

# The Quiz World Cup: A Game-Based Distance Learning Method for Teaching Cognitive Subject Matter Content

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**Abstract:** Teaching cognitive subject matter via distance learning often suffers from different aspects, such as providing passive content or missing motivational elements. Therefore, this paper deals with the extension of an online course on theoretical topics by game-based elements and proposes a distance learning method called “Quiz World Cup”. After highlighting problematic aspects of teaching cognitive subject matter and pointing out possible remedies, the realization of the Quiz World Cup within the Moodle platform is described. Consequently, results and experiences of a case study running this method in the area of adult education are summarized.

## Introduction

With focus on new didactical strategies for teaching cognitive subject matter, this paper introduces a game-based distance learning method called the “Quiz World Cup”. The method realized in the field of adult education at the Campus02 (2008) was developed on the basis of former research work described in (Mödritscher, 2006) and observations made in some kind of field experiment – in the classroom. Thus, the next section outlines problematic aspects of virtually teaching cognitive subject matter and describes how the idea for the Quiz World Cup arose. Thereafter, the implementation of this method is summarized. Finally, the results and lessons learnt of this case study, amongst others by comparing it to online courses held in former years, are presented, before the paper is concluded.

## Dilemmas of Teaching Cognitive Subject Matter Content and Possible Ways Out

According to the author’s experiences and backed on literature, a various number of problematic aspects can be identified in the field of distance learning, partially derived from traditional teaching within a classroom, but also resulting from the nature of distance and online learning:

- First of all, holding lectures about fundamentals in a certain domain often urges a teacher to define many cognitive learning objectives on a rather low level, such as “give an overview of concept X” or “explain concept Y”, to be able to meet the syllabus of a course, particularly if it is very comprehensive. Referring to Bransford et al. (2000) [p. 8-13], such curricula emphasize only the memorizing of the learner. As a conclusion, Bransford and his colleagues suggest to aim at learning with understanding and active learning.
- Secondly, the teaching strategy applied within a course – regardless of whether being held in front of the students or via an e-learning platform – is rarely or never being varied. In particular, experts often do not adapt the teaching activities due to a lacking consideration of possible difficulties in their domain Bransford et al. (2000) [p. 44-48]. Thus, learners fail to experience different learning strategies and can not transfer them to other domains [p. 95-98]. Further, the cognitive school of learning proposes to include a variety of learning strategies in online instruction (e.g. see Paivio’s dual coding theory or research on aptitude-treatment interaction) to accommodate individual differences of learners (Mödritscher, 2006).
- Thirdly, distance learning requires meta-cognitive abilities and self-directed learning, which might be missing if the teaching strategy is rarely varied or meta-cognitive activities are not incorporated into subject matter (Bransford et al., 2000) [p. 19].
- Fourthly, distance learning is often associated with passive learning activities. Similarly to the wide-spread concept of “teaching through lecturing” within the classroom, Lennon and Maurer (2003) outline the traditional distance learning pattern of “dissemination of material backed up by assignments, tests and exams” in the area of schools and suggest a paradigm shift to constructivism and discovery learning

accompanied by new methods within managed learning environments. In this connection, they point out a list of learning activities like picture competitions, treasure hunts, crossword puzzles, and the forth, each one addressing the pupil's motivation and being already successfully experienced in practice.

In spite of these problematic aspects of teaching cognitive subject matter content, the literature suggests different approaches. For instance, researchers in the field of cognitive science address didactical principles to enrich learning content with multimedia and interactive elements (Mayer, 2001) [p. 41ff]. Furthermore, technologists came up with adaptive techniques for e-learning, as summarized in (Brusilovsky, 2000). In addition, game-based learning approaches try to overcome shortcomings of e-learning by applying games (Underwater Sea Quest), simulations (Cabin Air Management System) (cf. Gredler, 2004) or virtual environments (Second Life) (cf. Linden Research, 2008). In this context, collaborative and competitive games were discovered and have been utilized for online learning during the last few years (Fogel et al., 2004).

Against this background, the distance learning phase of the author's lecture was redesigned according to two important aspects: On the one side, the study outlined in (Mödritscher, 2006) showed that a behaviorist approach is more efficient in terms of successful knowledge transfer than strategies following other learning paradigms. On the other side, observations revealed that, in the breaks between the lectures, many students were participating in the popular Austrian online game "Ski Challenge" (ORF, 2008) and that most of them were keen on being in a competitive situation with their colleagues.

## Realization of the "Quiz World Cup"

To consider these two insights, the game's principle was applied in online teaching practice, which led to the "Quiz World Cup" as a teaching strategy aiming at mediating cognitive subject matter, but also addressing motivational aspects by means of interactive learning content and a game-based element, namely a competition. Besides, this method should enable the students to transfer the learning activities to another domain beyond the course. Moreover, the Quiz World Cup should also reduce some of the teacher's work load, as explained in the next section analyzing the realization and the results of this method.

### From traditional e-teaching ...

The study about the teaching strategy was accomplished at the Campus02 in 2006 and dealt with an online course on the topic "document formats". Although the instructional unit can be considered as a lecture on the basis of information technology, attempts were made towards addressing knowledge, skills, and attitudes as well as some higher-level objectives, to cover and examine a broad range of didactical aspects. Characterizing the course with reference to the Bloom taxonomy (Bloom, 1956), the educational objectives mainly dealt with imparting knowledge on the students, but also included two skills and one affective goal (cf. Table 1).

Domains according to Bloom Taxonomy	Level 1	Level 2	Level 3
Cognitive Domain	5	4	2
Psychomotor Domain	0	0	2
Affective Domain	0	0	1

**Table 1: Statistics of educational objectives**

As a result of former research work, the course for the distance learning phase was planned with respect to Behaviorism, whereat learning objectives and materials were portioned into three modules (so-called "world cup sites"), and each of the 32 students had to study the learning content and finish the module within a given period of time. The sequence of the instructional portions as well as the schedule was determined by the teacher. The students' achievement levels were measured with online examinations. Each module was realized as one topic within the open source platform Moodle (Moodle, 2008) and consisted of the instruction, an overview of the learning objectives, the related materials (lecturer notes, slides) as well as an online quiz. Table 2 characterizes these modules in detail. Each module was available for a certain period of time; the beginning and the end were announced via email. As the number of pages and slides from the lecture indicate, the distance learning phase covered quite a large amount of learning content. Further, each module varied in the difficulty level, the examination mode and the scoring.

Module	Text Formats	Digital Images	Digital Audio & Video
Begin	5 <sup>th</sup> May	26 <sup>th</sup> May	16 <sup>th</sup> June
End	25 <sup>th</sup> May	15 <sup>th</sup> June	30 <sup>th</sup> June
No. pages	14	15	9
No. slides	37	38	26
Diff. level	medium	hard	easy
Objectives	2 x K1, K2, K3, A3	K1, 3 x K2, S3	2 x K1, K3, S3
Questions	7 out of 15	5 out of 12	4 out of 7
Duration of exam	10 minutes	12 minutes	6 minutes
Mode, scoring	best attempt	average	3 attempts, average

**Table 2: Characteristics of the course’s modules (Objectives: K=knowledge, S=skill, A=attitude, followed by the level; compare with Table 1)**

The students had to finish a module with an online examination consisting of typical behaviorist elements like multiple-choice questions, assignment tasks or short answers. Particularly, the second module was difficult to be realized and to be studied, because, on the one hand, the teacher had to simulate functionality of intelligent tutoring systems (ITS) for different compression algorithms by quizzes within the Moodle platform, and on the other hand, students had to train the encoding of any kind of character string (skill, level 3).

To increase the difficulty level and avoid statically exams, different techniques were applied by exploiting certain features of the Moodle system: Firstly, all kinds of questions were used, so that students did not experience only one question type, e.g. multiple-choices. Secondly, several questions were created for each objective, each one of them about the same answering effort and difficulty level. When a student took the exam, the test was randomly generated out of these question pools. Thirdly, Moodle shuffled questions as well as the questions’ answers. And finally, a trick was played on the students for the objective about compression algorithms in module 2: the character strings to be encoded by the students were modified after two weeks in order to find out whether the students collaborated and exchanged the answers.

### ... to a new learning experience

In contrary to former e-teaching strategies, the online course was extended with motivational elements. Precisely, the character of the distance learning phase was adapted with regard to the following aspects:

- First of all, the tests of the three modules differed in the number of questions, the duration of the exam, the examination mode as well as the scoring (see Table 2). While the first module consisted of five lower-level objectives and its test allowed any number of attempts, the second module included one particular complicated objective (applying compression algorithms), and the third one had to be concluded with a test which had to be finished in 6 minutes. In the first module, the test score was determined by the best attempt, while in the other two modules the average score of all attempts was used. Moreover, in the third module each student was allowed to attempt the exam only three times.
- Secondly, the overall concept of the learning phases was designed according to the before-mentioned “ORF Ski Challenge” game. Thus, the Moodle interface and the course were adapted with respect to commonly-known terms of a world cup, such as “site” and “race” instead of “module”, “race organizer” for the “teacher”, “racer” instead of “student”, etc. In addition, the students’ test scores were used to generate a ranking for each phase – Moodle even allowed to automatically creating the ranking immediately after each test attempt. The best performing students received smaller presents at various award ceremonies during the lectures. Furthermore, the 10 best performing students of all three “races” gained a bonus for the course.
- Thirdly, collaboration was not explicitly banned. In contrary, a chat and a forum were provided in the Moodle platform to enable communication and collaboration between the students for two reasons. On the one side, it was not possible to avoid that students talked about the learning phase, because they regularly came together in class. On the other side, it was intended that students actively dealt with – and also talked about – the learning content of the course. However, implementing the distance learning phase as a competition caused the effect that not the whole range of information about the tests was exchanged between the students.

- Finally, the distance learning phase was concluded with an online test in the first lecture after the end of the third module. So students were aware of the fact that they had to achieve all objectives of the online course by their own.

## Results and Lessons Learned

Including the motivational aspects of the last subsection into the learning phase of the author’s lecture, the results and lessons learned of the case study which lasted nearly two month are summarized in the following. The evaluation of the Quiz World Cup consists of two major parts: the experiences of the teacher and the observations made during and after the distance learning phase.

### Teacher’s experiences

Before the kick-off of the online course, both the idea of the Quiz World Cup and the Moodle platform were introduced to the students during the lecture. In addition, a brief overview of the first module was given. Thereafter, the students were dismissed into the distance learning phase. Within the next two months, only one further lecture was held, where the winners of the first “race” were awarded, and students were briefly introduced into the second and the third module. Concluding the study, a survey and the announced online test were accomplished in the first lecture after the distance learning phase. Finally, the best ten students of all modules were awarded with a bonus for the course in front of their colleagues.

Activities	Effort [h]
<i>1. Preparation stage</i>	<i>15</i>
1.1 Planning	3
1.2 Creating the online course	2
1.3 Generating (more) quizzes	10
<i>2. Implementation stage</i>	<i>6</i>
2.1 Notification emails	1 ½
2.2 Actualizing the ranking	3
2.3 Other Moodle activities	1 ½
<i>3. Concluding stage</i>	<i>2</i>
3.1 Grading	1
3.2 Evaluating questionnaire	1
<b>Overall effort</b>	<b>23</b>

**Table 3: Teacher’s activities and efforts**

The performance of the whole study took the teacher about 23 hours of effort, distributed as shown in Table 3. Due to former distance learning phases, the course content already available in digital form and the good usability of Moodle, the planning and creating of the online course was not very time-consuming. Nevertheless, the extension of the first set of quizzes to 14 pools of questions took about 10 hours whereby each pool consisted of at least two questions dedicated to one learning objective (see Table 1). In fact, these questions can be reused in future courses. Generating the tests for the three modules according to the specification in Table 2 was rather easy with Moodle’s quiz component.

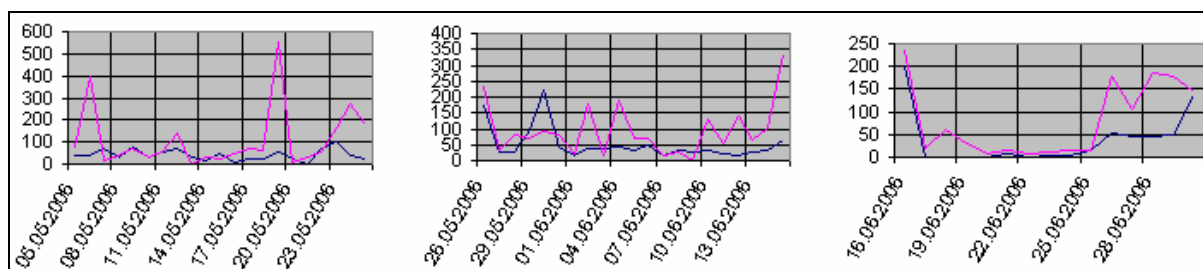
Running the distance learning phase mainly consisted of regularly sending notification emails to remind the students of deadlines, updating the ranking as well as executing various Moodle activities by switching from a module to the next one. Although the ranking could automatically be realized with one Moodle feature (using a navigational box showing the best performing students), the intermediary results of the “race” were manually updated in order to have full control over the ranking. Concluding the learning phase did not turn out to be too time-consuming. On the one hand, the grades resulted from the students score in the Moodle system; on the other hand, evaluating the post-questionnaire was not very extensive due to the usage of the Moodle’s feedback component.

In general, the distance learning method also aimed at reducing the teacher’s work load for future lectures, which was evidently achieved. Having a pre-build a Moodle course and a set of 34 quizzes distributed over 14 question pools, the online course can be repeated with an effort of approximately 10 hours in the next

year's lecture. As a result, the weight of the lecture's final exam is reduced to about 50% to 60% compared to the weight of it within the original course. Hence, it requires the teacher less time to grade the students at the end of the term. Moreover, the extensive final exam is split into two smaller tests, the one concluding the distance learning phase and the one held at the end of the lecture.

### Observations and their interpretations

Next to these didactical aspects, the following observations were made in the distance learning phase. First of all, the teacher's and the students' activities were analyzed during the whole period of the case study. According to Figure 1, the teacher's activities were well distributed over the course with only a few peaks, like concluding a module or creating questions for a module (e.g. from 29.05. to 01.06.). In contrast, the student's learning effort included several peaks and periods of less activity within the three modules. In the first module, students showed an initial attack of curiosity, regularly worked with the system, and tried to improve their scoring at the end of the period. Obviously, the number of activities was much higher in this module because of the mild examination mode (see Table 2). In the second module which consisted of the challenging examination activities were distributed rather evenly. In contrary, the third module is characterized by similar online behavior like the modules of the last year's course (Mödritscher, 2006), indicating that the level of this module was too easy and students tended to do the exam at the end of the period.



**Figure 1: Distribution of teacher's (blue) and students' (pink) activities over the period of module 1 (left), 2 (middle) and 3 (right)**

Characteristic	1st Race	2nd Race	3rd Race
No. Attempts	200	173	52
Max. Attempts	42	49	3
Attempts [ $\bar{x}/\sigma$ ]	6.3/8.0	5.4/8.7	1.6/0.8
Max. Score	10	12	8
Score [ $\bar{x}/\sigma$ ]	9.5/0.8	9.5/1.4	7.6/0.6
Min. Time [min]	0:48	6:04	2.02

**Table 4: Characteristics of the three modules**

Secondly, the observations about the students' participating in the online tests in accordance with the examination mode and scoring are summarized in Table 4. While the first module encouraged students to attempt the online test several times and reach the maximum score, the other two modules required a more strategic approach towards the exam to get a good score. In the third module, students were allowed to perform the test only three times, so the number of attempts was significantly lower. Students with a good performance can be characterized by a lot of attempts in the first module and only one or very few in the other two modules. However, it was suspected that a few students from the whole group were chosen to firstly attempt the online test of the last two modules and pass their experiences to the others. Thus, some questions were modified in the middle of the second module, which revealed that a few students were working with answers matching the old quizzes. Yet, the teacher did not set further consequences as students were seriously dealing with the course content. On the other hand, 6 out of the 32 students missed at least one deadline and, therefore, lost some points for the distance learning phase.

Thirdly, the results of the concluding test consisting of 10 questions and being restricted to 20 minutes are of interest to evaluate the learning process. In average, each student reached  $\bar{x} = 15.7$  out of 20 points (with

$\sigma=3.0$ ) in the concluding test which took place during the lecture after the online learning phase and is an excellent result for this examination.

Finally, the learning process was assessed using Moodle's feedback component right after the last module was finished. Students estimated their average effort for module 1 at about 2.5 hours, for module 2 at 3.6 hours, and for module 3 at 1.7 hours. All of the 32 students meant to have an overview of the course content. 84.4% of them considered the method to be adequate for knowledge transfer, while 15.6% said that method is too playful. Another 12.5% claimed the poor usability of Moodle and only 9.4% would have preferred the lecturer instead of the distance learning method and an extensive exam at the end of the term. Examining their motivational targets in the Quiz World Cup, 18.8% acknowledged that they aimed at winning the competition, while 53.1% wanted to receive full score, and 12.5% tried to pass the tests with minimum effort (15.6% did not specify their motivation).

## Conclusions

Combining the result of the concluding test with the active participation of the students in the three "races", the Quiz World Cup can be seen as a successful way to teach cognitive subject matter content online. In comparison to former online courses, which did not focus so much on motivational aspects such as interactive course content or competitive elements, the participation in and the acceptance of the distance learning phase as well as the learning results assessed by tests and students' feedback were improved. Moreover, students were more actively involved in the learning process than in past lectures which were carried out in the traditional sense, e.g. with lectures given by the teacher and a written exam.

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