance learning whereas the hands-on practical work is in separate sessions in person in a lab. Effective use of a learning management system (LMS, see below) can make this type of education a rich experience for students and many universities have explored this method during the recent pandemic.

3.1 Live streamed video

This is basically a face-to-face lecture delivered live to students attending remotely. Distance learning students may be watching the live stream on their own at home, work or in transit, or in small groups at another campus or local learning centre. In a hybrid format, there may be students in the lecture hall too. Typically, there is no change in the design of the lecture, but the instructor must be careful not to ignore the remotely participating students (e.g. questions or contributions to discussions), especially in a hybrid format. Open-source platforms like Jitsi can be used for larger groups of students, and there are also many commercial video-conferencing platforms such as MS Teams, Zoom, Meet and Cisco Webex, which are free to use to some extent and often have university/educational licenses/discounts. Most platforms are relatively easy to use and to set up and include various features that teachers might find helpful during a lesson, such as a virtual whiteboard and tools for sharing and annotating documents on screen. Of course, a stable IT infrastructure is critical.

3.2 Classes using lecture capture

This format was originally developed to make lectures available for repeated viewings by students at any time (e.g. for homework or reviewing). There are numerous programmes for recording video lectures on the market (e.g. Panopto, Opencast, etc.). There are many advantages of capturing lectures, both for the tutor as well as for students. Students have the comfort of knowing that they can revisit lectures whenever they like, which can help to close knowledge gaps. Typically students are also eager to review course content later to clarify especially difficult concepts and in preparation for exams (Davis et al., 2009). Recorded lectures also help to implement flipped classroom approaches (see Flipped classroom), because the information (e.g., the lecture) is already recorded and can be viewed online by the students before the class. Last but not least, lecture capture can relieve the pressure of note-taking, since the lecture can be viewed later again. This allows the students to devote their undivided attention to the lecture content. However, pre-recorded lectures on their own could promote student passivity if not combined with motivating features (e.g., flipped classroom).



3.3 Support through learning management systems

Learning management systems (LMSs) enable instructors and students to log in and work within an online learning environment with personalized and password protected accounts for both students and teachers. Traditionally LMSs are used to distribute course content, assignments, additional reading, et cetera.
Most online learning management systems, such as Moodle, Blackboard and Ilias (see eCampus at the University of Bonn in Statistics course using flipped classroom on eCampus), are in fact used to replicate a classroom-like design model. They consist of weekly units or modules, the instructor selects and presents the material to all students in the class at the same time, a large class can be divided into smaller groups with their own instructors, there are opportunities for (online) discussion, students work through the materials at roughly the same pace, and assessment is done through end-of-course tests or essays. Through incorporation of video-centric tools like Kaltura, LMSs can be used for online lecturing, especially for smaller groups, or when students are also expected to create video content. For teachers these video tools also enable them to create short knowledge clips to accompany their lecture materials. In fact, using green screen recordings or lightboards these knowledge clips (typically short videos of max. five minutes) can become a highly dynamic content resource that teachers can also adapt to further explain content that is difficult for students during classes. This content can be easily reused in following years.

The main differences to courses exclusively taught in a classroom are that (1) the content is a mix of text and video and audio, often with the possibility of integrating or linking to video-conferencing session, (2) online discussions are often asynchronous rather than synchronous, and (3) course content can be accessed online anytime from anywhere. Despite these important differences from a physical classroom, the basic organizational framework of the LMS remains like an actual classroom, and experienced teachers and instructors can modify or adapt LMSs to meet different teaching or learning needs (also similar to a physical classroom). The platform Gala (see The NTEU Case Library on the Gala Platform) can also be described as an LMS even though there are a few differences to 'classic' implementations.

3.4 Massive open online courses

Massive open online courses (MOOCs) are a newer strategy for information delivery and education. Courses consist of online videos and short lectures that can be combined with automated computer tests or peer assessments. They can be offered by cloud-based software platforms such as Coursera, edX and FutureLearn.

4 Innovative implementations in NTEU

Innovative educational practices are important to NTEU from several perspectives. On the one hand, we want content produced or available at one NTEU partner to be available to a maximum of students across the alliance. As already pointed out this inevitably implies that a considerable amount of content should be available online and accessible by digital tools. On the other hand, we want content newly produced by NTEU to take advantage of innovative teaching concepts. Given the diversity of teaching concepts and educational content no single (technical) solution will cover all our needs. Instead, we aim for creating a growing portfolio of innovative and feasible teaching solutions with known advantages, and clearly stated limitations. This will enable our teachers to select the most appropriate tool for providing a specific piece of educational content. We expect the following section to evolve as we develop, grow, and optimize the NTEU education and teaching infrastructure.

In the following section we describe the three platforms that are currently in use by NTEU and its partners and describe further developments of a platform where needed. They represent our past work in the Pedagogy field-lab (PFL). In addition to a brief explanation of the goals, content and implementation, the following sections highlight the specific advantages of a particular tool or platform and its challenges.

4.1 The NTEU Case Library on the Gala Platform

Gala is a learning environment for case-based sustainability learning, which was conceived and built at the University of Michigan for the Michigan Sustainability Cases (MSC) initiative. The platform was developed with two objectives: 1) to use case studies as an engaging and effective pedagogical tool; and 2) to reshape the way case studies are presented by bringing them online and adding multimedia elements to make cases more inclusive, adaptable, and immersive. Gala also breaks down established distinctions between instructors and learners as any user can be a reader, a teacher, and an author. There are no restrictions on who can author a case, form a learning group, or use cases for learning or teaching.

Gala's design and suite of features were developed over several years in response to feedback from users and an expanding sense of the platform's potential. All content is presented in so-called cases, which can be grouped into case libraries. The heart of each case study is a textual narrative, which is broken into pages and cards (see below). Segmenting information in this way creates a logical, flexible structure that can accommodate any learning module, and it takes advantage of chunking, the idea that grouping content into smaller, more manageable portions aids in information processing and retention. Each Page can have many so-called Cards, which contain one to two paragraphs of the narrative to which Edgenotes (i.e., embedded media elements) that appear alongside the Card can be attached.

Gala is accessible through any standard web browser and requires no further software installation. For the creation and editing of cases, a user profile needs to be generated. This is for free and only a name and an email need to be given. A full documentation of the Gala platform is available at : https://about.learngala.com/docs/.

4.1.1 Current implementation

Gala was initially used to make the NTEU Lecture Series on Current Methods in Neurotechnology available to a wider audience. The videos of the individual lectures (currently eight) are hosted on YouTube (https://www.youtube.com/playlist?list=PLSrV8056EZgAjupemhRT5CsK_op9ihXKK). Gala served as a tool to provide further information on the topic, in which the external videos are embedded. Two additional cases with NTEU-related content were also included in Gala to further explore the features of the platform. Each of these pieces of content have been created as a Gala case and grouped into the NTEU Gala library.

Link: https://www.learngala.com/catalog/libraries/neurotecheu
Contacts: Erik Vinkhuyzen (erik.vinkhuyzen@gmail.com) and Anne Boehlen (anne.boehlen@uni-bonn.de).

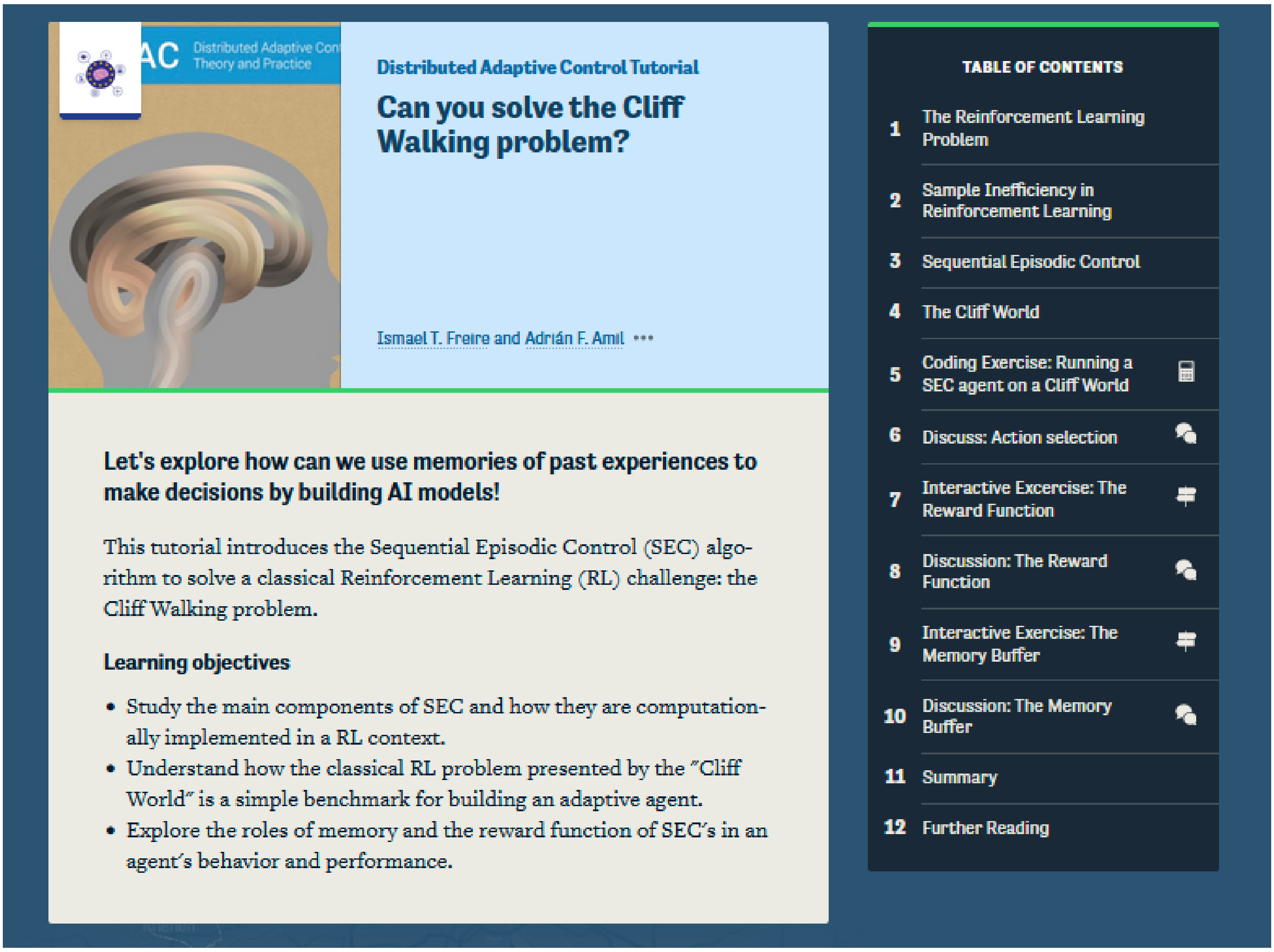


Figure 1
Example of a case study in Gala for teaching a reinforcement learning algorithm called Distributed Adaptive Control. The case study can be interactionally explored here (https://www.learngala.com/cases/dac-tutorial). The individual sections of the case are displayed on the right (Table of Contents). The user is suggested to work sequentially through the material.

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4.1.2 Advantages and Challenges

The main educational advantage of Gala is its co-creation abilities. Teachers and students can work together on course content, and in this way, students can become teachers as they bring in individual knowledge and experience that benefits fellow-students and teachers. Teachers can give different assignments to different groups of students to stimulate collaboration between students. And teachers can choose to reuse course materials from assignments in courses in following years, thus providing a continuous developing course.

The main practical advantage of Gala is the low threshold for its use. No software installation is required, and a user profile is quickly generated. Sufficient online documentation is provided, and cases can be created and edited in a user-friendly way directly through in the web browser. Very little training is required to get first results. In addition, the individual cases can also be reached directly via their URLs, which can be embedded where desirable.

Students can comment online in a discussion group that is public to that group but cannot make private notes for individual Gala cases. There is no infrastructure for controlling access to content, for moderating the discussion, and for monitoring case completion by individual students. The latter complicates the accreditation of participation. Private communication between case provider and participant is not possible via the platform. Learning performance assessments and real-time teaching cannot be offered.

For ease-of-use and to ensure consistency across all content of Gala, there are some restrictions regarding the design and organization of cases. (1) It is not possible to control the layout or the fonts of a page. For example, the image size and positions of text and images cannot be modified. (2) Cases cannot be easily grouped according to content within a library (e.g. folders and subfolders). Currently, a case library is a list of cases sorted by date of creation (date of publication). This can become confusing as the amount of content in a case library is increasing. (3) It should also be noted that material such as videos need to be stored on a separate platform and embedded by linking to it.

Gala is a database-driven web application for authoring, reading, and discussing media-rich case studies. It is built with the Ruby on Rails web application framework with a dynamic front-end that was developed with React.js, which serves both as the view on a case for collaborative study and as its graphical editing interface. Gala's source code is licensed under the open-source MIT license and published on GitHub (https://github.com/galahq/gala).

The pilot phase of using Gala for NTEU was free of charge. However, routine use of Gala as a NTEU content platform will not be for free. Specific pricing and conditions will have to be negotiated.

4.1.3 Conclusion

Gala is an easy-to-use platform for bringing relatively compact pieces of content online in very little time. Through its unique co-creation abilities collaborative and peer-to-peer learning methods can be easily transported to online or blended learning. There are limitations regarding the organization of content, controlling access and the interaction between users and content providers (see above).

4.2 Statistics course using flipped classroom on eCampus

In recent years, online tools have been increasingly used for our practical teaching activities. This was triggered by protective measures instated during the Covid-19 pandemic. Within a very short period, it was necessary to convert the traditional lectures and seminars held in face-to-face sessions into digital online formats. It quickly became clear that due to the lack of interaction possibilities in pure online sessions, new, more suitable formats had to be found.

The University of Bonn (UBO) uses eCampus (https://ecampus.uni-bonn.de) as a learning platform and as our web presence for digitalization. It is based on ILIAS (https://www.ilias.de/en/), which is an LMS (see Support through learning management systems). The automatic assignment of students to individual courses is done by connecting "eCampus" to the university's administration tool "Basis" (https://basis.uni-bonn.de). The results achieved are also documented there. Objects associated with individual courses and teaching appointments within the different courses can be uploaded directly onto eCampus. These can be reading materials or links to other sources for independent learning or tasks with various feedback options. All objects can be provided with specific settings for their visibility, changeability, and deadlines for feedback. Because eCampus is a well-established learning platform at an NTEU partner, we considered it as potential learning platform for NTEU. In the following, a single practical example is given (flipped classroom, see Flipped classroom).

4.2.1 Current implementation

In the statistics course using flipped classroom, the lectures were digitally recorded and made available to the students in advance via a streaming portal. In an associated online event called plenum, all the students' questions about the lecture were first collected and summarized in a structured way on a whiteboard. Afterwards, the students were grouped into small groups of about five people. Within these groups, the students themselves tried to answer these questions. The lecturer moderated this process without directly answering the questions himself. After an appropriate period, depending on the complexity of the questions and the progress made in the small groups, the answers found were presented to all students by one representative from each group and discussed by all students. In the remaining time, the lecturer set tasks related to the content of the lecture, which were then solved again in the small groups and discussed by all. Three to five cycles of about 10 minutes of problem solving followed by 5 minutes of plenary discussion proved to be a good guideline. The flipped classroom concept proved to be a very efficient method of imparting knowledge. Despite two years of missing face-to-face classes, the performance in the equivalent final exams did not drop compared to the pre-pandemic cohorts. In surveys conducted, 80% of the students preferred the flipped classroom concept to the classical system of lecture and seminar.

Practical implementation: The lectures were videotaped beforehand. The video tool "OpenCast" implemented in eCampus was used to make lectures available as streaming objects in the associated sessions on the learning platform. We had deliberately opted for a streaming solution rather than a download solution to better manage copyright for the lectures and to prevent the university's intellectual property from spreading uncontrollably on the internet. Students were encouraged to consult this material prior to the original lecture date. They also had the opportunity to find out about other available sources on the topic in question. We used the Zoom platform (https://support.zoom.us/hc/de) for online communication. The links for the individual Zoom sessions were provided in the associated session dates on eCampus. The plenary discussions took place there with all people logged in. For small groups, we used the breakout session function of Zoom. The allocation of students could be done automatically and immediately by simply specifying the group size. The lecturer could join any group. If problems arose, students could contact the lecturer through Zoom's internal chat function. In this way, it was easy to keep track of the status of the task processing.

Link: The specific content discussed here is currently only available for students enrolled in the course. eCampus URL: https://ecampus.uni-bonn.de

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4.2.2 Advantages and challenges

From a didactic point of view, the flipped classroom concept offers clear advantages over the classic concept of lecture and seminar. Students can view the digitally available lecture at any time and as often as they wish. If they do not understand some passages, they can look for alternative sources on the internet for the topic discussed. No time is needed in the course for this learning activity. The lecture material can be actively worked on in between joint plenary sessions and fixed small group activities. The active discussion of questions from fellow students, which an individual might not have thought of, or the tasks set by the lecturer, inevitably leads to a reinforcement of the learning process. At the same time, most students perceived this more active form of learning more positively than teacher-centered lectures as evident from our end-of-course surveys.

Initially, there were concerns about students being reluctant watch the digital lectures provided before class meetings. However, working in small groups, with the same participants each time, made students feel uncomfortable when they were repeatedly unable to contribute to solving the assigned tasks. Finally, we have not yet exhausted the full range of interactive learning possibilities. Online surveys and self-learning tests can and should complement the flipped classroom concept.

It should be noted however, that successfully setting up flipped classroom required a fully functioning online LMS combined with several additional platforms. This is associated with significant costs for personnel (e.g., administration of ILIAS) and other costs (e.g., for hardware, power, internet access provider), which was covered by UBO in this case. For use by NTEU, this may require negotiations. Also, opening this platform for general use by NTEU will require some agreement on access control because eCampus is currently only available to students and employees of UBO.

4.2.3 Conclusion

The use of digital infrastructure allows the transformation of teaching away from the classic combination of lecture and seminar. The solution presented here can probably be realized on most well-established learning platforms. In the context of NTEU, several points would need to be considered in more detail (e.g., access control, student enrollment, financial aspects).

4.3 Transforming the course Cognitive Science & Psychology: Mind, Brain, and Behavior to INCF

As a next activity in NTEU's Pedagogy field lab (PFL), the NTEU is setting up a pilot course to test the INCF Training Space. The International Neuroinformatics Coordinating Facility (INCF, https://www.incf.org/) is an international non-profit organization. Its aim is to develop, evaluate, and endorse standards and best practices based on the principles of open, fair, and citable neuroscience. In addition, it provides trainings on these topics. It is hosted by the NTEU partner Karolinska Institutet (KI).

We will take advantage of the INCF Training Space and including a co-use of Gala platform (also see chapter The NTEU Case Library on the Gala Platform) to implement the course "Cognitive Science & Psychology: Mind, Brain, and Behavior", taught by Prof. Verschure. It contains two teaching methods. First is a lecture series that is already available in recorded form. Placing lectures like these online is, since the Covid-19 pandemic rapidly becoming a new standard in education. Interwoven with these lectures are, however, discussion groups in which students are tasked to read a scientific article and then, in groups, formulate arguments supporting the paper, or counter arguments towards the paper. After that, the two groups of students discuss with each other, trying to convince the other group of their arguments. To this discussion, a third group of students sits in, like arbiters, deciding which group, pro- or con-, is more convincing. It is this second teaching method, involving co-creation, presentation and discussion, and peer-to-peer assessment that is more challenging to bring to a pan-European online environment. We are designing this second part as a co-creation between INCF Training Space and Gala, where teaching materials, papers, discussion platform are made available in the INCF Training Space, and co-creation groups are formed in Gala.

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7 Appendix/Annex/Glossary

7.1 Teaching formats and course types

7.1.1 Lectures

Lectures are teacher-centred instructions often, but not exclusively, directed at large groups of students. Depending on the topic, several hundred people may be attending a lecture. Topics can range from a basic introduction to the subject (“textbook knowledge”) to a presentation of the latest research and technologies. A lecture is usually one to two hours long. They can be ‘stand-alone’ if they deal with a narrow subject or combined into a series to cover broader topics.

As a rule, lectures are usually not very interactive although follow-up questions from the audience are encouraged. In addition, lecturers may address students directly and actively involve them in the lecture by asking questions. However, this does not lead to a classic classroom discussion.

Students are often provided with scripts to accompany the lectures. The scope of these scripts varies widely, ranging from sparse lecture notes – for example, a collection of the diagrams presented, for which students must write down the actual knowledge themselves – to complete lecture notes that virtually eliminate the need to purchase a textbook (or to attend the lecture in the first place).

Overall, lectures are highly suitable for digital teaching, and especially so if complemented by scripts (or the possibility to attend a lecture or specific parts of a lectures multiple times) and an option for follow-up questions (live, chat, learning platform). Also see Webinars and Implementing distance teaching and learning.

7.1.2 Seminars

A seminar is a small group session (up to 30 students) offering the opportunity to discuss teaching content (discussing papers, working on an assignment, group work, etc.). Seminars typically serve to deepen scientific knowledge and can be offered on any topic of the subject area. In contrast to the lecture, they are characterized by greater interactivity of the lecturer and seminar participants. The online version is called a Webinar (see below).

7.1.3 Webinars

Webinars are now used to describe events of various kinds that take place in a virtual classroom (e.g., seminars, offers on learning platforms, coaching, and mentoring meetings, courses and exams). Webinars make seminars accessible from anywhere in the world. In contrast to an on-demand webcast, where the information is only transmitted in one direction, a webinar is designed to be interactive and enables two-way communication between speaker and participants. Other typical interaction options include downloading files, asking questions via chat or taking part in surveys.

7.1.4 Tutorials

Tutorials are usually held in smaller groups (up to 20 students) by a lecturer or a graduate student (or teams of graduate students), Tutorials often accompany a seminar as a supplementary exercise. Students can review and deepen the material of a course together with a tutor.

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7.1.5 Practical classes

Practical classes are more complex training units. They are often designed to deepen knowledge about a particular concept and to simultaneously obtain practical skills related to that area of science. The number of participants is typically small (< 20). Participants learn and practice skills, and further increase their understanding of a subject through experimentation, observation, and interpretation. The goal is to improve skills regarding the design of experiments, the safe use of equipment and the recording, analysis, and interpretation of experimental data. In NTEU, and especially in its life science related disciplines, practical classes are usually the most difficult to hold online.

7.1.6 Courses and modules

A course or module usually consists of a sequence of teaching units. The unit formats within it can vary widely. They typically consist of lectures to provide basic knowledge, seminars and tutorials to deepen the understanding, to discuss the material and apply the newly gained knowledge. A module description should clearly outline the requirements, learning goals and what the path from the starting point to the learning objectives is. A course is usually designed for a specific number of participants. Outlined below are examples of formats with a very specific purpose.

Method Course/Practical Course: A methods course should enable students to deepen their understanding of the strengths and challenges of their chosen approach at a general level. Methods courses focus primarily on teaching practical skills. Practical work is usually accompanied by lectures, seminars, and tutorials.

Language course: A language course in NTEU is intended for promoting exchange and for enabling learners to move between NTEU partners by acquiring specific local language skills (university administration, shopping, work, local geography). They also support multicultural and multilingual cooperation and awareness thereby strengthening community spirit.

Soft skill course: For a successful career, it is essential that learners and students continuously upgrade their academic and non-academic skills through soft skills courses (e.g. academic writing, publishing, scientific presentation, independent research, learning to teach, leadership, data management and career management). The courses, taught by professionals in the respective fields, facilitate the strengthening of leadership, management and networking skills. In NTEU, such content is offered for example by the NTEU Lifelong Learning Centre and the NTEU graduate school.

Good Scientific Practice Course: Safeguarding good scientific practice is essential in all scientific work. The essential principles are typically taught in short courses to researchers and students at all levels.

Workshop: Workshops focus on specific concepts or techniques by a highly qualified instructor and have a smaller number of participants (5-20). They tend to last for several hours up to days. They emphasize close interaction and are therefore often held in person, especially if they have a practical component.

Summer School and Winter School: They provide a systematic and comprehensive introduction to a key topic. The aim is typically twofold: 1) to expose students to current research topics and methods at an early stage in their careers and 2) to bring students together to create professional networks. These schools are typically very interactive and structured around a series of lectures or seminars. They can also contain practical components or practical courses and can be combined with visits to research laboratories.

7.2 Assignments and assessments

7.2.1 Objective tests

Objective tests are types of exams that typically have multiple-choice questions, questions with short answers and/or questions where the answer is true or false. They can also include problems or mathematical proofs. In addition, they can involve drawing schematics or charts (Hadwin, 1999). Because of their relatively simple design these tests are often straight-forward to do online.

Multiple-choice tests: A multiple-choice exam is a type of test that can be used to measure the knowledge of facts, concepts, rules, and quantitative techniques across disciplines. Its typical duration ranges between few minutes to several hours. It is often easy to score automatically (also see below). However, developing this type of test can be challenging, because it requires particularly well-formulated multiple-choice questions (Davis, 1993). Also, this type of assessment can be less helpful for assessing higher level skills and intelectuall abilities because it is typically limited in its ability to evaluate for example sophisticated problem-solving, creativity, and evaluation (Bates, 2019).

True-false tests: True-false tests are less reliable than other types of exams because random guessing generates the correct answer half of the time. These items, however, are suitable for occasional use. When using true-false questions, some include a “explain” column in which students write one or two comments to support their choice (Davis, 1993).

Matching tests: Using the matching format is efficient for examining students’ knowledge of the relationships between terms and definitions, events and dates, categories and examples, and other links (Davis, 1993).

Computer-based objective tests: Because of their relatively simple structure and their pre-defined sets of answers, the three tests mentioned above can be easily performed on a computer or online. Scoring the exams of large number of students is very fast and easily automated. In addition, analysis of results is fast and adjustment of evaluation/scoring criteria can be easily adjusted (e.g. to obtain a certain distribution of scores

7.2.2 Essay tests

These exams typically require students to respond to specific questions in an understandable and readable manner. Because the questions are focused, the student is usually expected to include some basic points in their essay. As a result, before marking these tests, the teacher should write down the key points so he can prepare model answers ahead of time (Hadwin, 1999). This method is effective for evaluating understanding and more sophisticated intellectual abilities, such as critical thinking, but it is time-consuming, prone to subjectivity, and ineffective for evaluating practical skills. Scoring such tests is usually more time-intensive compared to objective tests and automated scoring is typically not possible although experiments are being conducted taking advantage of advances in artificial intelligence. However, automated essay marking has difficulties in identifying the true semantic meaning of an answer and comparing it to a model answer so far, particularly at a higher education level (Bates, 2019).

7.2.3 Performance tests

Students are required to perform tasks under timed conditions (e.g., follow directions, draw pictures, work with materials or equipment, conduct experiments, and respond to actual or simulated events in performance exams). Performance evaluations can be given to individuals or groups. Because they are logistically challenging to set up, difficult to grade, and the material of most courses does not always lend themselves to this sort of examination, they are rarely employed in colleges and universities. Performance examinations, however, can be helpful in courses where students must demonstrate their abilities (e.g. medicine, education) (Davis, 1993).

7.2.4 Formative assessment

The term describes methods that are used during a class or course to discover misconceptions, difficulties, and learning gaps while evaluating strategies for closing such gaps. The underlying idea is that when students comprehend that the purpose of the formative assessment is to improve learning rather than to increase final grades, they are more likely to take ownership of their learning. There are several strategies such as the use of open questions and the integration of extracurricular activities into the curriculum (e.g. idea mapping) (Wyse, 2016).

7.2.5 Summative assessment

At the end of a unit, course, or program, the learning, knowledge, proficiency, or success of the students is examined. Summative tests are virtually always officially graded and frequently given a lot of weight. Summative evaluation can be utilized effectively in conjunction with formative assessment and in accordance with it. Such assessments are also known as 'assessments of learning' since they aim to summarize and report on what has been learnt at a specific point in time. Although it may not have the same direct impact on learning as formative assessment, it can still be used to enhance learning in a less direct way when results are used to inform decisions about courses or teaching. Summative assessment is significant for several reasons according to (Wyse, 2016): 1) Provides accurate reports on the accomplishments and academic development of specific students. 2) Enables tracking of the academic progress of particular groups (e.g. top and bottom achievers, surface vs. deep type of learning, students' prior knowledge) and educational opportunity equity. 3) Can identify expectations and standards for students, teachers, and other users. 4) Improves learning in the long and medium terms.

7.2.6 Open book examination

An "open book test" allows students to access their class notes, textbooks, and other authorised materials while answering questions. This is not unusual in legal exams, but it is almost unheard of in other subjects. Although the concept may appear radical and perplexing to people accustomed to traditional tests, it is perfectly suited to teaching programs that specifically aim to improve critical and creative thinking skills (Vishavpreet, 2016).

7.2.7 Take-home-exams

Take-home exams (also homework assignments) enable students to work at their own pace while still having access to books and tools. They allow for lengthier and more complicated questions. Appropriate types of take-home tests include problem sets, short answers, and essays. Excessively demanding questions or not including time or word constraints should be avoided. Also, students require precise instructions on what they can and cannot do (e.g. discussing responses with colleagues). Another type of homework assignment is to announce some time before an exam that from a set of questions, some will be selected for the exam. This allows students to better focus on relevant topics while learning. (Davis, 1993).

7.2.8 Project work

Project work promotes the growth of real-world abilities that call for content comprehension, knowledge management, problem-solving, group collaboration, evaluation, creativity, and useful results. Project work is one of the greatest ways to evaluate the high level skills, but it necessitates a considerable amount of expertise and inventiveness from the instructor, and the assessment procedure can be labor-intensive (Bates, 2019).

7.2.9 Peer assessment

In this type of exam, participants rate each other's work. This is considered as an effective technique to build deep comprehension and knowledge. Guidance and well-formulated model answeres or outcomes are particularly important.

7.2.10 Self assessment and e-Portfolios

Self-assessment through reflection, knowledge management, recording and evaluation of learning activities is another form of assessment even though it typically does not results in scores or grades. E-Portfolios are online tools, which are self-managed by the learner but can be made available or modified for formal assessment purposes or job interviews (Bates, 2019).

7.2.11 Progress Report

Training measures can be complemented by mentoring and reporting programmes. These are typically found during work on complex projects (e.g. BSc, MSc or PhD thesis). Progress reports help students reflect on their progress and better plan their future milestones. It also allows the supervisor and advisory board to evaluate the students' work and the direction they have taken with their research. It is in both the student's and advisor's best interest to ensure that the research moves forward in a timely and well-thought-out manner. A standardized form/document can be used to document the progress of the leraning. Such a form provides an opportunity to provide an overview of the student's achievements to date and recommendations for future development.

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