INNOVATIVE AND TECHNOLOGY-ENHANCED TEACHING AND LEARNING

ACTIVE LEARNING WITH SPECIAL FOCUS ON TECHNOLOGY ENHANCED COLLABORATIVE LEARNING

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Promoting Innovative Teaching & Learning

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ERASMUS+ PRINTEL PROJECT "CHANGE IN CLASSROOM: PROMOTING INNOVATIVE TEACHING & LEARNING TO ENHANCE STUDENT LEARNING EXPERIENCE IN EASTERN PARTNERSHIP COUNTRIES"

INNOVATIVE AND TECHNOLOGY ENHANCED TEACHING AND LEARNING: ACTIVE LEARNING WITH SPECIAL FOCUS ON TECHNOLOGY ENHANCED COLLABORATIVE LEARNING

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PART 1

AN INTRODUCTION INTO ACTIVE AND COLLABORATIVE LEARNING

Why is it active?
Why will it be collaborative?

1.1. Introducing Activating Teaching for Obtaining Active Learning

The whole idea of reformation of higher education (HE) and changing didactics towards active learning is to be framed into several global changes in education:

- a shift in HE from general universal development to competence development and application of knowledge,
- a leap forward progress in information and communication technology,
- the globalisation of science and education based on a new tendency of managerialism and neoliberalism.

The reorganisation of the European Higher Education started with the Sorbonne and Bologna declarations. The most practical impact for HE in partner countries was the introduction of the ECTS, the European Credit Transfer System from 1989. Formally, from 2007 on, ECTS has been introduced in all HE institutes participating in European educational projects (e.g.: Erasmus+). However, in international cooperation projects the actual operational status of ECTS in many countries and universities is different or even divergent from the original aims of the ECTS system. Especially, in practical cooperation essential misunderstanding, lack of basic operational rules and standards, ambiguities or even contradictions between national legal requirements and internationally accepted quality rules in the European Higher Education Area (EHEA) are the order of the day.

The academic level of universities in the EHEA today is far from homogeneous. Simple differences in the formulation of teaching and operational goals, assessment methods and examination goals, student and teacher workload definition, legal and educational quality requirements, the universities' funding rules, integration of research and service to society in the universities' teaching tasks are all influencing in as many ways the educational output of HE, they are

still hindering student and staff mobility in the EHEA and limit educational and didactic degrees of freedom for university students and staff.

Even the introduction of new didactic methods, i.e. new IT based methods in Teaching and Learning (T&L), is influenced and is being threatened on all sides by these annoying internal and external divergent parameters. Now that the use of photographic slides in teaching really becomes out-dated, the acquisition of suitable IT teaching hardware may become a new barrier.

That is why we have not only to pay interest to new and commonly available educational and didactic methods, but as well to the universities' organisational systems.

That's why this brochure must be more than a cookbook, a simple list of recipes, but has to pay attention to the whole environment of educational "cooking practice".

1.2. Active Learning: a Definition

The website of Queen's University (CA) (https://www.queensu.ca) in its section on "teaching and learning" is offering a suitable definition of active learning [1]:

"Active learning is an approach to instruction that involves actively engaging students with the course materials through discussions, problem solving, case studies, role plays and other methods. Active learning approaches place a greater degree of responsibility on the learner than passive approaches such as lectures, but instructor guidance is still crucial in the active learning classroom. Active learning activities may range in length from a couple of minutes to whole class sessions or may take place over multiple class sessions".

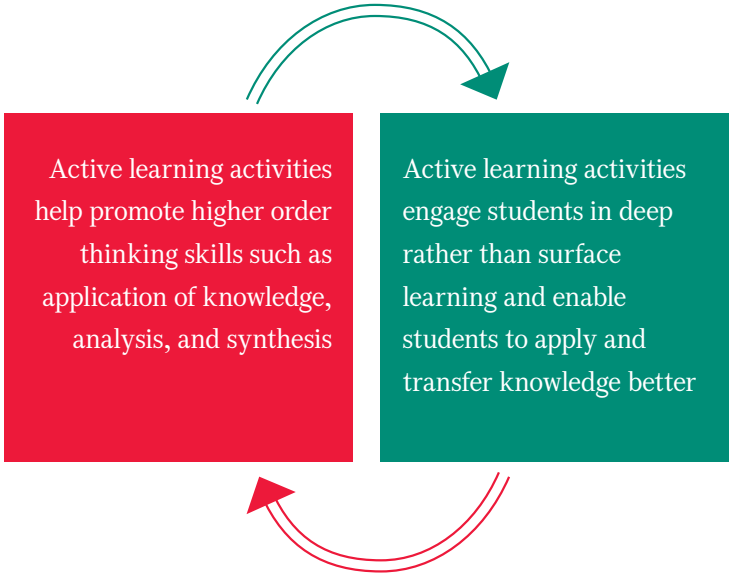


Fig. 1. Active learning: the teacher's and the learner's perspective

This website also mentions a practical answer to the question why to apply active learning and allows to explore how and when action is required in active learning from a teacher's perspective as well as from the learner's point of view.

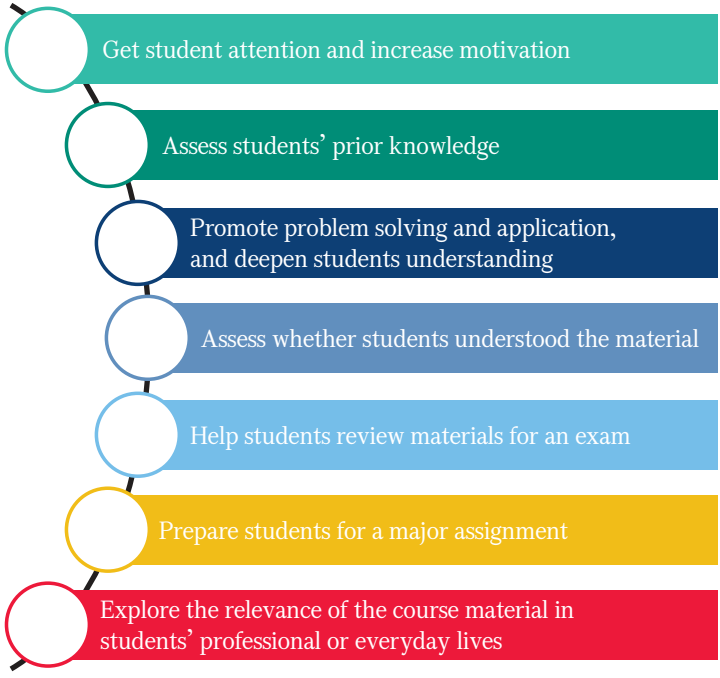


Fig. 2. Major outcomes realized by active learning

1.3. Active Learning: is it an Opportunity or a threat to the Teacher?

… Or is it simply a matter of changing didactical concepts, methods and attitudes?

The lecturer had a nagging question: " for so many years I wrote a good course text; why should I change it now?"

… The students have changed,
… the graduates' profile has changed,
… the field of professional teaching has changed,
… the university changed,
… the world changed,

… even you changed, but did you change your teaching method? So, … shouldn't you change it now?

To our oinion active T&L offers a perfect opportunity for changing academic T&L: updating programme and course building concepts, teaching methods and past attitudes.

In the past few decades, several major facts have lead to significant changes that should be taken into account when talking about education and learning and definitely, when providing academic education and designing academic programmes and courses.

External factors of change

Discussion text based upon the ideas of Sir John Daniel [2].

The overwhelming growth of IT-technology.

The digitalization of the world and the availability of vast amounts of information created a new environment for young people and for education. Undoubtedly, the generation of students now starting an academic education is acquainted with IT-technology: PCs, laptops, tablets, smartphones, … are common elements in their daily world and they are using these technologies. This is the first real IT-generation. These younger people are IT-literates, but do they use these sources of information for learning? Or does this abundance of information result in a very ephemeral confrontation that has no learning effect?

Is this IT generation really "learning" by using IT-technology?

The changing economy.

Where the previous centuries were dealing with industrialization, mechanization and automation, industry in the last few decades has been catapulted into computerization. The fast growth of IT-technology transformed industry into a knowledge-economy. This fast transition created

a huge increase in demand for highly educated scientists and highly skilled technologists, while expelling unskilled workers.

Although the demand for competent graduates is high, the study offer never has been as large as today and the study duration has never been as long as today.

Do IT-generation students study and learn in an effective and efficient way?

Employment, unemployment and underemployment.

Computerization and robotization are destroying simple jobs for low and middle-skilled workers causing a huge problem of unemployment all over the world, even for younger people.

On the other hand there is a massive problem of underemployment of graduates while – very contradictory – employers loudly complain that they cannot find the highly qualified people they need: technologists and scientific generalists, engineers.

Lots of graduates seemingly do not dispose of the competences and attitudes requested by industry. The graduates' profile should change because professional fields have changed.

Are our IT-generation students not learning the right things?

Internal factors of change

The student has changed.

University students' profiles changed dramatically; some characteristics of the generations Y and Z heavily impact their ability to study and to learn.

- The Internet allows fast tracing of information, but the perception might be fragmentary and often there is no proof of scientific value.
- The abundance of information on the Internet causes great volatility of the students' attention and loss of concentration during a scientific search; constant distraction and loss of attention prevents logical thinking and good understanding of complex scientific concepts.

- The false idea of having all information at hand via the internet search engines causes a lack of motivation to find and to acquire new knowledge; "we all know it anyway" in fact means: "Google" knows.

The university is changing. The shift in competences required for graduates should influence dramatically the content of university education and greatly contribute to the urgent need of life-long learning. Is that really so? Historically, universities have an inbuilt "conservatism" and that is good, because the university not only provides market directed professional education. However, changing education programmes, working habits or teaching methods is going slow before it is answering to the call of rapid social and economical developments.

Because of a rapid transformation of professions, the education system should already train students for both, newly emerging jobs, the scope of which is not clear yet, and for future jobs that yet are not defined or known at all.

Can we speak today about a crisis of "graduates' profiles"? Then, what is the new role of the university? Therefore, the university clearly needs to redefine the learning objectives and set again its scope of programmes and courses.

The university can cope with the shift in professional fields by shifting the education of students from specialists to scientifically educated generalists.

The students' profile – The profile of the IT-generation: generation Z

Let's spend some more attention to the changing students' characteristics.

Nowadays, learning and teaching systems at higher education institutions (HEI) in developing and developed countries are confronted with a generation of people born in the late 1990s and early 2000s, who are now leaving secondary school and are joining the university. This new students' generation is named the IT-generation or Generation Z (Fig. 3), they grew up with the Internet and social media and all these young people currently use smart phones, tablets, laptops, etc.

Many students are using various social networks for getting information and online tools for studying professional subjects (Fig. 3 and 4).

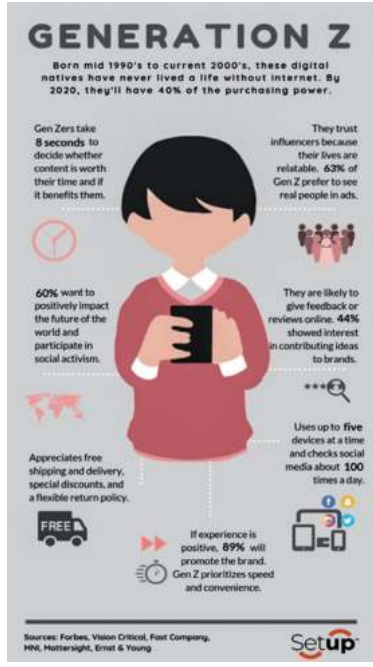


Fig. 3. Generation Z or IT-Generation
https://setup.us/infographics2/marketing-to-generation-z

To address this issue we first need to understand the possibilities and capabilities of students, lecturers and universities to modernize their educational systems and to implement new methods of teaching based on quality and tools that are used by the new generation. The raised issue is a challenge mainly for the HEI in developing countries as the modernization of teaching methods also based on IT technologies needs financial and human resources. For higher education in developed countries it is easier to cope with the pace that IT-technologies are firmly occupying their territory in the social and economical environment; for developing countries to move in the same direction with the same speed as it happens in the IT-generation is quite difficult.

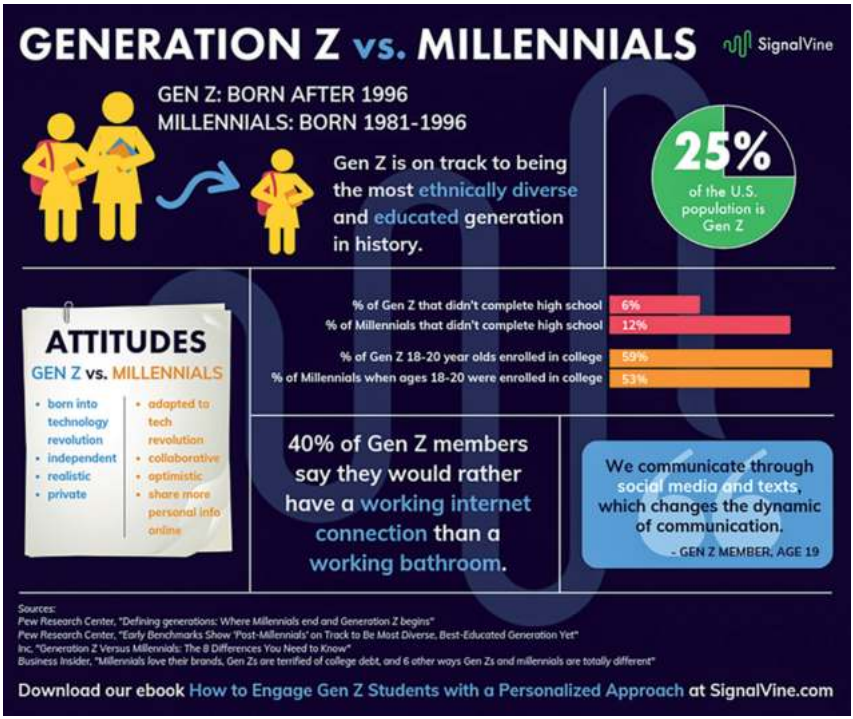


Fig. 4. Difference of Generation Z (born between 1995-2015) and Millenials (born between 1980-1994)
https://www.signalvine.com/higher-education/infographic-gen-z-vs-millennials

Moreover, because of the conservative character of the educational and research systems in HEIs the speed of change for responding to the new global environment will remain an issue for the coming 10 years.

One way to try to solve partially the issue is to implement active learning methods considering for some parts of the lectures using technology based active learning methods such as using online tools that are related to the use of smart phones or tablets, e.g. the assessment tool "Mentimeter".

It is recommended that classical lectures would not be less than the suggested new ones (see Fig. 5). So, when deciding on the volume of implementation of this

new type of lectures or the percentage in the study programme we should be aware that these new methods might require more teaching time and that the positive learning effect is far from equally spread over the student population.

Adapted from Thinking Together:
Collaborative Learning in the Sciences – Harvard University – Derek Bok Center

Fig. 5. Possible lecture time frame when applying active methods
https://cei.umn.edu/active-learning

The main problems that can interfere are:

- Resistance within the education system;
- Calculation of the lecture hours and students' study load when pursuing active learning methods;
- Evaluation criteria used for exams and assessment;
- Student mobility effects;
- Difference in acquired study skills between bachelor and master programme students;
- Difference in learning goals between human and natural science programmes;
- Financial and human resources.

These are main issues that must be considered when implementing and deploying active learning methods on institutional level.

However, some methods can easily be used in PRINTeL PC-universities as these are already used by some lecturers, albeit not in a structured and formalized way.

Anyway, the first step should be to conduct a first cycle of trainings for university teachers in PC-universities. After controlled deployment, the success of the new methods should be evaluated after 3-4 years.

Next will be the change of the teaching environment, regarding the structure of auditoriums and lecture rooms (Fig. 6).

Of course not all methods can be accepted; that is why it is important to evaluate the needs of each university and involved educational programme , for each educational programme is requiring an individual approach.

For PC-universities it is suggested to implement active T&L first in the Master programmes as there is more flexibility in the study units' content compared to the Bachelor programmes.

In the Bachelor programme, it is more recommendable for ease of working to limit the implementation to multidisciplinary or general education courses or subjects.

Fig. 6. Active learning classroom: a multifunctional and flexible setup
https://www.insidehighered.com/digital-learning/article/2018/09/12/study-trying-new-forms-instruction-wont-lower-student

Overall the monologue lecture system must be transformed to interactivity, which will promote developing critical thinking among students (Fig. 7).

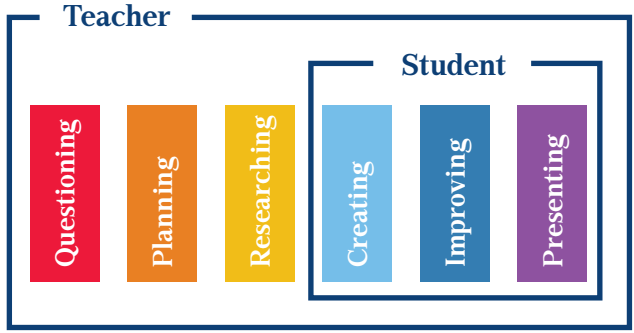
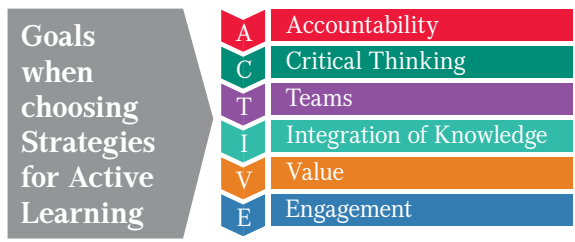


Fig. 7. Teacher and student responsibilities
http://institute-of-progressive-education-and-learning.org/k-12-education-part-ii/based-learning/

Moreover, specific active learning strategies (Fig. 8) should be chosen according to the specific requirements of the educational programme, which will help to develop skills and attitudes required by the professional environment on the labor market.



Nelson, Nancy "Active Learning"

Fig. 8. Goals when choosing strategies for active learning
https://www.slideshare.net/nnelsn/active-learning-ceea-2015-48809769

In PC-universities, today student mobility is limited and is a problem as students are not free to choose subjects from different faculties or universities.

Considering the study ability, the lecturer first shall evaluate the students' prior learning achievements to understand which methods to use during the lectures. This depends on the students' prior knowledge, socio-cultural acceptability and preparedness to study using these new T&L methods.

When considering the implementation of active learning methods, it is important to review and to adapt the assessment and evaluation system for the students' performance. Moreover, there are many active learning methods and each of them requires a proper and effective evaluation method.

An important challenge in all PC-universities is the implementation difference in natural and human sciences subjects and this problem shall be solved at the institutional level.

In some cases, the same methods can be used for subjects in Bachelor and Master Programmes but still the evaluation criteria might be different.

Generally, on these issues the decision should be taken at university or faculty level specifically for each programme as it is part of the strategic plan for implementation.

In all universities, the financial and human resources always pose serious problems. Frequently, the university management shall be facing a shattering problem: how to maintain the high education quality level: decreasing the number of programmes, focusing on the strategically most important ones? Or should be opted for decreasing the lecturer's assignment of weekly lecture hours by increasing the multidisciplinary subjects? Or is it an option to resist to global educational changes by rejecting technological development in didactics and hence, or opting for a lower educational quality level?

1.4. Strategy for the Introduction of Active Learning

Strategic deployment of new, computer-assisted technology should contribute to improve the effectiveness of the learning process and should increase the efficiency of the educational practice. New IT-based educational technology should contribute to educational feasibility.

Educational feasibility is defined by four parameters:

- Learnability: are the learning content and the pace of teaching adapted to the students' prior knowledge and learning capacity?
- Teachability: are teachers sufficiently trained and technically able to apply the new IT-based systems for creative didactical and methodical application? It requires not only new skills, but also new structurally different ideas in programme and course development.
- Organizability: is the university management able and ready to put the new IT-based systems at disposal of the teaching staff? Will the adapted classroom with the required equipment at the right moment be available for each student group? The last factor might be a critical or limiting factor.
- Affordability: can the university dispose of the necessary budgets for acquiring and maintaining sufficient and adapted IT-based systems (hardware and software), to install these in the necessary classrooms? (Fig. 9. Educational feasibility).

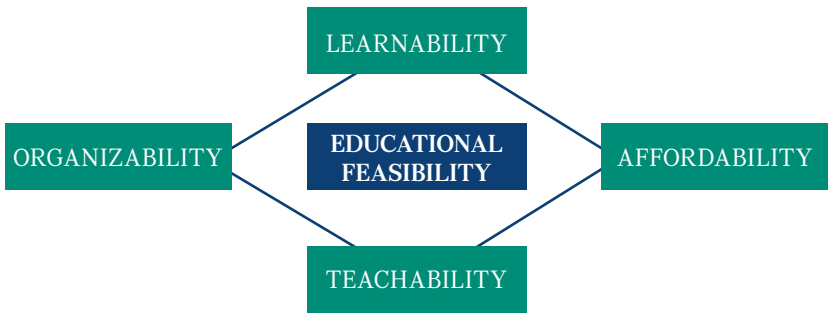


Fig. 9. Educational feasibility: defining parameters

As a consequence and a primary requirement for realizing educational feasibility, input and action is required from all stakeholders in the T&L (teaching and learning) process: i.e. students, teachers and the management level of the educational institutes.

At the level of teaching staff the introduction of active learning in a technology supported environment puts forward new requirements in instructional design:

- taking into account students' characteristics, i.e. previously acquired competences;
- defining educational goals, specific teaching goals, operational goals;
- defining the competences to be acquired according to the predefined educational goals;
- defining clearly the knowledge/skills that shall be transferred according to the specific teaching goals;
- strategically selecting teaching tools and methods according to predefined operational goals;
- creation of a supportive learning environment, teaching tools including assessment tools, coaching and supportive communication channels.

The university management is responsible for providing all means needed for the well functioning of the university community and for a university environment that is nurturing a good functioning of the university. It means that the university management shall create an academic environment that allows the university organisation and staff to work out their triple task: creating new science and technology by doing *research*, providing *academic education* and delivering *scientific service to society.*

Switching the university's system to the implementation and deployment of active learning is not possible without the support of the university management, for the management has an impact on the application of legal rules and educational quality requirements, on the budgeting of and investment in information and communication technology and on the human resources

management. Each of these three parameters has an undeniable and important effect on the academic education level and the education quality and hence, on the national and international reputation and ranking of the university.

It is therefore self-evident that university managers must be familiar with the new developments in building a "learning environment", the use of new teaching methods, including IT-facilitated teaching and learning, and on-the-job training for teachers. The university does not need full-blooded administrators; every university manager should remain a "learner" in the field of didactics and methodology.

Implementing active learning requires to adopt a set of well thought educational strategic goals and hence, a strategic planning how to reach these goals using the available means – financial and material means – and human resources, i.e. the corresponding group of teachers and students.

Basic ideas on strategic planning should underpin the actions of the administrative, financial and educational management team of the university for introduction and deployment of active learning.

Even when the university management provides all necessary resources and creates an environment that promotes academic education, innovation and initiative for the introduction of active learning, effective initiatives and practical introduction will have to come from the teaching staff. Therefore teaching staff should be motivated and must be well instructed and trained. So, retraining, additional training, and on-the-job training are an absolute necessity and continuous learning is the destiny of every teacher.

Even teachers shall know and understand the university's strategic plan for introduction of active learning because it is up to them to execute the university's "*active learning strategy*".

How to bring the university teaching staff towards the introduction of active learning?

Even though you will find competent teachers everywhere, let us be fair, it is not the teaching staff that shall draw up the university's strategic plan for active learning.

Even though in all schools, in all universities, one will always find individuals experimenting with activating learning and new teaching methods, the main question is how to bring these many small islands of innovation together in a structural innovation project of the university's teaching culture.

Maybe, an Erasmus+ project like PRINTeL can do? At least, this is the main aim of the PRINTeL project. And we know that there are many of these projects on-going and some already finished. So, the seeds of educational innovation may generally be present, a structured innovation project can be the tool for uniting individual initiatives.

How to start the "active learning" innovation project?

An "active learning" innovation project per definition is a strategic project. The strategic goal is to introduce active learning as a generalized didactic approach within a well-defined timespan, for example five years. The realisation of this strategic goal requires an updated learning environment, the adoption of new teaching and learning methods and therefore we need a well-trained teaching staff that can dispose of adapted IT-supported technologies.

To make a success of an "active learning project" we have to work out this project in regular business terms and should approach it as a strategic project. This approach includes: linking the realization of the educational innovation *goal* in each *specific university* to the *available means* – material means such as buildings, class rooms, technology, but also people as teaching staff, students and the whole university organisation support.

This project management approach requires some well defined steps:

- Write a *good* ***vision statement***, based upon the *mission statement* and *values* of the university, which is always a variant on the same theme: "Offering the best academic education, developing new knowledge by doing research and offering scientific service to society …".

The vision statement is telling where the university wants to stand within a defined timespan (e.g. 5 years) in this case concerning the deployment of active learning in the university.

Example. Vision statement of university x. Within five years, university x will reorganize its teaching and learning system in such a way that the whole university organization, all teachers and students, will be able to participate in active learning.

- A ***gap-analysis*** *and a* ***SWOT-analysis***: we need to compare the situation "as is" to "as should be", hereby defining the gap that we have to bridge. A SWOT analysis is defining Strengths, Weaknesses, Opportunities and Threats in our specific situation; it reveals the university's capabilities, opportunities and risks. Of course, these parameters will be different and specific for each academic institution, for each university.

Example. A gap and SWOT analysis for university x might reveal that:
- *classrooms are not equipped to allow the use of the necessary electronic tools for active learning,*
- *the furniture of the classrooms does not allow practical rearrangement,*
- *there is insufficient expertise available in the university for the introduction of active learning,*
- *the teachers' corps is insufficiently trained to apply active learning,*
- *there are insufficient information and communication resources available.*

- ***Strategic priorities***. The SWOT analysis is the basis for the defining the *strategic priorities*: these are the limited numbers of essential and well-delineated concepts and conditions to fill in first for realizing our vision statement.

Example. University x could define as strategic priorities:
- *Necessary material and financial means. Provide on middle long term financial and material means and electronic tools allowing for the*

implementation and deployment of active learning methods in the regular educational system

- *Knowledge and skills. On short term, start a central service organization within the university to bring together and to broaden all available individual expertise related to active learning and teaching and to build up resources and structures to anchor and generalize this expertise in the teaching staff through on-the-job training*
- *Technological means and electronic learning platform. Install a central electronic learning platform to allow sufficient information retrieval for academic education and inter- and intra-university communication.*

- ***Strategic objectives.*** From the strategic priorities can be derived a limited number of strategic objectives or goals. What shall we aim at, first of all?

Example. University x could define as strategic priorities:

- *Equip classrooms in each faculty building with the necessary electronic tools for active learning;*
- *Adapt the layout of (small and medium sized) classrooms to allow flexibility and rearrangement enabling interactive teaching and learning methods;*
- *A central service department will be staffed with the required pedagogical and technical experts for research into active learning and for technical supervision and methodical coaching of teaching staff for active T&L;*
- *Offer training in active teaching and learning methodology for all university teachers;*
- *Adapt the university's educational organization to the implementation and deployment of active T&L;*
- *A central electronic learning platform will be installed to allow sufficient information retrieval for reaching pedagogical, didactical and methodical information and for inter- and intra-university communication with all the university's stakeholders.*

- ***Effective projects, operational objectives and operational plans.*** Each strategic objective shall be worked out in a *subproject*, having this specific

project goal to be reached through the achievement of delineated *operational objectives* and *operational plans*. Do not forget to define the operational plan answering the questions: *what, who, where, when, and how?* Effective projects are ordered in a time-schedule, which can be clearly presented on a *time-line*.

Example. In the following enumeration we can only mention some possible outlines of project themes.

- *Classroom equipment: install in the classrooms the required electronic hardware and software: a laptop or PC, connected to the university's central IT-system, a beamer and/or interactive whiteboard, … Remember that the classical teaching system by lecturing at the blackboard still has its merits and does not have to disappear completely.*
- *Adapt the classrooms' layout for offering flexibility in class arrangement: rearrangement of classroom furniture to allow for interactive teaching, refurbishment of classrooms, …*
- *Training for active teaching and use of new learning methodology: training and retraining the largest possible number of teaching staff members, which most efficiently could be done in an external training-for-trainers schedule, coupled to an internal train-the trainer schedule, …*

  Internal promotion of active T&L might be fruitful: highlighting individual active T&L success initiatives, offering a reward system for successful active T&L projects, providing an instalment for a competitive system for financial and/or material support for active T&L teams and projects, …
- *A central electronic learning platform. This is a must for each well performing university management system. An electronic learning platform includes a central administrative and operational management system, a full educational system (lecture tables and announcements, provision of all documents like courses and additional reading, coaching system, electronic assessment system, etc.), a functional communication system for organizational staff, teachers and students (communication of organizational data, e-mail, chats, online phone-communication), etc. …*

- ***Milestones*** and ***Key Performance Indicators*** (KPI). The follow up of the achievement of the subprojects in function of time can be guaranteed when the end of each subproject is defined as a milestone on the time-line. Reaching subsequent milestones visualizes the progress of the over all project performance.

  KPIs are measurable values that demonstrate how effectively the project's key objectives have been achieved. KPIs are used to evaluate the success at reaching targets.

Example. Hereafter we can only mention some examples of KPIs and milestones.
- *KPIs: number of (re)trained teachers, percentage of course texts offered on the learning platform, numbers of course units using active T&L methodology, teachers' and students' satisfaction data, …*
- *Milestones: start/end of T&L train-the-trainer cycle, opening of refurbished classrooms, opening of the electronic active T&L library, …*

- ***Continuous improvement.*** Apply the ***PDCA-cycle*** to improve continuously the process achievements.

Example. The management of each project is always subject to the Plan-Do-Check-Act cycle. It means that after ending a (sub)project, the project team shall restart a PDCA cycle to guarantee the good quality of the project's outcomes. The PDCA cycle is a systematic way for continuous improvement. More information on quality management and the PDCA cycle you can find in literature on project and quality management.

As we have mentioned before, the introduction of active T&L originates from individual initiatives of teachers. The shattered introduction of a new student-centred didactic method can create a wake-up call for a wider part of the university staff, teaching staff as well as management staff.

The strategic approach of a university-wide introduction and a generalization of practice shall be conceived and guarded or at least shall be actively supported by the *university management team*. That is part of the management's decision-making responsibility.

The scientific and operational aspects of the project belong to the *teaching staff's* tasks.

The *IT-department and the financial and administrative departments* of the university shall play only a supportive role.

PART 2

INSTRUCTIONAL DESIGN: THE BASICS FOR DESIGNING A GOOD COURSE

Good design and planning, while crucial for every type of course, are even more important for activating and technology enhanced courses. In traditional training, the largest effort is in the delivery of training sessions, while in activating and technology enhanced learning, the design and development of the learning environment and materials is much more crucial to guarantee the quality and achievement of the objectives. Therefore, the use of **instructional design** is imperative.

> ***Instructional design (ID), also known as instructional systems design (ISD), is the practice of systematically designing, developing and delivering instructional products and experiences, both digital and physical, in a consistent and reliable mode toward an efficient, effective, appealing, engaging and inspiring acquisition of knowledge and skills.***

In the next chapters the following **instructional design basics** will be covered:

2.1. A good starting point for incorporating technology into active learning is to apply the **TPACK model**. It blends the use of technology, content and pedagogy by finding the ways in which they connect, intersect and then support active learning. As a teacher it gives you a good overview of the knowledge needed to successfully integrate technology in your course(s).

2.2. The components that need be taken into account while designing a course will be examined by using an **instructional design model developed by the KU Leuven (Belgium)** turning mainly at users without much prior instructional design experience.

2.3. Then it's time to take a closer look at the actual instructional design process itself. The **ADDIE Model** and its five design phases are used to illustrate the practice of systematically designing, developing and delivering a course.

2.4. Finally the actual design and development of these instructional design

components will be examined more in-depth using the five design phases of the ADDIE Model. We will take a closer look at how you can address them **in practice** and introduce qualitative technology enhanced learning experiences in your course or curriculum.

2.1. Knowledge Needed as a Teacher - TPACK Model

Technological pedagogical content knowledge (**TPACK**) is a framework to understand and describe the kinds of knowledge needed by a teacher for effective pedagogical practice in a technology enhanced learning environment. Mishra and Koehler added technology as a third modeling element to Lee Shulman's pedagogical and content knowledge based model. They proposed that addressing content knowledge, pedagogical knowledge AND technological knowledge concurrently provides a framework for successful technology integration in the curriculum [3].

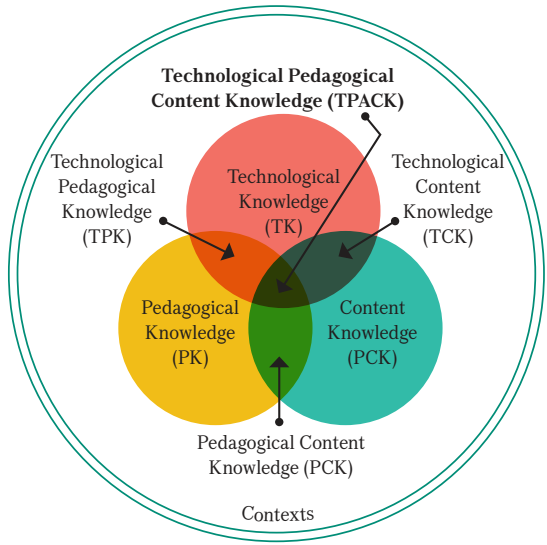


Fig. 10. TPACK Model

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At the heart of the TPACK framework there are three main components of teachers' knowledge:

- **Content Knowledge (CK):** Knowledge about the subject matter to be learned or taught.
- **Pedagogical Knowledge (PK):** Knowledge about the processes, practices or methods of teaching and learning.
- **Technological Knowledge (TK):** Knowledge about ways of thinking about, and working with technology, tools and resources.

The TPACK approach goes beyond seeing these three knowledge bases in isolation by emphasizing the kinds of knowledge that lie at the intersections:

- **Pedagogical Content Knowledge (PCK):** Knowledge of pedagogy that is applicable to the teaching of specific content.
- **Technological Content Knowledge (TCK):** Knowledge of the manner in which technology and content influence and constrain one another.
- **Technological Pedagogical Knowledge (TPK):** Knowledge of how teaching and learning can change when particular technologies are used in particular ways.

Therefore to effectively incorporate technology into active learning, teachers need to combine all the above components:

- **Technological Pedagogical Content Knowledge (TPACK):** TPACK is the basis of effective teaching with the use of technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones.

Learning always takes place in a specific **context (dotted line)**. Effective technology integration, therefore, requires developing sensitivity to the dynamic, transactional relationship between the TPACK components and the unique context it's situated in: individual teachers, grade-level, school-specific factors, demographics, culture, infrastructure and other factors ensure that every situation is unique, and no single combination of content, technology, and pedagogy will apply for every teacher, every course or every view of teaching.

2.2. Instructional Design Components - KU Leuven Model

The KU Leuven (Belgium) designed the following all-inclusive and low threshold instructional design model for its own teachers. This model is aimed at user-friendliness and allows first time users to (re)design their course without much prior instructional design knowledge or skills.

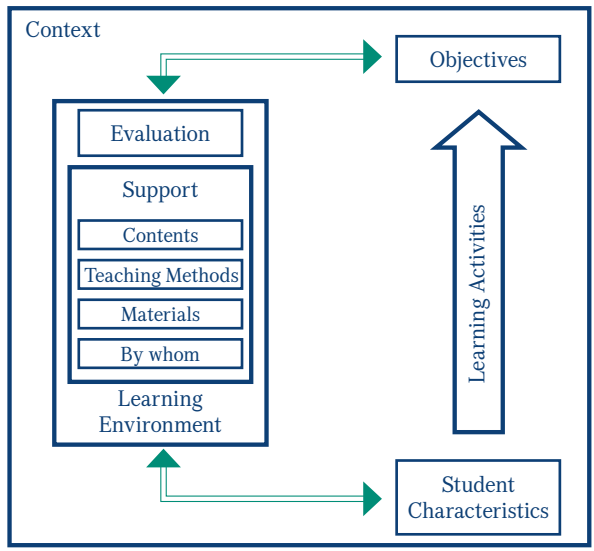

Fig. 11. Instructional Design Model at KU Leuven

This model collects all components that need to be taken into account while (re)designing a course and makes it feasible for less experienced teachers to (re)design their course by taking a closer look at all components and their intermediate relationships:

- **Student Characteristics** - What characteristics do the students have?
- **Learning Activities** - Through which activities will these students acquire new knowledge and skills?
- **Objectives** - Which knowledge and skills do the students have to acquire?
- **Learning environment** - How will the learning of the students be supported and evaluated?
- **Context** - What is the context of learning for the students?

2.3. Instructional Design Process - ADDIE Model

Now we know about the different instructional design components, it's time to take a closer look at the actual **design process** itself. Instructional design (ID), also known as instructional systems design (ISD), is the practice of systematically designing, developing and delivering instructional products and experiences, both digital and physical, in a consistent and reliable fashion toward an effective, efficient, appealing, engaging and inspiring acquisition of knowledge and skills.

The **ADDIE model** is the most used generic design process traditionally used by instructional designers and training developers. The five phases – Analysis, Design, Development, Implementation, and Evaluation – represent a dynamic, flexible guideline for building an effective training or course [4].

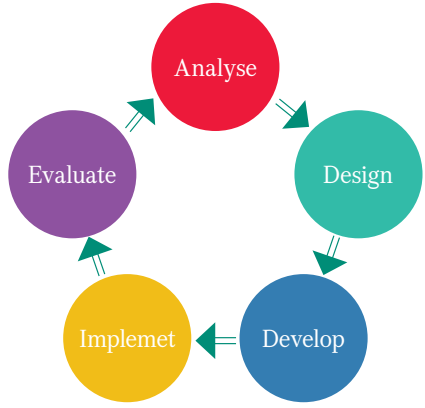

Fig. 12. ADDIE Model

In the ADDIE model five design phases can be distinguished, where each step has an outcome that feeds into the subsequent step:

1. Analysis phase

In the analysis phase the instructional problem is clarified, the instructional goals and objectives are established and the context and learner's existing knowledge/skills are identified. Below are the components (see. 2.2) that are addressed during the analysis phase:

- Student characteristics
- Objectives
- Context.

The process of asking these questions is often part of a needs analysis. During this needs analysis instructional designers will determine constraints and resources in order to fine-tune a plan of action.

2. Design phase

The design phase deals with the different components of the learning environment that need to facilitate learning and help students achieve the course objectives: content of the course, teaching methods, tools and materials used, who will teach/guide the course, how will it be evaluated, …?

The design phase should be systematic and specific. Systematic means a logical, orderly method of identifying, developing and evaluating a set of planned strategies targeted for attaining the course goals. Specific means: each element of the instructional design plan needs to be executed with attention to details. The design phase may involve writing a design proposal to aid final development or funding.

The components (see 2.2.) that are addressed during the design phase:

- Contents and Materials
- Teaching methods and learning activities
- By whom
- Evaluation.

3. Development phase

In the development phase, instructional designers and developers actually create and assemble the components described in the design phase. If e-learning is involved, now you develop (new) or integrate (existing) technologies and tools needed. Always test and debug the e-materials and procedures. After completing the development of the course material, an imperative pilot test should be conducted. Involving key stakeholders and giving the new learning environment with its course material and tools, teaching methods, evaluation and teachers a thorough test run, can carry this out. A final revision now takes place based on the reviews of this test run according to the feedback gathered.

4. Implementation phase

During the implementation phase, a procedure for training facilitators and learners is developed. The facilitators' training should cover the course content and materials, objectives, teaching method and evaluation procedures. Preparation for learners includes training them on new tools (software or hardware) and student registration.

This is also the phase where the course manager ensures that the course materials, hands on equipment, tools and software are in place as well as the learning management system or website is functional.

5. Evaluation phase

The evaluation phase consists of two parts:

Formative evaluation is present in each stage of the ADDIE process, by using a range of formal and informal assessment procedures during the instructional design process in order to modify and optimize all components.

Summative evaluation consists of tests designed for specific components and provides opportunities for more in-depth feedback from the users on course reception, learning outcomes and behavioral outcomes. A summative evaluation is mostly done at the end of the course or at specific intervals.

2.4. Instructional Design – In Practice

Here the actual design and development of the instructional design components will be examined more in-depth using the five design phases of the ADDIE Model. We will take a closer look at how you can address them **in practice** and introduce qualitative technology enhanced learning experiences in your course or curriculum.

2.4.1. Analysis phase

During the analysis phase the instructional objectives are established, the student characteristics are identified and the broader context in which this learning takes place is determined. The process of asking these questions is often part of a needs analysis, determining constraints and resources in order to fine-tune the plan of action.

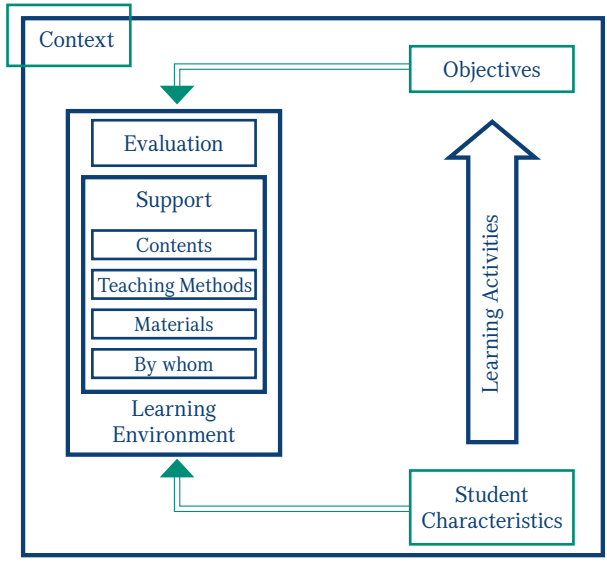

Fig. 13. Components covered during Analysis Phase

Analysis of student characteristics

The concept of student characteristics is used to designate a target group of learners and define those aspects of their personal, academic, social or cognitive self that may influence how and what they learn. Student characteristics are important for instructional designers as they allow designing and creating tailored instructions for a target group. It's expected that by taking account of the characteristics of learners, more efficient, effective, and motivating instructional materials can be developed [5].

Dick and Carey (1978) describe the process of analyzing students and identify a set of student characteristics shown to affect learning above and beyond general characteristics such as age, grade level and topic being studied [6]. While this may seem like a lot of information to collect about students, it can be very helpful in designing effective education programme s. The most important characteristics to take into account are:

- **Entry Behaviors** - Which skills associated with learning goals, should already be mastered by the students?
- **Prior Knowledge of the Topic Area** - What should students already know about the topic?
- **Attitudes Toward Content and Potential Delivery System** - What are the students' impressions and attitudes about a topic and how it might be delivered? In other words, will they have any preconceived notions about the topic or the delivery system (teaching method and materials)?
- **Academic Motivation** - How motivated are students to learn the topic and skills, and how much is it likely to interest them?
- **Educational and Ability Levels** - What are the achievement and general ability levels of the students? Knowing this helps determining the kinds of instructional experiences they may have had and their ability to cope with new and different approaches to instruction.
- **General Learning Preferences** - What types of learning approaches do the learners prefer? For example: lecture, seminar, case study, collaborative, e-learning, …?
- **Attitudes Toward Training Organization** - How do the learners feel about the organization providing the training?
- **Group Characteristics** - Is there heterogeneity within the target population? If so, make sure to accommodate the diversity. Also, get a general overall impression of the target population based on interactions with them.

Digital natives

Information and Communication technologies (ICTs) have changed our societies. As a consequence knowledge is changing; access to and acquisition of knowledge are changing; the ways in which we work with others are changing. In this digital society, a new generation has emerged: **digital natives**. They have grown up in the digital age, rather than having acquired familiarity with digital systems as an adult, as a digital immigrant.

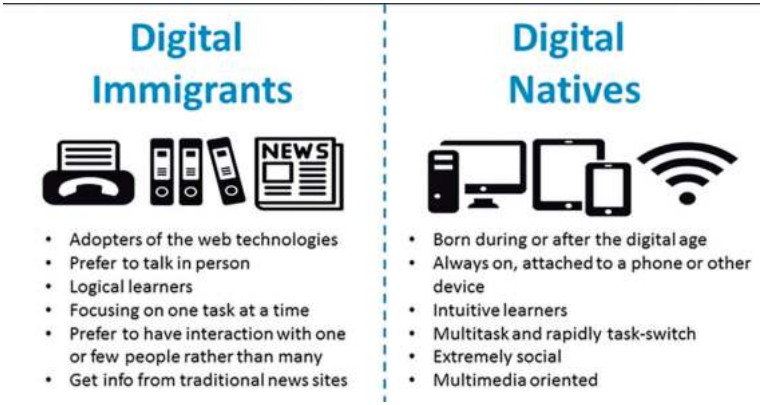

Fig. 14. Characteristics of Digital Immigrants vs. Digital Natives

The new era of technology accompanies with it the new era of education. These digital natives shall be taught in a way quite different than ever before. Therefore adapting courses to an active learning format with a special focus on technology enhanced and collaborative learning is an important step towards taking into account modern student characteristics and making it future proof [7]. Some helpful guidelines on working with digital natives:

- Examine the content of your "traditional" course and focus more on content and skills that are essential to knowledge construction in the digital era.
- Embed digital and technological content in your teaching.
- Instead of focusing on the teacher, the education system should focus on the student.

- Instead of teaching students how to memorize information, teachers should teach their students how to discover it themselves using critical thinking skills.
- Instead of delivering a one-size-fits-all form of education, customize the education to fit each student's individual learning styles.
- Encourage them to collaborate among themselves and with others outside the school.
- Learn to communicate in the language and style of the Digital Natives.

Analysis of the context

The **context** in which learning takes place, can greatly affect the student's ability to learn [8]. Therefore it's important to already consider the learning context and its ability to facilitate the content being taught during the analysis phase, in order to optimize learning for all students. An examination of the context allows us to address the fact that learning is not just a mental activity that occurs in a vacuum. Rather, many interacting factors affect learning and performance. Consider some of the following questions when planning the learning environment to gain insight in the characteristics and possible restrictions or opportunities of the context in place:

- **Infrastructure** - What are the characteristics of the teaching location? Which equipment and technologies are available? Are they suited for the learning activities of the students and the teaching methods of the teacher? Is the learning environment comfortable, free from distraction and does it adequately enable learning?
- **Accessibility** – How can the course and the accompanying materials be made available for the students? Are there access restrictions? Learning management system available?
- **Mobility** – What about learning beyond the classroom? Support for 24/7 anywhere, anytime' e-learning possible? Learning management system available?
- **Culture** – How does local culture influence learning? What is the learning culture on institutional level?

- **Size of the group** – What is the group size? What are the group dynamics? How will these influence teaching method, location, guidance and evaluation?
- **Technological resistance** – How open for and experienced with technology are the students, teachers and institution?

SWOT Analysis

A helpful tool to gain insight into the learning context is by doing a **SWOT analysis**. A SWOT analysis organizes the strengths, weaknesses, opportunities and threats of your course into an organized list and is usually presented in a simple two-by-two grid. Strengths and weaknesses are internal to your course/institution—things that you can control in some way and can change. Opportunities and threats are external—things that are going on outside your course/institution, in the larger environment. You can take advantage of opportunities and protect against threats, but you can't change them.

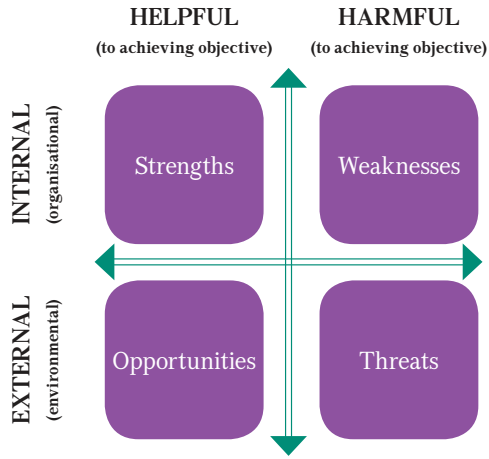

Fig. 15. SWOT Analysis

To perform a SWOT analysis, first you gather people involved in the course and from different parts of your institution [9]. Then you start generating a list

of prioritized ideas for each of the four quadrants:

- **Strengths** - Internal, positive attributes of your course/institution. These are things that are within your control.
- **Weaknesses** - Negative factors that detract from your strengths. These are things that you might need to improve on to optimize your course and facilitate learning.
- **Opportunities** - External (or environmental) factors that are likely to contribute to the teaching and learning success.
- **Threats** - External factors that you have no control over. You may want to consider putting in place contingency plans for dealing with them if they occur.

Based on the results of the SWOT analysis, you gain insight into the main characteristics of the context and you can start thinking about strategies on:

- how to use the strengths and take advantage of the opportunities?
- how to optimize the weaknesses?
- how to combat possible threats?

1.3. Objectives

Learning objectives

A **learning objective** is a description of what the learner must be able to do upon completion of an educational activity. They are the foundation for instructional alignment whereby the learning objectives, evaluation tools and teaching methods mutually support the desired learning outcome. Therefore a well-written learning objective outlines the knowledge, skills and/or attitude the learners will gain from the educational activity and does so in a measurable way.

Research from Simon and Taylor (2009) shows why it's so important to have clear learning objectives for the learners and the teachers [10]:

- **Learners** - "Students expressed relief and gratitude at being given *clear direction* as to how to *focus* their efforts, most notably in the lectures, and

also in organizing their studying, reviewing, and preparing for exams".

- **Teachers** – "The most common point made by the instructors was that learning goals enhanced *communication*, both with students and other faculty members… The instructors mentioned that the learning goals streamlined the process of writing exam questions and improved *assessment*".

SMART Method

The **SMART Method** - Specific, Measurable, Attainable, Relevant, and Time-bound—can be used to develop all the elements of a well-written learning objective. SMART learning goals, with their detailed structure, provide focus as well as a clear idea of what you want to achieve. This structure makes it easier to 1) select relevant learning activities, 2) measure the progress towards achieving the goal and 3) know when the set goal is met [11].

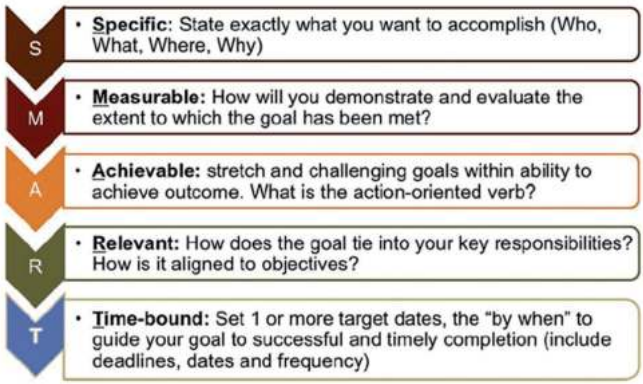

Fig. 16. SMART method for formulating learning objectives

Bloom's Taxonomy

An important element of a well-written learning objective is the **action verb**. Always choose an action verb that is measurable and observable to specify the desired learner performance. To help teachers with selecting an appropriate

action verb the use of **Bloom's Taxonomy** can be advised. Bloom's Taxonomy describes six levels of hierarchy in the cognitive domain: knowledge, comprehension, application, analysis, synthesis, and evaluation (revised 2001 version). Each level of the hierarchy correlates to action verbs that teachers can use to help formulate learning objectives.

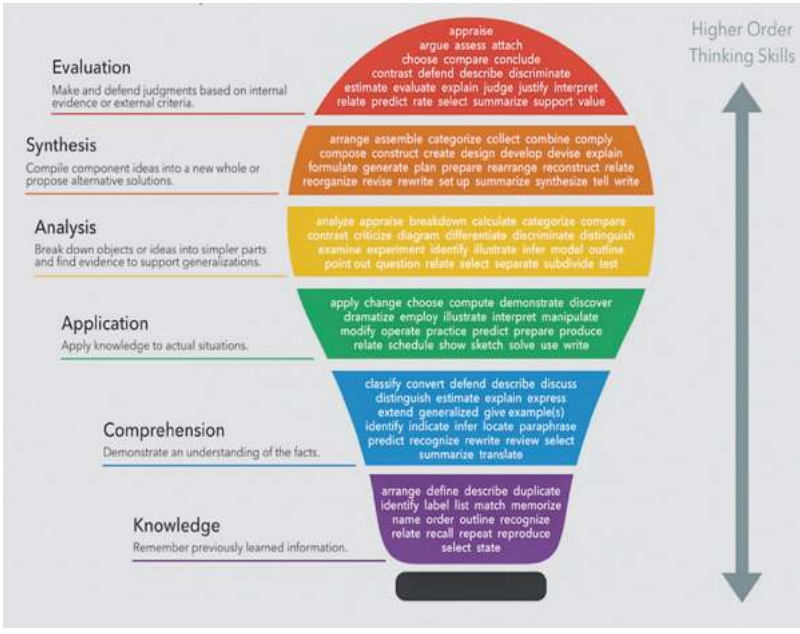

Fig. 17. Revised Bloom's Taxonomy (2001) with corresponding action verbs
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With the advent of technology and digital natives, Andrew Churches developed a more recent interpretation of Bloom's Revised Taxonomy. He has aligned *Bloom's Revised Taxonomy* with specific digital skills to create ***Bloom's Digital taxonomy.***

With the advent of online tools that provide students and teachers with easy access to options for collaboration and sharing, a new level was added to the framework: *sharing*. This framework can be a valuable resource when incorporating technology and active learning in a course.

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Bloom's Digital Taxonomy

FRACTUS LEARNING

Bloom's taxonomy	Bloom's modified taxonomy	Bloom's extended digital taxonomy	Functional Levels	Activities with digital tools
		Sharing	Publicly sharing, publishing, broadcasting	Contributing to open social networks, publishing, broadcasting, networking
Evaluation	Creating	Creating	Designing, constructing, planning, producing, inventing, devising, making	Programming, filming, animating, blogging, video blogging, mixing, re-mixing, wiki-ing, videocasting, podcasting, directing
Synthesis	Evaluating	Evaluating	Checking, hypothesising, critiquing, experimenting, judging, testing, detecting, monitoring	Blog commenting, reviewing, posting, moderating, collaborating, refactoring, testing
Analysis	Analyzing	Conceptualizing	Comparing, organising, deconstructing, attributing, outlining, finding, structuring, integrating	Hacking, mashing, linking, validating, reverse engineering, cracking
Application	Applying	Applying	Implementing, carrying out, using, executing	Running, loading, playing, operating, uploading, sharing with group, editing
Comprehension	Understanding	Connecting	Interpreting, summarizing, inferring, paraphrasing, classifying, comparing, explaining, exemplifying	Boolean searches, advanced searches, blog journaling, tweeting, categorizing, tagging, commenting, annotating, subscribing
Knowledge	Remembering	Doing	Recognizing, listing, describing, identifying, retrieving, naming, locating, finding	Bullet pointing, highlighting, bookmarking, group networking, shared bookmarking, searching

Higher Order Thinking Skills

Lower Order Thinking Skills

2.4.2. Design phase

The design phase deals with the different components of the learning environment that need to facilitate learning and help students achieve the course objectives: content of the course, teaching methods, tools and materials used, who will teach/guide the course and how it will be evaluated. The design phase should be systematic and specific and may involve writing a design proposal to aid final development or funding.

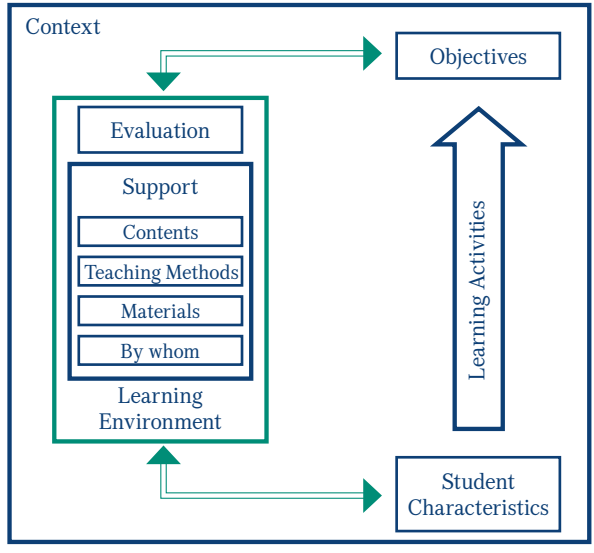


Fig. 19. Components covered during Design Phase

Design phase: 1. Instructional strategy (Contents – Teaching methods – Materials)

Based on the results of the analysis phase the different components of the learning environment that are needed to facilitate the learning and help the students achieve the course objectives have been identified. Now the instructional designer must propose the appropriate mix of teaching methods and materials for the content that needs to be delivered. This mix is called the **instructional strategy**.

Teaching methods & formats

The design of a technology-enhanced course will involve using a combination of the following types of **teaching methods** [12]:

- **Instructive methods** - which emphasize the "absorption" of new information by the students. Instruction methods include lectures and demonstrations.
- **Application methods** - which emphasize the active processes that learners use to perform procedural and principle based tasks and build new knowledge. Application methods mainly include exercises and simulations in any shape or form.
- **Interaction methods** – which emphasize the communicative dimension and engage learner/teacher interactivity. Interaction methods include discussion, debate and brainstorms.
- **Collaborative methods** - which emphasize the social dimension of learning and engage learners sharing knowledge and performing tasks in a collaborative way. They include group work and project work.

Each type of the four above-mentioned teaching methods can be delivered in different **formats**. For example, for the instructive method you can use the lecture format but also the demonstration format. Another example is for the interaction method, in which you could opt for the online debate format but also for brainstorm sessions in smaller groups in the classroom.

Therefore, the selection of the most suited teaching method and format should be done carefully and based on the factors determined during the analysis phase:

- **Student characteristics** – What are the personal, academic, social or cognitive characteristics of the target group that may influence how and what they learn?
- **Learning objectives** - What must the learner know or be able to do upon completion of this educational activity?
- **Context** - What are restrictions/opportunities of the context in which the learning takes place?

Teaching materials & tools

Once teaching methods and formats have been selected, you will need to complete the instructional strategy by pairing them with accompanying **teaching materials and tools** to facilitate and support the learning in your course. For example the teaching format of a lecture can be facilitated by different teaching materials and tools like a PowerPoint, web college, virtual classroom, … Therefore, these materials and tools should be chosen with care and keeping in mind the factors determined during the analysis phase.

Instructional strategy design model

The following **"instructional strategy design model"** was created for assisting teachers with designing an instructional strategy for an activating and technology-enhanced course. It gives an overview per teaching method of the main learning objectives addressed – activities of all stakeholders – different teaching formats available – which teaching materials and tools could be used. For more info and examples of specific teaching materials and tools, see chapter 3.

	Teaching Method
Learning Objectives	Which learning objectives are addressed by this teaching method?
Learner Activities	What is the learner doing during this teaching method?
Teacher Tasks	What is the job of the teacher during this teaching method?
Teaching Formats	What are the most used formats for this teaching method?
Teaching Materials & Tools	What are good teaching materials and tools to facilitate and support this teaching method/format? (details see chapter 3).

Fig. 20. How-to-use the "Instructional Strategy for a Technology-Enhanced Course" model

	Instructive Methods	Application Methods	Interaction Methods	Collaborative Methods
Learning Objectives	Develop: - Knowledge	Develop & Apply: - Knowledge - Skills	Develop & Apply: - Communication skills	Develop & Apply: - Knowledge - Communication skills - Interpersonal skills - Problem solving skills
Learner Activities	Listen & read/observe	Apply knowledge & skills	Interact with students/teachers	Work together
Teacher Tasks	Instruct & present	Provide guidance & coaching	Interact with students	Provide guidance & coaching
Teaching Formats	▪ Lecture ▪ Demonstration	▪ Exercises	▪ Brainstorm ▪ Discussion ▪ Debate ▪ Role play	▪ Group work ▪ Project work
Teaching Materials & Tools (see chapter 3)	▪ Presentation ▪ Web college ▪ Virtual classroom ▪ Audio - Video rec. ▪ Screencast	▪ Dig. exercise platform ▪ Simulation ▪ Edugames ▪ Virtual classroom	▪ Forum ▪ Mindmapping ▪ Poll ▪ Weblog ▪ Edugames ▪ Conference tools ▪ Virtual classroom	▪ Collaborative work space ▪ Virtual classroom ▪ Conference tools ▪ Digital collaborative tools ▪ Social media ▪ ePortfolio

Fig. 21. Model for designing an Instructional Strategy for a Technology-Enhanced Course

Design phase: 2. By whom

Designing a technology enhanced course requires capabilities in certain areas – such as technology and multimedia-related skills – that are not essential when designing a traditional course. Moreover, people may have to diverge from their traditional **roles** and perform new tasks. For example, a subject matter expert (SME) still provides the required knowledge for the course, but will need to interact with other professionals needed for designing a technology enhanced course like the instructional designer (ID), web and media developers, etc.

Some of the roles described in this section could be combined into a single profile. In fact, the **composition of the team** depends on factors such as:

- Size of the project
- Amount of work outsourced
- Capacity of team members to cover different roles
- Specific tools, media and technologies required

The **roles** described below are required to perform the **ADDIE model's** activities [13]:

Human resources/Capacity development manager

This managerial-level person conducts needs and audience analyses before starting the course design, coordinates all activities and roles in the different stages of the process and evaluates the results for the institution.

Instructional designers (ID)

IDs are responsible for the overall instructional strategy. They work with managers to understand the training goal, collaborate with SMEs to define which skills and knowledge need to be covered in the course, choose the appropriate instructional strategy and support the team in teaching methods and evaluation strategies. IDs also are responsible for designing specific learning activities, tools and materials that will be part of the course.

Subject matter experts (SME)

SMEs contribute the knowledge and information required for a particular course. They collaborate with IDs to design a course and define evaluation strategies. In facilitated or instructor-led learning, SMEs can act as instructors leading or supporting the (online) classroom activities. They can prepare and present material, assign tasks to participants and answer their questions.

Web and media developers

Web and media developers are responsible for developing the technological components of the course: digital courses and course material, multimedia and interactive components, e-tools, learning platform, website, …

Course administrators, facilitators and tutors

These are roles involved in the implementation stage. Course administrators manage learners' subscriptions. (Online) tutors and facilitators support participants' learning activities and motivate learners during the course. They create an environment that inspires participants' confidence in the learning process, assure the flow of information among the different stakeholders, motivate participation and facilitate and mediate participants' exchanges.

Technical support specialists

Technical support specialists usually are required to assist both producers and users of technology enhanced courses at every stage of the process.

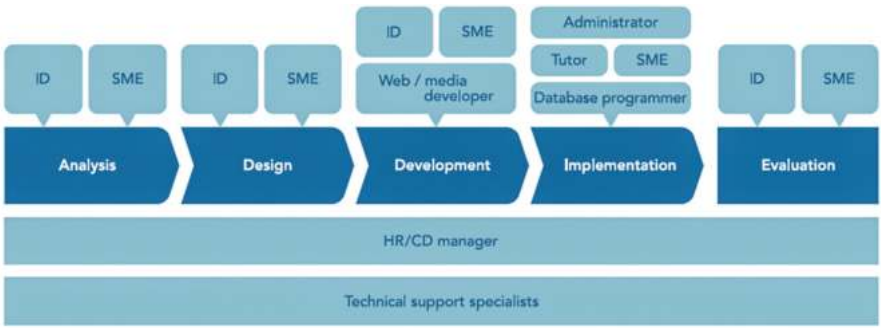


Fig. 22. Areas of responsibility for key roles in the ADDIE process

Design phase: 3. Evaluation

Evaluation strategy

Another important decision relates to the **evaluation strategy** for your course. It is very important to think about this from the design stage. Asking "Why assess my students?" is the starting point and prerequisite of an effective evaluation strategy. Assessment happens not simply because there is a need for grading students, but the key purpose must always be to improve students' learning by providing feedback.

Assessment methods & format

First you need to decide upon which (combination) of assessment methods will be used. There are two well-known methods of assessment: **formative assessment** and **summative assessment**. Formative assessment measures student learning during the learning process and summative assessment measures learning that occurs at the end of an instructional lesson or unit.

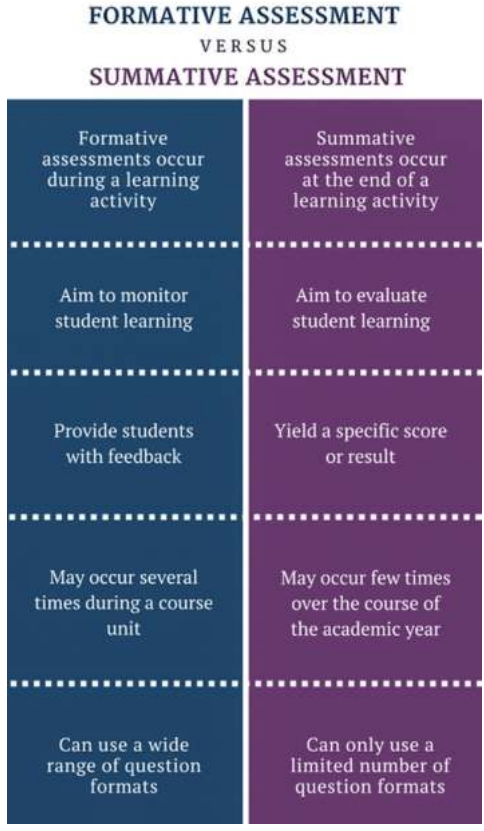


Fig. 23. Formative vs. Summative Assessment

Assessments are designed to measure the skills and knowledge the learner has mastered during instruction. While tests/exams are often used to assess mastery, there are countless other evaluation methods that could be equally (or more) effective for the given learner population, context, and learning objectives. It is important to keep in mind that the student characteristics, as well as the context and objectives, should influence **which evaluation method** you choose and develop. Varying the methods of assessment throughout a course will help to support appropriate skill and knowledge assessment,

and appeal to different learning and testing preferences of the learners. The following model will guide you through the different steps of choosing an appropriate evaluation format:

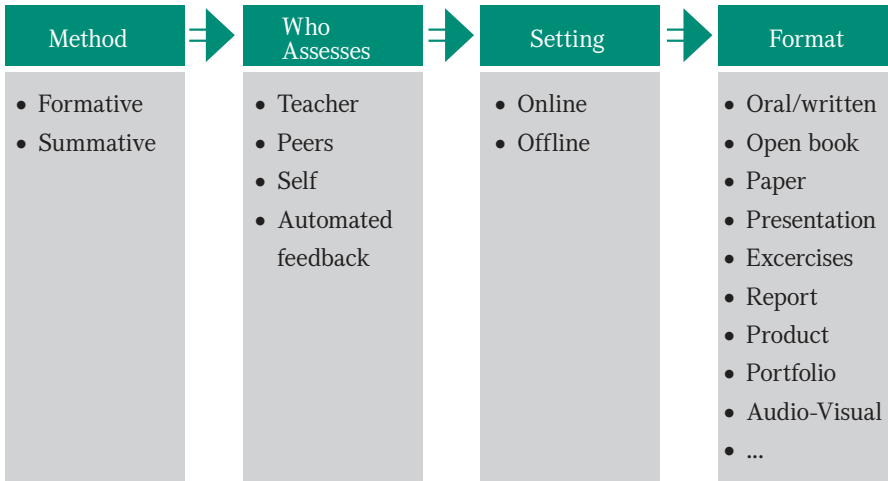


Fig. 24. Different steps in selecting a suitable assessment format

Principles of assessment

The following **principles of assessment** serve as the main guidelines while designing an evaluation strategy further and ensure that a test is useful, appropriate, effective and plausible:

- **Validity** - Validity ensures that assessment tasks and associated criteria effectively measure student attainment of the intended learning outcomes at the appropriate level.
- **Reliability** - There is a need for assessment to be reliable and this requires clear and consistent processes for the setting, marking, grading and moderation of assignments.
- **Transparency** - Clear, accurate, consistent and timely information on assessment tasks and procedures should be made available to students, staff and other external assessors or examiners.

Alignment with learning objectives

Another important principle is to ensure that the **assessment is aligned with the learning objectives**. An aligned course means that your learning objectives, activities and assessments match up so students learn what you intend and you accurately assess what students are learning. For this reason it is advisable to start drafting the assessment from the first stages of the project, just after the definition of the learning objectives.

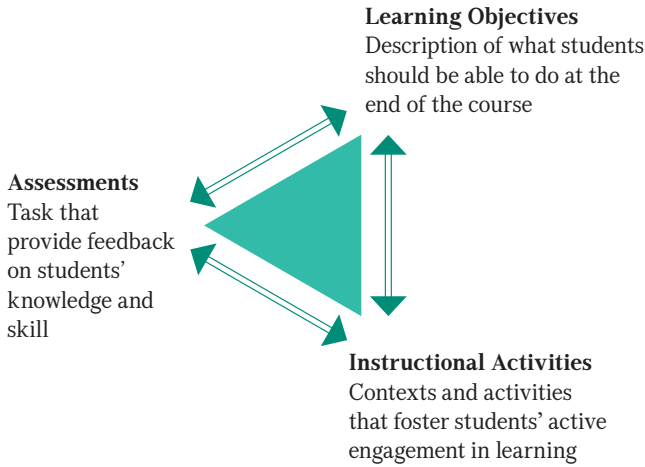


Fig. 25. Course Design Triangle – Alignment between components

2.4.3. Development phase

In the development phase, instructional designers and developers actually create and assemble the components described in the design phase. Because developing something for a technology-enhanced course can vary considerably from doing this for a more traditional course, we will focus now on the development of technology enhanced courseware and tools/technologies. After completing the development of the course material, an imperative pilot test should be conducted, so a final revision before implementation can take place.

Development of course materials & tools

Unfortunately, existing traditional course materials and documents cannot be automatically transformed into e-materials by just making them available from a website. It differs too much from face-to-face training and requires specific formats and tools. The development of these technology enhanced course materials and tools is comprised of three main steps [14]:

1. **Content development** - Writing or collecting all the required knowledge and information.
2. **Storyboard development** – Then we start integrating the instructional methods (all the pedagogical elements needed to support the learning process) and digital elements. Developing the storyboard does this. This storyboard is a document describing all the components of the final product, in the sequence they will be used: images, text, interactions, assessment tests, tools.
3. **Courseware development** – Finally the development of the actual technology enhanced courseware and accompanying tools can start. Depending on the technological development level needed, the help of a web or media developer could be necessary. If possible, integrate all elements into a learning platform that learners can access anywhere and anytime.

Pilot test & final revision

After completing the development of the course material, an **imperative pilot test** should be conducted. Involving key stakeholders and giving the new learning environment with its course material and tools, teaching methods, evaluation and teachers a thorough test run, can carry this out. A **final revision** now takes place based on the reviews of this test run according to the feedback gathered.

2.4.4. Implementation phase

During this stage, the materials created during development are introduced to the target audience and the learning process starts. The application of materials can take **different forms**, depending on the instructional strategy chosen during the design phase [15]:

Online Learning - Learners acquire knowledge autonomously by taking an electronic course and trying to understand the material with no/limited outside help.

Face-to-face - Knowledge transfer is facilitated by an instructor or a group of instructors using the developed materials as a basis for teaching. They deliver the information to learners and make sure that the main concepts of the course are well understood.

Combination - Learners study a part of the course autonomously, while an instructor, who also controls the acquisition and retention of knowledge from the parts of the course the learners studied with no assistance, explains the rest. Some examples are blended learning or flipped classrooms.

Depending on the chosen format, the implementation stage will likely include the following **main steps** to a greater or lesser degree:

1. **Training the facilitators** – Provide adequate training for the facilitators and make sure that they have all the necessary information about the course (course content and materials/tools, objectives, teaching and evaluation method) before the learning process begins.
2. **Preparation of the learners** – Prepare the learners for the upcoming education process. First and foremost that means making sure that they are familiar with the tools and have the knowledge required for completing the course.
3. **Preparation of the environment** – Ensure that the technical and organizational requirements of the course, formulated during the development phase, are met, and to prepare the environment where the teaching will be conducted. Depending on the chosen format, the

preparation may include the following: course material, equipment, tools are in place + learning management system/website is functional.

2.4.5. Evaluation phase

Despite the fact that evaluation is the final stage of the ADDIE methodology, it should be considered not as a conclusion of a long process, but as a **starting point for the next iteration** of the ADDIE cycle. Diligent evaluation will enable you to review and keep on improving the educational programme . Instructional Design is an iterative process, and evaluation should be carried out on a regular basis. Besides, keep in mind that to achieve best results, it is recommended to keep an eye on the quality of the course under construction throughout the development process according to the ADDIE framework, and not only at its conclusion. This phase can be broken down into two parts: Formative and Summative.

Formative evaluation

Formative evaluation is an essential component of the ADDIE model and has to be present in each phase of the instructional design process by using a range of formal and informal assessment procedures to **evaluate and optimize all components**. Special attention should be paid to the imperative pilot test during the development phase and evaluation moments running parallel to the learning during the implementation phase. The most common formative evaluation methods can be separated into the following categories [16]:

1. **One-to-One Evaluation** – In this format the developer works individually with some learners who are representative of the target population to evaluate specific components. There are three criteria by which this form of formative evaluation occurs: clarity, usefulness and relevancy.
2. **Small Group Evaluation** – Meant to understand how well the activities, materials and tools included in the course work in a group setting. Form a small group, preferably consisting of representatives of the various subgroups

that make up the student body that is the course's target audience.

3. **Field Trial** – Once the small group evaluation is complete, it is recommended to do one more trial, this time under conditions as similar as possible to the actual environments that will be used in the learning process. This "field trial" will help you evaluate the efficacy of learning in a specific environment and under specific conditions.

Summative evaluation

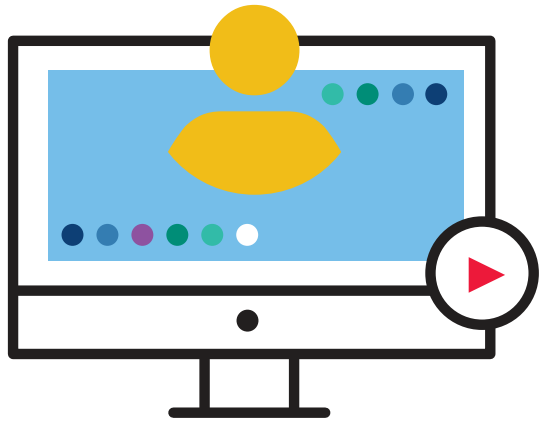
The main goal of summative evaluation is to prove, once the course is finished, that the performed training had the **desired outcome and effects**. It consists of tests designed for specific components and provides opportunities for more in-depth feedback from the users on course reception, learning outcomes and behavioral outcomes. Mostly done at the end of the course or at specific intervals.

The **Donald Kirkpatrick training evaluation model**, which has long ago become the standard for evaluating the effectiveness of training, could be a good starting point here [17]. Donald Kirkpatrick divided his model into four levels:

1. **Reaction** – The degree to which participants find the training favorable, engaging and relevant. (e.g. questionnaire).
2. **Learning** – The degree to which participants acquire the intended knowledge and skills during the training. (e.g. test or survey).
3. **Behavior** – The degree to which participants apply what they learned during training. (e.g. observation or focus groups).
4. **Results** – The degree to which targeted outcomes occur as a result of the training. (e.g. control group or test before and after).

PART 3

NEW IT-BASED TEACHING AND LEARNING METHODS AND TECHNIQUES FOR ACTIVE LEARNING



In part 1, we already defined the idea of "active learning" and broadened the terminology to "activating teaching for active learning".

We described the goals to achieve when using active T&L methods (see: Fig. 4):

- **A**ccountability
- **C**ritical thinking
- **T**eamwork
- **I**ntegration of knowledge
- **C**reating added value
- **E**ngagement.

We also were putting emphasis on the role of both primary partners in the process of active teaching and learning: the teacher and the student. Of course both partners in active T&L cannot be viewed separately from their educational environment: the university as an organisation is actively participating in the T&L process. Therefore, we also discussed the inputs and limitations of all three "parameters" in Part 1.

When choosing for introduction of active T&L we always have to be aware of the context of our action: the education activities are part of the university education and hence, are submitted to the organisational rules and procedures and to the legal provisions to which the university is bound. These rules and legislation eventually defines the type of academic programme s, the workload for teachers and the study load for students, the programme content, the educational organisation and even the teaching methods and types of assessment. We noted major differences between the national legislation of partner HEIs, the structure and educational goals of the universities and the educational Quality Management Systems.

Formally all partner country (PC) universities accepted the standards of the European Higher Education Area, and introduced formally the ECTS system. However, we detected different interpretations of these European provisions.

The international ranking of the partner country universities is an indicator for the many differences in academic education quality level, research outcomes and value, student guidance and social support and stakeholder relationship.

Using active T&L methods is not hassle-free, not without obligation or free of risk for failure. Besides of organisational and technical limitations, cultural or socio-ethological differences in student groups are holding risks for failures.

Remember that not all active L&T methods require sophisticated IT-technology. A somewhat older publication by the CTL of Stanford University [18] is giving a good overview of risks linked to some noncomputerlinked activating and collaborating techniques. (Fig. 26.)

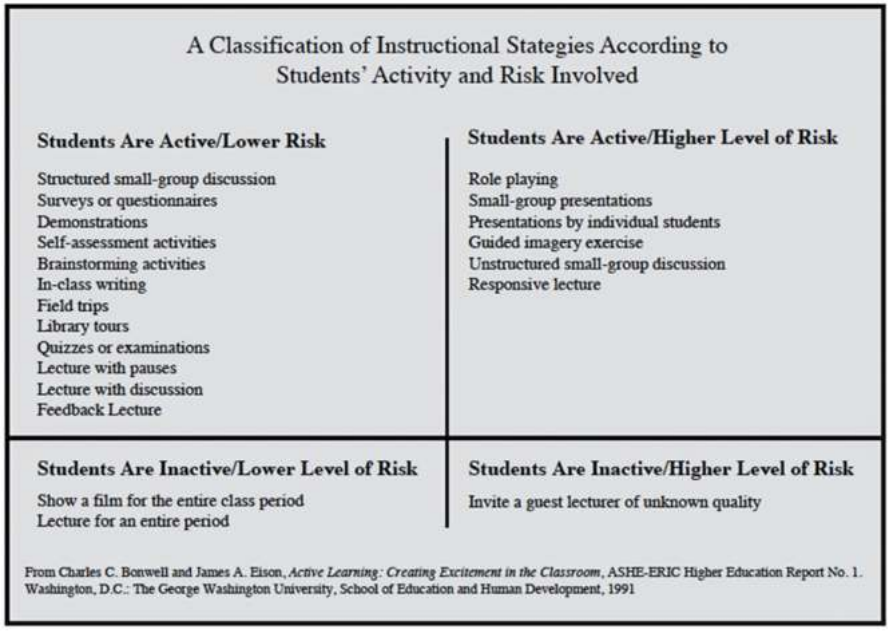


Fig. 26. Instructional strategies and inherent risks

Whatever method of active T&L you might introduce, don't forget that it will be more time-consuming than a classic reading-lecture. The extra-time needed, can cause conflicts in the calculation of the workload for students as it is a parameter used for calculation of the ECTS-credits attributed to the course and hence, to the number of lecturing hours for that specific course.

In the following part, we intend to present a non-exhaustive enumeration of methods and techniques. For more details on active T&L methods, we refer to the contents of the PRINTel TOT-training courses and the Teacher Training Courses organised in the PRINTeL PC-Universities.

These data and training documentation is published on the PRINTeL website and will be available on the PRINTeL VATL portal.

For practical reasons, we will subdivide teaching activities requiring adapted computer- and IT-based T&L methods in four major classes, according to the aim for using that specific T&L method:

1. transfer of learning content,
2. interactivity in the classroom,
3. assessment of the acquired knowledge,
4. organisation of the curriculum and teaching activities.

3.1. Methods and Techniques for Transfer of Learning Content and Reaching Intended Learning Goals

- *Printed courseware with accompanying electronic resources* (photo, video, access to the editor's website giving access to additional online resources). The method is expensive for students, but highly useful and a valuable source of information for the teacher when designing a new course or filling in his lecture subjects. However, good courseware is also offered in free OER (Open Educational Resources) and has been discussed in one of the PRINTeL training courses (KU Leuven, November 2019).

- *Printed course texts, published by the lecturer* and eventually printed by the university.
  This is a classical way for lecturing, but frequently the course text is not including references, operational and teaching objectives, or a tool for self-assessment by the student. When the university disposes of a central electronic learning management system (LMS), an electronic version (PDF) of all printed course texts should be offered (for free) to the students enrolled for that specific course.

- *Blended learning.*
  Full online courses or fully interactive teaching is seldom used in the university context. Classical forms of teaching shall be alternated with self-directed and collaborative forms of active T&L. This teaching strategy is the most preferred one and perhaps the most effective and efficient one.

- *Use of slide-presentations and video.*
  The era of photographic slides might be over, but the same photos and slides can be presented now in PPT presentation. When using PPT slide shows and sharing them with your students, do so in a PDF-version to have a minimal protection or, when uploading it online, don't forget that you can copyrightprotect your work. CreativeCommons.org offers a simple and free way for copyright protection.
  (see: < https://creativecommons.org> or in the PRINTeL – KU Leuven – OER-training report and course materials, Nov. 2019)

- *Use of an interactive white board.*
  A perfect alternative presentation tool for replacing the laptop and beamer the teacher has to carry on to the classroom, but expensive and it will not completely replace the old-fashioned blackboard.

- *Video recordings of lectures or lecture-fragments.*

Video recordings can be used:

- To increase access to learning, to make learning more flexible and diverse;
- To give students the opportunity to resume a lecture or part of it, or to learn independently;
- To feed the students' interest for a specific subject or a course;

Therefore the use of video recordings needs some recommendations [19]:

- Video should be short to keep the students' attention;
- Eliminate extraneous and highlight important information;
- Speak at a natural pace and with enthusiasm;
- Video should be used in addition to other active learning methods, e.g. as part of an assignment or in preparation for the flipped classroom;

Video should match the teaching/training course.

Video recordings of fragments can easily be used for presenting an additional and alternative way explaining complex scientific phenomena. Fully recorded lectures cannot replace the regular lectures, but can be handy instruments for students who want a lecture or lecture-fragment to be repeated when studying the course at home. It can bridge a gap in the students' course notes. Making video recordings of lectures requires some basic technical equipment and – besides that – a lot of teaching experience and camera habituation from the presenter. This technique has been explored in depth and trained in the PRINTeL TOT courses.

- *Use of open educational resources and open courseware.* This technique has been explored in depth in the PRINTeL training course at KU Leuven, November 2019.

- *Online T&L / MOOCs* (Massive Open Online Course).
  See: the PRINTeL training course at KU Leuven, November 2019.
  Making a MOOC is a tedious and time-consuming task. Offering a MOOC requires a well-equipped, well-staffed and experienced IT-service.

- *Use of simulation software for instrumental lab-work.*
  Simulation programmes can be used to prepare students for handling complex and expensive laboratory apparatus and hence, to protect these apparatus from being mishandled or damaged. It is a common practice in chemistry, physics and material testing. Simulation software is often available from the companies selling the lab-hardware. Simulation of experiments can be a cheap alternative in chemistry lab-work, saving on expensive chemicals or hardware. Some simulation software is freely available on the Internet. Specialised simulation software is complex to write and very expensive to acquire.

- *Blending formal and informal learning.*
  Informal learning never has been made that easy as with the modern available IT-technology and the Internet. Hence, self-directed learning never has been that accessible as today; almost all learning materials can be found online. Peer-to-peer learning can be an inherent part of informal learning and in this way is stimulating intensively collaborative learning. However, students should be trained for effective and efficient collecting information and how to process it and learn from it. In this way of working, a very important task for coaching of students online or face-to-face is attributed to the teacher. This coaching is a fairly new part in teaching assignments and also requires teaching time on top of the lecture hours. Again, as we told before, a balanced alternation of formal and informal self-directed learning is most desirable.

- *Flipped classrooms.*
  The basis for the flipped classroom method is that the students study a well-delineated package of the subject matter in advance and that during the lecture time the teacher is answering their questions, highlighting the most important topics, explaining more complex concepts once more if needed. The flipped classroom is an ideal system for high-achievement

learners experienced in retrieval of essential information, selecting and processing this information in self-directed learning. For that reason, it is evident that it will be easier and more effective using this technique in Masters' courses rather than on Bachelors' level. The system is time-consuming for students; it is not a simple transfer of knowledge, but it is training them effectively for autonomous learning. And, don't forget, coaching by the teacher is an essential new task.

3.2. Methods and Techniques for Promoting Interactivity in the Classroom

- *A specific and appropriate organized classroom* is a need for efficient application of interactive or collaborative teaching methods.
  Although it is a real need for efficient working in this teaching strategy; most classrooms in older university buildings still have a layout for classical teaching: the lecturer in front and several parallel rows of tables and seats for 10 up to 600 students. Changing this setup will be difficult and expensive for the university organisation and for that reason should be part of a strategic project for refurbishing university teaching buildings. It should be clear that most active T&L methods are meant for relatively smaller groups of students, but on the other hand, this setup definitely will require more floor area per student and will be more expensive for the university or faculty.

- *Use of laptops, tablets or smartphones connected to the LMS*/Internet.
  Almost all students today dispose of a smartphone, tablet or laptop; so, why not to use it in the classroom for educational purposes instead of emailing or surfing on the Internet during the lecture. Smartphones, tablets and laptops can be used for requesting information from the central server (on condition that the teacher has uploaded that

information in advance) or the Internet (although this may cause a lot of distraction and loss of concentration). Welldefined packages of information then could be used for teamwork assignments, information processing techniques, as basic materials for presentations and communication, etc. These IT-tools can be used in interactive parts of a lecture and for assessment phases and as a classroom response system. This application allows the teacher to assess at each moment and on the spot whether or not the audience is following and understanding the presented subject matter. On the other hand, the teacher needs to prepare the key-questions that allow evaluating the attention and cooperation by the audience. This means additional work for the teacher in preparing the lecture: questions shall be drafted to assess whether the educational objectives for that part of the lecture has been understood and is mastered by the audience.

- *Teamwork/electronically shared documents and projects.*
  See also above: Use of laptops, etc.
  We should emphasize that teamwork and communication in all academic programmes is a "compulsory to reach" competence and fully corresponds to the Qualification Descriptors – originally the Dublin descriptors – of the ECA (European Consortium for Accreditation in higher education – see: < http://ecahe.eu/w/index.php/Dublin_Descriptors >). It means that training towards this competence is indispensable in all academic programmes.

- *Electronic portfolios* allow proof of self-directed working and autonomous learning by students. A student's portfolio is becoming an indispensable tool in specific professional education programmes.

- *Online classroom response systems*, e.g. Mentimeter.
  See above: Use of laptops, etc.

3.3. Methods and Techniques for Assessment of the Acquired Knowledge

Remember that the only purpose for examination and assessment is testing whether the learner reached the learning objectives. Changing teaching methods by turning to active T&L, includes the pursuit of acquiring new or different competences and therefore requires reconsidering and adapting the learning and operational objectives.

- *Electronically supported examination and assessment.*
  Since the introduction of the first computers in the university, already 50 years ago, the automatic processing for correction of written examination papers has been pursued and the use of multiple-choice exams has won ground. Multiple-choice is not always a good examination system, frequently even a bad one when testing only memorisation and reproduction of course subjects. It all depends upon the quality of the questions; are these questions testing effectively whether the proposed learning objectives have been achieved? Even open-question exams can be taken electronically and corrected by detecting selected keywords in the answers.

- *Online examination and assessment* is possible and yet applied, although we should admit that technical problems are many and safety problems are imminent. Developing a fraud-proof system is an absolute requirement. Current application of online exams is not easy and it makes little sense to use this system in regular university programmes.

- *Students' peer assessment* is a good method for improving the students' critical thinking; it is easiest to apply when the assessment results can be collected anonymously, e.g. by using an online classroom response system, cf. Mentimeter.

- Portfolios. See 3.2.
- *Online classroom response systems*, e.g. Mentimeter.

  See 3.2.: Use of laptops, etc.

3.4. Methods and Techniques for Organisation of the Curriculum and Teaching and Coaching Activities

- *The university's Learning Management System* (LMS; electronic learning platform) should be a specific module in the electronic university management system and should give access for staff and students to the learning content of curricula, communication facilities (email, messages, chats, …) and the teaching organisation system (academic calendar, lecturers' time schedules, tasks and assignments, …). Many LMS are commercially available; well known are Blackboard (https://www.blackboard.com/teaching-learning/learning-management), CANVAS or MOODLE. An extensive comparative list of learning management systems for higher education is given on the PAGELY website <https://pagely.com/blog/learning-management-systems-in-higher-education/>.
- *The university management system* can be used for general management of the university administration and in the education framework for attribution of adapted classrooms for teaching activities to enable active T&L activities.
- *On duty active T&L training centre*. The university's Teacher Training Centre (TTC) should provide a proper offer of teaching and training for teachers on duty.
- *Coaching of teachers starting with active learning* is another task for the Teacher Training Centre.

- *Organising freely accessible study rooms* for students, providing access to the LMS.

- *Organising a students' mentoring system and/or a students' buddy system.*

This is not a complete list of possibilities for introducing and deploying active T&L in HE systems. It is an indicative overview and contains many subjects that have been presented in the PRINTeL TOT and Teacher Training courses.

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This Guidebook is developed within the frame of Erasmus+ PRINTeL project aimed at promoting innovative teaching and learning pedagogies in Eastern Partnership Countries.

Innovative teaching is a proactive approach to integrate new teaching and learning (T&L) strategies and methods into a classroom. New technology plays a key role in innovative T&L to offer students a more interactive and attractive experience. Innovative T&L also involves creativity on the part of the teacher who reorganizes the educational process by transforming from "being a lecturer" to "being a designer" of learning methods and environments. Here the teacher serves as a guide or consultant while students participate. A primary motive of innovative T&L is to encourage the students' broad engagement in the learning process. When students interact with teachers and peers, they gain more practical experience and retain more information from a class.

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