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How to Design Learning Applications that Support Learners in their Moment of Need – Didactic Requirements of Micro Learning

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Completed Research

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Abstract

The COVID-19 pandemic is showing the limits of our traditional education systems that mainly build on classroom lectures with face-to-face interaction between teachers or trainers and learners. Now more than ever, there is a growing need for digital learning formats that make it possible to maintain teaching in universities, schools, and enterprises despite the spatial distance from the learners. To address these new conditions of learning, short and small learning units are a promising approach when it comes to demand-oriented learning solutions. However, the question of how to design didactically appropriate micro content is not yet answered by research. To close this research gap, we conducted a qualitative interview study with professionals in the field of instructional design and technology-enhanced learning-design. With this information, we were able to derive 20 requirements for designing effective micro content.

Keywords

Micro learning, technology-enhanced learning, e-learning, didactic, instructional design, requirements

Introduction

Because of COVID-19, educational institutions around the world are being forced to massively expand their digital learning opportunities to minimize the risk of infection for teachers and learners (UNESCO 2020). The current situation is increasing the demand for innovative learning formats that go beyond the spatial or temporal boundaries of traditional classroom teaching. However, providing learners with ubiquitous access to learning content independent of specific times or locations requires more than just offering recorded lectures. As self-regulated learning requires a high degree of self-reliance and discipline of learners (Zheng et al. 2018), complementary and supportive learning offerings are crucial. For example, short and small learning units, so-called micro content, have the potential to provide learning content when learners need it. In combination with the technical capabilities of mobile devices to distribute micro content (e.g., built-in sensors to localize the learner and adapt the learning content to the surrounding context), situated learning can be enabled to avoid information overload (Decker et al. 2017). However, prior research on micro learning concluded that the didactic design of learning content (i.e., the design of teaching and learning with web-enabled technologies) is a major aspect of its successful implementation (Jahnke et al. 2019). Information System (IS) researchers also point out that to understand a technology-based phenomenon such as technology-enhanced learning, theoretical models need to consider all the elements of the social-technical system (Gupta and Bostrom 2009). Consequently, especially in the field of IS Education, the didactic perspective needs to be considered in addition to the functional and non-functional perspective when implementing forms of technology-enhanced learning. However, the didactic design of micro content still represents a research gap (Busse et al. 2018). “Design-oriented IS research aims to develop and provide instructions for action that allow the design and operation of […] innovative concepts

within IS" (Österle et al. 2011). In this tradition, research on IS Education needs to give didactically sound guidelines on how to develop artifacts such as micro learning applications. Thus, the aim of this study is to analyze how to design micro content didactically. We employed a semi-structured exploratory interview study and asked the following research question:

RQ: What requirements are relevant for the didactic design of micro learning content?

To answer this research question, we organized the remainder of this article as follows: In the next section, we describe the theoretical foundation and the related research of our study. Following that, we present the research methodology and framing of our study. Finally, we discuss our findings, showing the limitations of our research approach, and give a conclusion.

Theoretical Foundation and Related Research

Micro learning has drawn increasing attention in recent years for workforce development (Bitzer et al. 2013). Predominating application scenarios of micro learning mentioned by enterprises are work-integrated learning and learning in idle or non-productive times (Decker et al. 2017). Generally, micro learning refers to small learning units (micro content) that can be dealt with within a short period of time (usually just a few minutes). Due to these small content portions, micro learning supports "a high level of interaction", which influences the learning process positively (Bruck et al. 2012). Using technology, micro learning offers the advantage of supporting the workforce with context- and demand-related content causing only short interruptions of the actual working process (Alkhatib and Rensing 2016). According to Bruck et al. (2012), micro learning is distinguished from traditional forms of technology-enhanced learning in three aspects:

(1) A reduction of the volume of learning content and avoidance of a possible overflow of information by structuring the content into small units
(2) Re-design of learning processes and environments according to the paradigm of small learning units
(3) Empowerment of the learner to choose the time, place, and pace of learning with personalized learning

Micro learning is used, even in the IS community, in diverse formats such as augmented reality (Santos et al. 2016), educational chatbots (Hobert 2019), or more traditional forms like wikis and learning videos (Leene 2006). However, the IS community and its educational stream still study this learning format and its characteristics in a very limited way. In February 2020, we conducted a literature review with the keyword "micro learning" and its synonyms in the AIS eLibrary and received 14 results in total. Three of 14 articles were research in progress and not related to the topic (e.g., Zheng et al. 2018). One article had no learning context and described the contribution of mobile applications to environmental sustainability (Brauer et al. 2016). Eight articles did not explicitly relate to micro learning or just mentioned micro learning as an innovative learning format. For example, Bitzer et al. (2013) evaluated the quality of technology-enhanced learning in general. In summary, we identified two contributions that dealt with micro learning in detail. The contribution by Bruck et al. (2012) mainly dealt with the evaluation of a micro learning application. Within three iterations, they developed a prototype from a screensaver over a desktop application to a final mobile application. Bruck et al. (2012) conducted evaluations with three case studies in the university and government sectors. Even though this contribution showed the architectural design and mockups of the prototypes, detailed explanations about the design process of the learning content itself were missing. The second paper dealt with a hybrid health solution designed to improve health-related behavior (Simons et al. 2014). A mobile micro learning health quiz was implemented. The authors mainly described the evaluation of the learning app with a multiple-case study. The focus was more on lifestyle intervention than on learning with micro content, however, and the paper did not describe which design requirements or didactic assumptions were made. Even though the contribution offered no new insights concerning our research question, the evaluation results did show the positive effects of short learning content. The users of the application indicated that the micro learning health quiz courses provided new and relevant information and contributed to health readiness and health behavior improvements. These limited results underline the lack of research on this subject. Furthermore, even the psychology-related research stream shows very limited insight on how to design micro content (Busse et al. 2018). Therefore, an explorative research approach seemed the best choice for identifying the inherent design requirements of micro learning and for defining the necessary instructions of actions for designing innovative learning formats based on micro content.

Method

To identify didactic requirements, we conducted a qualitative empirical interview study (Myers 2013). For data collection and data analysis, we applied the highlighted procedures in Table 1 according to Wiesche et al. (2017).

Contribution	Theory	Model		Rich description	
Procedures	Theoretical sampling	Role of prior theory	Open coding	Axial coding	Selective coding
	Theoretical coding	Constant comparison	Memoing	Coding paradigm/coding families	

Table 1. Categorization of Data Collection and Analysis

Our study consisted of three phases. **First**, we identified potential experts through direct contact from trade fairs or projects and a search in practice-relevant journals. Considering the specifications of micro learning, the selection process required that the experts chosen have experience in the didactic design of micro content. In particular, we found professionals in the field of instructional design (IDesign) and technology-enhanced learning-design were highly qualified to provide us with valuable insights into the practice of digital content design. In total, 13 experts accepted our interview invitation. Most of the experts work in e-learning agencies that provide their customers with professional digital learning solutions. We summarized the characteristics of the sample in Table 2.

Expert	**Position of Expert**	**Type**	**Length**	**Expert**	**Position of Expert**	**Type**	**Length**
E1	Employee E-learning		40 min	E8	CEO E-Learning Agency		25 min
E2	Employee IDesgin		35 min	E9	Employee IDesign		36 min
E3	Employee IDesign		60 min	E10	CEO E-Learning Agency		31 min
E4	CEO E-Learning Agency		24 min	E11	Employee E-learning		18 min
E5	Employee E-learning			E12	Employee E-learning		35 min
E6	Employee E-learning		22 min	E13	CEO E-Learning Agency		38 min
E7	Employee E-learning		43 min				

Table 2. Sample Characteristics

In the **second** phase, we conducted interviews with the experts via telephone, video conference, or face-to-face. The interviews lasted between 18 and 60 minutes ($\bar{x}$=34 min; $\tilde{x}$=35 min). We used a semi-structured interview guideline to leave the interviewees enough room to express their own ideas. Due to the flexibility of a semi-structured guideline, the order and the specific formulation of the questions could be adapted ad hoc during the conversation (Myers 2013). To systematize our results, we used the decision fields of the Decision Oriented Instructional Design Model (DO-ID model) (Hillen and Landis 2014), as it is a well-established Instructional Design Model with a focus on the didactic aspect of technology-enhanced learning formats. The interview guideline consisted of questions that focused on the decision fields of the DO-ID model (analysis, format of unit, multimedia design, interaction design, content structuring, and motivation design). Exemplary questions were: *"How must the learning content of micro learning be designed in order to motivate the learner?" and "How should the feedback to the learner about the learning process be designed?".* As the last interviews did not reveal any new insights, we decided not to conduct further interviews (Glaser and Strauss 2006). We recorded and transcribed the interviews. In the **third** phase, we analyzed the empirical data with the help of a structured content analysis approach (Mayring 2014). In this step, we anonymized the transcribed recordings and coded relevant statements by using the software MAXQDA. Two independent researchers conducted the coding through continuous analysis of the transcripts, followed by a mapping of the codes to the core topics.

Findings

In the following section, we show the findings of our study. In total, we derived 20 requirements for the didactic design of micro content. This also includes requirements for the analysis of the initial conditions, as they form the basis for all subsequent decisions. Further, we classified them into the DO-ID model (Hillen and Landis 2014) (see Table 3). Sorting follows the logical process of content development.

Fields of DO-ID	Didactic Requirements	Named by Expert	∑
Analysis	R_A1: Consider prior knowledge of target group	1-13	13
	R_A2: Define application and usage context	1-2;7-8;11	5
	R_A3: Define learning objectives	1-2;5;7;10;12	6
Format of Unit	R_F1: Select learning format based on context & learning objective	2;7	2
Structuring of Content	R_S1: Consider the characteristics of micro content	1-2;4-6;8-13	11
	R_S2: Prepare uniform structure of learning units	2-5;7-10;12-13	10
	R_S3: Use basic patterns of sequencing	2-3;10-13	5
Multimedia Design	R_M1: Consider application and usage context	1-2;4-7;10;13	8
	R_M2: Use multimedia learning objective & target group-oriented	2;4-7	5
	R_M3: Design multisensory learning content	1-3;6-13	11
Interaction Design	R_I1: Use didactic interactions	1;3;6-7;9;13	6
	R_I2: Provide assistance during learning	1;10;12	3
	R_I3: Enable collaboration during learning	1; 3-4;10;12	5
Learning tasks	$R_{LT}1$: Provide personalized and adaptive learning content	1;3-5;7-8;13	7
Assessment tasks	$R_{AT}1$: Use varied task and question formats for assessment	1-3;6-10;12	9
	$R_{AT}2$: Ensure appropriate difficulty level for assessment	1;6;8;10;12-13	6
	$R_{AT}3$: Provide individual and instant feedback	2;6-7;9-11;13	7
Motivation Design	$R_{MO}1$: Create emotional involvement of learner	2-3;5-6;8-10;12-13	9
	$R_{MO}2$: Create authentic problem scenarios	2;6-8;12-13	6
	$R_{MO}3$: Create experience of success	5;8;10;13	4

Table 3. Didactic Requirements of Micro Learning

Analysis

All subsequent decisions in the decision fields are based on the conditions examined in the analysis phase. Therefore, this phase is the basis for the entire conception and is of particular importance. We identified three requirements that are relevant in the analysis phase according to the practitioners. The first one is to **consider the prior knowledge of the target group (R_A1)**. For Expert 10 (E10), it is the very first step in the process of content design: "*We always advise our customers that we clearly define our target group and prior knowledge is a very important factor*". To address the prior knowledge of each learner, the experts recommend using knowledge queries in advance. According to E2, the queries can already be done with micro learning: "*You can do that quite well with micro learning, because you can see immediately, okay, I don't know that*". The second requirement is a clear **definition of the application and usage context (R_A2)**. It is obvious that learning in a noisy machine shop requires different contextual demands than learning in a private office. The experts point out that the context can change from case to case. The workforce is increasingly "*on the move, be it in meetings or at other locations or home office and therefore it is important that the content adapts to the flexibility*" (E10). As a last step in the analysis phase, previously collected information needs to merge, **defining the learning objectives (R_A3)**. Especially for micro learning, it is necessary to *"define learning objectives at different levels of granularity" (E10).*

Format of Unit

After the analysis, the next step is to select an appropriate learning format (e.g., computer-based-trainings, serious games, simulations with virtual reality). In this decision field, we derived the requirement to **select the learning format based on context and learning objectives (R_F1)**. According to E2, the decision depends "*on the learning objectives and which formats or media best support them*". E7 notes the crucial question for the use of micro learning: "*Is that something that you can actually teach in these 2 or 3 minutes?*". If this requirement can be met, the next step is to structure the content into micro content.

Structuring of Content

Because micro learning "is learning in small units within a short period of time" (Bruck et al. 2012), the question of how to divide the content into small micro content is central. This is especially important as the short units are necessary to satisfy individual and demand-related learning needs within a short period of time. The essential requirement is to **consider the characteristics of micro content (R_S1)**. This means "*that it is just short, concise, fragmented […], to break it down to the essentials and make it understandable*" (E11). It is important "*to use simple phrases, not complicated ones*" (E9). Beyond that, a characteristic of micro learning is that the content "*must be self-contained. A unit must be learnable*

independently of another unit" (E9). When it comes to segmentation of the content, the experts indicated that a **uniform structure (R_S2)** of the short learning units is crucial. If the units have the same structure, the learners orient themselves more easily. Several experts stated that a phase-oriented structure of the learning units is appropriate for this purpose. E9 described an exemplary structure: "*The opening sequence is a small trailer about what the topic is. Then follows a knowledge unit. What is the relevant information about this unit? Then comes a game, do I understand what the learning unit is about? The fourth step is repeating to consolidate the knowledge and to have a preparation for the final exam. Then the fifth step is testing. Can I apply this to a new situation?"*. Especially when micro learning is stand-alone, the experts highlight that is important to "know from the beginning what you are facing" (E7). Consequently, it is very important to begin every unit with an explanation about the relevance of the content and to highlight the corresponding learning objectives. To complete a unit, the experts recommend that the learners "have to take a test at the end" (E12). That way, learners can assess on their own if they understood everything. Additionally, we derived the requirement to define the chronological flow of the units. The experts recommend using **basic patterns of sequencing (R_S3)** for micro learning. They suggest applying sequencing principles such as "from general to detailed, from simple to difficult" (E11). E10 ensures "*that learning is not necessarily linear*" when designing micro content. Instead of topical sequencing, E10 uses spiral sequencing (i.e. "*you jump back and forth between topics"*) because that leads to a higher learning effort and thus to an increase of the working memory capacity (E10).

Multimedia Design

In the decision field of multimedia design, we derived three requirements from the transcripts. The first one is to **consider the application and usage context (R_M1)**. According to E2, "*context and environment are very, very important*". If the workforce will be learning with mobile devices, they "*need headphones and may not have the 2.5 minutes of attention to watch a video. Then I have to make it (the content) even smaller and maybe without sound*" (E10). Additionally, E5 recommends the consideration of context aspects like sunlight and other possible disturbing factors: "*It must also work in very strong sunlight, which means that the contrasts must be sufficient"*. The second requirement is the **use of multimedia based on the learning objective and the target group (R_M2)**. "*One has to think anew each time, for whom is it produced, for what purpose and in what scenario*" (E5). E7 uses an example to convey procedural knowledge: "*If I have 4 or 5 pictures in front of me, where I see what I have to enter (in the software) […], I don't need music or audio for that"*. The key message is that multimedia richness is not the only measure of a perfect learning unit, which depends also on the specific learning objective. If the content is easier to explain with a text, then a text is the appropriate medium to consider: "W*hen it comes to mobile use, you still have special challenges simply because of the very small size of the screen […]. This definitely has a didactic consequence. You can actually only design things in portrait or landscape format or it has to be scalable"* (E7). Furthermore, the target group may have some specifications or preferences. "*For example, what language do they actually speak? […] It must be suitable for all intercultural target groups. That has implications when you work with figures, the way you draw figures, how they look, how I avoid stereotypes*" (E7). For example, E6 indicated she "*would only use 10 percent animated for officials in the Federal Ministry of Security*". If the content has a certain seriousness, playful elements may not fit into the storyline. The third requirement is **designing multisensory learning content (R_M3)**. This requirement relates to psychological findings of multimedia learning and cognitive information processing. E10 said, "T*his multi-sensory approach has great didactic advantages*". Therefore, designers try to combine pictures and audio: "W*e try to use all the senses that are possible […]. Because in our experience this is the highest learning effect that can be achieved"* (E8). E7 argues that learning is consequently more long-term: "*Especially in this short format (micro learning), I think, that it is always most promising when the different senses are well addressed so that the processing into long-term memory is improved*". Beyond that, using multimedia can foster emotional involvement: "*Multi-sensory processing also offers the possibility to arouse emotions and this is a great anchor that I throw out, to which I then also attach abstract facts more easily*" (E10).

Interaction Design

In total, we derived seven requirements in the decision field of interaction design. Three requirements generally relate to interactions between the workforce and the micro learning application (R_I1-3). We also identified one requirement for the design of learning tasks ($R_{LT}1$) and three requirements for the design of assessment tasks ($R_{AT}1$-3).

The first requirement is **using didactic interactions (R_I1)**. Didactic interactions differ from other interactions in that they intend to improve the learning process. According to E7, "*it needs a didactic interaction in which the learner does something. S/he moves something from here to there. S/he answers a question and s/he gets feedback.*" It is about activating the learner and assuring that s/he is "*not sitting passively in front of the computer*" (E6). Didactic interaction aims to integrate the learner into the learning process and to "*try to make the learner work actively on a solution*" (E9). The second requirement is **providing assistance during learning (R_I2)**. Especially in self-regulated learning scenarios, it is important that the learners have "a feedback channel that is not standardized" (E10). The experts recommend offering options in which the learners can communicate with a real person to ask questions (e.g., via chat). "*I think this is a great advantage that can bridge the gap between the potentials of classroom training and micro learning*" (E10). Another possibility mentioned by E1 is implementing an "*automated e-assistant, which is already programmed to answer probable questions that might come from the participants*". A further social aspect of interaction design is **enabling collaboration during learning (R_I3)**. According to E4, "*the social aspect is important, that you can discuss the content […] and get answers perhaps from the peer group*". Additionally, the experts recommend implementation scenarios like message boards or votes to foster collaborative learning.

We also derived the requirement to **provide personalized and adaptive learning content ($R_{LT}1$)**. This requirement relates to the design of learning tasks and is one of the most important aspects necessary if micro learning is to reach its full potential in demand-oriented learning. Beyond that, it underlines the advantages of implementing micro learning as technology-enhanced learning. If enterprises want to support their employees in their moment of need, the learning units must be short, precise, self-contained, and related to the prior knowledge of the employee in an individualized way. Otherwise, "*the difficulty arises that the learners must know what kind of information they actually need. This is the more difficult the less prior knowledge they have. […] I think this is the biggest challenge with micro learning*" (E7). Therefore, it is crucial to have "*a platform that knows the profile of a user, that provides the content that could be relevant for him as accurately as possible*" (E4). E5 explains "*that is where recommender systems are suited for, which use artificial intelligence to recommend the right content according to the profile*". In this context, it is important that the algorithms used "*are self-learning and adapt to individual learning behavior*" (E5). However, the algorithms can only recommend personalized learning content if the learning content is prepared accordingly. Therefore, it is necessary to prepare different levels of difficulty. Then it is possible to link the individual learning profile to a certain learning path, and consequently, provide prior-knowledge-oriented learning content. E1 explains this procedure: "*If I have segmented my micro content from 1 to 10 (degree of difficulty), then I can adapt the tasks accordingly and then the learners should have no difficulties with this task at all*".

Once a learning task is completed, it is important to evaluate if the learners understood the content. According to E8, "*learning sequences should always be followed by interactions so that you always ask yourself what is the important thing that I need to know*". As mentioned in requirement R_S2, tests can be used for this purpose. Concerning the question of how to design assessment tasks for micro learning, we identified three requirements in the interviews ($R_{AT}1$-3). The first one is to **use varied task and question formats for assessment ($R_{AT}1$)**. According to E12, "*it is always good to have variety between different formats of questions, that you sometimes have multiple-choice, sometimes you use one of these reordering or rearrangement questions or a completion question*". Several experts also create assessment tasks with a game-like character: "We also make animated games, where you can answer certain questions in a playful way" (E8). It is important, however, that the assessment questions are "*focused on the learning objectives. You have to think about what you want to ask with these small test questions or what you would rather cover with other exam forms*" (E12). It is equally important to make the tasks as authentic as possible. If the learners are to evaluate certain decision situations then it is appropriate to design a task where "*I have a decision situation in front of me, I have to weigh up, I have to assign, as I have to do in my everyday life*" (E7). Therefore, E7 often uses drag and drop elements in the assessment tasks to ensure authentic situations: "*We work a lot with drag and drop; we work a lot with questions that are as authentic as possible*". Another aspect that correlates with authenticity is the requirement to **ensure an appropriate difficulty level for assessment ($R_{AT}2$)**. As E13 states, "*The worst thing about micro learning is when the test is so superficial*". However, it is not easy to formulate appropriate questions, as E12 explains: "*I think the most important thing is to find appropriate questions, which is also the most difficult thing*". The aim is to formulate questions that are challenging but not overstraining. Therefore, a crucial task is to define

"*good distractors. This is the quality of the didact*" or instructional designer. When the learners complete the assessment tasks, they need to get feedback. In the transcripts, we derived the requirement to **provide individual and instant feedback ($R_{AT}3$).** The experts insist that it is important to provide instant feedback: "*I believe that it is important that feedback is provided in a timely manner*" (E10). Furthermore, the experts recommend designing detailed feedback. "*That means not only to highlight correct or wrong answers, but best would be to give qualifying feedback, where you also explain what s/he did wrong or what was done right*" (E6). According to E13, this can be very elaborate (E13). Most experts agree in recommending feedback for correct answers as well as incorrect ones. Similarly, detailed feedback must contain formulations that are sensitive and have positive connotations. As E13 explains, "*people are extremely sensitive when the computer corrects them. This means that when giving feedback, […] we try to comment very carefully on a wrong answer*".

Motivation Design

In self-directed learning formats, motivation is an important factor. Initially, motivation determines whether one chooses to learn at all. Additionally, motivation is influenced by the design of the learning content; for example, if it arouses emotions. In the expert interviews, we derived three requirements to use the design of the learning content to foster motivation. The first one is **creating emotional involvement of the learner ($R_{MO}1$).** E8 shows a correlation between motivation involvement and the learning effect: "*What always receives far too little attention are the emotions in the learning process. […]. The consequence is that the learning effect is not particularly high in micro learning units".* One approach to promoting motivational activation that we identified in the expert interviews is to embed the learning content within a storytelling framework. E10 explains: "*The first sentence and the first impression should activate the learner and make them curious".* Likewise, some experts use an avatar to foster emotional involvement: "*We also have an avatar for some series, […] that guides you through the lesson"* (E9). Another way to involve learners' emotions and increase their motivation is by creating playful learning experiences. One way to foster playful learning experiences is to use game-like design: "*We rely on this so-called game character. Our applications look a bit like the start page of an online game"* (E9). Furthermore, the experts suggest using gamification elements like badges, experience points, or progression bars: "*You can do a lot in the area of gamification; for example, such feedback that communicates the progress, badges or such experience points and the levels that you can communicate"* (E5). A further requirement that we identified in the transcript is **creating authentic problem scenarios ($R_{MO}2$).** If enterprises offer micro learning to their employees as a supplementary learning environment, everything depends on the relevance of the content: "*The learning content must be relevant. If I have a question and I know that I can get an answer now in this micro learning, I would even read a PDF*" (E7). To design the learning units more realistically and authentically, the experts also work with real cases: "*We have learned over the years that it is very good to start the learning unit with real cases*" (E13). Ultimately, it is important to design the content to be "*as descriptive and practical as possible [so] that the people will be able to make use of it*" (E12). The last identified requirement is **creating experiences of success ($R_{MO}3$)**. $R_{MO}3$ is closely related to the consideration of prior knowledge and consequently to finding the appropriate level of difficulty for the learning units: "*It is important that the target group has the feeling that they have learned something after each unit. Here we jump back to the topic of prior knowledge. To design a learning unit that is challenging but not overstraining"* (E10). Another way to trigger an experience of success is to offer commendations after the learners do their exercises: "*Every time I do the exercises from that day, I get commendation*" (E13). A further way to promote experiences of success was mentioned by E5. She recommends showing the individual learning progress of each learner: "*I think giving feedback is a very big aspect, especially with such small units, that you still have a feeling that you have made progress and that it is documented*".

Discussion

In total, we identified 20 requirements that represent instructions for action to design micro learning artifacts from a didactic point of view. Since we believe that the potential of micro learning lies primarily in demand-oriented learning, we will discuss below to what extent the requirements identified in the transcripts are crucial for supporting learners in their moment of need. Furthermore, we will discuss the implications of our study for designers of micro learning.

What is crucial for supporting learners in their moment of need?

In demand-oriented learning, it is crucial to convey the right content to the right person within a short period of time. Therefore, the prior knowledge of the target audience is important to consider (R_A1). As a target audience is never homogeneous, each individual may need different levels of difficulty or different types of information to solve their problem. For example, whereas experts only need process steps, trainees need supplementary and more detailed content. Besides the previous knowledge of the individual learner, the application and usage context is a decisive factor (R_A2). Demand-oriented learning is aiming to solve a particular problem in a particular situation. Therefore, the context (e.g., a problem with a machine) is crucial to consider. To define learning objectives (R_A3) seems to be less important for demand-oriented learning, as the objectives are obviously to help the employee to solve the problem. Nevertheless, the objectives can be helpful to describe the topic of a micro unit. Furthermore, the learning objectives provide useful meta-data for organizing several micro units and their level of difficulty. The learning objectives are also crucial for choosing the multimedia design and defining appropriate assessment tasks. Additionally, the learning objectives are the basis for dividing the content into small micro content (R_S1). This is, in turn, especially important, as the short units are necessary to satisfy individual and demand-related learning needs causing only short interruptions of the actual working process. A uniform structure of the learning units (R_S2) is of indirect importance, as it helps learners to orient themselves more easily and to concentrate on solving the problem. Using basic patterns of sequencing (R_S3) is relevant for demand-oriented learning as the patterns guide the designer in structuring the content into different levels of difficulty. The patterns are related to theoretical implications from the field of instructional design and go along with the principles of elaboration theory (Reigeluth 1999).

The requirements of the multimedia design are relevant for demand-oriented learning. Even demand-related learning content needs to fit the environment conditions (R_M1). A loud production facility prohibits using videos and audios without additional headphones. Consequently, text or subtitles are necessary. Adjusting the multimedia design to a certain learner is closely related to this aspect (R_M2). While some individuals may prefer to learn with videos, others prefer to learn with pictures. The requirement to design multisensory learning content (R_M3) depends on the learning context (see R_M1). Addressing the auditory and the visual working memory also leads to an optimized cognitive load following the Theory of Multimedia Learning (Mayer 2005). According to the assumption that humans possess separate channels for processing visual and auditory information (Paivio 1986), both channels should be addressed by the learning content to optimize the cognitive load. Consequently, multisensory design can facilitate the learning process.

With regard to interaction design, the use of didactic interactions (R_I1) is not necessary for demand-oriented learning. However, interactions that enhance the learning process do lead to a better and faster understanding of the learning content. Even if demand-oriented learning aims to cause just short interruptions of the working process, didactic interactions have the potential to activate the learner. Beyond that, providing assistance in demand-oriented learning (R_I2) is crucial. If the offered micro content is not appropriate to solve the problem, the learner needs other forms of assistance provided by the learning application (e.g., a function to contact the supervisor provided by the learning application). Otherwise, the acceptance of the learners to use the learning application is missing. Collaboration (R_I3) seems not to be of primary interest in demand-oriented learning. However, by way of providing assistance, collaboration with other employees can help to solve problems that are not adequately addressed by a micro learning unit. A central aspect of demand-oriented learning is to provide personalized and adaptive learning content ($R_{LT}1$). The experts recommend using artificial intelligence to create individual learning profiles and match them with certain learning content. However, other (easier) ways to determine the learning context are appropriate as well. For example, QR-Codes are suited to match the learner with a specific context and the related learning content (e.g., a machine). However, what remains completely unnoticed in the interviews is the effort required to provide the learning content in this high granularity. As the content changes at ever-shorter intervals, this is a major challenge. Less relevant seems to be the design of assessment tasks for demand-oriented learning as the success of a learning unit is determined by its impact on solving the problem ($R_{AT}1$-3). However, it can be quite useful to evaluate the learning success after a certain amount of time and, therefore, foster a repetition of the lessons learned. In demand-oriented learning, the question of how to motivate the learner seems not to be of primary interest, as the learner him/herself initiates the learning process. Therefore, the learner has intrinsic motivation to use the micro learning application as long as the content is relevant to solve the problem. This is in line with our requirement to create authentic

problem scenarios ($R_{MO}2$). However, gamification or storytelling ($R_{MO}1$) is not necessary to achieve this objective. Nevertheless, the derived requirements can help to increase the long-term intention to use a micro learning application. In summary (see Table 4), eight of our identified requirements are crucial to consider, whereas eleven requirements are optional to consider for demand-oriented micro learning.

Requirement	R_A1	R_A2	R_A3	R_F1	R_S1	R_S2	R_S3	R_M1	R_M2	R_M3
Evaluation	●	●	⭘	○	●	⭘	●	●	⭘	⭘
Requirement	R_I1	R_I2	R_I3	$R_{LT}1$	$R_{AT}1$	$R_{AT}2$	$R_{AT}3$	$R_{MO}1$	$R_{MO}2$	$R_{MO}3$
Evaluation	⭘	●	⭘	●	⭘	⭘	⭘	⭘	●	⭘

(A requirement is ● crucial, ⭘ optional, ○ not relevant)

Table 4. Evaluation of Requirements

What contribution does our study make for IS Educators and designers of micro learning?

Twenty requirements for the didactic design of micro content may seem like a lot to assess and apply, especially considering the rapidly changing environmental conditions that require adjustments of learning content in shorter intervals (Busse et al. 2019). Furthermore, demand-oriented micro learning does not address a broad target audience, which would enable economies of scale. However, we aim to provide a holistic concept of design guidelines, which is the basis for a process model for designing micro content. As we discussed above, the learning context may prohibit some aspects like gamification or multisensory multimedia design. Nevertheless, micro learning without gamification can still be effective for a certain context. Therefore, the requirements describe more an ideal design of micro content than an obligatory concept. Finally, it is the specialty and responsibility of the designers of micro learning to decide which requirements are crucial and which they can consider optional. Nevertheless, our paper makes several contributions to the existing body of knowledge. We contribute to the research stream on IS Education by extending the discussion on technology-enhanced learning with a focus on the didactic design of micro learning. Thus, our approach is in line with the recommendation of Gupta and Bostrom (2009) that designers of technology-enhanced learning need to consider all the elements of social-technological systems and do not just focus solely on Information Technology. Therefore, the requirements consider even steps that are crucial before the technical implementation such as analyzing the target group or preparing a uniform structure of learning units. Also, the requirements include steps that are directly related to the technical implementation such as the design of interactions or the use and adjustment of multimedia formats. Thus, for IS Educators and designers, the requirements provide instructions for action for the entire development process not only of micro learning artifacts, but also for other learning formats that provide micro content (e.g., educational chatbots).

Conclusion

The goal of this research study was to analyze how to design micro learning content from a didactic point of view. To achieve this goal, we conducted a qualitative interview study among 13 professionals in the field of instructional design and technology-enhanced learning-design. As a result, the experts named 20 requirements that we evaluated with regard to their importance for demand-oriented learning. To tap the full potential of micro learning as demand-oriented learning, it is necessary to provide personalized and adaptive micro content. In doing so, designers of micro learning must prepare the micro content in advance in a didactically appropriate manner. This includes, for example, different levels of difficulty in the learning content. However, we acknowledge that our research has some limitations. The conducted literature review is somewhat narrow due to the focus on the IS stream and should be expanded by further research. Furthermore, we conducted a qualitative study with a relatively small sample size of 13 experts. Even if we could not reveal any new insights in the last interviews, our results may not be complete. As a further limitation, the analysis of interviews is always subjective, as different researchers might come to different results interpreting our data. However, in order to minimize subjective influences, we used the approach of structured content analysis and double-checked our codes and results. To address these limitations and further investigate our findings, we are currently developing a process model for designing micro content. In doing so, we will verify to what extent the requirements are applicable. For future research on this field, the near future will show us to what extent the many digital learning arrangements now in use will be able to replace classroom teaching and what role short learning units such as micro content will play in this context.

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