The Multiple Faces of Peer Review in Higher Education. Five Learning Scenarios developed for Digital Business

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ABSTRACT

Peer review, as an e-assessment tool incorporates the human factor to treat complexity for rating and grading students. It could address the qualitative more than quantitative aspects with flexible human feedback that leads up to metacognitive knowledge aspects, which e-assessment usually is not able to achieve. Peer review is an internationally well-known method for quality assurance in science; it is now used for teaching and assessment in universities. This paper presents an analysis of five teaching scenarios that use peer review. All scenarios have been working with the same technical setting within different courses in Digital Business and included 765 participants. Regarding e-peer review qualitative and quantitative data from 298 students were collected. The tasks in the different learning scenarios differ between well-structured to complex and cognitively ambitious assignments like academic paper writing. Further analysis of criteria like lead time, support expense, dimension of cognitive processes, meeting of professional standards and social interaction shows how the five scenarios lead to either better or less efficient learning performances.

Keywords: higher education, inquiry-based learning, learning scenarios, peer assessment, peer review, self-directed learning, teaching method

INTRODUCTION

The assessment of different dimensions of knowledge, which also means the grading of students, is a big challenge for teachers, especially when it comes to lectures attended by a huge number of students. Therefore, computer assisted assessment (e-assessment) becomes more and more important. With the aid of assessment activities, information about the learner's knowledge and skills can be collected at different points of the learning process. Thereby the two forms of assessment – assessment for learning and the assessment of learning – are distinguished. Diagnostic and formative assessments are used at the beginning and during the learning process, in order to be able to intervene if necessary. Summative assessments, on the other hand, are applied at the end of the learning process and serve the

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State of the literature

- In the digital age with broad e-scenarios in learning, like the MOOC movement, personal and individual learning methods are required that are easily scalable and suitable for regular and larger classes.
- Peer review as a learning scenario supports the concepts of self-organized learning and self-determination of the learning process, increases communication, collaboration and peer interaction, and leads to mutual support among learners.
- Various approaches with peer assessment are described and particularly reviewed that showed how reviewing helped learners to improve their own work and benefit from peer feedback.

Contribution of this paper to the literature

- This paper describes todays digital possibilities with peer review: how to include the human factor into computer supported assessment and how to address complex dimensions of cognitive processes with this teaching approach.
- Insights from five general learning settings using peer review are exemplified for teachers who wants to apply this method.
- Effort, variations, difficulties, acceptance, outcome is demonstrated with empirical data from 298 students out of Digital Business education, showing best practice and improvement possibilities from 6 years of experience.

purpose of grading students. They complete the learning process and very often have a selective character, as they can be decisive for students' further educational career. Summative assessment usually takes place either as a partial test or a final test at the end of a course and serves the purpose of finding out whether students reached the predetermined learning objective of the course or not. In case they did the teacher certifies the achievement. Thereby the focus is on testing the achieved level of competence.

Together with the development of e-learning scenarios, models for e-assessment are created that are specifically tailored to these developments, for example the integrated model for e-assessment by Wesiak, Al-Smadi, Höfler, & Gütl (2013) which – starting from the learning objectives defined – takes into consideration the different learning resources in order to establish and integrate into the evaluation the different form of assessment. Also the level of complexity can vary according to the educational objectives as represented in the Bloom's Taxonomy involving cognitive dimensions that starts from just remembering and understanding to analyzing, evaluating and creating solutions (Krathwohl, 2002).

According to the classical test theory, tests should be based on the quality criteria of validity, reliability and objectivity. For summative exams furthermore the quality criteria of equality of opportunity, fairness and economy are mentioned. Concerning the compilation of exam questions the challenge is to generate valid questions that ask for what was previously defined in the learning objectives. Objectivity and reliability are the preconditions for a valid exam. Computer-aided assessments guarantee the requirement of objectivity, as it is free of

any subjective influence. E-assessment systems offer a whole range of question and answer forms, such as single choice, multiple choice, yes/no or right/wrong type answers, which can be evaluated automatically.

In order to test learning objectives on a higher level of knowledge the automated evaluation is not possible and human ratings are necessary in these cases. Writing as well as collaborative skills have to be promoted by the use of collaborative environments to improve students' written production (Dominguez, Cruz, Maia, & Pedrosa, 2012). To encourage students to promote and improve their skills in teamwork, communication (writing, interpersonal interaction and cultural awareness, and presenting), critical and creative thinking (problem solving and decision-making), the assessment method has to be adapted (Issa, 2012). The academic activity of peer review is a possibility to improve those skills. Peer review has been advocated for as an intentional strategy to support the knowledge, skill, and disposition development of adult learners preparing for professional practice (Brill, 2016).

On the other hand, it covers the aspect of linking informal and formal learning that helps to consider learning in different ways, such as learning design, activity design, rethinking assessment and recognition, and the ways in which methods and technology can help to transfer information and experience across settings (Sharples et al., 2015). Learning is found to be effective when informal and formal learning coexist and a variety of learning practices are followed within more flexible learning ecosystems that allow learners to build on and extend their formal learning (Scott, Sorokti, & Merrell, 2016).

Above all the students learn from the personal feedback from the teacher or another person. Peer review is a possibility to realize personal feedback. If peer review is used for grading, it is an assessment method. Peer assessment can be used also at various points during the learning process providing continuous practice for the assessors and feedback on progress to the assessed (Alias, Masek, & Salleh, 2015). So the computer-aided process of the peer review is a kind of e-assessment.

In the academic publication world, peer review is regarded as a suitable method of quality assurance and evaluation. Researchers of similar competence review and comment on papers of their peers. After a revision phase, in which the comments are considered and incorporated, the paper is turned in again. The aim of this process is a sensitive, valid and reliable measurement of research performance, although the method has not remained undisputed (Bornmann, 2011).

Peer review is also increasingly used as a learning method particularly in university contexts where competence acquisition and active student-centered methods tend to complement or replace conventional methods. A peer review method is easily integrated into learning arrangements that place special emphasis on self-regulated and experience-oriented learning. In order to review a paper, reviewers must acquaint themselves thoroughly with its topic which will also enhance their own understanding. Reviewing papers requires that the reviewer closely deals with the content of the relevant paper, which in turn means a benefit

for his/her own work as well. So peer review has two aspects; on the one hand it is a learning method that draws on learners' knowledge and expertise from their different work experiences and fields of study. Especially part-time students often can exploit knowledge from their work experiences in their peer reviews. On the other hand, it is an assessment method especially for complex learning scenarios.

Furthermore, since peer review can be done independently and autonomously, it accommodates many student scheduling constraints. It also integrates collaborative learning as peer comments and reviews provide useful feedback. Moreover, it triggers the formative promotion of mutual support groups among learners. From a teacher's perspective peer review can be beneficial since it is suitable for large classes and it is easily scalable - many submissions lead to many reviewers (Sharples et al., 2012). Consequently, peer review can also be organized for large scale learning services (Lehmann & Leimeister, 2015). Turner & Perez-Quinones (2009) showed a wide range of further advantages and application possibilities for peer review. In the broad literature review they summarized the possibilities of the subject.

Peer review is frequently described in literature, especially since the 1970s. Surprisingly it seldom has been investigated for its concrete applicability as an instrument for different teaching tasks and assessment (Kollar & Fischer, 2010). In the fields of the assessment for learning (formative assessments) peer assessment is a central principle (Panadero & Brown, 2016). A literature review by van Zundert, Sluijsmans, & van Merriënboer (2010) shows that few empirical studies examine how peer assessments might be best utilized for learning. This gap is significant in this respect since many capable tools for the organization and utilization of peer reviews have been developed particularly during the past five years. Thus the efforts required from teachers have decreased and the instrument is more easily available for broader use. This provides new opportunities for use of peer review with other learning approaches especially in connection with student-centered methods. A good example for a combination possibility of peer review with constructivist methods is described in the Expertiza approach where students develop small-scale learning materials for use by their fellows, which can be improved by peer reviews (Gehringer, Ehresman, Conger, & Wagle, 2007).

The study of Breuer & Schreier (2010) shows that peer review leads to mutual support among the learners. Peer review in the sense of mutual reviewing and assessing is applicable in courses with many participants, as it is a scalable learning method. In a large class or MOOC the resources from teaching staff are limited, formative feedback from their peers can help (Song, Hu, & Gehringer, 2015).

The increase of communication, collaboration and peer interaction among the learners is a target for new learning approaches; the learners are encouraged to cooperate and interact (Ge, 2011). These forms of learning are self-directed, flexible, problem solving (Ehlers & Steinert, 2010) and provide a concept of self-organized learning that increasingly finds its way into higher education. This includes teaching and learning methods that aim at

the self-determination of the learning process (tasks, methods, learning locations, study time, etc.) on the part of the students and involves learning methods such as e-portfolio work or peer review (Hornung-Prähauser & Wieden-Bischof, 2010).

Electronic peer review is a learning method that can improve the quality of education at a personal level. When students assess their co-students' work the process becomes reflexive: they learn by teaching and by assessing. Peer assessment is interactive and dynamic as students assess, critique and make value judgments on the quality and standard of other learners' work, and provide feedback to the authors (Nagel & Kotzé, 2010)

Peer review has the potential to increase cognitive, social, affective and transferable skills, and also include higher levels of critical thinking (Trautmann, 2009). The development of critical thinking is enhanced through discussion and feedback. Peer reviewing other students´ papers help the learners to improve their own work and they benefit from the feedback. In Trautmann's (2009) study the students pointed out that they gain new perspectives through seeing both good and bad examples in the work of fellow students.

The role of teachers and learners in traditional learning contexts is fixed, the teacher is responsible for the content and the learning process, the learner has a more passive role. Evaluation and assessment is the exclusive right and task of the teacher. Nevertheless, evaluating someone else's work could become a very useful task for the learning process of the evaluator shown also by Zenha-Rela & Carvalho (2006).

Peer review may be part of the e-portfolio work; thereby the e-portfolios are not only assessed by teachers, but also by peers who give feedback to their fellow students. This enables students to integrate their peer's suggestions and correct their work; a procedure that is commonly used within the scientific world as papers are revised and comments of reviewers are considered in the final publications. The comment function of weblogs can also be used as another form of peer feedback (Liou & Peng, 2009).

PEER REVIEW PROCESS

Preconditions for the Implementation of the Solution

The implementation of electronic peer reviews was realized within the learning management system Moodle. For the first reviews of the present study, the activity "peer review", an additional module of Moodle 1.8, was used. This module is basically equipped with necessary functions for peer review; however, usability and process operation have weaknesses (Katzlinger & Herzog, 2012). The advancement of this module is found as "Workshop" under activities in Moodle versions 2 with many options, from which many different fields of application arise. The workshop activity permits peer assessments, where the learners mutually assess each other on the one hand and are assessed by their teachers on the other hand.

The underlying workshop activity runs through four different phases that are processed consecutively (see **Figure 1**). Overlapping of the single phases is basically provided for, however only in exceptional cases useful.
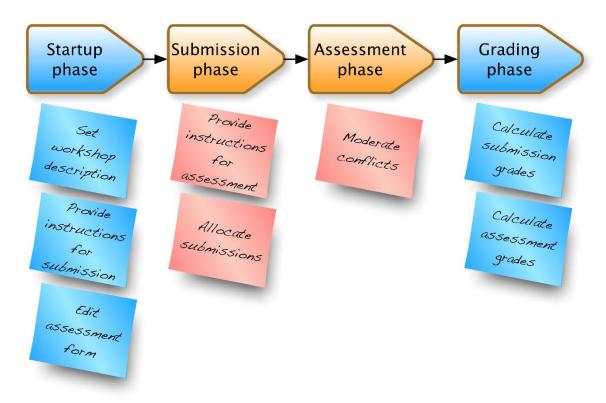

Figure 1. Peer review process

For the present study, peer review was applied and subsequently compared as a learning method in different courses of different topics from the field of e-business, ICT Ethics and academic writing at the University of Linz and Magdeburg-Stendal University of Applied Sciences. The courses were part of the Bachelor Program Business and Economics and Master Programs Cross Media, and Digital Business Management.

Startup Phase (Preparation)

In the startup phase, the individual options for the workshop activity are chosen, for example, mutual assessment or group mode. Furthermore, it can be specified whether it should be a "blind review" or the teacher is able to trace back who assessed whose paper. In addition, in this phase, the time schedule for the activity is determined (**Figure 2**).

Figure 2. Time allocation within Moodle 2.9 Workshop Module

Learners receive precise instructions and tasks how to review their peers. One or more files (papers, models, figures, presentations, videos etc.) can be submitted. In order to lead the learners towards their activity, a model submission can be provided which the learners can review for testing purposes. Experience has shown that learners are rather unfamiliar with giving feedback; thus for useful peer review support for the learners is necessary.

To work out the criteria for the assessment requires diligence from the teacher. The individual criteria may be weighted differently. The reviewers award points for each criterion and give feedback in the form of comments.

The criteria in this study concern to

- Quality of content and information density (e.g. 40%)

- Originality of the content (e.g. 20%)

- Methodological background (e.g. 20%)

- Formal aspects like structure, language and organization (e.g. 20%)
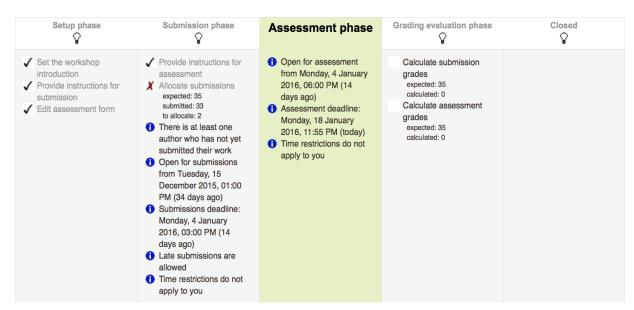
Submission phase

After the preparation phase the teacher activates the submission phase, in which the learners turn in their papers. In this phase it is of great importance that the deadlines for submission are met, as late submissions can hardly be considered during the distribution process for the peer review.

Assessment phase

After the submission of the papers, the teacher initiates the distribution of papers to reviewers. The papers are assigned either randomly, manually by the teacher or in a time-controlled way. Additionally, in this phase it is specified how many papers each reviewer has to assess. The reviewers award points for each of the predefined criteria and can furthermore give feedback in the form of a comment on each criterion.

Grading phase

In case of conflicts, for example one of the papers is assessed very inconsistently or contradictorily, the teacher is able to intervene and decide after the end of the assessment phase. The grading and the transfer of the weighted points (gradebook) have to be initiated by the teacher (see **Figure 3**).

Figure 3. Peer review grading phase

LEARNING SCENARIOS

In the present study, teachers from two different universities, in Germany and Austria, investigated the use of five different learning scenarios that incorporate peer review as an essential learning method. It includes experiences from 19 courses with a total of 765 participants. These scenarios are compared by the use of a criteria analysis and related to results of an accompanying online study in order to determine the advantages and disadvantages as well as recommendations concerning practical application of peer review. At this point data from three of the five scenarios, gathered by an online survey of 298 participants, are examined.

Since October 2010, via the ERASMUS teaching staff exchange program, a collaboration has been established between the Department of Economics of the Magdeburg-Stendal University of Applied Sciences, Germany and the Department of Data Processing in Social Sciences, Economics and Business of the Johannes Kepler University Linz, Austria. For this collaboration certain courses from the field of E-business are interconnected. In addition, students were questioned online about the different learning methods (interuniversity case study, peer review, game-based learning scenario) and their media use simultaneously. In total, 765 students have participated in the study 2010 - 2016; 212 from Magdeburg, 343 from Stendal and 210 from Linz (**Table 1**).

Table 1. Average age and gender ratio of the Peer Review study (N=298)

	Number of men	Age	Number of women	Age	Total number	Age
Linz (Austria)	92	27,5	51	25,7	143	26,9
Magdeburg (Germany)	73	25,0	82	23,3	155	24,1
Total	165	26,4	133	24,2	298	25,4

The gender ratio in this study is 56:44 concerning the students from Linz, and – more balanced – 47:53 with more female students participating in Magdeburg in the peer review study. The average age of the students from Linz is higher than the average age of the students from Magdeburg, which is probably due to the different position the course has within the curricula of the two universities and mirrors the high ratio of working students in Linz, where 60% of students work 16 hours or more a week, while in Magdeburg this ratio stands at 28%.

In this section the five different learning scenarios that use peer review as a learning method are described (**Table 2**).

Table 2. Learning scenario overview and basic data of survey (grey columns)

	Scientific paper writing	Abstract writing	Case study reporting	Process model creation	Exercise editing
Number of participants in each course	6...16	26	22...24	40...130	15...40
Number of courses (2013-2015)	3	1	3	5	5
N in survey	-	-	54	155	95
Study progress / semester (1...12)	10	8	9	3	4
Individual work	x	x	X	x	x
Group work	one course	-	-	one course	-
Structure of task	unstructured	unstructured	Semi-structured	Pre-structured	Semi-structured

Individual criteria are rated by use of numeric points. Additionally, individual criteria can be weighted differently. Furthermore, each criterion should be commented on by means of a short verbal statement that should contain the reviewer's reasons for his or her evaluation. During student training it was important to draw students' attention to the possibility of verbal feedback since it offers great learning opportunities.

Scientific Paper Writing

Similar to the peer review process at academic conferences, students prepare a scientific article and submit it. In this research-based teaching scenario at the Master level, peer review is applied as one of several possibilities for providing feedback within an iterative, self-directed learning process (see **Figure 4**) (Katzlinger & Herzog, 2014).
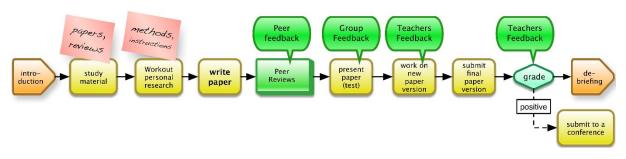

Figure 4. Research-based learning scenario with peer review (scientific paper writing)

Since such learning situation tends to become very complex because of intensive feedback and the individual supervision and support needed, only one course was conducted in group-work, in order that this method could be applied for larger groups of

students. We underestimated the challenges in assigning reviews, motivating the process and managing conflicts as shown later.

Peer Review of Abstracts with the Possibility of Revision

Within this learning scenario from an e-business seminar in a Master program, students were assigned the task of defining a subject for their seminar paper and writing an abstract for it. The topic of the seminar was "sharing economy" (Rifkin, 2014) and its characteristics. Students received guidelines on the structure of the paper that included information on what should be covered. They finally submitted a two-page abstract for the review.

Each student was assigned three abstracts to review. For assessment reviewers were provided an evaluation grid from one to ten points but the main focus was on verbal feedback that was used by all reviewers. Subsequently students had the opportunity to revise their abstract based on suggestions from reviewers. Revised and updated abstracts were presented to the seminar group and compiled to a seminar program of content-related sessions.
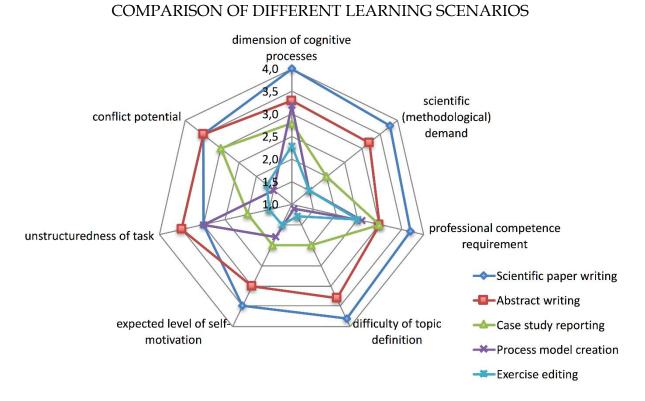
Peer Review of Case Studies

In the class "ICT Ethics" in the Masters' program in Digital Business Management, students deal with a case study on Computer Ethics. They independently choose one case study from a case study compilation "remorse" by Weber-Wulff, Class, Coy, Kurz, & Zellhöfer (2009). The case study is developed in writing and submitted anonymously. Students organize their draft based on an analysis grid in order to make sure that they work on the ethical issues and problems methodically as well as systematically. Reviewers evaluate those drafts by means of an analysis grid and give verbal feedback mainly focusing on whether the argumentation regarding the case studies is logical and comprehensible. In this scenario the reviewers benefit not only from the work on their own case studies but also from their peers' approaches to their own cases and the solutions they developed.

Peer Review of Models

For bachelor courses with more than 50 participants an alternative approach needed to manage courses requiring significant support efforts by teachers. Students of Business Engineering received the task of gathering information about a modeling technique in the field of business process management and employing it in a standardized case of application. The developed process models (one to three pages) were submitted to peer review and evaluated by two or three peers according to review criteria that were specifically created for modeling tasks. There was an attempt to use the advantages of group work within larger classes during a pilot semester. To limit the efforts of guiding large groups e-tutors were involved in following courses providing additional feedback in peer reviews. E-tutors, in this field, are older students who support and supervise learners. In the

context of online learning, they are one of the key players in this process. Providing tutorial help to online learners encourages them to be more active during their learning process. (De Lievre et al. 2006).

Peer Review of Exercise Examples

In the course "Business and Internet", an introductory course for bachelor students of economic sciences, students received a short task description on e-procurement. In this task various goods needed to be purchased. Students chose a suitable classification method and corresponding acquisition methods for the various goods and based the reasons for their choices using the background theory of the course. The reviewers evaluated different criteria and especially the reasons for choices as well as their argumentations.

COMPARISON OF DIFFERENT LEARNING SCENARIOS

Figure 5. Teachers' expert rating from 5 learning scenarios from 17 courses (No empirical data, Scale from 1 = low to 4 = high)

The use of peer review opens up a whole new range of design possibilities as the aim was to create already improved learning situations during the courses of this study. This is the reason why model creation task and e-procurement exercise with large or medium-sized groups of students in second or third year of their bachelor degree are rather focused on one specific subject. Scientifically more challenging learning scenarios, such as paper and abstract

writing, as well as the case-study on ICT Ethics are addressed in smaller groups of Master students requiring a high level of support.

Figure 5 shows different dimensions of learning scenarios and gives an estimate of the characteristics of tasks underlying the peer review, conducted from the 3 involved professors. Tasks differ in their degree of structure, their associated complexity, but also their cognitive challenges. According to the dimensions of cognitive processes described Anderson, Krathwohl, & Bloom (2001) the different tasks were classified. For comparing reasons in our context the scale was adjusted to 1…4. Less pre-structured tasks – in this study scientific paper writing and abstract writing – demand either a high level of methodological and subject-specific knowledge from students or intensive and often individual support from teachers. Well-structured tasks on clearly limited subject matters – such as the exercise and model tasks – are suitable for larger groups of beginning undergraduates.

These surprising differences between individual tasks are also reflected in the learning effects expected by teachers: complex, cognitively, methodologically and scientifically more challenging tasks should achieve higher learning effectiveness in peer review, too, which can only be seen in connection with corresponding tasks.

Support Efforts and Benefits

Time efforts of teachers during peer review strongly varies from scenario to scenario, depending on the given task (**Table 3**). Exercise editing and model creation requires a review of most feedback by teachers, especially in case of varying results. The review of abstracts and case studies were announced and completed as mere peer activities on the part of the students without any intervention by teachers.
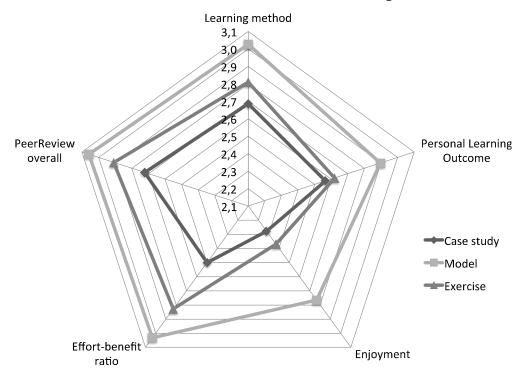
Table 3. Subsumption of time effort for the five learning scenarios)

	Scientific paper writing	Abstract writing	Case study reporting	Process model creation	Exercise editing
Planned time span of task for students (~in hours)	120	20	16	16	8
Time span of reviews (~in hours)	8	3	4	3	3
Number of expected peer reviews	2	3	3	2	2…3
Support effort for peer reviews per student (~in hours)	1,8	0	0	0,2 (tutor supported)	0,5
Evaluation of learning effects by teachers, scale 1 = low … 4 = high	3,8	3	2,5	3	2

The planned time span of task for students (see **Table 3**) refers to the time that students need to complete their paper for review. The second line refers to the expected time for student´s review process. In order that peer review can be successfully completed by

students without further supervision by teachers, a meticulous planning and preparation of the task description as well as a perfect technical and content-related implementation of the preparatory work on peer review platform are critical for success. The scenarios abstracts and case studies additionally require high support in the follow-ups of reviews. The particularly high support effort required by peer review of papers was determined by the length of the papers (between 9 and 20 pages) and on the quality of the peer feedback. In the process modeling scenario with large groups, teachers revised submitted models and all of their reviews. Due to the very clear assessment criteria and good examples, this task could be easily delegated to tutors in a second step. Students readily accepted the tutors' assessments and the conflict potential was quite low.

As frequently mentioned in literature, here, too, dealing with different papers at the same level and learning from mistakes were mentioned as the main learning benefits from the scenarios investigated. This benefit, as well as student satisfaction, could be considerably increased if a second submission was graded. However, a second submission requires more feedback and an increased workload for teachers.

Student Evaluation of Learning Scenarios

Figure 6. Student evaluation of peer review (n=298); scale 1 = poor … 4 = excellent

Students participating in the scenarios case study, model, and exercise were asked in an online questionnaire about their experiences with peer reviews (**Figure 6**). On a four-point Likert scale, peer review as a learning method was positively rated in all criteria. Former investigations (Katzlinger & Herzog, 2014) already show that peer review as a learning

method surprisingly compares favorably with other learning scenarios (e.g. game-based learning) from the students' perspective. The model creation task was rated best in all categories, whereas the peer review of the case study got the worst rates here. Review on case study was conducted in three different terms, whereby one of the three courses was rated considerably poorer in all categories (the mean score is 0.5 points lower). Thus, external factors such as group atmosphere and dynamics can have a significant impact on the student's assessment of learning methods.

The high level of satisfaction with the review of models is certainly explainable by the clear definition of assessment criteria, the brevity of the submitted work (1-3 pages) and their evaluation as well as the involvement of teachers and tutors in the assessment process. In qualitative feedback students often referred to a lack of knowledge of their peers as being a hindrance in connection with this scenario, although they rated peer review generally positively as a learning tool.

Investigating students time for processing the peer review showed surprising differences. Students without a paid job spent 1,5 hours while employed students (16…34 paid working hours a week) invested 3 hours on average. Most differences in processing time were detected in the modelling scenario from male students (**Figure 7**).
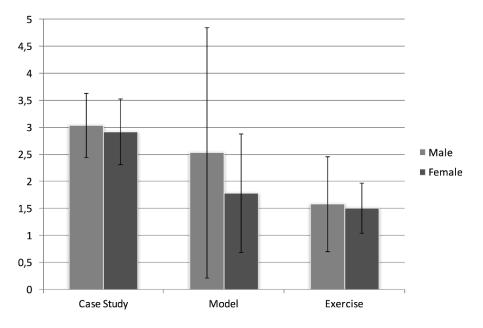

Figure 7. Medium processing time (in hours) for Peer Review, N=296[1]

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[1] Because of a small lack of data incompletion in 2 questionnaires, for one aspect, the N number varies in this result presentation.

Instruction, Support and Organization of Peer Reviews

As showed above all peer reviews described in this study were conducted by means of the activity "Workshop" on different versions of the learning platform Moodle. The implementation of the Moodle activity demands a meticulous planning and strict adherence to the different steps of the process by teachers. In newer versions it became possible to assign each review individually which makes the arrangement for group assignment more manageable (section 1.1).

Giving students detailed information on peer review, its procedure and especially the assessment criteria are crucial preconditions for the success of this learning activity. An increasing level of satisfaction of students as well of teachers over the past five years shows that continuing improvement of instructions and examples, improved technical and organizational framework as well as more teaching experience could lead to better learning satisfaction for students with the use of peer reviews. [2]

In some learning scenarios the peer review was directly used as a basis for grading, whereas in other courses it was used as an ungraded feedback-method. With the aid of the feedback, students could revise their papers and subsequently submit them again (**Table 4**).

Table 4. How peer review points influence grading

	Scientific paper writing	Abstract writing	Case study reporting	Process model creation	Exercise editing
Updating possibility (revised version is graded)	y	y	n	n (Bonus system)	n
Students review gets into grade	n	y	y	y	y
Rating of review gets into grade	n	y	y	n	y
Participation of teachers/tutors in peer review	y	n	n	y	y

Students evaluated the influence of assessments from peer review on the overall grade quite differently, as becomes obvious from the qualitative feedback. As it turned out, the feedback of reviewers was more complex and sophisticated. It was striking that the assessment competency of peers was not doubted, depended both on the task itself and the student's academic progress. As students occasionally lack the professional background for good, fair and constructive assessments, conflicts may occur which require the intervention of teachers. This effect could be prevented if the submitted works were reviewed more than

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[2] Examples for briefings and assessment categories and criteria are available on the authors' website. Especially an overview document which describes the whole peer review process is provided. Within the framework, a short introduction in the lecture already before students start the peer review module of the learning platform for the first time, has proven to be useful (Briefing).

twice. Thus, it is recommended to plan for three or four reviews per paper for the learning scenarios investigated.

Particularly getting the opportunity to revise and update one's own paper after receiving a peer review and before being graded is perceived as improving learning by students as well as by teachers. Much has been written already about the problem of how to secure anonymity in a peer review process in small classes. This problem played also an important role in the quantitative feedback in this study. Getting the chance to revise and update one's own paper and being guaranteed a final grading by teachers helped with this. But also the declaration of good reviews as bonus achievements could defuse the resulting conflict potential. Yet, conflicts can also trigger productive reflection processes which contribute to the learning process.

Learners individual perspectives

For the present study, feedback of the learners was analyzed also qualitatively (Mayring, 2000). Within the framework of the survey, learners had the possibility to provide feedback on the peer review in general and also to make specific comments or suggestions for improvement. 83 of the 298 learners participating in the peer review courses gave an extended qualitative feedback in project reports, which is also included in the analysis below.

In general, most learners rated the peer review positively; 77% of them rated it as a very good or good learning method. Their feedback mainly concerned suggestions for improvement either relating to the method itself or to how the method could be applied more efficiently.

In the following the statements of the students are clustered and assigned to specific topics:

A lack of anonymity in courses with a small number of participants

Students remarked that especially in courses with a small number of participants anonymity could not be guaranteed. Even if the reviewer does not know the authors' names, students usually know each other.

"There is no real anonymity in small classes – all the students know each other and you don't want to hurt these people and so you often don't evaluate them critically enough. However, I can well imagine it for a large class."

Assessing peers

A number of responses addressed the issue of the assessment of learners through learners, which was regarded as a difficult task. Students remarked that they did not want to be responsible for the bad marks of their colleagues. To get the chance of giving feedback was

appreciated; having to assess their colleagues in a way that influences their marks was however regarded with skepticism.

"It is difficult to assess a colleague fairly, as you don't want to "spoil somebody else's chances"."

"I realized that it is difficult to mark objectively."

"I found it really hard to mark my colleagues' work."

"I don't think it's good to give the real marks. Peer review yes, but marking no, because you don't want to spoil someone else's marks. Maybe to give a suggestion for the mark, but the tutors should do the real grading. So you can hand over the responsibility and the assessments will be more realistic."

One of the students thought that students assessed each other more critical than teachers would assess the students.

"Students tend to assess their colleagues more critical than a professor would do. This could be prevented if students were relieved from the pressure of expectation that is associated with this task."

Possibility to defend the paper

Students expressed their wish for a possibility to defend their papers several times. In some of the courses students were allowed to correct their papers after the peer review. Students, who attended these courses, achieved significantly better results concerning the final assessment of their papers.

"There is no possibility to defend your paper. This means that you are forced even more to float with the current and do what you think will be assessed best – so there is no improvement compared to the other methods of assessment."

"There is no possibility to criticize the results of the assessment! To get a bad mark just because someone else didn't do the peer review carefully should not affect my result but the result of the person, who didn't do his job right."

Lack of knowledge on the part of the reviewer

Many responses addressed the issue of a lack of knowledge on the part of the reviewers, which became obvious especially in connection with one of the tasks given (Modeling with Lindner Diagram). In this connection students also expressed their wish for a general discussion of the task.

"As this method presupposes that all participants carefully deal with the task, which was not the case, I'm not convinced 100%. This led to unqualified results."

"General discussion before the assessment with the students. Partly (factually) wrong assessments were made. Probably this could be prevented in the future by discussing it in advance."

Wish for more than one review

In order to mitigate the lack of knowledge of some of the reviewers, students expressed their wish for at least three reviews.

"I received many reviews, which, however, differed very much from each other, with the result that I achieved a lower total score."

"From my point of view the biggest problem with the peer review is that you only get 2 opinions from two colleagues and you don't really know whether they really became acquainted with the topic before and thus are able to assess my paper "correctly". I really appreciated that they reviewed it again."

"In order to be sure to eliminate any "outliers" and to get a better, more correct overall picture of the assessment each submission should be reviewed by more than only two or three persons."

Assessment criteria before starting to write the paper

Much of the feedback concerned the incorporation of the peer review into the whole course process. Students expressed the wish that the review criteria should be discussed before starting work and that examples of good works should be provided.

"The criteria for the peer review appeared nowhere while we worked on the texts."

"It would be helpful if we had examples of good works towards which we could turn in fulfilling our tasks. Otherwise everyone has his own opinion about the task and thinks the opinion of the other one is wrong, although both opinions could be right with the right reasoning."

"The topic or the task you get for the peer review could be discussed in some more detail in advance in order to get more information and suggestions how the task should be completed."

Yes/No Assessment

The first peer reviews were realized in the learning management system Moodle 1.9. In this version the reviewers did their assessments on the basis of a list of criteria. Each criterion could be answered by either yes or no. The feedback revealed that students are critical of this mode.

"Some people did not get the assessment system with the tick marks right. Maybe this could be adjusted better."

Positive feedback

In the feedback students expressed their approval of the peer review method, especially when it came to their learning success.

"The peer review is good in order to get feedback on the projects you worked on. You get information on what you did well and what could be improved."

"I think the peer review is good, as you could see how others completed the task given and you could see where and how you could improve your own work or where you did better than the others. Nevertheless, I think that some didn't really make an effort in regards of the assessment of others."

"Because of the peer review you really had to become acquainted with the topic, which was really interesting and which led to a consolidation of what was learned, at least in my case."

"A really interesting way of learning. May definitely be applied more often."

"Interesting experience."

"It was fun to try this method and to gain new experiences through this approach."

"Good exercise, very practical."

DISCUSSION AND CONCLUSION

Due to the use of different tasks and learning scenarios, peer review has a far wider range of application possibilities than is commonly expected. It allows for the achievement of highly different cognitive learning levels as well as a high-level assessment competency. A differentiation according to target group and learning level is necessary – in this context a "one size fits all" approach is neither sensible nor useful. The inclusion of learners into the learning process causes an active participation and, as a consequence, enhances the learners' motivation. Regarding learning success and evaluation by learners, peer review compares favorably with other media-based learning scenarios.

Complex and comprehensive study tasks turn out to require a considerably higher level of support on the part of teachers, as well as smaller groups in the settings described. For larger groups well-structured, small-scale tasks have proven useful; whereby especially reviews of similar tasks can be handled quickly and the teachers' workload per student seem to decrease with each additional participant. At this point tutors can be easily involved and carry out some of the assessments independently on the basis of sample reviews (e.g. from previous terms). It is, however, important to remember that the peer review process itself requires intensive supervision and support by teachers even if no direct involvement in the actual review is necessary. Preparation and completion of peer review is time-consuming for teachers. In a process where students received feedback from their peers first and could upload an improved version later for grading, learning impact and results were recognized much higher than in a singular peer review. The effect raises again if there is additional, multiple teacher feedback in the process.

Particularly meticulous preparatory work including clear work instructions and task descriptions are necessary preconditions for the success of peer review as a learning method, which can be best achieved by means of an additional briefing to increase assessment competency and enhance communication. Even with advanced peer review tools, vague or

incomplete work instructions lead to an abundance of queries, frustration and conflicts on the part of students. Especially in smaller courses, teachers should be prepared for stronger group dynamics and make use of this effect for higher learning outcomes.

This study describes on the basis of empirical data the application of peer reviews utilizing modern support tools and demonstrates its wide range of scientifically backed application possibilities. But further research is needed in the area of cognitively more challenging, more complex learning situations before utilizing these kinds of scenarios in larger groups.

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