

Evaluation of E-Learning

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ABSTRACT

Evaluation is an important measure for quality control in e-learning, which aims at improving a learning environment and adapting it to users' needs, as well as proving values and benefits of a course to financiers and participants. However, results and styles of evaluation are subject to the designers', the evaluators' and the participants' individual and socio-cultural backgrounds. This paper examines evaluation from an infrastructure perspective and presents dimensions and parameters for the evaluation of e-learning. The authors take cognitive, epistemological, social and technical infrastructures into account.

Keywords: E-Learning, Formative Evaluation, Learning Environments, Quality Control, Summative Evaluation

1. INTRODUCTION

E-learning has evolved intensively over the past decade technologically as well as concerning its scope. E-learning means the acquisition and use of knowledge distributed and facilitated primarily by electronic means (Learnframe.com, 2005). Beginning with text based measures that were presented on media like CDs only 10 to 15 years ago, e-learning nowadays use all possible electronic media and hardware to serve the learner with multimedia, virtual and personalized contents. This enlargement – technologically and with regard to content – poses new challenges on evaluators. They relate mainly to the rapid development of e-learning and the associated changes in infrastructures (Ertl, Winkler, & Mandl, 2007) as well as in

missing experiences in the applicability of the new technologies for beneficial learning. Both aspects emphasize the need for appropriate quality management that can be established by thorough evaluation.

Stockmann (2000) defines four possible results of an evaluation: to get insights into a project and receive data necessary for decisions, to get control over a project and to be able to make refinements, to establish a dialogue between different stakeholders, e.g. financiers, providers and the target group, and to legitimize costs and sustainability of a program. In sum, evaluation means to exactly define and measure a product's or programme's usefulness and worth (Reinmann-Rothmeier, Mandl, Erlach, & Neubauer, 2001).

In the field of e-learning, evaluation mainly focuses on the quality of the learning environment and on learners' negotiation in and with

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the learning environment. Thereby, evaluation has two main purposes: To improve and to adapt the learning environment to learners' needs (which combines the functions of insight and control) and to prove the quality of the learning environment and its values and benefits for financiers and participants (legitimization). Regarding the first aspect, Mandl and Hense (2007) emphasize the importance for evaluators to learn about the particular functions and effects of a learning environment to realize learners' best benefits. We will elaborate on this in the further sections of this paper. However, also the second argument has special weight: given the costs of research and development as well as purchase of an e-learning environment or program, money plays a role for especially two stakeholders. The one is the company that is offering the environment or product on the education market and the other are companies and organisations that buy and apply it (Haben, 2002). As profit-organisations are interested in satisfactory cost-benefit-relations, the producer may be interested in knowing how well one performs with its product and will try to test it or to get evaluation data to confirm the product's quality (Harhoff & Küpper, 2002). Furthermore, the purchaser might be interested in information about the usefulness of the implementation of the product or environment in terms of learning results (Harhoff & Küpper, 2002): Human resources divisions in companies are responsible for implementation of and reporting on the usefulness of methods and measures offered to the company's employees and are obliged to choose measures that support the organisation's overall success (Sonntag, 2002; Knyphausen-Aufseß, Smukalla, & Abt, 2009).

Another reason to broaden the efforts in evaluating e-learning is the growing market: not only the quantity of e-learning measures and products evolved strongly during recent years, but also the array of recipients increased intensively: young adults with academic qualification take master-programs at distance universities to qualify themselves during they are in job (Schnurer, 2005), undergraduate students have the choice to study at home without attending

presence courses, adults without higher formal qualification try to educate further while taking e-learning-courses of private institutions (Erlach, Hausmann, Mandl, & Trillitzsch, 2002) and so on. Having this in mind, it might not only be scientific interest but mere practical need to evaluate e-learning further.

Taking a collaborative perspective on e-learning and its evaluation, we may have to deal with some additional peculiarities (Resnick, Levine, & Teasley, 1991). According to this perspective, learning is more than the pure cognitive act of knowledge acquisition - it includes the participation in cultural practices (Sfard, 1998) and the enculturation in a community (Lave & Wenger, 1991).

In this contribution, we will first have a look on the goals of an evaluation. Then we will focus on evaluators and show which perspectives designers of an e-learning environment, participants of a course, and external experts have towards evaluation. After that, we'll describe two styles of evaluation, a process oriented one (formative evaluation) and a product oriented one (summative evaluation), and will then give a short overview of possible methods convenient to formative or summative evaluation demands. Finally, we will deal with dimensions and parameters for evaluating e-learning and discuss policy impacts of evaluation.

2. GOALS FOR EVALUATION

Evaluation may have different goals, and program-particular goals may influence the issues of the evaluators to ask, the methods to chose, and the dimensions to consider. In general, there are two goal-categories; the one relates to a (continuing) refinement and optimisation of the learning environment, and the other relates to prove the quality of the learning environment.

The traditional focus in evaluation is in general – that means independently from e.g. the media that is chosen to transfer knowledge on the learner – the assessment of the learning success. The results might be an indicator as well as an impulse for both above mentioned

goal-categories. The assessment of the learning success relates to the inherent pedagogical concern to support learning and development. Therefore, the overall evaluation indicators are the learners' changes regarding their knowledge, e.g. declarative, procedural and contextual knowledge (De Jong & Ferguson-Hessler, 1996) as well as behaviour changes (Kirkpatrick, 1994). Considering the special form and media that is applied in the e-learning context, another goal has to be considered in evaluation e-learning: efficiency and effectiveness during and because of learning electronically (de Witt, 2005). Therefore, both indicators – effectiveness and efficiency – have to be assessed in evaluating e-learning as well.

Beyond these two broader goal categories, there is a variety of perspectives taken by evaluators stemming from different disciplines which lead to specific sub-goals. Harvey, Oliver, and Smith (2002) emphasize the goal to ensure the quality of instruction, organizational benefits, and cost-effectiveness. They discriminate therefore three different focuses: One focus is on instructional design and teaching methods, a second focus is on the organization and participants, and the third focus is on costs and benefits. Furthermore, they also distinguish between different layers of evaluation which comprise of the assessment of the measure, the assessment of outcomes related to learning goals, and the application of contents and organizational outcome (Henninger & Balk, 2001).

With respect to the evaluation of e-learning, goals for evaluation may also be to ensure the accessibility and interoperability of a learning environment (Kollias, 2007) or to prove the compliance with technical standards (e.g. SCORM; Buendia Garcia & Hervas Jorge, 2006).

Furthermore, the goal of evaluation in e-learning may also be to certify an environment for a particular standard, e.g. according to ISO 9126 (see Abran, Khelefi, Suryan, & Seffah, 2003), which requires the evaluation of functionality, reliability, usability, efficiency, maintainability and portability (Chua & Dyson, 2004).

3. EVALUATORS

The goals of an evaluation also relate to the issue which evaluators are chosen. Evaluators may be internal or external with respect to the institution which offers e-learning (see Hense & Mandl, 2006; König, 2000). Thereby, internal evaluators may be either the developers of an e-learning course themselves (which is called self-evaluation), or they may come from other departments within the organization or they even come from outside the organizations. Usually, evaluators are experts. This means that the particular goals for an evaluation may specify the particular fields to be analyzed and may invite experts from different fields to be involved in the evaluation.

Hense and Mandl (2006) emphasize advantages and disadvantages of self-evaluations. Considering their advantages, self-evaluations are easy to handle (see also Harvey et al., 2002). Thereby, the developers and designers of a course do the evaluation by themselves. They are reviewing parts of the course to see if everything is working as expected, if contents are correct and if the course meets their own expectations. They are usually very familiar to the peculiarities of their course and this allows a focus on the specific aspects that are necessary for further course development. Due to these advantages, self-evaluations often take place in an early stage of the course development, particularly if there is only little time and results are needed quickly (see Hense & Mandl, 2006). Besides this, Tergan (2004) emphasizes the importance of self-evaluations as one aspect of quality assurance for providers of e-learning.

In contrast, external evaluations may be more objective and more reliable, because they usually use standardized methods and external evaluators are less involved in the development process (see Hense & Mandl, 2006). They may have also more heterogeneous individual and disciplinary backgrounds than the developers and therefore may be able to discover socio-cultural traits and stereotypes, which may underlie the design of a course. Furthermore, they may also have some particular expertise which

is not available in a course development team. For example, one could imagine that a course is evaluated by content experts who analyse if the content is state of the art. Besides that, they may also evaluate if the content is encultured for participants of a particular target group.

A peculiarity in evaluation is course participants as evaluators. They are experts for the perception of the target group, because they are a part of it. Thus, a course could be evaluated by (test) participants who could give insights in the usability of the learning environment and the comprehensiveness of the content (with respect to the target group). Henninger and Balk (2001) report that teachers may have reservations about participants' evaluations, because they attribute them only few knowledge about course design and deny them skills for valid evaluation. However, course participants can reveal the course acceptance (Mandl & Hense, 2007) and identify particular difficulties with and preferences for a course. Furthermore, they could disclose how far they estimate course contents as valuable and applicable.

4. STYLES OF EVALUATION

Talking about goals for evaluation and evaluators in the last both sections, we implicitly also talked about two styles of evaluation - a process oriented one and a product oriented one. The process oriented one is called *formative evaluation*, the product oriented is called *summative evaluation* (see Scriven, 1980). According to Fitzpatrick, Sanders, and Worthen (2003), formative evaluation provides information for program improvement. With respect to learning, Fricke (1997) relates this to the evaluation of learning processes. Formative evaluation takes place during the course application and its development. By analysing learners' pace for example within the learning environment, evaluators seek for knowledge about the learners' learning process to discover their needs and make target group specific improvements. They try to discover and resolve problems and find aspects for the optimization of a learning environment.

Summative evaluation aims at providing information for serving decisions about program adoption, continuation or expansion (see Fitzpatrick et al., 2003). According to Scriven (1991), summative evaluation serves to provide evaluative conclusions for any other reasons besides development. In some cases, this may prove the effectiveness of a course. By this, financiers, participants and designers can see that the course offers a special value and that customers are satisfied with the course. Fricke (1997) relates summative evaluation to learning as an assessment of learning outcomes and knowledge transfer. In this context, many evaluators use the Kirkpatrick model (Kirkpatrick, 1994), which describes four levels of evaluation: The first level relates to learners' pure reaction to the learning material, the second to their learning results, the third to the behavioural changes in the workplace and the fourth to business results. Using the model (Kirkpatrick, 1994), one can analyse how sustainable the effects of a measure have been. Particularly the third level concerning behavioural changes can give hints about how far an e-learning course had effects with respect to learners' enculturation. Summative evaluation can be done quite statically by a one time analysis and it usually takes place at the end of a course. Besides learning outcome and transfer, it may also evaluate learners' acceptance of the learning environment. However, a concluding quality analysis by experts or an ISO certification may also be a kind of summative evaluation.

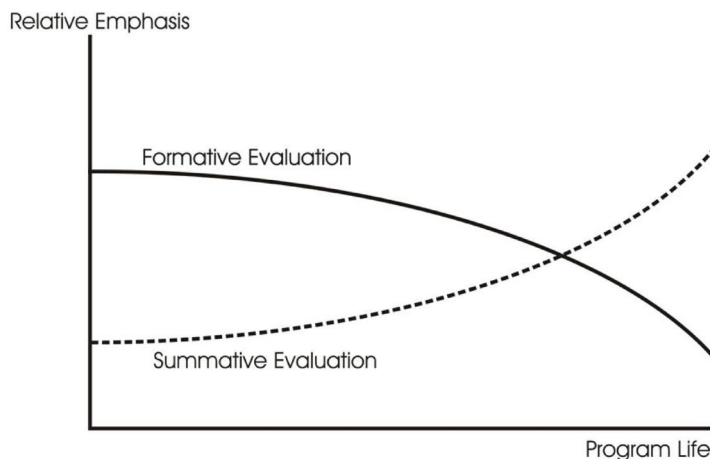
Formative and summative evaluations are two styles of evaluation that may be applied either independently or combined. Fitzpatrick et al. (2003) propose a model for program evaluation. In this model, formative evaluation is primarily important at the beginning of the course development (see Figure 1). However, it loses importance during several iterations of a course. In contrast, summative evaluation has only a marginal importance at the beginning of a course development. However, its importance increases with each iteration of the course and finally provides a basis for the decision about running the course once again or not.

Methods to apply in formative and/or summative evaluation are diverse. The common methods known and applied in the social sciences fit to either formative or summative evaluation best. There may be, for example some kind of field experiment to test a prototype of an e-learning course. However, experiments and quasi-experiments are seldom possible in real life even if experiments in the laboratory allow accompanying the learner's development and learning process without disturbing influences and so lead to valuable insights into processes and outcomes of a course. Laboratory experiments suit formative evaluation quite well in order to implement changes after the experiment. Besides experiments, collecting data about the learning process is also possible by observing the learner, course, or program during the productive phase. Another way besides experiments and observations to keep track of the learners' experiences is interviewing individual learners or discussing in groups of learners (Lamnek, 2005).

Observations and interviews are mainly qualitative nature and allow exemplary and punctual insights into a course by providing the perspectives of some individuals. Quantitative methods, which allow for more generalization, may be appropriate to evaluate e-learning as

well. Questionnaires, for example, may be distributed to all participants after the course or program, measuring not only the learners' satisfaction with the learning environment (or its usability) but learning transfer as well (see Kirkpatrick's model (1994) for evaluation, level 2, introduced above). Longitudinal designs with more than one point of measurement are necessary to sharpen the validity of these results and guarantee to survey the transfer in the best possible way. Furthermore, the introduction of a control group can provide insights in the effects of a particular treatment (Bortz & Lienert, 1998). Additionally, correlative evaluation studies should include independent variables that may serve as moderators and/or mediators on learning success: section 5.1 will mention the learners' prior knowledge to an e-learning course that has impact on the degree that new content may be acquired. Also, the learners' technical skills in interacting with the e-learning environment play an important role for the acquisition of knowledge or skills during the course or program (Dobson, 1999). It should also be tested if individual learning strategies play a role in a specific instructional design as it has impact on how new information is processed and how appropriate the design is for a single learner (Mandl & Friedrich, 2005);

Figure 1. Relationship between formative and summative evaluation across life of a program according to Fitzpatrick et al. (2003)



collecting data about learning preferences, general motivation as well as learners' self-efficacy (Fetaji & Fetaji, 2009) should serve as base to differ evaluation results that are contained as independent variables. Suitable models must be developed or adapted to make an evaluation study to more than a mere self-rating of satisfaction or a knowledge test (e.g. Measure-outcome-Inventory, see Kauffeld, Brennecke, & Strack, 2009, and multi-dimensional approach, see Bell & Farrier, 2006).

5. DIMENSIONS AND PARAMETERS FOR EVALUATION

There are many different approaches helping to identify dimensions to consider for an evaluation. Their application depends upon the specific goal of an evaluation. Henninger and Balk (2001) emphasized instructional, organisational and economical aspects, Buendia Garcia and Hervas Jorge (2006) focused on technical aspects and Abran et al. (2003) on the ISO 9126. Of course, such dimensions are important for evaluation, because they evaluate the framework of a course and prerequisites for an economical and technical success.

In this paper, we will have a closer look to issues which may be important from a socio-cultural perspective. Therefore, it is necessary to consider different contexts of an e-learning measure. Tergan and Schenkel (2002) distinguish four different contexts, which are relevant for e-learning scenarios: an individual context, which relates to the learner, the application context, which relates to the content, an educational context, which comprises of the instructional design, and a technological context, which comprises of learning technology and media. However, this model omits the collaborative aspect of e-learning. Lakkala (2008) suggests a framework of pedagogical infrastructures. She suggests to classify, to design and to evaluate the elements of technology-based collaborative learning according to a cognitive, an epistemological, a social and a technical infrastructure.

Using this framework for evaluation, each of the dimensions describes different parameters to evaluate. The cognitive dimension relates to learners' cognitive prerequisites and evaluates if learners have the knowledge, skills and strategies which are necessary for working in the learning environment. The epistemological dimension relates to the content and evaluates the quality and structure of the content, its implementation and its effects on the learners. The social dimension is related with sociability which comprises of facilitation and tutoring, and learners' opportunities to have social interactions and finally the technical dimension deals with the usability of the learning environment and support for learners' technical problems. In the following, we will describe exemplarily these dimensions in more detail.

5.1 Cognitive Dimension

The cognitive dimension relates to the issue how far learners have the *learning prerequisites* and appropriate *learning strategies* to work within the learning environment. In contrast to the epistemic dimension, which mainly focuses on aspects of the target group, this cognitive dimension focuses on the individual learner.

The evaluation of *learners' prerequisites* is essential for running an e-learning course. Fricke (1997) calls this input analysis. This helps to characterize and define a target group and particular learning goals. The most obvious prerequisite is a learner's individual prior knowledge (see Ertl, Kopp, & Mandl, 2005; Shapiro, 2004). The knowledge about how learners with different levels of prior knowledge perform in a learning environment can be an important aspect for specific facilitation and the tailoring of the learning environment (see Stark & Mandl, 2002).

One specific prerequisite are individual learning strategies (see Mandl & Friedrich, 2005; Pintrich, Smith, Garcia, & McKeachie, 1993). E-learning allows many different learning scenarios ranging from drill and practice-exercises to case based learning scenarios and inquiry. These different learning scenarios also

require different *learning strategies* to benefit of the learning environment. Learners of different educational backgrounds may also differ with respect to their strategies and therefore they may be important to evaluate.

Learning prerequisites

- Does the learning environment enable learners to activate their existing knowledge?
- How does the learning environment prevent cognitive overload?
- How much prior knowledge do the students have about the subject being taught?

Learning strategies

- Which learning strategies and processes are encouraged within the environment?
- To what extent are the learners supported in these strategies?
- To what extent does the learning environment enable learners to take control of their own learning?

5.2 Epistemological Dimension

The epistemological dimension relates to the structure and implementation of the content. This dimension should cover three parameters, the issue about the *correctness and appropriateness* of the content, the issue of the presentation of the content (*didactical design*) and the issue of learner perception of the content (*acceptance*).

The parameter of *correctness/appropriateness* is crucial for the development of learning material. It is obvious that designers should take care not to teach wrong facts. Different approaches to explain certain phenomena should be categorized as approach rather than as evidence. Furthermore, the appropriateness of content for the target group may be important to consider. Appropriateness of the content may relate on its level of difficulty as well as on learners' social and cultural context.

The parameter of the *didactical design* evaluates which instructional efforts are made to facilitate learners' knowledge construction

(Tennyson, Schott, Seel, & Dijkstra, 1997). Evaluating the didactical design, one can make conclusions about the appropriateness of the teaching methods. The evaluation of the didactical design may comprise of several aspects, e.g. the theoretical foundation of the learning environment, goals for the learners, curriculum integration and motivation.

The parameter of *acceptance* relates to the issue how learners perceive the contents and the teaching methods (Bürg & Mandl, 2005; Davies, 1989). The acceptance of a learning environment is of particular importance for its success, because if learners don't accept a learning environment, they would hardly use it beneficially.

Correctness/Appropriateness

- Which specific knowledge will be imparted?
- Which didactical content will be realised?
- Which types of knowledge sources are used within the environment?
- Who is the target group?
- Are the content and learning goals congruent?
- Is the content such, that learners are able to theoretically and actively apply it to their own personal situation?
- Are the situations addressed in the environment authentic?
- Is the content up-to-date?
- Is the content presented in an adequate depth?
- Is the content presented in a coherent way?
- Are foreign/new words explained in an adequate way?
- Is the number of sources adequate?
- Is the content appropriate for different political/religious/ethnic views?

Didactical design

- Is the learning environment based upon a particular educational theory?
- If so, is it well designed?
- Is the didactical design of the learning environment appropriate?

- Which concrete learning goals are formulated?
- Is the learning material well integrated into the curriculum?
- Does the content of the environment encourage learners to actively solve problems independently?
- Does the content engage the learners emotionally?
- Does the content allow users to make mistakes and learn from them?
- Do images/animations clarify textual relationships?
- Does the content direct the learners' attention to certain essential aspects?
- Does the learning environment increase the students' level of motivation?

Acceptance

- Would the participants recommend the learning environment to friends/colleagues?
- Are the participants satisfied with the content?
- Did the learning environment meet the learners' expectations?

5.3 Social Dimension

With respect to the social dimension, the focus should be on *facilitation/tutoring* and *sociability*.

Facilitation/tutoring is an important parameter, because it may cover several aspects. It may evaluate tutor support for learners' content specific problems, e.g. if learners have difficulties with comprehension, as well as the moderation and guidance through learners' collaborative work (Schweizer, Pächter, & Weidenmann, 2001). E-learning environments may be subject to particular group phenomena (e.g. lurking, flaming, illusions of consensus; Weinberger, 2003) and a tutor's intervention may be an important mean for the success of the collaborative work.

Sociability relates to the issue how far learners perceive the learning environment

as a social medium (Kreijns, Kirschner, & Jochems, 2002). This may be important for learning environments which requires learners' commitment over a longer period of time. Ensuring the learner's commitment is in the focus of social validity, as well which is an important quality criteria in diagnostics. Social validity makes the diagnostic aspect of a situation to an "acceptable one" and is achieved through transparency (in terms of background information about the evaluation situation), the learner's participation, his information, and feedback (Schuler & Stehle, 1983). In sum, it can be seen as fairness of the situation. Social aspects of evaluation are important and must not be neglected. The sociability of the learning environment may have effects on the drop off rates of a course and therefore it is important to evaluate.

Facilitation/tutoring

- To what extent do the users receive support in their use of collaborative learning methods?
- Are the learning processes and outcomes shared between and transparent to the learners as a group?
- Do the tutors and pupils have set roles and tasks?
- How are these roles combined?

Sociability

- If the learning environment includes a combination of face-to-face and electronic teaching, how well are these aspects integrated into each other?
- Is there a positive social environment within the learning groups?
- Are there chances for learners' socializing?

5.4 Technical Dimension

Regarding the technical dimension, *usability* and technical *support* should be evaluated.

The parameter of *usability* is important for evaluation, because it reveals if the learning environment provides particular problems

for learners when working within. Usability is defined as “the extent to which a product can be used by specified users to achieve specified goals effectively, efficiently and satisfactory in a specified context of use” (FORTH, 2010). Usability describes how easy a product or media can be used. It considers the satisfaction of the user who wants to fulfil a specified task with the aid of the product. It is a multidimensional property of a system or user interface (Nielsen, 2003). Thus, usability may cover several aspects. Considering e-learning in first line, it should particularly focus on the computer literacy of the target group.

The parameter of *support* receives importance because many e-learning environments use proprietary media format and rely on particular player software. Furthermore, streaming contents rely on high-performance streaming servers, which should be placed in an appropriate network structure. Learners may experience technical problems and need therefore technical support.

Usability

- Are the learning tools appropriate and adequate?
- Do the students have a sufficient level of media competence to navigate the learning environment?
- How is the use of technology organised?
- Is the usability and screen design of the environment such that a user can easily navigate the environment and find what they are looking for?
- What kind of media will be used?

Technical support

- How adequate is the technical support offered to the users?
- What are the reaction times of technical support?
- How far is technical support subject to different national or religious holidays in different countries?

6. SUMMARY

Evaluation is an important aspect of any e-learning project. There are different issues to consider, e.g. which style of evaluation to use, which evaluators to choose and which aspects to evaluate, depending upon the overall goal of the evaluation. Taking a socio-cultural perspective, evaluation should focus on participants' background and differences in attitudes, values and stereotypes. Even evaluation methods may be influenced by social-cultural issues, because different methods are accepted differently from country to country depending upon the culture's openness to evaluation in general and its familiarity with diagnostic methods.

The paper first gave a general definition of evaluation. It then pointed out that evaluation goals might be quite heterogeneous: instructional design and teaching methods, the organization and participants, as well as costs and benefits may be of interest and specify the evaluation outcomes learning goals, application of contents and organizational outcomes. The article then described the difference between internal and external evaluation and emphasized advantages and challenges for each approach. Formative and summative evaluation were introduced and adequate methods for each of the two perspectives were commended. Different parameters for evaluation then were in the centre: a thoroughly conducted evaluation from a social-cultural perspective must not ignore to consider a cognitive dimension (learner perspective), an epistemological dimension (structure and content of medium), a social dimension (interaction between learner and facilitator), and a technical dimension (usability and technical support).

Schaumburg (2008) emphasizes that evaluations can be substantially better if they take place in an early stage of development already to prevent inefficient developments, if they ask questions which are oriented on the goals of development, if they consider the particular context of a course and if they take different perspectives into account, e.g. deciders and

developers, teachers and learners, and directly involved persons as well as external experts.

In the future, the knowledge about evaluation of e-learning must be sensitively transferred onto a socio-cultural perspective which may be a challenge for scientists, evaluators and practitioners.

7. OUTLOOK

This paper focused on evaluation mainly on the level of course implementation and thereby allows continuous optimization and quality assurance. As we mentioned before, evaluation may also be decision-oriented. CIPP-models which analyze context, input process and product (see Stufflebeam, 1978) can furthermore provide insights on a macro level with respect to how far particular measures, e.g. e-learning courses have an impact on organizational development. Such analyses take the step beyond aspects of a particular course towards the integration of e-learning and its penetration of a developing knowledge society. As knowledge societies aim at new forms of learning, e.g. by changing lecture models (Ronchetti, 2010) or implementing educative networks (Diaz Gibson, Civis Zaragoza, Longas Mayayo, & Murat, 2010), it is important to explore the values and benefits of such approaches. However, there is the need for high quality project management (Bodea, Dascalu, & Coman, 2010) and thorough evaluation of each single measure.

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