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## EDUCATIONAL DESIGN FOR DIGITAL LEARNING WITH MYSCRIPTING

*Claude Müller and Jennifer Erlemann, Zurich University of Applied Sciences*

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### Abstract

Designing teaching and learning is both a planning-conceptual and an operative design process, and one that is very close to the concept of design as it is used in other disciplines. This paper discusses design principles for digital learning and describes how digital learning can be designed with the educational design tool myScripting5 based on the ADDIE process model. The tool suggests context-dependent activities, analyses the design continuously, and provides valuable indications for further development. Role-specific outputs and interfaces to learning management systems (LMS) facilitate the implementation of the scripts. In addition, the collaborative functions support teaching in teams as well as in-depth reflection on educational designs.

**Keywords:** Educational Design, Digital Learning, Educational Technology

### Educational Design Process

More and more educational institutions are considering replacing some face-to-face teaching with blended or online learning. Research shows that such flexible study formats can improve access to education without compromising learning outcomes, but the effectiveness of blended and online learning depends largely on the quality of implementation (Müller & Mildenerger, 2021). The conception of teaching and learning is, therefore, not a process that can be automated but rather a planning-conceptual as well as an operative design process. In order to achieve specific learning outcomes in a particular educational context, teachers must make decisions that are analytical as well as creative. This is remarkably similar to the concept of design thinking used in other disciplines (Graham, 2019; Laurillard, 2013).

Design tools and processes offer valuable support, particularly when teachers have to develop educational designs for previously unknown contexts such as blended learning or online learning. A commonly used process model for systematically planning, implementing and reviewing technology-enhanced teaching and learning is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). In this model, each phase builds on the results of the previous development step.

In the analysis, all necessary information for the subsequent design phase of a learning offer is elaborated. This analysis examines what the educational context looks like and whether there is a need for training at all (needs analysis), who the target group is (target group analysis), the competencies that are to be developed (task and content analysis) and, related to this, what learning outcomes are aimed for. This is to avoid developing a learning offer without taking into account the needs and prerequisites of the learners. In addition, resources must also be analyzed. A teaching design might be suitable for a certain context, but that result might still not be practicable due to the time structures (e.g., the number of lessons in certain intervals) or infrastructure available (room characteristics, incl. ICT equipment). The design phase is dedicated to the conceptual planning of the learning offer. In this phase the learning objectives and content are structured, and suitable teaching strategies are identified. Then, in a circular scripting process, the educational design is adjusted to four aspects: content delivery, activation, interaction and assessment. Next, in the development phase, the various learning resources are produced and assembled into a learning environment and then, in the implementation phase, the digital learning environment is implemented in practice. Finally, in the evaluation phase, the learning environment is critically reviewed, and appropriate adjustments are defined

for the next design and development process. The following principles are of central importance for the

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<sup>5</sup> The online tool *myScripting* can be used free of charge at the URL [www.anonymous]

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educational design process:

- **Backward design:** First, the learning outcomes, i.e., the competencies that the participants should acquire by completion of the learning offer ("Beginning with the end in mind"), are defined. The learning organization and content structure, as well as the educational design (scripting) are then developed on the basis of the learning outcomes.
- **Constructive alignment:** The design of the digital learning offer is aligned with the learning outcomes, i.e. the learning environment should promote and assess the competencies that are targeted (Biggs, 1999).
- **Agile design process:** The development and implementation of a digital learning offer is not a process that can be automated, but is rather a circular process with iterative feedback loops that is both planning conceptual and operational.

The design process with *myScripting* is based on the ADDIE model. In the first step, the temporal and spatial organization of the learning offer (horizontal), as well as the structure of the content (vertical), are determined based on the analyses (see Table 1). Then, in a circular design process, the aspects of content delivery, activation, interaction and assessment are defined. The design may be guided by a specific teaching strategy (such as direct instruction or problem-based learning).

With *myScripting*, the digital learning offer is conceptually developed. The goal is a detailed blueprint for the subsequent media production and the building of the course on a learning platform. The focus of *myScripting* is, therefore, on the design phase in the development of digital learning opportunities. Nevertheless, the preceding and subsequent ADDIE steps are also supported in *myScripting*:

- **Analysis:** The results of the analysis are documented in *myScripting* under the fields of prerequisites (e.g., regarding target audience), learning outcomes, content and assessment. In addition, the analysis determines the basic script settings such as planned workload, target platform and assessment system.
- **Development & Implementation:** For the production of the digital learning offer, the developed script can be exported into LMS. Role-specific outputs for the teaching and learning process can be generated from the scripts. For teachers, *myScripting* develops a chronological lesson plan with optional additional information for class management (table view), and for learners a syllabus is available. These outputs are in Word format and can be further edited.
- **Evaluation:** Once developed, learning offers can be reviewed directly in *myScripting*. For the individual learning phases, topics and the entire script can be specified and assigned a development status.

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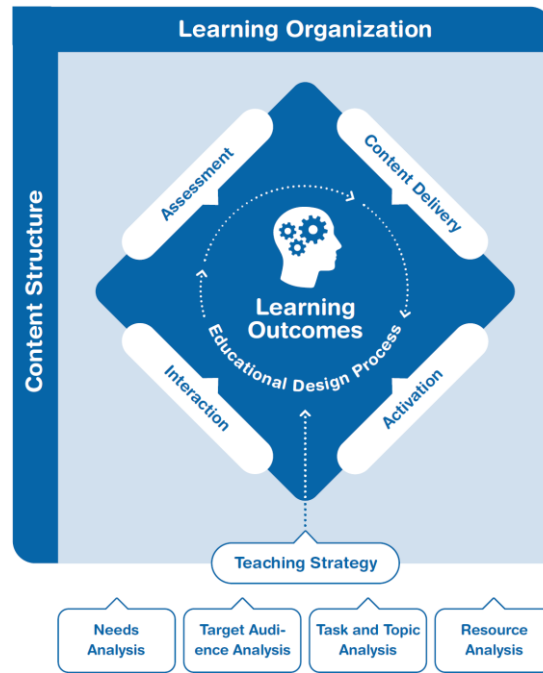


Fig. 3. Educational Design with myScripting.

**Learning Organization and Content Structure**

Based on the analyses and the learning outcomes developed, the temporal and spatial learning organization and the content structure of the digital learning offer can then be determined.

**Learning Organization**

Various forms of learning modalities are conceivable depending on the target group, the competencies to be acquired, and the available infrastructure. If the learners are, for example, geographically dispersed and not very flexible in terms of time, the learning offer can be primarily offered asynchronously and online. If they are flexible in terms of time and place, if a modern infrastructure is available (for example, with labs), and if skills are promoted, a synchronous learning organization in the available physical classrooms (onsite) may make more sense. Table 1 shows the possibilities of learning modalities that result from the dimensions of time and space.

<i>Time Space</i>	<i>Synchronous</i>	<i>Asynchronous</i>
<i>Onsite</i>	Physical presence event (e.g., in classrooms, in the field)	Onsite self-study (e.g., in the learning center, lab, library)
<i>Online</i>	Virtual presence event (with video conferencing system)	Online self-study (with electronic learning resources or learning platform)

Table 1. Learning Modalities.

With today's technical infrastructure, it is also possible to offer face-to-face courses simultaneously onsite and online (also referred to as hybrid learning). Often these synchronous courses are also recorded so that they can then be used for asynchronous learning (Hyflex courses). The following factors have an influence on the structural characteristics of the learning organization in addition to the learning outcomes, which are the guiding factors for all structure characteristics (see Table 2).

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<i>Learning modality features</i>	Influencing factors
<i>Proportion of asynchronous/synchronous learning</i>	Availability and needs of learners, desired learning culture
<i>Proportion of online to onsite learning</i>	Availability and needs of learners, required and available learning infrastructure (e.g., lab facilities), desired learning culture
<i>Workload</i>	Prescribed workload (formal education) or reasonable workload (informal education), content structure
<i>Length of learning units</i>	Availability and needs of learners, learning culture
<i>Control (self-paced or instructor-paced)</i>	Availability and needs of learners, resources of instructors, desired learning culture

Table 2. Influencing Factors for Learning Modality Features.

In myScripting, an initial structure of the intended learning phases is created on the basis of the above decisions (see Fig. 2). For this purpose, the learning phases face-to-face physical and face-to-face online for synchronous learning or self-study for asynchronous learning are available. In the course of the design process, the learning phases can be continuously adapted.

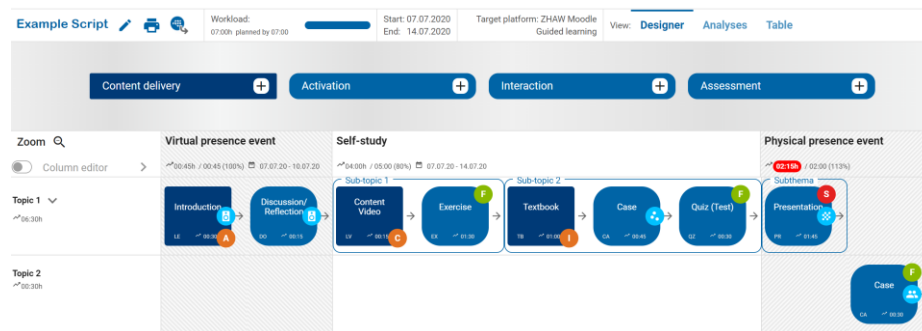


Fig. 4. Learning Organization and Content Structure in the Designer in myScripting.

### Content Structure

In the task and topic analysis, the contents to be acquired in a course are identified, and in the definition of the learning outcomes the related levels of abstraction (overview or in-depth) and the targeted cognitive demand levels are defined. Due to the limited capacity of the working memory, novices in particular are usually unable to process complex content and its interrelationships simultaneously (Sweller, 1994). Therefore, the content has to be prioritized and reduced and, if necessary, simplified (didactic reduction), divided into segments (segmentation) and put into chronological order (sequencing).

A frequently used approach for structuring content is the learning hierarchy. In this approach, the content that is a prerequisite for learning the content that builds on it is dealt with first. However, there are various other principles that can be used to segment and sequence content, such as the inductive or deductive approach or the process principle in skills courses (see also Reigeluth, 1999). In the case of very complex content with a high number of interacting elements, the intrinsic load can also be reduced by dividing the elaboration process into sub steps with isolated elements. After the partial elements have been elaborated, they are combined into the whole in a further step (see also 4C/ID-Modell Van Merriënboer & Kirschner, 2017).

The content structure is mapped vertically in myScripting with topics and sub-topics (see Fig. 2). For each topic, the learning process is depicted with the activities in one row. Sub-topics can be represented by grouping activities.

### Educational Design

Recent research on digital learning has analyzed aspects of online and blended learning in scientific reviews

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based on surveys of learners and teachers. The following factors have been found to be particularly effective for digital learning:

- Adequate course structure and guidance for learners
- Activating learning tasks
- Stimulating interactions and social presence of the teachers
- Timely feedback on learning process and outcomes

Activation, in particular, is crucial in the design of digital learning because starting from the learning content, the design of digital learning often focuses on the creation of content delivery, for example, by means of instructional texts and videos. However, content delivery in itself does not imply a pedagogically designed learning environment, or as Merrill (2018, p. 2) puts it: "Information alone is not instruction." In addition to learning resources, learners also need adequate activation: this is what enables learners to transform the information they have absorbed into knowledge and skills, and facilitates the application of learned knowledge and skills in new and real situations. Therefore, the teacher's task is to design goal-oriented and attractive learning so that learners engage in the learning offer (Kahu, 2013) and achieve the learning goals. The ICAP model (Chi & Wylie, 2014) addresses learners' varying levels of engagement with learning resources and assumes that the more intensively learners engage and interact with learning content, the more successful learning will be.




	Passive	Active	Constructive	Interactive
 <p>Lecture</p>	Listen carefully to a lecture	Repeat or rehearse; copy solution steps; make notes	Reflect aloud; draw concept map; ask questions	Argument, defend a position
 <p>Text</p>	Read text passages silently or aloud attentively	Underline or highlight text passages	Explain the text yourself; summarize in your own words	Ask questions of understanding and discuss/clarify with a peer
 <p>Video</p>	Watch video carefully	Pause, play, speed up, rewind video	Explain video content and compare it with previous knowledge or other materials	Explore contents with peers, discuss similarities and differences

Table 3. Activities in the ICAP-Model (according to Chi & Wylie, 2014).

Engagement can be stimulated through assignments on how to use the learning resources. Learners often have little experience with virtual interaction, and need concrete guidance on how to organize and design online interaction and collaboration (Vogel et al., 2017). Useful assignments are, for example, conducting forum discussions (with contributions and feedback), working collaboratively on texts or videos with the annotation function (or other approaches such as producing them with a wiki), explaining learning content to each other (for example, in the context of a jigsaw/group puzzle), or giving each other feedback on learning outcomes or projects. Although often implemented, writing summaries, underlining and marking have been shown to be not particularly effective (Dunlosky et al., 2013). It is better for learners to recall their knowledge and write it down in their own words or explain it to each other, review worked examples, or answer sample exam questions (see also the compilation of learning strategies in Fiorella & Mayer, 2015).

The biggest difference between onsite classroom teaching and online learning is the interaction, which changes with the temporal and spatial distance. For example, synchronous phases are difficult in MOOCs or courses for in-house training with a global group of participants due to the different learning times. It is, therefore, even more important in asynchronous learning environments to integrate opportunities for interaction, such as forum discussions or peer feedback, or to organize learning in smaller groups (e.g.,

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forming learning groups) to promote the sense of social inclusion in a learning community.

In myScripting, the educational design is carried out in the designer. The topics are arranged vertically and structure the script in terms of content; the learning phases are arranged horizontally and structure it in terms of time. The planning consists of specifying how the individual topics are didactically implemented over time. To do this, users choose from predefined activities. Since myScripting was developed especially for digital learning courses, the activities correspond as closely as possible to the tools in LMS. If none of the listed LMSs and corresponding activity sets is used, "Other" can also be selected, which contains a set of activities that is available in all common LMSs. For each of these activities, information is provided on the teaching function as well as on the technical implementation. The activities are assigned to the groups of content delivery, activation, interaction and assessment based on the primary function of an activity; however, activities can often have several functions: a forum, for example, is activating and used for interaction, and the contributions can also be evaluated in the sense of assessment. For this reason, the activities of activation, interaction and assessment are colored light blue to distinguish them from the dark blue content delivery activities.

During the design process, the designed script can be continuously evaluated and reflected upon in the analysis view in myScripting (see Fig. 3). The following analyses are available for this evaluation:

- *Workload*: comparison of the planned and designed workload.
- *Flexible learning*: comparison of workload for asynchronous vs synchronous learning
- *Activities*: comparison of workload for content delivery activities vs activation/interaction/assessment activities
- *Assessment*: number of activities with formative or summative assessment
- *Peer learning*: number of activities with peers (in small/large groups)
- *ICAP learning tasks*: number of learning tasks according to the ICAP model
- *Learning Outcomes*: Number and workload of topics, subtopics and activities that promote the different learning outcomes.

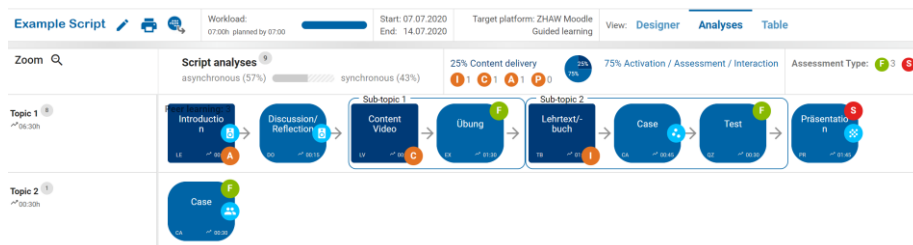


Fig. 5. Analysis View in myScripting.

The educational design should be coordinated in such a way that there is congruence between learning outcomes, learning environment and assessment in the sense of constructive alignment: the digital learning offer should promote the competencies being aimed for and assessed. Digital learning environments enable new learning approaches and processes (e.g., by means of simulations or adaptive learning processes). It is therefore important to design digital learning environments that extend and change conventional learning (according to Puentedura's <sup>6</sup>SAMR) and do not merely reproduce conventional classroom teaching.

## Conclusion

The didactic design process presented here shows how the educational design tool myScripting can be used to develop educational designs for digital learning systematically. The tool suggests context-dependent activities for a teaching setting, which can be assigned to topics and learning phases. In addition, design templates are available for central teaching strategies such as flipped classroom, problem-based learning or direct instruction. The various views allow the teacher to maintain an overview during the design process,

<sup>6</sup> <http://www.hipposus.com/resources/tte/>

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and role-specific outputs of the teaching and learning process can be created for teachers or students. Thus, myScripting enables the design of context-specific, diverse learning environments, such as blended learning courses with specific LMSs or online courses for MOOC platforms. In addition, the collaborative functions support teaching in teams and in-depth reflection on lesson designs.

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