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Quality Standards for Learning Environments – an Overview

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Zusammenfassung

In diesem Arbeitsbericht wird ein Überblick über die Qualitätsstandards bei Lernumgebungen gegeben. Die verschiedenen Aspekte unter denen eine Qualitätsbeurteilung stattfinden kann, werden dabei in Kürze dargestellt und kritisch beleuchtet. Dieses Working Paper entstand im Rahmen von „InnoMathEd[i] – Innovations in Mathematics Education on European Level", einem Projekt, das sich der Förderung von Schlüsselkompetenzen von Schülern und ihrer Fähigkeit ICT beim Lernen im Mathematikunterricht widmet.

Schlüsselwörter: Learning Environments – E-Learning – Didactics – Quality Standards

Abstract

This working paper gives an overview of quality standards for learning environments. The various aspects for an evaluation of quality are presented and analyzed critically. This working paper is a deliverable within "InnoMathEd - Innovations in Mathematics Education on European Level" which is a project with ten partners in eight European countries. The program aims at the development of pupils' key competences and their ability to use ICT for learning processes in mathematics.

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key words: Learning Environments – E-Learning – Didactics – Quality Standards

Quality Standards for Learning Environments – an Overview

Content

1   Introduction

What determines if a learning environment meets high quality standards? Are there common quality standards? What does quality in the context of e-learning mean? Ehlers (2004) says: "Finding answers to questions regarding quality in e-learning is one of the central challenges for theory and practice if e-learning is to become as important as traditional qualification measures in the future." The aim of this paper is to give an overview of quality standards that can be applied to learning environments. As so often this topic is prone to change since the field of e-learning is very dynamic and has to make necessary adjustments quite often. Nevertheless there are criteria that are widely used in the literature and empirically tested to be useful for evaluation learning environments and therefore will be stated in this paper. The various criteria will be listed and critically evaluated regarding their usefulness for a learning environment.

2   What is a Learning Environment?

Within the context of e-learning there are several terms in use. The term "learning platform" describes the technical functional range of specific software (Müllner, 2006, p. 8). A "learning environment" in comparison refers to an environment in which digital media is used and aspects of social-communication and content for adaptive processes in learning and education are offered to the user (cf. Meder, 2003, p.58). Learning environments therefore incorporate a wider range of aspects: Different media and content are arranged regarding to the needs of the individual users. Planning and steering processes for learning behavior account for a large part of a learning environment. It should be kept in mind though, that "learning platform" is a term which is used for a "multitude of tools" (Baumgartner, Häfele et al., 2004, p. 95) intended for the arrangement of learning processes.

3   Quality Standards for Learning Environments

There are several ways to start the discussion about quality standards for learning environments. Schulmeister (2000) proposes a catalogue of quality standards for learning environments as can be seen in Table 1.

Table 1: Quality criteria for learning environments (adapted from Schulmeister, 2000)

Criteria for Quality Standards for Learning Environments	
Administration	Design
Course Management	Evaluation
Didactic	Technology & Technical Questions
Communication	Support
Media	Economic Aspects

This structure is helpful to get a guideline; therefore it will be applied in this paper. Since the aspects sometimes cover similar directions, some of these categories will be combined.

3.1 Technology, Technical Questions and Support

In this first part technical aspects will be covered, since they are the starting point of each learning environment. Without a good technical foundation no learning environment will be successful. One main interest will be "usability" since it is said to be the key to an efficient user-machine-interface. Regarding technical questions in general it is necessary to tell the user in advance if any pre-requisites are required for the use of the learning environment. This accounts for the operating system but also for the browser or any other software that should be installed in order to run the learning environment properly. A stable system which is not prone to failure is a must-have. In case the learner is confused and any questions come up, it is also a good idea to have a contact person that can be found and reached easily. A system that supports individual breaks within the learning process comes as an advantage. Learners can stop their exercises as they please and continue when they are ready to do so (Flindt, 2007, p.299). Graphs, pictures etc. should have adequate loading times – otherwise the user will lose patience and will experience frustration. Frustration is a large problem when dealing with learning environments. Users often blame themselves when inconveniences or problems with the computer occur, even though the problem has to be credited to the system itself. Research dealing with usability, names several elements that can help to give the learner orientation and clear structures within the learning environment (cf. Niegemann et al., 2008, p. 419).

(1) *Elements for orientation*: They support the learner to find their way within the net of connected pages.

(2) *Elements of navigation*: These elements help to give quick access to specific sub-pages, for example by displaying a tree-structure of the learning environment.

(3) *Elements for screen-layout*: With purposeful chosen colors and a specific design-grid the content, like e.g. texts or videos, is structured.

(4) *Elements of emotion*: Positive emotions determine whether a learning environment will be accepted and willingly used. These elements can reinforce the enjoyment of using a learning environment by making it for example more social through interaction between users.

(5) *Elements of interaction*: The learner can chose various elements to get in touch with other users or to modify specific objects. For example writing a post in a forum or an e-mail can be listed here but also retrieving a mathematical formulary or changing a parameter within a dynamic worksheet is relevant here.

To support learning it is obligatory to design all elements in a way, so that long searches for relevant information can be avoided. To find out what the learner needs, is again part of the evaluation process (see chapter 3.4) which is connected to questions of usability. But what exactly do we understand by the term "usability"? Nielsen (1993, p.26) says it „has multiple components and is traditionally associated with these five usability attributes: Learnability, Efficiency, Memorability, Errors, Satisfaction." Niegemann et al. (2008, p. 419-424) explain the different aspects as follows: Efficiency gives the ratio between the resources used and the outcome achieved. Effectiveness is an additional aspect that Niegemann et al. (ibid.) state and refers to the possibility of the user to achieve his or her personal goals precisely and completely. Under the category memorability fall aspects of design that account for learners that only occasionally use the learning environment and therefore need it to be intuitive to make it easy for them to get back into the learning process. Errors in the learning environment should by all means be avoided. The last aspect of Nielsen's definition is satisfaction, an aspect which diffuses into all other characteristics: The user's demands and expectations are met and they gladly accept the environment as a useful tool to assist them with their learning (ibid.).

3.2 Administration, Course Management and Design

Next to technical concerns, each learning environment needs an easy to use administration and a simple course management. Otherwise administrators, instructors and learners will soon be frustrated due to the malfunctions of the system. In general it is important that the chosen system runs on any computer with any common operating system or – if applicable – with any common browser like the Internet Explorer or Mozilla Firefox. The teacher or instructor should be given rights to administer the learners and assign them with specific roles (e.g. author, editor). Since teachers or instructors usually do not have large amounts of extra time which they want to spend on administration it is necessary to have an environment that can be used intuitively and which is mostly self-explanatory.

As a bonus it is useful to have user statistics that show which persons use the environment how often. This is of course also important for the evaluation (see chapter 3.4). Depending on the learning environment it is also supportive to have interfaces that allow import and export of other data (e.g. class lists).

When it comes to design one has to be careful in not exaggerating the given possibilities. The motto "the more the better" does not count for learning environments. Too many colors, too many (unnecessary) functions and useless add-ons might hinder the actual learning since the learner will be distracted upon the large amount of "side-shows".

3.3   Media, Communication and Cooperation

When the user reaches the stage of actually using a learning environment, questions of communication, cooperation and media are brought to bear.

All types of media have one thing in common: They are used to share thoughts (cf. Boeckmann, 1994). Therefore media is used to enable any communication, which is a crucial part of any learning environment. There are three basic functions of communication: a) inform people about a specific content or the outside world (propositional function), b) to assist with the interaction between individuals and c) to help people to share or establish their personal experiences. Any process of communication has a recipient and a sender even though sometimes information is not passed on directly (cf. Reinmann, 2005, p. 75). For learning purposes the following aspects are central: Is communication and collaboration between the individual learners fostered? Does the learning environment actually help the learners to exchange themselves about their ideas and problems with the specific task?

There are two common ways to differentiate within the field of computer supported communication: (1) asynchronous and (2) synchronous communication.

(1) *Asynchronous communication*: A well known example for this form of communication is writing an e-mail. The communication process is not simultaneous which means that the parties involved do not receive and response to the triggered subject at the same time. For learning environments forums are a widely used tool to assist the exchange of information within the learning community. The advantages of this tool are obvious: written text is persistent and can be seen by everyone registered for the platform, thoughts might be phrased more thoroughly and in a more reflective manner (and can be changed as often as wanted before posting them), social barriers can be minimized and interaction between learners is encouraged (cf. Schulmeister, 2006, p. 163). Drawbacks of asynchronous communication are the possibility of procrastination (ibid., p. 165) and delays within the communication process. With an adequate culture of discussion this problem can be solved, though. Too many parallel discussions might foster confusion with the learners and should therefore be avoided. A common problem is also "lurking" (Reinmann, 2005, p. 100) which means that some learners just withdraw themselves from the discussion and do not participate at all.

(2) *Synchronous communication*: When learners have the possibility to communicate at the same time, we call this synchronous communication. A plausible example might be "chats". In chats the communication is published directly and usually cannot be taken back or changed afterwards. The discourse is ended once the chat is closed so the persistence of this tool is far less compared to forums. There is the possibility to safe transcripts but the use of them is arguable. Chats can be a good way for a first brainstorming (Schulmeister, 2006, p. 160) and for short-term consultations. Instructors could use chats for a substitute for consultation-hours. Disadvantages of a synchronous communication are oftentimes confusions within the actual conversation. Regarding to the amount of participants communication can be misleading or can be misinterpreted. An actual discourse with profound arguments is sometimes hard to establish within these forms of communication.

Regardless of the specific type of communication: Both alternatives account for the interaction between learners and instructors, instructors and instructors and learners and learners.

The cooperation between the various individuals can be achieved through exchange of learning material, (virtual) team work and interaction within the learning environment.

Learning contents should be short, precisely formulated and assembled modularly. When writing texts, it is helpful to cover one subject per page, so that scrolling is avoided. Longer texts should be separated in chapters and have page numbers for better orientation. If personal opinions of the author are stated in the text it is required to mark these passages accordingly. Rules for citation should also be kept in mind. Crucial for the success of learning environments is the recentness of the content. Updates are very important to avoid the production of "dead content". Font type and size have to be chosen carefully, so that users will be able to read the texts and instructions without problems. When writing texts for multimedia learning next to didactical aspects, it is important to keep other aspects in mind as well: The learner should be informed about the goal of his or her learning – why is it necessary to read this text or to do this exercise? The instructor has to check in advance in which order the individual aspects of the content should be presented to increase the learning success even more. Another fundamental point when writing texts or building exercises is the learners pre-knowledge – what can I, as an instructor, assume to be known? Additionally, when using summaries, the instructor has to balance reason for or against a longer summary at the end versus short summaries in between (Niegemann et al., 2008, p. 179).

Other media than texts have to bring an added value when used. It is obstructive to just use media for the sake of the usage. Each picture, graph or presentation has to have a high quality and an intended effect on the learning process. Otherwise the media might not foster but hinder learning altogether. For videos etc. that call for a decoding skills it is helpful to state the amount of time needed for downloading and viewing (cf. Flindt, 2007, p. 296ff).

3.4   Evaluation

To ensure that the learning environment meets high quality standards continuous evaluations have to be made. Tergan (2000) points out that this evaluation process has to be carried out in three phases: (1) planning, (2) development and (3) use.

(1) *Planning*: In this stage usually a formative evaluation will take place. It is conceptualized to improve the specific project and aims at the following subjects: What are the needs of the learning process? Which pre-conditions do the learners have? What is our goal? Which technical and instructional qualifications apply? Methods used in this stage are surveys, analysis of documents and observations.

(2) *Development*: The second phase aims to ensure and optimize the pedagogical quality of the respective educational offer. As main subjects of evaluation the didactic measurements and the content which is wanted to intercede should be identified. For this phase of the evaluation again surveys, checklists, observations, tests and empirical studies can be used as methods.

(3) *Use*: To evaluate the use or – to be more specific – the acceptance, the learning success or the transfer of knowledge, it is necessary to measure the learning environment with similar offerings. Also it is important to take a look at the cost-benefit-ratio. In detail the subjects in this phase of the evaluation are the effects and benefits of the learning environment. Mostly this stage is realized as a summative evaluation and the methods used here are again surveys, observations, tests and empirical studies.

Without a proper evaluation the development of a learning environment is normally useless. One has to monitor if the learner actually has a positive effect for his or her learning success and if the use of computer supported learning brings an advantage to the learner.

3.5   Economic Aspects

Even though the expenditures for education have increased (cf. OECD, 2005) there is never enough money for all the acquisition of equipment needed. Therefore it is essential to find learning environments that will not use up the whole budget of the educational facility.

Nowadays "open source" software is widely available and comes with excellent quality. Programs like "Geonext"1 for dynamic mathematics are only one example of software that is widespread, easy in use and without any costs.

When using software that is licensed it is necessary to calculate not only the costs for the initial purchase but also following costs, for example when the license may only be used by a certain amount of students and will not work for the exceeding amount of learners. Another aspect to be kept in mind is, if the learner may use the software at home or if the use is restricted to public facilities like school or the university. There may also be restrictions regarding the log-ins (Schulmeister, 2000, p.31) – some providers will limit the amount of single uses of the program. Moreover the provider should have a good reputation – otherwise many investments (e.g. money, time, effort) might be without success when the provider won't deliver necessary updates, improvements or – in the worst case - discontinues its service.

If a lot of users have to work with the learning environment it raises the question, who will provide a server to guarantee stable performance of the program – the institution or an external provider? External providers charge extra costs but might still be an alternative, if there is no one experienced with the administrations on the server that are needed for the specific learning environment.

3.6   Didactics

One aspect that is clearly the one to be very significant in the field of learning and education is the issue of didactics. Didactics focuses on questions regarding the design of education and instruction. Media didactics are a relatively new field of didactics which deal with infrastructures that support learning and the media used for learning and teaching. The planning, development and use of didactical media is another part of media didactics (cf. Flindt, 2007, p.97).

In the field of education and pedagogy there are three main models of learning: behaviorism, cognitivism and constructivism. The latter has become very popular during the last years and within its different schools of thoughts one common core can be stated: the outside world is not recognized directly and without prerequisites – any reception, cognition and thinking is

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1 Geonext is a project by the University of Bayreuth (Germany) and on the project website a free download of the software is possible. The use is free for all students and pupils and the software is supposed to be used at home and in school. See URL: http://geonext.uni-bayreuth.de/ [24.04.09].

dependent on the individual construction of the person. Even though constructivism has become very popular, the other paradigms are still in use and are in different parts of education still accepted and acknowledged. It has to be kept in mind that each paradigm has its strengths and weaknesses which for reasons of space cannot be discussed in this paper2.

Within the cognitive revolution, that redeemed behaviorism, the shift to a cognitive approach was enhanced by the work of Bloom (1956) who presented his Taxonomy of Educational Objectives that gives a clear structure on how learning can be hierarchically built up. Bloom and later Gagné set milestones for a shift from goals of behavior to cognitive goals in learning. Gagné (1985) was the first to introduce "Instructional Design" as a way to find the right arrangement for various settings of learners' but also institutional pre-conditions. Any part of a systematic arrangement of conditions that may help to foster competences is called "instruction" (cf. Resnick, 1987). Smith and Ragan (1999, p.2, original emphasis) define the term "Instructional Design" as follows: "[…] instructional design refers to the systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation."

One of the prototype-models of instructional design was presented by Gagné, Briggs and Wager (1987). It follows nine steps which can be seen in Figure 1.
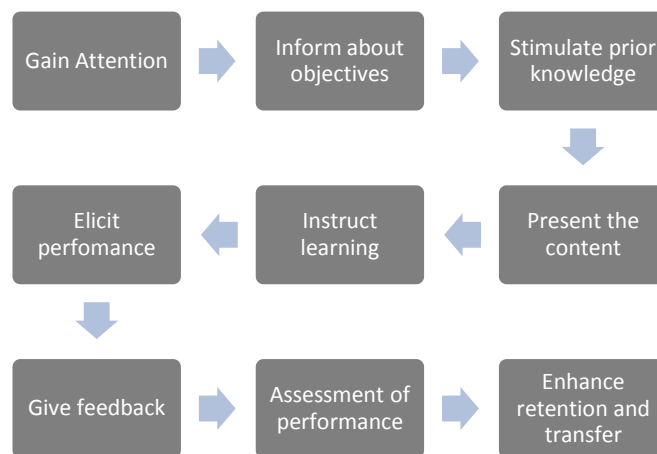

Figure 1: Gagné's Nine Events of Instruction (modified after Gagné, Briggs & Wager, 1987)

The model has been criticized for being too linear and therefore won't activate self-directed and cooperative learning (cf. e.g. Niegemann, 2008, p.22f). The second generation of models take this criticism into account and try to foster exploration, active learning and collaborative and cooperative learning (ibid., p.23). Nevertheless, the model of Gagné, Briggs and Wager is still helpful and in use. Schulmeister (2005), one of the pioneers in the field of e-learning in the German speaking community, for example states, that it is still useful when designing lessons for class. Today the two streams of thoughts that can be found parallel in literature: One is the more structured approach that refers to a clear guideline in learning and the other is a discovery approach that focuses more on the active and self-directed learning alone or in groups (e.g. Colvin Clark, 2000).

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[2] For further information to these learning paradigms see e.g. Reinmann, 2005, p. 145ff; Reinmann-Rothmeier & Mandl, 2001.

4 Conclusion

When designing and using a learning environment many aspects have to be taken into consideration. The aim of this paper was to give an overview of common quality standards or criteria and to give examples of how these settings might be found in practice. The valuation of each criterion is not easy and a controversial issue, since the diverse authors emphasize different aspects. In the end it is important to keep an eye on what the learner really needs and what is helpful for his or her learning success. The emphasis which is put on each criterion is dependent on the goal of learning or teaching and of course there are criteria that are "must-haves" like a clear structure within the environment and others, which are nice to have but not vital for the learning success of the learner. Each individual will have different preferences in what determines "good" learning and according to Ehlers (2004) the future research will have to be even more learner-centered than before. Currently the "Web 2.0" and its user-generated content as well as "PLEs" (Personal Learning Environments) are the predicted trend and enhance learner-centered learning on another so far unknown level (Schaffert & Kalz, 2009). There is a shift from learning environments made for masses towards a learning environment that is created by the individual itself. "Social Software" is a relatively new way to get the single person involved in its own learning. With tools like weblogs, social communities and wikis, learners get the chance to determine what they think is important for their learning and they get the chance to reflect on their own work – without being "lonely soldiers". They are still involved in a community of learners and therefore the human needs for competence, relatedness and autonomy (cf. e.g. Ryan & Deci, 2000) are nurtured.

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