

Dynamic curricular concepts for research orientated programs in optics and photonics: The importance of consistent evaluation

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ABSTRACT

Redesigning a curriculum for teaching media technology is a major challenge. Up-to-date teaching and learning concepts are necessary that meet the constant technological progress and prepare students specifically for their professional life. Teaching and studying should be characterized by a student-oriented teaching and learning culture. In order to achieve this goal, consistent evaluation is essential. The aim of the evaluation concept presented here is to generate structured information regarding the quality of content-related, didactic and organizational aspects of teaching. The exchange of opinions between students and lecturers should be encouraged in order to continuously improve the teaching and learning processes.

Keywords: Curricular concepts, evaluation, research-oriented education, learning scenarios, media technology, optics and photonics

1. INTRODUCTION

Redesigning a curriculum for teaching media technology is a major challenge. Up-to-date teaching and learning concepts are necessary that meet the constant technological progress and prepare students specifically for their professional life. For this purpose, a defined strategy is pursued in order to convey all necessary topics and competencies in a vivid and intensive manner. A suitable learning environment also plays an important role here. Teaching and studying should be characterized by a student-oriented teaching and learning culture.¹ In order to achieve this goal, consistent evaluation is indispensable. There are many different ways of evaluating courses: summative or formative, qualitative or quantitative, related to satisfaction, learning success or transfer. The aim of the evaluation concept presented here is to generate structured information regarding the quality of content, didactic and organizational aspects of teaching. But also the exchange of opinions between students and lecturers should be promoted in order to continuously improve the teaching and learning processes in the teaching of media technology. Presented are the selected forms of evaluation for the different courses and which aspects led to this selection. Basically, all information can help to improve teaching. But all information cannot be collected with a single evaluation. Therefore, the choice of the evaluation form is of special importance, which is explained and justified in detail here.

2. RESTRUCTURING OF TEACHING AT THE FACULTY OF MEDIA

Offenburg University is a university of applied sciences with the independent profiles of technology, business and media. The format of research-oriented teaching is anchored in its mission statement as a central guiding principle of teaching. The goal of teaching is the best possible qualification of students based on a strong scientific and research-oriented education.^{1,2}

2.1 Redesign of the curriculum for the Media and Information Science program

In order to live up to this mission statement and the formulated goals, the Faculty of Media focuses on interdisciplinarity. Students are offered courses in the fields (pillars) of media informatics, media technology, media design and media economics. With a wide range of courses, these fields are specifically brought together and linked. In order to successfully pursue this approach, the teaching and learning concepts used must always be adapted to the constantly evolving requirements and the resulting challenges. These challenges include, due to the interdisciplinary approach, a clearly detectable great heterogeneity of students, especially with regard to the strongly varying qualification levels and inclinations. The Covid19 pandemic has further exacerbated these challenges.¹

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To meet these challenges, a new concept for the curriculum of the study program was developed, which will be implemented in the winter semester 2023. This will be accompanied by a renaming of the study program to "Media and Communication". The conceptual focus of the redesigned curriculum is to specifically link the areas of research and teaching in the sense of research-oriented education. To this end, existing approaches and concepts have been further developed with the aim of familiarizing students with current research topics and processes already in the first semesters. For this purpose, typical research activities are integrated as essential elements in the learning process in order to make research visible and tangible. ^{1, 3-5}

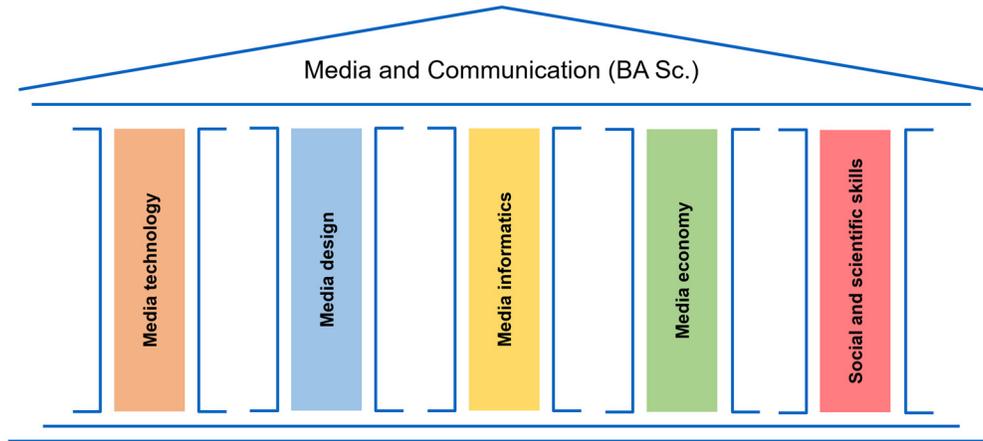


Figure 1. The new organization of the Media and Communication program is based on an interdisciplinary approach with five main areas of study (pillars). ¹

As part of the redesign, the interdisciplinary approach was continued with the four main areas (pillars) of technology, design, computer science and economics. These are complemented by an additional area for social and scientific skills. As a result, courses such as Scientific Work, Ethics, Creativity or Rhetoric and Presentation Techniques are deliberately brought to the fore. Another significant change was made in the structure of the study sections. The first study section has been shortened to two semesters, giving the second study section a higher weighting for the possible specialization of certain study focuses. The most significant structural change is the third semester. This is intended to serve students to specialize according to their inclination after a broad basic study with contents of all main areas. Here, students have the opportunity to select various modules that contain the necessary advanced basics for the lecture courses for specialization in the second study section. These are obligatory prerequisites for the further courses in semesters 4-7 of the second study section that belong to the respective areas and can be freely selected from the curriculum. A clear pillar assignment remains in place. But the interdisciplinary basic idea of the study program is still preserved, because initially only one main area can be completely deselected. At the same time, in the second section of the study program, a lot of value is placed on interdisciplinarity through new cross-pillar courses. ¹

2.2 The teaching concept of media technology

The implementation of the new curriculum is both an opportunity and a challenge. By restructuring the curriculum of the study program, it is possible to bring together all previous advancements of the teaching concept of media technology towards research-oriented education and to create an open and modern learning environment. At the same time, the opportunity is given to set new focal points in order to meet the challenge of getting students excited about media technology. The areas of research and teaching must be very consciously linked and research thus made visible and tangible for students. A broad platform for practical projects as well as applied research is to be created. ¹

In the first study section (semesters 1-2), the basic theoretical and scientific principles of media technology are taught in classical face-to-face lectures. The focus of the teaching is placed on the various media technologies and the underlying fundamentals of physics, mathematics and electrical engineering are taught in the direct context of the respective technical subject area. Parallel to the courses, various hands-on workshops are offered in the media technology lab. At the end of the first study section, a final event with a defined practical component takes place. This is also used to present current projects and research work in order to introduce the perspectives of media technology in the further course of study. ¹

The second study section begins with the third semester, in which the advanced fundamentals for specialization in media technology are laid. Two modules are offered to deepen the basic knowledge, which must be completed as a prerequisite for the further courses in media technology. The Media Technology module includes advanced physical and electrical engineering fundamentals as well as fundamentals of sensor and microcontroller technology. The contents of the Media Technology Applications module are somewhat more specific. Here, the fundamentals of audio-video (AV) studio and broadcast technology are offered, as well as the basics of print production. These modules are a prerequisite for taking the advanced courses offered in the following semesters in the area of media technology. From the fourth semester on, the range of courses is broad and includes many hands-on activities. The modules Broadcast Technology, Audio-Video (AV) Studio Technology and Printing Technologies and Print Production are offered here. In addition, the module Research and Projects offers students the opportunity to participate in three current research projects with different focuses. First, specific properties of display technologies are examined in context with typical features of human visual perception.⁶ Second, specific work is being done on the realization of virtual experiments and laboratory environments in order to gain new insights in the field of e-learning in conjunction with AR, VR, and MR technologies.⁷⁻¹¹ Furthermore, various interdisciplinary projects are brought together in which optics and photonics are specifically applied in art, which should lead to concrete art installations.¹²⁻¹⁴ Finally, in an interdisciplinary course, microcontrollers are used in a variety of ways to teach content from the fields of optics and photonics.^{1, 15, 16}

New organization of teaching in media technology

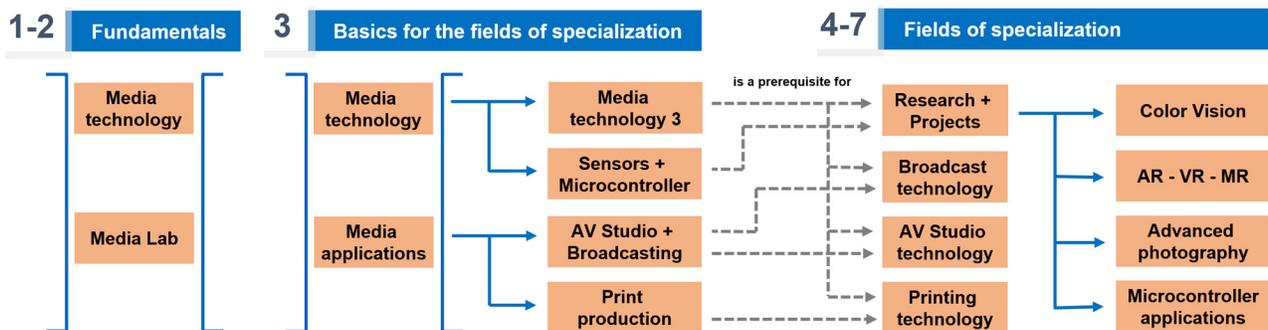


Figure 2. Overview of the new organization of teaching in media technology with all advanced courses offered.¹

3. EVALUATION OF STUDIES AND TEACHING

According to § 5 para. 1 LHG (Landeshochschulgesetz), Offenburg University is obligated to regularly evaluate its performance in teaching and research through self-evaluation and external evaluation. The object of the evaluation are the individual courses or modules in a degree program as well as overarching characteristics of the teaching and study situation. This is an important component of quality management for studying and teaching, an instrument of quality assurance and development. Data and information on the various study offerings and conditions, the associated administrative and service features, and the infrastructure are systematically collected, evaluated, and discussed. The aim of the evaluation is to take a critical and perspective-oriented look at study operations, to promote quality in study and teaching, and to develop and support quality-assuring and quality-promoting measures in cooperation with all groups.^{17, 18}

Offenburg University fulfills this obligation on the basis of the evaluation regulations of July 1, 2009. The evaluations of courses and modules are carried out by the respective evaluation officer of a faculty according to uniform university guidelines. Standardized online or paper-based procedures are used. A uniform university evaluation system has been introduced and an evaluation framework has been defined. The courses to be evaluated are determined by the respective study commissions. All courses of a faculty are evaluated within a two-year cycle. The whole process is embedded in a cycle of continuous development. Within the framework of the course evaluations, students are asked about the process and organization of the course, the way in which the subject matter is presented and communicated, the motivation or commitment of the teacher, and the supervision situation, and the answers are analyzed.^{17, 18}

The following objectives are pursued with the evaluation of the study programs:

1. Systematic and regular review, assurance and improvement of the quality of teaching and studies.
2. Timely recognition of examples of successful structures and procedures and, where appropriate, of existing potential for optimization.
3. Feedback for lecturers on their own performance and the identification of problem and perspective areas in teaching courses.
4. Improvement of communication between lecturers and students.
5. Transparency about the quality of teaching and studying.
6. Improvement of the study and examination process.
7. Development of a working basis for the conception and implementation of quality assurance and promotion measures, e.g. in a target agreement.^{17, 18}

3.1 Evaluation of courses

Course evaluation means the regular and systematic collection, processing and feedback of data to assess the quality of teaching and study programs and their conditions using standardized procedures and instruments. The goal is to provide lecturers with information about student perceptions of the courses they hold. An exchange with the students in this regard is to be encouraged and improvements are to be made if necessary. The lecturers receive qualified, anonymous feedback from the students on the most important aspects of the quality of the course in a timely manner. This makes it possible to identify potential for improvement, to derive measures from it and to give feedback to the students. As a rule, course evaluations are to be carried out in such a way that the lecturers can give the students feedback on the evaluation results during the lecture period. Results are communicated to lecturers in person. Which form of evaluation is used depends primarily on the objective. Other factors include the number of students or the resources available. The forms of evaluation are manifold: summative or formative, qualitative or quantitative, related to satisfaction, learning success or transfer. With all evaluation methods, it is important to consider on which aspect exactly the focus of interest lies. In principle, it is not possible to collect all desired information with a single evaluation.¹⁹⁻²²

The term summative evaluation refers to a form of assessment carried out at the end of a course. It provides information on whether or not a set objective has not been achieved, which allows the effectiveness of a course to be assessed. Data and information on the overall performance of students in the course are collected and evaluated. Various assessment tools are used, such as exams, written assignments, or other evidence of performance. The results can be used to identify potential areas for improvement. Formative evaluation accompanies the course, i.e. continuous evaluation takes place during a course. The aim of formative evaluation is to measure learning progress at regular intervals, to give and receive feedback in order to improve the students' learning process during the course. To this end, various methods can be used to measure and assess student learning progress. Assessment tools include short tests, quizzes, homework assignments, peer feedback, and verbal feedback from the lecturer. Student feedback, in particular, can help the lecturer identify which aspects of the course can still be improved to enhance student learning. In this way, formative evaluation can help students achieve their learning goals more quickly and effectively.¹⁹⁻²²

A qualitative evaluation refers to a type of evaluation that aims to assess subjective and non-measurable aspects of a course. Unlike quantitative evaluation, which focuses on measurable data and numbers, qualitative evaluation collects narrative and descriptive information about the course. In terms of implementation and evaluation, this method is particularly laborious, but leads to information and insights that are not possible through quantitative questionnaires. Standardized questionnaires are used here, and although they can be used to collect student feedback on a wide variety of aspects of teaching. But the questionnaires usually contain only closed questions, which are evaluated with a defined scale, allowing a statistical evaluation of the results. A qualitative evaluation can be carried out by means of various methods, such as interviews, group discussions, open questionnaires and observations. These methods allow students to describe in detail their experiences and opinions about the course or class. The results can help improve understanding of students' experiences and perspectives. With the help of these two forms of evaluation, it becomes possible to measure, for example, student satisfaction, learning success, or transfer.¹⁹⁻²³

4. EVALUATION CONCEPT FOR THE MEDIA TECHNOLOGY COURSES

Especially in a newly designed curriculum with new content and course formats, it is very important to evaluate them from the beginning. Through evaluation, weaknesses and strengths of courses can be identified. This enables lecturers to work on targeted improvements in order to increase the quality of the courses and improve the learning success of the students.

Through evaluation, lecturers receive feedback on their work. They learn how students perceived their courses and can adapt and improve their teaching methods as a result. Evaluation makes the work of lecturers transparent. The evaluation of courses serves the purpose of quality assurance at universities. Based on the results of the evaluations, universities can take measures to improve the quality of courses.¹⁹⁻²²

4.1 Constructive Alignment

When redesigning the curriculum and the individual courses, the didactic model of Constructive Alignment was applied. This model pursues the goal of supporting lecturers in the planning of a course to coordinate learning objectives, teaching and learning methods as well as the examination forms. The constructive alignment of these three essential elements is enormously important. In concrete terms, both the structure and the content of the course are aligned with the final learning outcome assessment. The course thus gains in coherence and transparency. At the same time, the learning outcomes targeted and addressed by the examination can still change in the course of time. The concept of a course can therefore be flexibly adapted. The didactic model is based on the constructivist approach, according to which the focus is on the students, who actively and independently acquire their knowledge and are thus responsible for their own knowledge acquisition. The lecturers, on the other hand, provide the students with the opportunities to acquire knowledge and communicate the learning objectives clearly and unambiguously. They also ensure that the learning methods are adapted to the intended learning outcomes and that the final examination tasks show students what they have learned.²⁴⁻²⁸

This basic orientation requires a constant evaluation of the courses and is expressed in the following concept. The development of this concept includes the following sub-steps, which must always be adapted to the selected format of the course:

1. Definition of learning objectives:
Clear learning objectives must be defined to be achieved in the course. These learning objectives form the basis for the evaluation of learning success.
2. Definition of assessment criteria for evaluation:
Assessment criteria are defined on the basis of which the course will be evaluated.
3. Selection of appropriate evaluation methods:
Appropriate evaluation methods are selected according to the established evaluation criteria.
4. Implementation of the evaluation:
The evaluation is conducted to obtain feedback from the students. Depending on the evaluation method chosen, different data are collected to obtain a comprehensive picture.
5. Analysis of evaluation results:
The analysis of the collected data is carried out under defined aspects in order to derive appropriate measures.
6. Implementation of the derived measures:
The results are used to make potential improvements.
7. Adaptation of the evaluation concept:
An adaptation of the evaluation concept to the derived measures should take place. These are then evaluated again to ensure that the desired effects have been achieved.

Overall, evaluations should be conducted regularly and adjusted to ensure that they meet the needs of students and the goals of lecturers.^{19-22, 24-26}

4.2 Evaluation tools

The redesigned curriculum for teaching in media technology includes different course formats based on e-learning scenarios developed over the last few years and the further development towards research-oriented education. The aim of these concepts is to facilitate knowledge transfer and individual learning. Students are required to work independently and develop individual solution strategies. The core element of these concepts is the university's e-learning platform. This provides easy access to a wide variety of online learning materials with many opportunities for interaction. E-learning is ideally suited to expand established teaching scenarios with digital media. The e-learning platform is maintained by the lecturers and provides the entire course content in the form of lecture notes, presentations as well as screencasts on the individual topics. Literature, scientific papers and documents are also made available. It also offers many valuable tools (activities) that can be used to evaluate a wide variety of assessment criteria. These allow the collection of data adapted to specific evaluation criteria and their automated analysis and output in reports. Efficiency control and also motivation is possible via a variety of awards and feedback to students. In the concept for the evaluation of teaching media technology, the following tools are used in a form adapted to the goals of the different courses.^{3-5, 29}

With Tests it is easy to implement certain types of learning assessment. Designing a flexible system makes it possible to measure performance levels and keep participants active and engaged in the course. Tests should be used as frequent checks at a defined rate that require relatively little effort. This allows both lecturers and students to check knowledge and skill levels in an automated way at regular intervals. This tool offers a high number of possibilities and thus creates a high flexibility in the design of tests, combined with an automated evaluation. A well-designed test provides flexible information about the student's performance level. Timely feedback is important here, making tests an important self-assessment tool for students. The Task tool makes it possible to provide tasks to be completed online on the e-learning platform. The solutions can be entered directly by the student or uploaded in the form of files. The lecturer is responsible for designing the tasks. The solutions can be requested in the form of one or more files or as online text input. These can be submitted individually or in groups. In addition, a submission period can be specified. It is also possible to evaluate the submitted solutions anonymously, i.e. it is not visible during the evaluation who has submitted the solution. Following the evaluation, the lecturer can give feedback on the submitted solutions in various forms. The forms of feedback range from grading and comments, to grading tables, to the specific use of feedback files. These can be submitted solutions with comments, sample solutions, assessment templates or feedback in the form of audio files, etc. ^{30, 31}

Two other tools are Feedback and Survey which are very similar in their usage. Feedback is used to create and conduct surveys with self-formulated questions. It is particularly suitable for evaluating the progress of a course or the lecturer. Survey provides a set of standardized questionnaires that have proven useful for assessing and activating learning processes in online learning environments. These include the COLLES (Constructivist On-Line Learning Environment Survey) ³² and ATTLS (Attitudes to Thinking and Learning Survey). ³³ The lecturer can use these survey forms to gather information about the group of students. This information helps to learn more about the group of students, which also allows for reflection on individual teaching methods. ^{30, 31}

In addition to the evaluation methods provided by the e-learning platform, other tools with differing objectives are used. In basic courses in the first study section (semesters 1-2), the physical, mathematical, electronic and technical fundamentals of media technology are taught in theoretical face-to-face lectures. Experience shows that the confrontation with a multitude of new terms, theories and models can quickly lead to excessive demands and demotivation for many students. The high challenge for the lecturer is to create a learning offer that also increases the learning motivation in this special teaching situation. For this purpose, a low-threshold learning offer in the form of a Quiz app is used, which can be used in teaching in compliance with data privacy regulations. The teaching content is prepared in gamified form and made available to the students at the end of each lecture. They can then work on the questions via smartphone, tablet or laptop. It is important to note that participation is always anonymous. The results of the overall group are always made available to all participants anonymously in the form of a rating. This gamification approach offers the lowest possible threshold access to the learning material and awakens a willingness among students to challenge themselves. In this way, the motivation to continuously deal with the learning material can be promoted and the social interaction of the students positively influenced as well as the performance improved. A positive aspect is that a lot of attention from the students is perceptible during the live quiz. ^{34, 35}

The Performance Record in the form of specified examination types is the final instrument for assessing and verifying the students' learning success. The types of examination are specified in the university's study and examination regulations and are generally carried out during examination weeks and outside the lecture period of the study semester. It is also possible to conduct partial examination performances during the course of the semester. Depending on the form of the course, the final examinations are offered in written or oral form. These can also be conducted online in compliance with defined regulations. In written examinations, students are to demonstrate that they can solve tasks and work on topics in a limited amount of time and with limited aids using the common methods of their subject. The written examination is also intended to determine whether they have the necessary basic knowledge. Other written examinations are term papers, seminar and laboratory reports, which usually accompany courses with a high practical content. Oral examinations are also possible. These give students the opportunity to demonstrate that they can recognize the interrelationships of the examination area and that they can classify specific questions in these interrelationships. This includes the verification of sufficient basic knowledge.

Outside of the concept presented here, the evaluation format of a questionnaire standardized in the evaluation regulations of the Offenburg University then finds its place. This contains a university-wide uniform, obligatory questionnaire part, which can be tailored by a special questionnaire part to the interests of the respective organizational unit. The courses to be evaluated are determined by the respective study commissions. All courses of a faculty are evaluated within a two-year cycle.¹⁷

Evaluation tools

Focus: summative, formative



"Tests" are used to monitor learning progress and success. This tool is used online via the e-learning platform. The evaluation is automated and enables direct feedback.



"Tasks" are used to monitor learning success. This tool is used online via the e-learning platform. Prompt assessment as well as the transmission of appropriate feedback is important.



A regular learning success check is carried out via app in the form of a gamified "quiz". The students can participate anonymously and receive direct interactive feedback.



The final tool for evaluating learning success is the "performance record" defined in the study and examination regulations. The type of assessment can vary depending on the structure of the course.

Focus: qualitative, quantitative



"Feedback" is used to create and conduct surveys with open self-formulated questions to evaluate the progress of a course or the lecturer. This tool is used online via the e-learning platform.



"Survey" includes a set of standardized questionnaires to assess and activate learning processes in online learning environments. This tool is used online via the e-learning platform.



"Verbal feedback" is a very important tool, especially in all practical courses. The personal exchange is in the foreground here enables the evaluation of a wide variety of goals.



The use of the university-wide standardized "questionnaire" is defined in the university's evaluation regulations and includes a quantitative and qualitative evaluation of courses by students.

Figure 3. Overview and brief description of the tools used in the evaluation concept.

4.3 Evaluation concepts of the different course formats

The goals defined for the restructuring of the curriculum led to the presented redesign and new content orientation of the lectures. These are implemented with different course formats. The listed evaluation tools are always used adapted to the different course formats. The basis for this is the selected content as well as the defined learning objectives and evaluation criteria.²⁰

In the first study section (semesters 1-2), the classical face-to-face lecture format is used to teach the theoretical fundamentals of media technology. These are accompanied by practical laboratory sessions. The focus of the teaching is placed on the various media technologies and the underlying principles of physics, mathematics and electrical engineering are taught in the direct context of the respective technical subject area. The learning objective of the face-to-face lecture is defined as the development of a basic understanding of the fundamental scientific theories and concepts of media technology. The learned knowledge should be able to be applied in simple examples. The defined type of examination for testing and evaluating the learning success is the written exam. In terms of content, this consists of pure knowledge queries and their application in text tasks to be solved. For the planned evaluation, the assessment criteria learning progress, learning success, learning methods and satisfaction were defined for the students. From the point of view of the lecturers, the evaluation criteria quality of teaching, teaching methods and didactic design, organization as well as equipment and learning materials have been defined. Formative forms of evaluation are used to check learning progress. At regular intervals, written tasks and tests are required to be completed online at defined times. Each lecture is concluded with a gamified online quiz. Summative is the written exam at the end of the semester to measure the learning success. As a qualitative evaluation, feedback rounds are held regularly during the lectures in conversation form. In addition, the online tools Feedback and Survey are used. Finally, the standardized questionnaire of the university is utilized.

The accompanying course form laboratory includes the practical implementation of physical and electrotechnical experiments. The learning objective also includes the basic understanding of fundamental scientific theories and concepts of media technology and the application in given practical laboratory experiments. The type of examination here includes the practical work as well as the preparation of a written report and a poster. For the planned evaluation, the same assessment criteria were set for students and lecturers. The review of learning progress is formative in the form of direct exchange and feedback during the laboratory session. Assessment of learning success is summative through the submission of the lab report and poster. For qualitative evaluation, the online tools Feedback and Survey are used.

Evaluation concept for theoretical face-to-face lectures

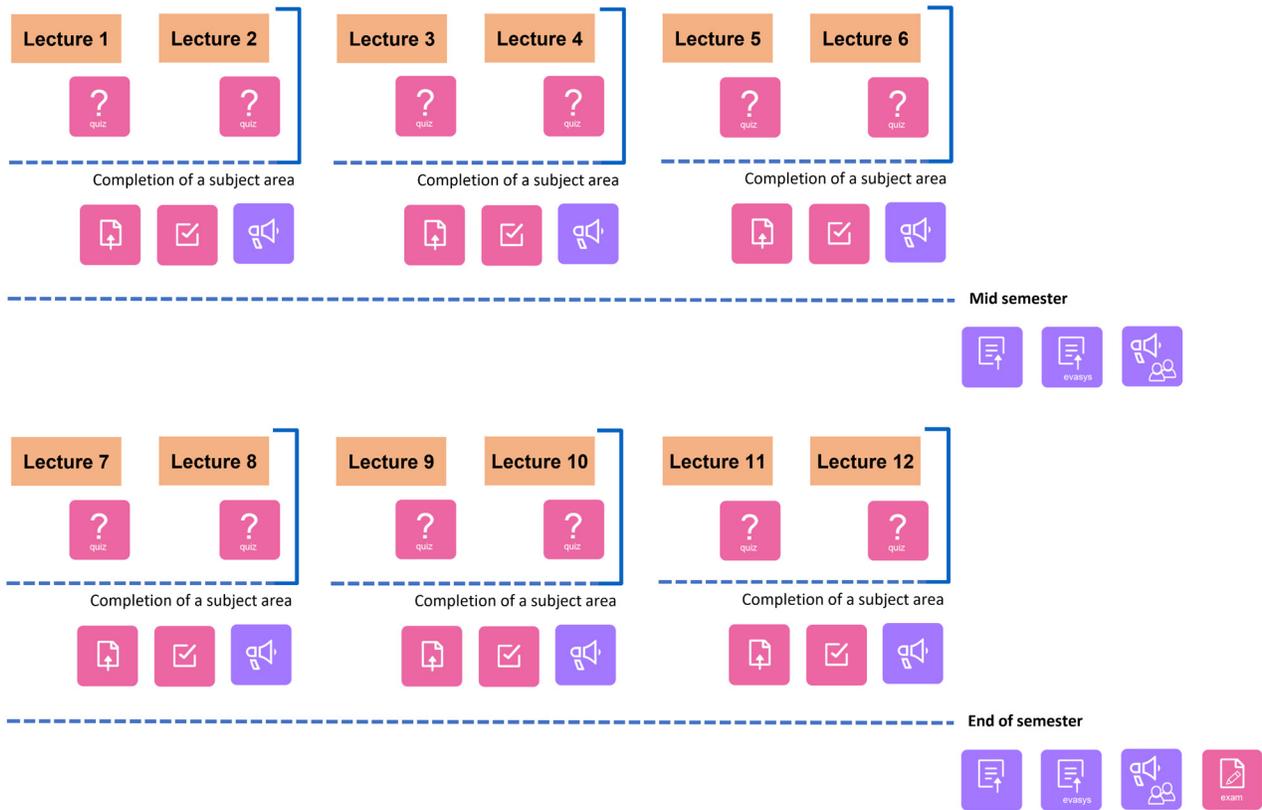


Figure 4. Representation of the planned evaluation concept for theoretical face-to-face lectures. In the first study section, the scientific theories and concepts of media technology are taught in 12 face-to-face lectures per semester. In terms of content, the various main topics are usually presented in two lectures each.

Evaluation concept for laboratory courses

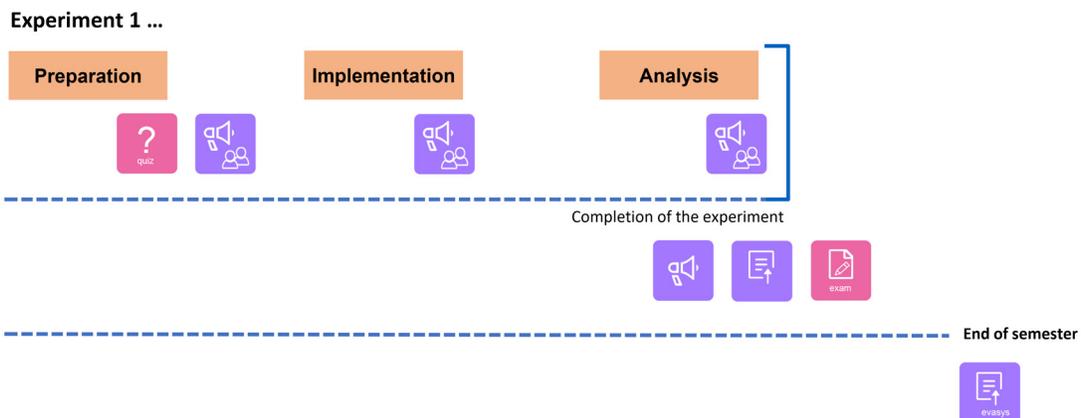


Figure 5. Representation of the planned evaluation concept for conducting experiments in the media technology laboratory. In the first study section, the theoretical face-to-face lectures are accompanied by six practical laboratory sessions. In group work, three physical and electrical engineering experiments are carried out per semester, thus applying the knowledge acquired. The evaluation concept is applied identically for each of the six experiments.

In the second study section, the format of the face-to-face lecture will initially be continued. Here, all the important theoretical and scientific fundamentals will be laid with the aim of specializing in media technology. To deepen the basic knowledge, two modules are offered which must be completed as prerequisites for the further courses. The Media Technology module includes advanced physical and electrical engineering fundamentals as well as fundamentals of sensor and microcontroller technology. The contents of the Media Technology Applications module are somewhat more specific. Here, on the one hand, basics of audio-video (AV) studio and broadcast technology are offered, as well as basics of print production. For evaluation purposes, the same evaluation criteria and forms of evaluation are used here as were defined for the basic theoretical face-to-face lectures in the first study section. Only the learning objectives are specified based on the clearly specified lecture content in the direction of a clear deepening of the knowledge to be developed and its application (see Figure 4).

Evaluation concept for courses with practical project reference

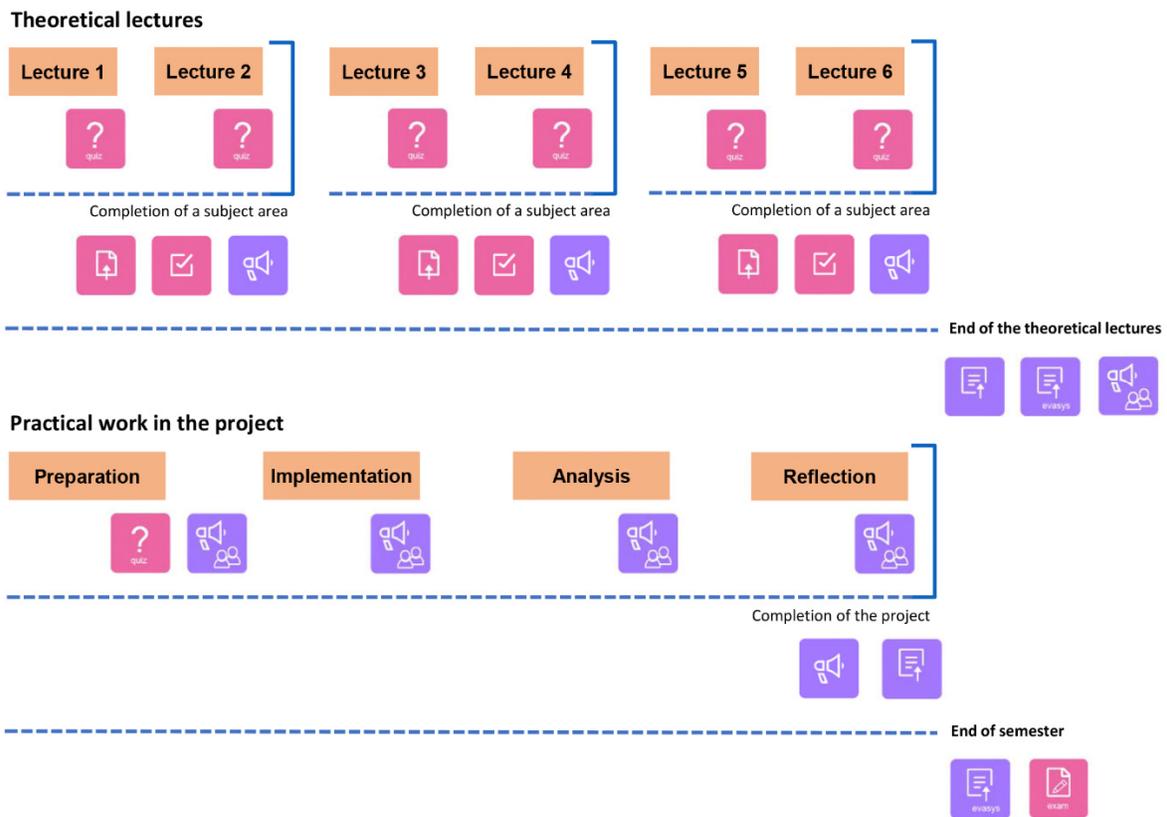


Figure 6. Representation of the planned evaluation concept for courses with practical project reference. In the second study section, specialized content is taught in various courses within the framework of practical projects. Six theoretical classroom lectures are supplemented by a high practical part in defined projects, which is done in group work.

From the fourth semester onwards, the range of courses is broader and includes many hands-on activities. In these courses, the defined content is taught with a specifically selected high practical component. The focus of the courses is on the development of competencies through the independent development of extensive areas of knowledge within the selected core subjects. Here, the course forms of face-to-face lectures and practical project work are combined. Contents are subject-specific advanced theories and concepts, which are then practically implemented within the framework of a defined project. The learning objectives are the further development of specialized knowledge in defined areas of media technology and its application and practical implementation within the framework of a project. For the students, the assessment criteria of learning progress, learning success, learning methods and satisfaction are supplemented by transfer. From the point of view of the lecturers, the evaluation criteria quality of teaching, teaching methods and didactic design, organization as well

as equipment and learning materials are retained here. The formative evaluation forms of Tasks and Tests (written online) are used in the face-to-face lectures to check learning progress. Here, too, each lecture is concluded with a gamified interactive quiz. The online tools Feedback and Survey are used as a qualitative evaluation. In the practical part, the focus is on personal exchange in the form of regular feedback sessions. Only in the preparation the tool quiz is used again. When the project is finished, the overall impression is evaluated again with the online tools Feedback and Survey. The Performance Record consists of a written examination to verify knowledge and an assessment of the practical work. The written exam at the end of the semester continues to be a summative form of evaluation. This is supplemented by an assessment of the practical work within the framework of the project, which also considers the transfer of knowledge. To conclude, the standardized questionnaire of the university is used again.

In addition, participation in three current research projects is also offered as part of the module Research and Projects, thus realizing research-oriented education on real projects. Students are offered the opportunity to systematically familiarize themselves with an entire research process. The conduct of the research, the evaluation and presentation of the results up to the reflection of the entire research process is completely in the hands of the students. In the course form of the practical research project, further specialized knowledge is imparted. By carrying out typical research activities, the learning objectives of systematic familiarization with the complete research process and the development of competencies relevant to research are to be achieved. The type of examination is the practical work and the results achieved. The work in a research project requires cooperation, i.e. a trusting collaboration between students and lecturers, which is why an individual form of examination is not used. The evaluation criteria for the students are still learning progress, learning success, learning methods, satisfaction and transfer. From the point of view of the lecturers, the evaluation criteria of quality of teaching, teaching methods and didactic design, organization as well as equipment and learning materials are also retained. Learning progress, learning success and transfer are qualitatively reviewed through a constant personal exchange in the form of feedback rounds, which is necessary in a research project. The results achieved are jointly analyzed and reflected upon. This exchange is supplemented by the online tools Feedback and Survey.

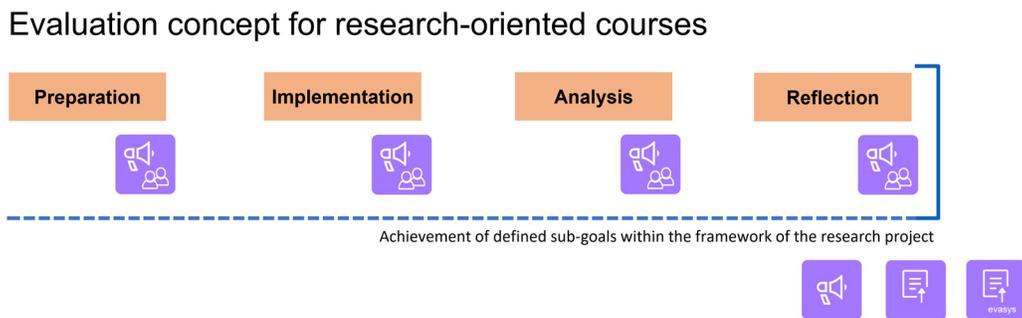


Figure 7. Representation of the planned evaluation concept for courses within the framework of research-oriented education. Students work on real research projects within the framework of teaching and thus systematically learn about the complete research process.

5. PERSPECTIVE

The redesign of the curriculum offers a great opportunity to raise teaching in media technology to a new level. This requires up-to-date, modern teaching and learning concepts that do justice to the constant technological progress. Teaching and studying should be characterized by a student-oriented teaching and learning culture. An open, modern learning environment is also of high importance. The aim of the evaluation concept presented here is to generate structured information regarding the quality of content, didactic and organizational aspects of teaching. In this way, weaknesses and strengths can be identified and targeted improvements can be initiated. The exchange of opinions between students and lecturers is promoted, and the work of the lecturers is made transparent. Feedback on all aspects of the course enables the best possible further development.

Further development will remain the focus in the future. The development of existing teaching concepts towards research-oriented education is only a first step. Currently, targeted work is being done on the realization of virtual experiments and laboratory environments in order to gain new insights in the field of e-learning in conjunction with AR, VR and MR technology.

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