

Method for Rapid Development of Educational Games by Students

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Synopsis

This concept shows a method developed in the summer semester 2020 in which students independently create new and quality-assured learning materials to accompany online lectures. The aim is to support students to absorb the online lecture content better, to work on it independently and let students to experience their own progress and success immediately. During the summer semester 2020, students created over 57 online quizzes with more than 350 questions using this method. The quizzes use modern and motivating gamification approaches and can be played on all types of devices, such as desktops, tablets and smartphones. They were created parallel to the my online lectures and playfully support self-learning of important lecture contents. The method was implemented in three modules of the Bachelor's degree in [Business Information Systems](#). At the same time, it was applied in the master's programs in [Digital Business Engineering](#) and [Digital Business Management](#) to test its use in other courses and to research various evaluation metrics for a continuous improvement process. With this type of learning, i.e. through independently created new learning content, students achieve a higher learning ability. The sustainable contribution is a highly efficient and tested method for creating supporting and quality-assured materials for teaching.

1 ONE-PAGER

Motivation and goal: The rapid change from regular face-to-face events to online lectures requires additional online offers and interactive materials so that students who are distributed online can better absorb the content conveyed, work independently and experience their progress and success immediately.

Problem: Lecturers cannot produce the new materials as quickly as required. Even technically well-versed lecturers have a resource problem.

Solution Approach: This concept tests a method by which students can create additional online learning materials tailored to the lecture in the form of multiple choice tests and quizzes. These are then made available to the participants of the lectures. It enables them to better rework content and see its progress. State-of-the-art platforms and tools with a low entry threshold are used, which allow a kickstart and use gamification approaches in a particularly good way. All activities take place online, are carried out in small steps and parallel to the online lectures.

Innovation: An innovative key element is the continuous measurability of the playful online quizzes and tests and the step-by-step improvements that are regularly carried out on them. Students who create quizzes observe and evaluate the quizzes and improve the content and quality. A new control loop for quality improvement is created. In addition, feedback on the scope of the content is obtained from the participants through simple, standardized surveys. The result is a high level of coverage of the lecture content along with a guaranteed quality without the lecturer's resource bottleneck. The sustainable contribution is a tried and tested method for creating quality-assured materials that support online teaching. These materials are made freely available.

Results: Using this method, a total of 24 subject-related quizzes were carried out during the 2020 summer semester in three modules with weekly online lectures of the Bachelor's degree in business informatics. In the master's program in Digital Business Engineering, 28 quizzes were created for four modules to accompany block events. In the KFRU training program Digital Business Management, five quizzes and new metrics for the evaluation of quizzes were experimentally evaluated. With this type of learning, i.e. through independently created new learning content, students achieve a higher learning ability.

Contribution: The tested method allows lecturers to coordinate the creation of online-based supportive and quality-assured materials for several lectures and modules in a highly efficient manner.

2 ONLINE TEACHING

The following Figure 1 illustrates a personal observation how students group themselves in a typical online lecture.



Figure 1. Symbolic representation of the grouping of students before / during / after an online event

Students come together for the planned online teaching events. Depending on the didactics of the events, they interact with each other. Figure 1 shows that after the end of an online event, the interaction breaks off almost immediately. This is the main difference compared to face-to-face teaching. In the latter, a loose contact, an informal and unplanned channel of exchange, remains between students.

2.1 HYPOTHESES

Didactic changes to the content of previous face-to-face events for use in online teaching are important in order to use the medium effectively. In addition, however, contact between students is severely limited in the 2020 summer semester. As a result, an important informal channel between students is also restricted. There is no spontaneous exchange about the course content. Through this channel, students realize where they stand in the lecture material in comparison to others and there is - sometimes unconsciously - the urgency to deal more intensively with the course content.

Recordings of lectures make it easier to revise content. Different learning speeds can be compensated. However, they also tempt people to neglect the discipline of learning. The constant availability of the lecture recording makes it easy to postpone dealing with it.

Additional Q&A events held online can have a positive effect in this situation, as they offer further communication opportunities beyond the lecture. Participation, however, depends on the student's self-motivation and the realization that this is necessary with regard to their personal level of knowledge.

2.2 CLASSIFICATION OF THE METHOD OF THIS TEACHING CONCEPT

High-performing students with a high level of self-motivation or self-discipline can recognize the gap between their own level of knowledge and the required level of knowledge even in the situation of a restricted informal exchange between fellow students and work actively to close the gap. Depending on the didactics and materials of the online teaching, they can even work more effectively.

Students with less self-discipline misunderstand the situation. You are subject to an unconscious self-deception that you have internalized the content of the lecture because your own performance is not related to the reference of your fellow students. As a result, there is a great risk that examinations will only achieve unsatisfactory results. However, this is not an expression of a lack of ability to study. Through the informal channel and spontaneous exchange with fellow students as it exists in the context of face-to-face events, these students would be able to perform well for academic success. My concern is increased with regard to the freshmen of the summer semester 2020, who in the past were not able to establish networks with other fellow students that they could fall back on in this situation.

It is necessary that students can experience a personal assessment and success control of their learning progress in a different way than before. Access must be easy so that a broad group of students with varying degrees of self-discipline can be reached. This motivates particularly the method in this teaching concept.

3 METHOD FOR THE RAPID DEVELOPMENT OF EDUCATIONAL GAMES

Students in online lectures need additional channels in addition to the presentation of the content on the screen by the lecturer. Interactions and learning groups that otherwise die during face-to-face events are difficult to motivate by addressing them alone. The use of interactive offers such as multiple-choice tests and quizzes, which can be used by students for the follow-up and review of the lecture content online, is recommended by various lecturers with long-term experience in online teaching and didactics.

The creation of offers for several lectures, in particular, can result in an overload for lecturers who switch from face-to-face to online lectures at the same time.

3.1 INNOVATION

Existing online platforms can be used to create multiple choice tests and online quizzes. The gamification approaches contained therein can also be used to promote the motivation of participating students. Students who take a test or quiz receive immediate feedback on their success in the form of points and get an impression of their progress.

The method is implemented in the form of student projects. What is new is that a group of students separate from the participants act as creators of tests and quizzes and, at the same time, use the platform to receive feedback on the success and demands of the tests and quizzes created. The creators are embedded in a control loop for quality improvement. In addition, regular standardized surveys determine the scope and completeness of the content. The following figure illustrates the process.

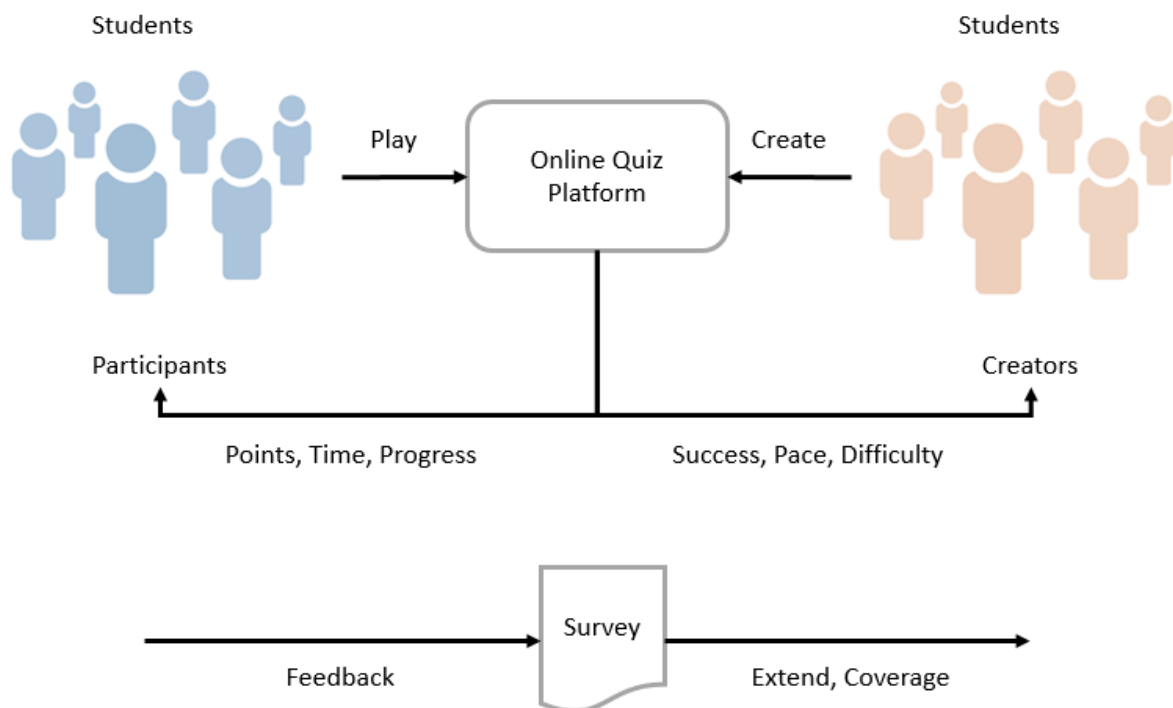


Figure 2. Creation of quality-assured learning materials from students for students. The creators are embedded in a control loop for quality improvement.

The activities, especially those of the creators, must be carried out regularly at short intervals in order to make small-scale improvements. The lecturer works in an advisory and supervisory role with

the creators. It introduces the participating students to the online tests and quizzes through announcements in the online lectures and in the learning management system. The result is a high level of coverage of the lecture content through additional downstream interactive online offers, accompanied by a guaranteed quality and created by students.

Technical equipment for participating in online courses is available for over 95% of the students in the business informatics course. This means that this project can be carried out with students.

3.2 RELATED OFFERS

Online quizzes and similar materials are already offered as Open Educational Resources (OER) or, for example, on platforms such as “learning snacks” (<https://www.learningsnacks.de>) or Quizizz (<https://quizizz.com/>).

In the fields of statistics, computer networks and software engineering, which I teach in business informatics, the offers are limited to collections of basic questions. A personally conducted test of several online tests by Quizizz in the area of computer networks also showed some errors in the answers. The OER collection “Mathematics Basics” (source: https://reutlingen-university.oerbw.de/edu-sharing/components/collections?scope=EDU_ALL&id=c870c902-fb9e-4e28-bb59-808383e6d305&mainnav=true) lists 19 resources. Almost half of them consist of electronic question pools. The target group is primarily schoolchildren or first-year students. Suitable quizzes and online tests for university students are rare. The specific content of my lectures is not covered.

The contents of the lectures at universities often reflect the lecturer's focus. The reuse of quizzes or online tests from external sources is therefore associated with adjustments and additional work for the instructor. This represents an entry hurdle for the use of these instruments in teaching. The methods of the present project make it possible to create or adapt online tests and quizzes with significantly less effort for the lecturer. They also integrate quality control in order to discover and correct errors or ambiguous formulations. The testing in this project ensures that they can be used successfully by lecturers in other disciplines and at other universities. The project offers the opportunity to methodically and substantially support the development of the OER offer.

3.3 IMPLEMENTATION OF THE METHOD

The method for the rapid development of learning instruments is implemented in agile student projects and applied to parallel lectures. Since the semester started in the summer semester 2020, six students from the fourth and fifth semesters have been working on the project as part of a semester project in the Bachelor's degree in Business Informatics. You, the creation students, develop the content of the online tests and quizzes for freshmen.

3.3.1 Platform

As a platform for creating online quizzes and MC tests, Kahoot! used. Kahoot! is a game-based learning platform with almost 50 million participants. The quizzes can be created with little effort and can be saved and played publicly. No account is required to use the quizzes. You can play it alone anytime. Another game mode is that you can compete with other participants against each other. As a playful stimulating element, a point list with the relative placement to each other is displayed in between.

3.3.2 Agile Approach

The process consists of four defined activities by the creator students, carried out repeatedly over a short period of two weeks. A two-week period represents a sprint with the activities in the table below:

Activity	Description
1. Setup	Creating a quiz game, MC test or similar for a lecture. Lecturer announces the current topic to the creators and makes documents available. The creators extract questions independently.
2. Experiment	Lecturer hands over the quiz to the students participating in the lecture. In the meantime, the creators collect the data of the metrics on success, duration and question understanding / difficulty.
3. Validation	Creators evaluate collected data in statistics about the students' performance in the games. Typical questions are: How good were the quiz takers? Was the quiz too easy / too difficult? A standardized survey is carried out as feedback to check the quiz for content coverage or errors.
4. Improvement	As a result of the previous activity, specific adjustments to the questions can be determined and errors can be corrected. These changes will be implemented in the next sprint.

Sprints are carried out repeatedly. At the end of each sprint, the following results are available:

1. Following the current lecture content, suitable online quizzes and tests are made available to the students of the lectures for follow-up, progress and success control.
2. Statistics on the success of the quiz participants are continued as a time series in order to validate the requirements of the content and to show the improvement of the test and quiz instruments.
3. With the help of standardized feedback instruments, a content-related quality assurance for necessary improvements is implemented, which will be implemented in the next sprint.

The project is planned and carried out in an agile manner using the Trello tool. The links to the games created are reported back by the creation students via the Trello Board as a completion message. The board in Figure 3 shows the quizzes to be developed next for the three modules Statistics, Computer Networks and Software Engineering of the Bachelor's degree in Information Systems.

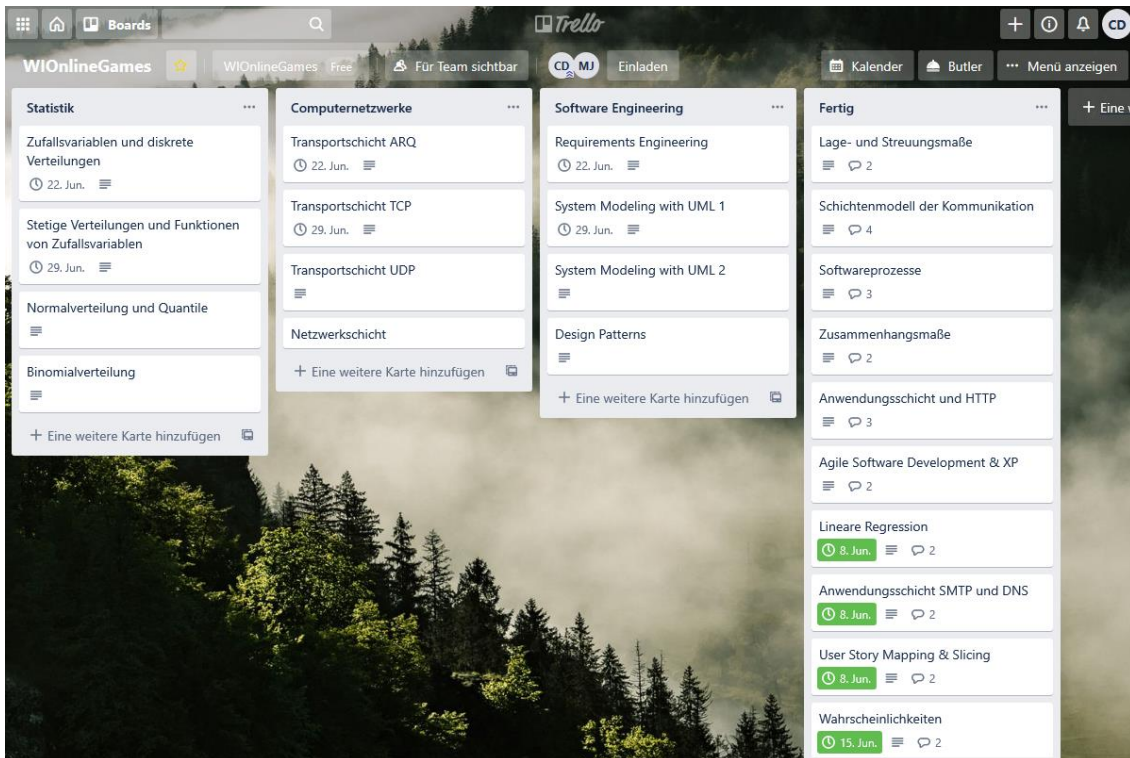


Figure 3. Trello Board for the agile organization of the student project to implement the method for the rapid development of learning tools.

As soon as a new quiz game is available, the instructor announces the game to all participants via e-mail via the respective course in the Learn Management System (LMS). In addition, all quiz games are collected in a separate section of the module (see Figure 4). Students have access to the current quiz game as well as to the quizzes of the past weeks.

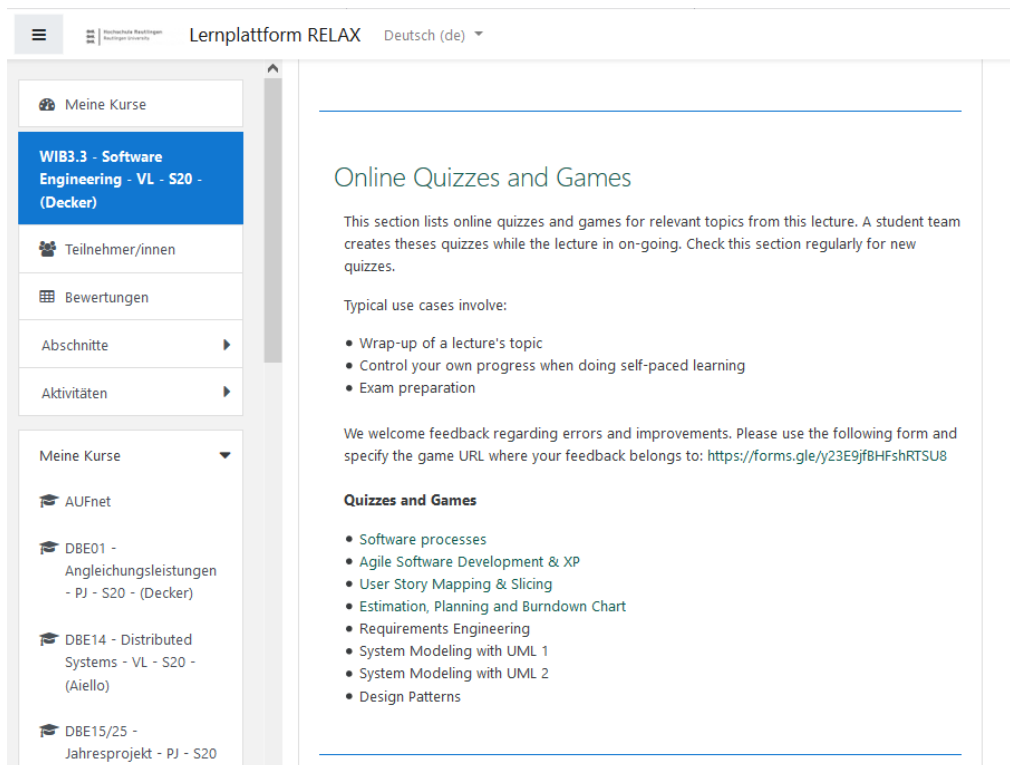


Figure 4. Excerpt from the course of the software engineering module with the list of all quiz games available so far and the quiz games still to come

3.3.3 Result Documentation

The student teams are continuously adding to a results document with the following content:

- Possible questions and answers in a quiz
- the values of the key figures on participants, aspiration and player strength
- the adjustments described as a result of the key figures

The following figures show typical performance statistics as they are documented at the end of a sprint.

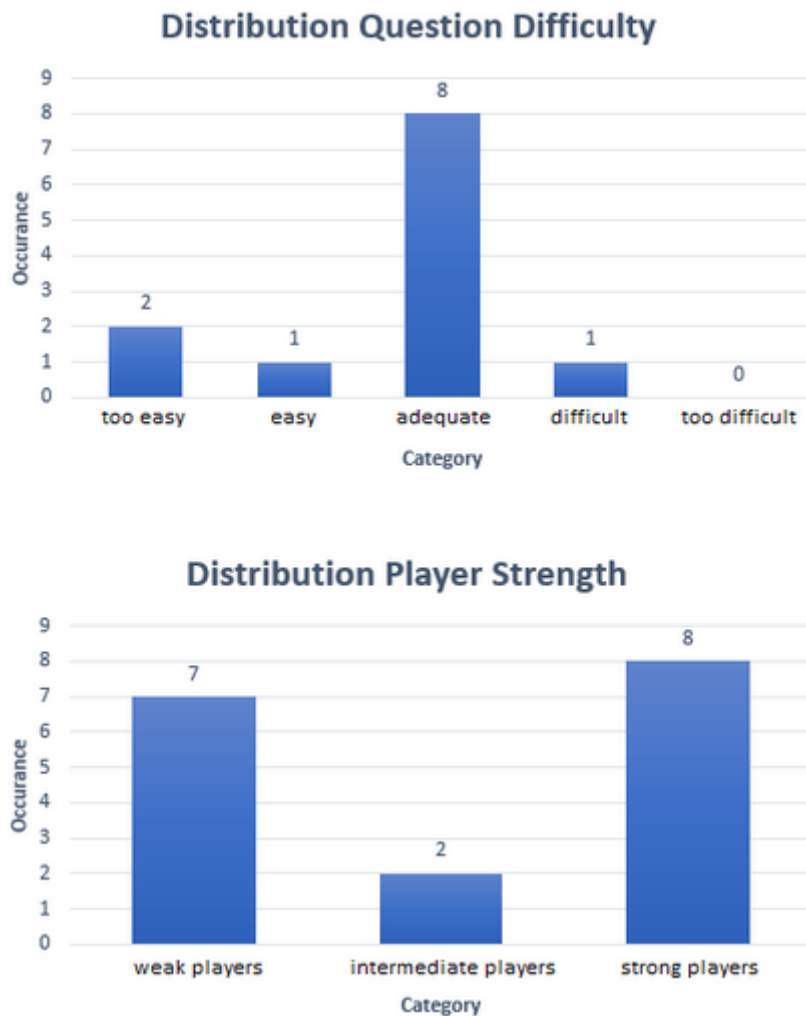


Figure 5. Typische Kennzahlenstatistik am Ende eines Sprints.

4 RESULTS FROM OTHER PROGRAMS

In the business informatics bachelor's degree, the modules

- Statistics (1st semester)
- Computer networks (2nd semester)
- Software engineering (3rd semester)

8 quizzes each, at least 8 questions per quiz. Thanks to the agile approach, a new quiz game could be announced every week.

In addition, a total of 28 quiz games for four modules were implemented in the master's program in Digital Business Engineering by 7 student teams. The course is characterized by completely block-oriented events. The aim is to provide additional learning material for part-time students. In the KFRU training program Digital Business Management, 5 teams have created various quizzes on the subject of software engineering. The focus here was on the design and experimental testing of various metrics for evaluating the quiz games.

The following table summarizes the results and shows the application of the method of this teaching concept in various courses of study.

	Bachelor of Business Informatics	Master in Digital Business Engineering	Master in Digital Business Management
Number of teams	3 teams of 2 people	7 teams of 2 people	5 teams of 4 people
Number of quizzes (modules)	24 (3 modules)	28 (4 modules)	5 quizzes (1 module)
Description	Standardized metrics (questions asked, skill level, number of players); Topics as in the lecture; weekly release of a new quiz game	Independent question research in books from the lit.-list of the module handbook and own project work, aim: additional learning material for part-time students	Design and test various metrics, critical reflection and adaptation of the quizzes

Table 1. Results from other programs

In all courses, the quiz games could be designed parallel to the lecture, on the Kahoot! Platform implemented, played through and evaluated using metrics. The total number of games and questions shows that the method of this teaching concept allows a lecturer to coordinate the creation of online-based supportive and quality-assured materials for several lectures and modules in a highly efficient manner.

5 VALUE CONTRIBUTION FOR STUDENTS

The project makes value contributions for students on several levels. I illustrate this with the help of the learning pyramid (Edgar Dale, Cone of Experience, 1946) and a corresponding assignment in Table 2. A different type of learning is indicated at the different levels of the learning pyramid. Higher levels of learning are associated with higher levels. The numerical values are controversial and are not used here.

Level	Type of learning	Instrument of Online Teaching
1	Listening to a lecture	Attend an online lecture
2	Reading and seeing	Additional documents, provided book chapters
3	Hearing and seeing	Follow up online lecture with the help of the recording; additional YouTube videos
4	Hear, see and talk about it	n / A
5	Hear, see, talk about it, become active yourself or teach	This method: independently create new types of learning content for students

Table 1. Levels of the Learning Pyramid www.wissenskurator.de

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