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### **Quality of learning materials**

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#### **Abstract**

With this article, we wish to discuss what learning materials are and how they can be included in didactic strategies. The question of what makes a good learning material can be answered in several ways, and places demands on professional judgement. Firstly, the answer will depend on how we view the learning material, as well as what type of learning material we are looking at, which is why we will start with a definition and typology of learning materials. Secondly, we will look at learning materials from three time perspectives: the potential didactic potential, the actualised didactic potential and the realised didactic potential. We will then attempt to identify five quality perspectives, each of which can contribute to the assessment of a learning material's quality based on objective, users, effect, standard and organisational system. As an example of how one can interpret the perspectives, we present quality principles for digital learning materials that have been formulated on the basis of existing knowledge of learning materials' design and effect. Finally, we reflect on the significance of professional judgement in the assessment of the quality of a learning material.

**Keywords:** Theory on quality, Learning materials, Design principles, Digital scaffolding.

## Resumo

O artigo propõe discutir o que são materiais de aprendizagem e como eles podem ser incluídos em estratégias didáticas. A pergunta sobre o que é um bom material de aprendizagem pode ser respondida de muitas formas e traz demandas de julgamento profissional. Primeiramente, a resposta dependerá de como se considera o material de aprendizagem, bem como qual é o tipo de material que se está analisando, razão pela qual o artigo começa com uma definição e uma classificação dos materiais. Em segundo lugar, os materiais de aprendizagem serão analisados a partir de três perspectivas temporais: potencial didático, potencial didático atualizado e potencial didático realizado. Em seguida, procura-se identificar cinco perspectivas de qualidade, cada uma das quais podendo contribuir para a avaliação da qualidade de um material de aprendizagem com base em objetivos, usuários, efeitos, sistema padrão e organizacional. Para exemplificar como se pode interpretar tais perspectivas, apresentam-se princípios de qualidade para materiais de aprendizagem digital, formulados com base no conhecimento existente sobre design e efeito dos materiais. Finalmente, propõe-se uma reflexão sobre o significado do julgamento profissional na avaliação da qualidade de um material didático.

**Palavras-chave:** Teoria sobre qualidade, Materiais de aprendizagem, Princípios de design, Andaimos digitais.

## Resumen

El artículo propone discutir lo que son los materiales de aprendizaje y cómo pueden incluirse en las estrategias didácticas. La pregunta sobre qué es un buen material de aprendizaje puede ser contestada de muchas maneras y demanda juicio profesional. En primer lugar, la respuesta dependerá de cómo se considera el aprendizaje material, así como cual tipo de material que se está analizando, razón por la cual el artículo comienza con una definición y clasificación de los materiales. En segundo lugar, se analizarán los materiales de aprendizaje desde tres perspectivas temporales: potencial didáctico, potencial didáctico actualizado y potencial didáctico realizado. Luego, se trata de identificar cinco perspectivas de calidad, cada una de las cuales puede contribuir a la evaluación de la calidad de un material de aprendizaje basado en objetivos, usuarios, efectos, sistema padrón y organizacional. Para ilustrar cómo se puede interpretar tales perspectivas, se presentan principios de calidad para los materiales de aprendizaje digital, formulados en base al conocimiento existente sobre el diseño y el efecto de los materiales. Por último, se propone una reflexión sobre el significado de juicio profesional en la evaluación de la calidad de un material didáctico

**Palabras clave:** Teoría sobre calidad, Materiales de aprendizaje, Principios de diseño, Andamios digitales.

## What is a learning material?

In this article, we provide a wide definition of learning materials. From our standpoint, 'learning materials' covers all materials and tools used as aids, with learning as the goal in an educational context. The concept of the learning material draws on a long didactic tradition. In one of the first and most influential textbooks for teacher education in the 19<sup>th</sup> century, G.P. Brammer's textbook on Didactics and Pedagogy (1838), there was an entire chapter entitled "On Learning Materials", where the function of learning materials was detailed in an extremely precise and fitting way, which is still relevant today and applies both to digital and analogue learning materials:

In order to divide up the Learning Content, give it to the Students in a visible Way, and to make the Learning path clear, we use Learning materials. This then contributes to making the Teaching more interesting and comprehensible for the Children and to gain Time for the Teachers. (Brammer, 1838: 36)

Note that Brammer is very aware of how learning materials can have a positive effect in terms of visible teaching, motivation, engagement and learning outcome from a student's perspective as well as a structuring of the material and streamlining of the work from a teacher's perspective.

We can also look at learning materials based on the following three time perspectives (Bundsgaard and Hansen, 2011):

- We can look at the learning material itself, as a text. Here, the learning material is present as *potential didactic potential*: that is to say, that we can see the potential in the learning material that could help support the teacher's teaching and promote student learning.
- We can look at the learning material as a tool in use. Here, the learning material acts as *actualised didactic potential*: that is, we look at what actually happens when the teacher and his/her students use the learning material as a tool in the educational context.
- Finally, we can look at the effects, and how the use of a learning material can make a difference – both to the students' learning and the teacher's teaching. Here, what is being registered is the learning aid's *realised didactic potential* as an effect, which becomes apparent over time.

## Learning materials' potential didactic potential

When we look at the learning material as a text, we are looking at its *potential didactic potential*. We can see, for example, that the learning material can help us fulfil the academic objectives and cover specific subject matter. However, it is only potential

didactic potential, so long as the learning material has not been put into use by a teacher or a student. Depending on the type of learning material in question, this 'potential potential' will be more or less clear or more or less easy to realise.

We can break down learning materials into three general types (Hansen, 2010) depending on what the learning material's potential is:

- *Didactic learning materials* are characterised by having been especially developed for teaching and therefore with a didactic intention (e.g. a textbook for teaching mathematics or an ICT-based teaching system).
- *Functional learning materials* can support processes in the teaching for both the teacher and the students. These could, for example, be tools such as an interactive smart board or a word processing program.
- *Semantic learning materials* are texts which have been produced for purposes other than teaching (e.g. a novel or a food recipe). Semantic learning materials must be *adapted didactically* by the teacher in order to become suitable as learning materials, i.e. they must be adapted to teaching situations.

Didactic learning materials are thus *didactically designed* by their producer, as opposed to semantic or functional learning materials. It is, however, the teacher or the educator who must discover the didactic potential in a functional or semantic learning material and integrate these learning materials into the teaching situation. The teacher or educator must, for example, in order to be able to use a picture book in his or her teaching, make decisions regarding academic goals, design and plan activities for the students to participate in as they work with the book, and make decisions regarding organisation etc. This requires a didactically creative teacher or educator. Most often, didactic learning materials will consist of semantic and functional learning materials in an organised progression, where many of the didactic choices are made for the teacher in the learning material and ideally presents a coherent and well thought out design for learning. A didactic learning material can also function as a form of support or instruction to the teacher and help him or her to formulate the academic content. The producer of the didactic learning material is typically very clear about the didactic potential of using a specific didactic learning material.

International research has documented that didactic learning materials play a very central role in elementary school teaching (Moulton, 1994). For example, Agnes Edling (2006) has documented that didactic learning materials dominate the teaching's content, and that students are, in the teaching, expected to reproduce the learning materials' content rather than build upon, assess or process the information. We also know that printed textbooks remain the most widespread and used learning material by far in comparison with digital learning materials, and that this also applies in those countries that can afford to purchase digital technologies for schools. A recent Norwegian

questionnaire showed that 72% of all teachers in Norwegian elementary schools, according to their own assessment, use printed teaching books (Gilje, 2015). The trend is the same at a global level (Knudsen, 2011; Hansen, 2015). Those teachers who use digital learning materials will most often either use of combination of printed textbooks and digital learning materials or digital textbooks, which have much in common with the printed textbook.

## **The actualised didactic potential**

*The actualised learning potential* deals with what actually happens when teachers and students use a learning material in teaching and learning situations. A learning material is rarely just thrown into the teaching situation to function independently in a particular way. Typically, the teacher and educator must make a multitude of decisions in terms of how a learning material is presented in relation to his or her students, and will also adjust the use of the learning material depending on the students' needs and academic level. Naturally, this is most obvious when semantic and functional learning materials are brought into play in a teaching situation. The same functional learning material will have many different potential functions depending on the teaching situation.

How direct a line can be drawn from the learning material's potential potentiality to its actualised potential will also depend on what type of learning material we are dealing with, and what the characteristics of the learning material are – for example, whether the learning material includes teachers' guidelines, and how specific these guidelines are. Another important point is that we often become aware of actualised potential which we had not noticed before as 'potential potential', because it is when something is used that its potential becomes evident. It is also on this second level that the teacher will use his or her didactic insights to get the most out of the learning material in relation to the actual student group.

If we turn our gaze towards didactic learning materials, then the teacher or educator will be guided, through the instructive texts of the learning material, in terms of being able to see and realise the didactic potential of the learning material. One crucial point here is that the teacher or educator must not, in any way, forget his or her 'didactic toolbox'. When the learning material meets a group of students in a specific context, it is essential for the teacher to actively present the learning material so that it functions in the best possible way in terms of his or her objectives in using it. The teacher must therefore form a *didactic design* that is to frame some social processes, which will build the foundation for the students being able to learn something and form an opinion (Selander & Kress, 2010). In other words, the teacher needs to make a didactic reorganisation of a learning material, a *redidactisation* (Hansen, 2007), that is to make a number of didactic decisions in relation to the learning material and its didactic intention, which is already present in the learning material from the publishers, if the learning material's quality is to be actualised and become a quality of the teaching.

Some learning materials have extremely prescriptive guidelines, which can appear to take the teacher's judgement and didactic creativity out of play. To what degree, however, is the producer able to anticipate the local differences, which there will be from class to class, or all the specific needs which the individual students will have? Do learning materials most often aim at hitting the middle group in the class or do they leave it up to the teacher to include the rest of the students? Skjelbred, Solstad, and Aamotsbakken (2005) found that printed textbooks were most often the only learning material used in the Norwegian classrooms the study analysed, and that neither the learning materials themselves nor the teachers, in their use of the learning materials, had adequate focus on adaptation and differentiation.

There are examples of learning materials where it is hard to see how the teacher can have any real didactic influence on the students' learning. This especially applies to digital didactic learning materials that exclusively offer proficiency training. Here, the students meet a barrage of closed and self-correcting tasks, which train already learned skills (e.g. multiplication). Typically, there is a strictly managed progression from the simple to the more complex. These learning materials are produced for the students to sit individually, each at their own computer, and solve tasks suitable for their individual level. What is the teacher's role here? As all students can potentially do something different at different levels, the teacher cannot frame a classroom dialogue. Moreover, as the learning material gives the student simple feedback, i.e. whether the answer they gave is correct or not, the teacher has no role there either. This underscores the need for learning materials to be assessed both in terms of their didactic intention (for example, on whether they are training in a consistent and appropriate way) and their significance to the completion of the teaching task as a whole (e.g. whether they create an inappropriately high level of individualisation, which disconnects the teacher and the groups' functions). Gissel and Skovmand (2016) have analysed the didactic, digital learning materials used by 390 Danish teachers in their recent teaching using ICT, and found that proficiency-based learning materials with skills and drills were the most widespread type of didactic digital learning materials.

Learning materials and teacher's guidelines will not, however, normally be able to cover all the areas about which the teacher must make critical decisions. For example, the teacher must make decisions in terms of how much time to spend on a subject over the course of a year, whether all students should be taught in the same way, or whether some groups/students need another form of teaching, and so on. If a learning material is to dictate the teacher's use, then it must be unambiguous on all points, and there are few learning materials which are (Freeman & Porter 1989).

A certain amount of research has focused on teachers' use of didactic learning materials. The picture that emerges across the studies is that teachers use the learning materials in very different ways (Moulton, 1994; Watt, 2015) rather than blindly following the recommendations in the teaching guidelines (Stodolsky, 1989; Freeman et al., 1989;

Barr et al., 1989). Gissel (2015) has studied how three teachers used the same Danish digital, didactic learning material 'iSkriver' (Alinea). It appeared that two of the teachers used the learning material in a way that departed notably from the didactic design suggested by the teaching guidelines. Unlike the typical proficiency-based learning material, iSkriver encourages the teacher and the students to work together, with the learning material playing a very active role as dialogue partner in a shared construction of information and texts.

On the one hand, the teacher must thus typically be didactically active in his or her use of a learning material, and this applies to didactic as well as semantic and functional learning materials. On the other hand, the question is to what degree the teacher's didactic design can deviate from that intended by the learning material before it becomes an inappropriate use.

### **The realised didactic potential – the wider impact on learning and teaching**

When we look at a learning material's *realised didactic potential*, we are looking for an effect which becomes apparent over time. In practice, this point deals directly with evaluation. Did the teaching and the students' learning develop in a way that corresponds with our analysis of the potential didactic potential and our way of using the learning material? Didactic learning materials will often facilitate evaluation of the students' learning outcomes. Digital training programs often both give the student direct feedback and the teacher the opportunity to monitor how far the student has reached, and how high his or her success rate is in terms of responding to the tasks. It is relatively simple to measure the student's proficiency level in training programs.

At the same time, research also attempts to map the ongoing efficiency of using different learning materials in the teaching, partly to advance educational research by adding new information about what is effective in which contexts, and partly in order to give teachers and educators greater opportunities to make informed decisions in relation to their own practice.

The variations that exist in teachers' use of learning materials become a disruptive factor when we attempt to measure the effect of using a specific learning material. This is because, if teachers use the same learning material in different ways, perhaps radically differing ways, how can we say for certain that we are measuring the effect of teaching with the same learning material? Normally, when conducting efficacy studies, the participating teachers are instructed in how to use the learning material in a particular way and trained to use the learning material correctly. Furthermore, the researchers typically observe whether the learning material is actually used as intended. However, does this provide a realistic picture of what the effect will be from using the learning material in a normal classroom situation, where the teacher has only

limited time to prepare his or her teaching? We also know that the optimal use of a learning material demands adapting it to the context that is to the specific class, school or institution in which the learning material is to function. To get learning materials to function appropriately with a group of students typically implies adaption, innovation, and redesigning it didactically (Randi & Corno, 1997). The problem, of course, only becomes greater when we talk about measuring the effect of the use of functional learning materials. These can be used in countless ways in different subjects with different objectives. What effect do we see, for example, when we allow the students to use word processing programs on a computer? In order to answer this, we must also investigate how the word processing software is used, i.e. what potential potentiality is actualised by the teacher, and to what purpose it is used.

### **Five quality perspectives on learning materials**

How do we determine the quality of learning materials? We often talk about qualities as characteristics of the learning material itself, but it is a classic philosophical point, which can be traced right back to Plato, that the question of quality is a more complicated one that concerns the relationship between the object itself (the objective) and our approach to the object (the subjective perception). The question has since been discussed as a relationship between the objective, measurable features (primary sensory qualities) of an object on the one hand, and the more subjective features (secondary sensory qualities) it is attributed on the other. Moreover, the concept of quality has been extended to cover many aspects of an object's nature other than sensory qualities – including aesthetic, moral and practical qualities.

When we talk about good learning materials and the qualities of learning materials, this presupposes that there is a number of fairly stable factors that apply to those who will be using the learning materials (students, teachers and educators), and the contexts in which they will be used (teaching and lesson situations). In other words, it is implicit that they have been judged on specific didactic functions and purposes in a particular context.

In *Kvalitetens beskaffenhed* [*The Nature of Quality*] (2007) Peter Dahler-Larsen provides a detailed description of how quality is determined based on five perspectives, which can be used to put the quality of learning materials into perspective based on goal, users, effect, standard and organisational system. The first four perspectives are relevant and will be dealt with in this article, while the fifth will only be touched upon briefly, as there to our knowledge are no organisational quality control systems in the Danish elementary school system that checks the quality of learning materials. Another important point is that all five perspectives have their strengths, limitations and blind spots, which means that to determine quality we need multiple perspectives and a negotiation of what constitutes quality. Quality cannot be reduced to one single



perspective. It is therefore crucial that teachers and educators can, as an important aspect of their professional judgement, bring more perspectives into play in relation to a specific learning material, which is to be used and assessed in a more detailed and specific context.

### ***The goal perspective***

The goal perspective of learning materials is, in particular, known from the marketing used by publishers, where it is often emphasised that a learning material is in accordance with aims, goals and objectives in current curricula. In principle, a learning material cannot fulfil this, as it is the teaching, the realisation of potential in the material, that must live up to aims, goals and objectives. However, the learning material can, more or less systematically, contribute towards this being achieved.

The strength of the goal perspective is that it helps to ensure legitimacy, if there is a broad political backing to coverage of the quality goals.

The challenge with the goal perspective is that this is relatively demanding and difficult to put into action. How can we ensure that learning materials contribute to for example the requirement of personal development in the Danish curricula? This challenge can be made more specific in a number of ways. It can be a requirement that learning materials help to differentiate, motivate, engage, challenge, cultivate and democratise, and depending on the interpretation, the individual requirements can be perceived as more or less in agreement. It cannot be assumed that what is immediately motivating (e.g. gamification), is also democratising (e.g. dialogue and discussion on a common and informed basis). Controlling the quality of learning materials through goals requires clear and stable political objectives. Moreover, it requires that the political objectives are translated into practice in a cohesive and clear way so that additional goal criteria are not added which cannot be legitimised in the overall political objective. There can be large differences between the general objectives of the curriculum and the formulation of specific goals in learning materials and in the teaching. Goals are interpreted and formulated on many levels and in many different contexts in the educational system, and there can be conflicts of interest hiding behind different interpretations. Finally, the goal perspective limits and restricts quality, because it is notoriously difficult to comprehensively establish quality goals ahead of practice.

### ***The user perspective***

The limitations of the goal perspective become clear in a user perspective, which has its strength in being able to accentuate subjects' experienced quality. Two of the most common methods of evaluating learning materials – skimming test (what is your first impression of the learning material?) and the neighbour test (what do your colleagues say about it?) – will typically focus on experienced qualities that are not necessarily

goal-determined. This, for example, applies to usability, which can be evaluated fairly systematically based on criteria for good design. One of the pioneers in usability is Jakob Nielsen, who has formulated ten principles for good web design, which deal with the extent to which it is easy to learn and easy to remember, as well as whether it is flexible and effective (Nielsen, 1993). These are important qualities in a busy working day, where design qualities in the world outside the school also rub off on the assessment of design in the school. Learning materials are increasingly competing against other artefacts in the areas of aesthetic and user-friendly design.

There is a difference however between usability on an everyday level and usability vis-à-vis teaching, which rather takes on the form of “teachability” in relation to the teachers and “learnability” in relation to the students, because the didactic framework is relevant to what is experienced as user-friendly. Usability criteria are superficial by nature, as they concern interaction with a user interface, while didactic-use criteria focus on academic challenges and deep learning, as they concern interaction with subject specific content.

The challenge with the user perspective is that it focuses on satisfying the user’s immediate needs. The result can thus be short-sighted and coloured by personal needs and preferences, which do not promote a more ambitious or long-sighted quality appraisal. An immediate need to create a sense of calm and pleasure in the learning environment with the use of a learning material can thus stand in opposition to a more long-term need to create academic commitment and enthusiasm. Nor can the user perspective help in dealing with discrepancies between different users’ quality perspectives beyond confirming that there are differences in taste.

### ***The efficacy perspective***

The limitations of the user perspective become clear in an efficacy perspective, which defines quality based on efforts and the agents’ lasting effects (outcome). If you wish specific outcomes from the teaching, e.g. the development of specific skills in reading comprehension or mathematical problem solving, these will be linked to academic challenges, perseverance and often also the frustrations, which are at odds with the users’ immediate needs. There is therefore a tradition for narrowly assessing the quality of the teaching by establishing the relation between intervention and outcome within one domain, i.e. one didactic operationalization of academic and pedagogical theory. This not only applies to reading comprehension and problem solving, but also to the use for example of class management, discipline and digital learning materials.

The strength of a didactic efficacy perspective is that academic and educational insight makes it possible to look critically at quality, in this perspective defined as a sign of learning outcome and that learning is being supported. Used in regard to a learning material, this means that one can assess whether the learning material supports students’

academic progression that can lead to the desired outcome. Such an assessment thus demands a double-sided anchoring in the students' needs, prerequisites and potential on the one hand, and in academic theory on the consistency between interventions and outcomes on the other. This double anchoring must make it probable that the learning material both supports the students' learning, based on what Lev S. Vygotsky (1978) referred to as the 'zone of proximal development', and also towards what Wolfgang Klafki called the 'double-sided opening-up', which opens up the subject to the student and the student to the subject (Klafki, 1983).

The challenge, however, with the efficacy perspective is that our knowledge about the relation? Between interventions and outcomes is typically very general and also limited in many respects. What does it mean, for example, if "classroom management" and "clarity and structure" are qualities of good and effective teaching (Fibæk Laursen, 2015)? It requires both intuition and an understanding of context to assess whether a given learning material can add clarity and structure in relation to a specific group of students. Furthermore, the efficacy perspective does not necessarily match political goals or users' wishes. Finally, there is a risk that the efficacy perspective leads to a prioritisation of those parts of a curriculum where there is a clear connection between intervention and effect. This could, for example, be training for academic skills or regulating social behaviour, which have visible effects in the short-term (output), but which do not necessarily contribute to the students' all-round development or academic engagement in the long-term (outcome).

### ***The standardisation perspective***

The standardisation perspective has gained ground with the digitalisation of learning materials. It is a perspective characterised by its definition of quality based on fixed standards that make quality a measurable unit. The major digital learning materials from the publishers are produced based on specific standards and requirement specifications. This makes them uniform, with a recognisable user interface and the potential to transfer and integrate content. It also makes it easier to mass produce content.

Standardisation is also familiar from analogue learning materials, where the publisher has standards for the quality for example of paper and covers. The introduction of different types of user surveys, library reviews and peer reviews in connection with the production and distribution are also standards that ensure a certain level of quality in relation to one or more of the other quality perspectives. The peer review is a method initially developed by the research environment but which is increasingly being used in other areas, including quality control of learning materials on digital platforms in Canada and the USA. The method requires that an external, qualified specialist in that field assesses and approves the quality of the learning material prior to publication.

The strength of standardisation is that it can help to ensure a certain level of quality in terms of the other quality perspectives. The Danish Agency for Digitisation thus sets a number of standards for digital solutions, which are of great importance to usability, because a certain degree of standardisation is a prerequisite for interaction between ICT systems in order that the users are not, for example, prevented from transferring content from one system to another.

The challenge with standardisation is that it can lead to promotion of technocratic solutions, which are founded in neither academic theory, ethical norms or political goals, but rather in the efficiency around the production of learning materials. This is because standardisation presupposes a quantification of quality, which in turn promotes that which can be measured over what is considered valuable. This also means that there is often a loss in variation, because standardisation promotes mass production. This can be the mass production of digital portals, for example, with a progression that is built up uniformly, using the same template for academic goals, dissemination, exercises and evaluation activities. Consequently, the form and structure of learning materials will not be developed to tightly fit academic content, but rather based on the set standard.

### **Quality criteria and principles for digital learning materials**

How can we then use quality perspectives to evaluate learning materials? It can be a challenge to handle different quality perspectives in practice since they are general and contribute to complexity when they are combined. Therefore it's more common to use a definite set of manageable criteria for the evaluation of learning resources, for example textbooks (Johnsen, Lorentzen, Selander and Skyum-Nielsen, 1998) or multimedia learning resources (??, 2007). A range of criteria often prioritise a certain perspective on quality at the expense of other. Hence, usability criteria prioritises the user perspective while national standards for evaluation of learning materials prioritise the goal perspective.

To meet this challenge Bundsgaard and Illum Hansen have developed a range of quality criteria in an attempt to incorporate multiple perspectives in the evaluation of digital learning materials? (Bundsgaard & Illum Hansen, 2013). The result is a set of criteria which call for a reflected use because they are mutually interdependent and in practice can be partly contradictory since they are based on a plurality of perspectives. As a consequence of this principle point of view they are articulated as guiding principles in order to scaffold a dialogic approach to design, evaluation, procurement, use and investment of digital learning materials.

The primary basis for the principles is international research into digital learning materials' design and effect. The principles thus, in particular, contribute to an efficacy perspective of digital learning materials, but they are also related to a goal, user and

standardisation perspective. Thus they include pedagogical values and objectives as well as usability requirements.

The quality principles for digital learning materials can be consolidated into three groups, which can, very generally, be summarised into three themes and assertions:

1. Focus: Digital learning materials should minimise unnecessary processes and actions and sharpen student attention and focus on the specific subject of learning.
2. Support: Digital learning materials should support student activities and promote their academic and social development.
3. Commitment: Digital learning materials should motivate and stimulate the students and contribute to academic absorption and continued industry.

### **Focus: avoid unnecessary cognitive load**

#### ***The accessibility principle***

Expression, content and activities in digital learning materials should be accessible to the learning material's target group. The texts should be readable and characterised by a meaningful interplay between language and images as well as a format that is available on universal reading software. Furthermore, there should be requirements placed on reading and prediction functions, so that learning materials support both reading and writing. They *must* support the student with reading and writing difficulties, but *should* also offer support for all, e.g. in the form of word suggestions that extend the vocabulary and support a process-oriented text production.

#### ***The reduction principle***

All forms of expression, content and activities in digital learning materials should have a function in relation to the learning material's academic and educational goals. Unnecessary and superfluous material should be reduced and omitted so that students do not waste cognitive or emotional energy on irrelevant details. The reduction should minimise superficial gloss, outside discussions and activism, but on the other hand, there must also be a context for relating actions and understanding. Moreover, note that aesthetic qualities in digital learning materials can have a function in terms of creating relevant focus and contributing to open learning processes. On the other hand, empirical studies suggest that irrelevant but eye-catching films, photos, anecdotes and everyday stories attract unnecessary attention and reduce the learning outcome (Mayer, 2010; Maagerø & Skjelbred, 2010). The goal is to focus the students' attention on the relevant factors as a whole, without distracting from them or decontextualising

them – the latter results in transfer problems; that is, problems in using the learning outcome in other contexts.

### ***The figure/ground principle***

Digital learning materials' representation of content should be prioritised based on a figure/background principle, which places the important parts in the foreground – like a figure in relation to a background – by using graphics (e.g. headlines, highlighted quotes, colour coding, icons) and layout (positioning and organisation of the space) to manage the students' attention. The relationship between figure and background should support an appropriate screen reading and spatial and temporal orientation and prioritisation of language, images, diagrams and soundtracks (Kress & van Leuwen, 1996; Bundsgaard, 2008; Hansen, 2012). The figure/ground principle is supported in cognitive gestalt and perception psychology (Rubin 1915; Talmy 2001; Mandler 2004).

### ***The repetition principle***

The repetition of expression, content and activities should supplement and expand upon new knowledge and/or changes in the representational form. A repetition should both contain some of the same (create recognition) and something different (create revelation). Students perform better when presented with a combination of different representational forms, e.g. text and images, than when presented with double the amount of the same representational form, e.g. spoken and written text on the screen in connection with an animation (Brünken & Leutner, 2001; Mayer and Moreno, 2003; Mayer, 2010). It is thus possible to distinguish between positive redundancy, where repetition adds depth and variety, creates continuity and reduces the cognitive load by combining representational forms (multimodality), and negative redundancy, where repetition simply becomes unnecessary reiteration.

### ***The proximity principle***

Related forms of representation should be placed in close proximity in time and space and clearly support the construction of a reading path (Kress, 2003). Proximity in time and space increases the learning outcome, for example when animation and a narrative voiceover take place simultaneously, or when an explanatory text, image and diagram are arranged in succession as a visual cluster (Baldry & Thibault, 2006; Maagerø & Skjelbred 2010; Mayer 2010). The proximity principle for digital learning materials is derived from the principles for analogue information graphics and the text visualisation (i.e. visualisation of what is being discussed via a front page, where text, image and diagram are combined) used in journalism and textbook production (Lidman, 1973).

## **Support: support of important cognitive and collaborative activities**

### ***The principle of the exemplary***

The selection and combination of expression, content and activities in digital learning materials ought to be exemplary and represent ordinary, important and special features within the learning material's subject field.

The starting point is that there will always be more information than it is possible to represent in a learning material, which is why the information should be included, excluded and organised based on materiality criteria. At the same time, it should be possible for the students to relate to the representative information and make it relevant and accommodating in terms of their horizon. The exemplary requirement is anchored in academic didactic research and has been furthered by, in particular, the German science educator Martin Wagenschein (Wagenschein, 1968).

### ***The genetic principle***

Digital learning materials should consider the students' learning time and realisation steps into their didactic design. Several studies suggest that digital learning materials that make it possible to segment the content and set one's own tempo increase the learning outcome (Mayer, 2010). This segmentation can take the form of sub-tasks, sequences and phases in a working process. The genetic element entails the students themselves receiving the opportunity to go through a process of cognition and independently experience problem solving rather than being presented exclusively with pre-packaged cultural products and technological and scientific achievements (Wagenschein, 1968). Wagenschein warns against exchanging the content's systematics with those of the learning process, which has its own built-in structure and progression, and which the learning material's didactic design should take into account.

### ***The multimedia and multimodality principle***

Digital learning materials should exploit the opportunity to bring more media (sound and light on the screen) and sensory modalities into play (e.g. the auditory and the visual). Digital learning materials typically primarily appeal to the visual sensory modality through film, images, diagrams and written text. However, there is evidence supporting that a combination of sensory modalities increases the learning outcome, a cause and effect relationship which, for the same reason, is called the modality effect. The combination of spoken text and image promotes learning compared with a combination of written text and image (Moreno and Mayer, 2007; Mayer 2010). As an extension of this it can, more generally, be recommended to bring more representational forms into play by combining spoken and written text, images, icons and soundtracks in a varied way, so that different sensory modalities work together – including the kinaesthetic, in

that icons, graphics and layout are significant to the physically anchored orientation. If interacting correctly, this can increase the learning outcome (Mayer, 2010; Baldry & Thibault, 2006; Kress & van Leuwen, 1996; Leutner & Brünken, 2001). What is special about digital learning materials is that interactive multimedia (screen, sound devices, input devices) open up the opportunities for dynamic multi-modality (e.g. an interaction between soundtrack, spoken text, film, animations, interactive models etc.), and it is this dynamic that should be used to create a committed teaching.

### ***The collaboration principle***

Digital learning materials should support collaboration and make it easy to communicate about process and product. Several studies suggest that collaboration increases the learning outcome of using ICT as a tool in teaching (Hattie, 2009; OECD 2010; Shear, Gallagher, & Patel, 2011). A design that supports collaboration can thus be justified cognitively and educatively.

### ***The compatibility principle***

One of the biggest advantages of the digitalisation of learning materials is that digitalisation makes it easy to share and reuse them in different contexts (Harden, 2005; Hirumi, 2005; Koppi, Bogle & Bogle, 2005). This does, however, require that the various digital systems can communicate with each other, which is why digital learning materials should build upon open standards as a requirement, and enable integration and use across systems and digital learning environments. It should be possible to download, work on and save the content, so that it can be used in the students' digital portfolios, as documentation of the students' learning process and as part of the teachers' formative evaluation.

## **Commitment: motivate and stimulate students to immersion and enthusiasm in the subject matter**

### ***The principle of personalisation***

Digital learning materials' expression and user interface should be personalised or personalisable in relation to the target group. Both studies in analogue and digital learning materials suggest that a "vivid expression" of an explicit sender and a clear use of causal links have a positive influence on reading comprehension and learning outcome (Reichenberg, 2000; Mayer, 2010). Studies of children's use of websites add that personalised functions, e.g. the opportunity to use a 'my games' function and save one's favourite games have a significant influence on usability (Nielsen, 2010). Digitalisation has made it possible to personalise learning materials with 'my' functions, e.g. in connection with notes, coursework or film preferences.



### ***The principle of interactivity***

Digital learning materials should exploit the potential for creating interactive design, which opens up the opportunity for action and interaction with some form of content. This could be in the form of simulations, user controls, hypertext or the opportunity for programming. The interactivity should be adapted to the target group and offer opportunities for action that correspond with the cognitive capacities of the user. This principle can be justified on the basis of studies into the importance of interactivity on the students' experienced learning outcome (Kay, 2006-2007). More generally, it appears that there is a greater positive effect when it is the students who are controlling the activities than if they are controlled by the system or the teacher (Hattie, 2009).

### ***The principle of authenticity***

Motivation research suggests that long-term commitment depends on the factors of goals, feelings and personal agency (Ford, 1992). If students feel that they have a meaningful goal that is worth striving for in their activities while also encountering a friendly, supportive and accommodating atmosphere as well as having and experiencing trust from their surroundings that they can handle the challenges of the situation, then they will also have the motivation to take on complex and difficult challenges. Together with the desire for the students to be able to handle challenges in complex situations ("21<sup>st</sup> century skills"), this is achieved through a principle of authenticity, "thick authenticity", (Shaffer & Resnick, 1999). By entering into authentic situations – possibly simulated ones – the students will experience challenges in a context, they will experience social relations, and they will have the opportunity to act using the specialist approaches, methods and knowledge that the learning material supports, and that the students are developing and using. The challenges in such situations must have an appropriate, authentic complexity and difficulty level, i.e. not be too easy or too hard, possibly supported through scaffolding (Bruner, Wood & Ross, 1976), so that the students can get into a state of flow, where they have focused all their attention on a particular activity, can maintain it, and also derive pleasure from it.

### **The professional judgement**

The issue of what makes a good learning material places, as noted in the introduction, demands on professional judgement. Based on this articles, we can condense this down to a central point, namely that quality, in the final instance, is a concrete and singular phenomenon. The different perspectives on, and principles for, quality are too general and inadequate to grasp what is special about the quality of a specific practice. This is why we emphasise the actualised didactic potential in our presentation. It is through the repeated use of learning materials and didactic reflection over their use that teachers and educators can develop a sense for the quality of learning materials

and a professional judgement that enables them to actualise and realise the learning materials' potential. To this end, we need a language for learning materials and their qualities. It is necessary to be able to bring more perspectives and principles into play and have specialist terms for the experience of quality, so that one is not locked into one single perspective or a ritualised practice.

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