

# Internal Conferences as a Constructivism Based Learning Arrangement for Research Master Students in Software Engineering

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**Abstract** - *This summary describes the idea and the realization of “Internal” conferences as a constructivism based element in the education of Research Master students in Software Engineering. The conception is dealing with research based learning, activated learning, and constructivism based methods to acquire knowledge in an ideal way: performing research work, by preparation of posters, papers and presentations and by attending the conference as a presenter.*

**Keywords:** research based learning, activated learning, constructivism methods, internal conferences

## 1 Introduction

This paper deals with university internal conferences as an experimental laboratory for young academic research master students in Software Engineering to achieve competencies in presenting and expressing their own research results. Constructivism based methods are used in the seminar “Scientific Presentation” which is followed by the internal research master conference at the Regensburg University of Applied Sciences as a partner of the cooperative master’s degree program of four Bavarian Universities of Applied Sciences. Because Software Engineering is a very volatile subject constructivism based learning methods will be recommended.

### 1.1 Cooperative master's degree

The cooperative master’s degree program started at the Regensburg University of Applied Sciences in 2009. It is a cooperation program between four Bavarian Universities of Applied Sciences (Deggendorf, Nürnberg, Regensburg and Ingolstadt).

The aim of the program is qualification for the implementation of scientifically based application-oriented research and development work in the fields of Electrical Engineering and Information Technology, Software Engineering, Mechatronics and related disciplines. The goal is to educate students in analytical, creative and design skills.

Technical, methodological and personal competencies are trained.

The teaching of these skills is based on related projects, applied in the research and development activities of the participating universities.

Thus, the relevance of topics is secured by the specific qualities of the involved faculties. Systematic work in the scientific research fields is managed by succeeding project phases. Both appropriate teaching modules, and the project and master thesis work, relevant for scientific publications, are an integral part of the course. The final thesis has the character of an independent and original paper which highlights the student’s problem solving and method skills.

Professors supervise the research master students intensively in all research phases and in the corresponding seminars.

The advantages of a long term involvement of students in research master projects during a three semester education are that, in addition to the technical and methodological skills, the adaption of personal skills are promoted in practical training: teamwork, communication, language, and presentation skills.

The implementation of training objectives in connection with application-oriented research projects must involve appropriate scientific parameters. Criteria for this are:

- Sufficient experience of the faculty in research and development activities, e.g. demonstrated by relevant publications.
- Existence of an infrastructure in the participating laboratories.
- Interdisciplinary cooperation of colleagues in the field of work.

Research Master Students are involved in research projects from different faculties and universities of applied sciences. Therefore there is no strict subject canon as given in

normal master examination regulations. In consequence every research master student can select subjects from existing master programs of the cooperating universities. In an assortment colloquy the student's subjects decision is checked against the demands of the research topics. The final subject selection must match the module structure given in Table I. The possible subjects are given by the master programs of the cooperating universities.

The German abbreviation SWS means Semester week hour (1 SWS =  $\frac{3}{4}$  hour per semester week), whereas ECTS is the abbreviation for European credit transfer system. One academic year corresponds to 60 ECTS-credits that are equivalent to 1500–1800 hours of study.

The research master students use this module structure in the first and second semester of the cooperative master's degree program.

TABLE I. MODULE STRUCTURE – TEACHING MODULES

No.	Module	SWS	ECTS Credits
1	Mathematical, physical science, and natur sciences module	8	10
2	Technological module	4	5
3	Interdisciplinary Module	4	5

The module Research Methodology (see Table II) is offered by the involved universities as a network contribution.

TABLE II. MODULE STRUCTURE – RESEARCH METHODOLOGY

Semester	Module	SWS	ECTS Credits
1	Research Methods and Strategies, Part 1	6	6
2	Research Methods and Strategies, Part 2	6	6

In detail the following subjects can be selected by the research master students:

- Literature and patent search.
- Standards and standardization.
- Funding opportunities for national and EU projects.
- Academic writing and presentation.
- Scientific conference in combination with a master seminar.
- Rhetoric.
- Project methodology.

The high portion of research oriented work for research master students is summarized by the project work 1 and 2, and also by the final master thesis project as given in Table III. Overall there are 58 ECTS directly assigned for research related work. If possible, research master students work in cooperating research teams with PhD students.

TABLE III. MODULE STRUCTURE – PROJECT AND MASTER THESIS

Semester	Module	SWS	ECTS Credits
1	Project 1	10	12
1	Seminar to Project 1	2	2
2	Project 2	10	12
2	Seminar to Project 2	10	2
3	Master project	-	28
3	Masterseminar	2	2

## 1.2 Background

Constructivism is a theory about the acquisition of knowledge, about learning and teaching [1, 2, 3, 4]. The core statement is that every person constructs his or her own personal reality by communicating with the environment. Thus, this perception of reality differs from the ones of other people. Learning is seen as the construction of meaning and therefore as dynamical evolution of the individual reality.

The educational approach of constructivism contradicts the thesis that knowledge can be transferred from the teacher to the learners. Constructivism emphasizes the origination of ideal conditions for learners so that they are able to construct their knowledge themselves. It prefers to support surroundings which enable the learner to acquire knowledge by researching and exploring of so-called authentic questions individually or in groups instead of providing information and skills to the learner as the traditional approach would suggest.

A constructivist learning environment [5] is characterized by giving the learner a chance to think, explore and discuss in collective cooperation with other learners. This constructivism approach is applied in the seminar “Scientific Presentation” and the corresponding internal research master conference.

## 2 Internal Conferences

### 2.1 Preparing Internal Conferences

The seminar “Academic Writing and Presentation” is placed in the beginning of the semester, whereas the scientific conference is placed in the final weeks of the semester cycle.

Both the seminar and the conference contribute to the module “Research Methods and Strategies”.

In order to attain our main objective of improving student involvement, motivation, and self-directed learning, we wanted to create a learning arrangement where the students could enjoy a sense of freedom. Those learning arrangements should include collaborative tasks that are of some personal interest to each student and promote individual and collective reflection about the seminar and research topics involved [6].

Therefore the research master seminar “Academic Writing and Presentation” is covered by the following elements:

- Basic information communicated by dialogue based lecturing of the professor.
- Self-organized learning phase [7] (students perform literature search by themselves).
- The student is able to design his or her own role using the learning environment and applying problem-solving-strategies.
- Preparation of a poster and a paper comprising of learning or research topics.
- Usage of a learning journal for documenting learning success and discovered problems with the learning issues.
- Group Puzzle (also called Jigsaw Puzzle [8]) – The students are self-directed and able to organize their learning process actively.
- Open Space [9].
- Usage of the computer based learning platform Moodle (blended learning approach).
- Retrospective – a feedback loop for collecting students’ learning experiences.

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## 2.2 Preparation of a poster

Poster sessions provide an excellent opportunity to present research results. They are an approved technology since their introduction in 1970 [10, 11]. You can find a short discussion from the beginning of poster sessions in [12]. Until the present day you will find information about poster sessions in various articles [e.g. 13, 14]. Because it is one of the keystones of our internal conferences we will study them in detail under the viewpoint of constructivist didactic.

Constructivist didactic consists of three major elements applied in individual learning phases [1]:

- Construction: we construct our reality.
- Rekonstruction: we are the discoverers of our reality.
- Deconstruction: we unmask our reality.

We will see that all three elements are part of the preparation process of a good poster. A good poster will be one which transports all the information you want and captures the audience’s attention. So it may be a challenge for the students to prepare a good poster.

First we have to define the content of our poster. That’s an easy decision in the process of preparing the poster because the master students want to present the results of

their research. Secondly we have to examine the audience of the poster session. That's not so easy and needs the help of the professor. In our case the audience consists of other students, professors and interested people from local industry and organisations. We are especially interested in the knowledge the audience will have in our subject of research. Normally they will be no experts in our research subject so we have to simplify our information.

When we know our audience and their knowledge, the students have to think about how they learnt the subjects of their research, more precisely how they constructed their reality. This method of self-reflection is not normally learnt by the students. So it is up to the professor to develop this method in earlier sessions. By thinking about their own learning process the students are able to put themselves in the position of the audience. Now they may have an idea how the audience will construct their reality. This knowledge will determine the design of the poster: which graphics do they need? Which information will they present as pure text? How will they guide the audience through all of their information so the audience will be able to construct their own reality? In the literature and the internet we find helpful information on how to design posters [10, 15, 16].

When the first version of the poster is ready the students can show it to the professor and to people comparative to the audience. In [15] we will find a nice process to check readability and clarity of the posters. A tester should read the sample layout aloud while the students listen. They notice every problem the reader will have with their poster. And the students will create new versions until every tester understands the information on the poster. Now the students have a poster which will be understood by the audience. For the students this is difficult because they have to reconstruct and deconstruct their reality from version to version. But they learn how the audience will think. In [17] Berkun describes that we need this process to get a good design. He quoted Einstein who said "the physicist's greatest tool is his wastebasket". So let's think about our wastebasket on the desktop as a great tool!

In addition to the poster the students should prepare a handout which they can give to the audience if they need more information. In that handout students may describe their results in greater detail.

Students should also prepare a small oral presentation of their poster for the people who will not read everything but are interested in their work. This presentation has to be consistent with what the audience can see on the poster, so it should be well prepared.

Now we will present a checklist for the professor:

- Define the content of the poster with your students.

- Tell the students about the audience.
- Tell the students about the audience's knowledge in the research subject.
- Tell the students about design of posters and show them links to designing guides.
- Be one of the first reviewers of the posters.
- Give hints to reviewers with the audience's knowledge.
- Help the students in preparing handouts.
- Advise the students of preparing a presentation.
- Advise the students of preparing a discussion about their poster.



Figure 1. Poster session

Let's write about our experiences with our students who never prepared a poster: The student's first question is often "Why can't we use slides for our presentation?" followed by "What is the difference between posters and slides? We only have to rearrange our slides to get the poster!" The students need time to understand that slides only maintain an oral presentation and that that is completely different from posters which were only read by the audience. Here the teacher has a big challenge to explain the differences and motivate the students to prepare good posters.

### 2.3 Usage of learning journal

As a flight recorder of the learning process each research master student writes a learning journal. A learning journal comprises the cooperating aspects in the learning process, the content and the learning process itself and also the working technique used.

This reflection about the personal working approach is carved out by the categories and questions in Table IV. The learning journal is a well verified memory tool for the final retrospective session of the seminar.

TABLE IV. QUESTIONNAIRE – LEARNING JOURNAL

Category	Leading Question
Cooperation	How was the cooperation?
	How were the tasks distributed?
	How do we handle conflicts?
	Did I notice anything?
Content and learning process	What have I done?
	How have I done it?
	What was my result?
	Was I confident?
	What did I understand?
	What did I not understand?
	What was missing?
Working technique	In which topics will I continue?
	How effective is my method?
	Is my method adequate for the problem solution?
	For which cases is my method applicable?
	Pros and Cons of my method.

Each student will come back to his or her project group and will try to present a well-organized report to the group. Therefore each individual is essential; and that is precisely what makes this strategy so effective.

## 2.4 Group Puzzle (Jigsaw Puzzle)

Group Puzzle or Jigsaw Puzzle is a cooperative learning technique which increases positive educational outcomes. Each student's part is essential for the completion and full understanding of the given learning issues. This method can be found in the constructivism method pool [1].

The research master students of the seminar “Academic Writing and Presentation” are divided into small project groups (see Figure 2). The project groups delegate a team member to each working group. In the working group the students discuss and learn in a self-directed manner, so that each member of the working group can explain the complete learning issue.

Each student will return to his or her project group and will try to present a well-organized report to the group.

Therefore each student is necessary for the project group; and that is precisely what makes this strategy so effective.

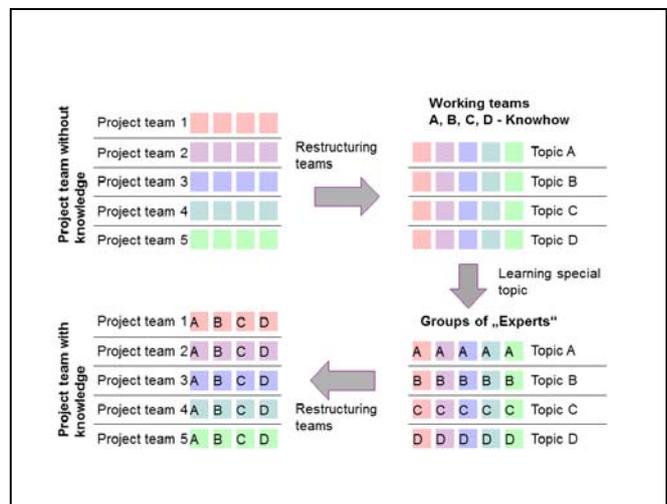


Figure 1. Group Puzzle used with the research master students in the seminar “Academic writing and presentation” .

During the seminar the Group Puzzle method is used for the following learning issues:

- How to create a poster presentation.
- How to write a scientific paper.
- How to perform a conference talk.

## 2.5 Open Space

Open Space is originally detailed in the introduction from Harrison Owen [18].

Open Space is a highly participative learning method in which participants self organize around an agenda. Participants generate issues and topics, e.g. poster presentations before or during the Open Space session. The discussion groups are self-selected by the students. Each group decides in which poster they are interested.

The process is particularly effective in uniting students with diverse competencies, in solving complex and contentious issues.

The poster session of the Applied Research Conference is performed in Open Space structure.

## 2.6 Retrospective

The retrospective as feedback instrument for quality improvement is used in software engineering process models, like SCRUM [20]. In our context of a constructivism learning arrangement the retrospective is applied as a kind of feedback loop about the learning process to finalize the seminar.

The leading questions for preparing a learning journal as given in Table IV are a good starting point for the retrospective session.

As a retrospective facilitator the supervising professor follows the content. A retrospective leader focuses on the process and structure of the retrospective. He attends to the needs and dynamics of the group and helps the group reach a goal. Retrospective leaders remain neutral in discussions, even when students have strong opinions [20].

When the content involves your own team, it is easy to get caught up in the discussion. It is tempting to jump into an engaging conversation, especially when you care about the topic, but you must refrain from doing so!

### 3 Experience

The proposed learning arrangement of internal conferences facilitated the self-organization of the students and created a context where they could work autonomously and felt pleased with what and how they were learning.

The first research master conference at Regensburg University of Applied Sciences was performed in April 2011. The students were highly motivated by the opportunity to present their research work to their peer students. They were consequently well prepared and practiced in the learned techniques for their research result presentation. Several students were encouraged to contribute their results to external conferences and scientific journals. An outlook is given on how to use the proposed learning arrangement in bachelor education courses.

#### 3.1 Conference structure

The Applied Research Conference is placed in the 3rd semester of the research master education. The Applied Research Conference is prepared by the seminar “Academic Writing and Presentation” in the 2nd semester (see Figure 3).

The workflow of a real conference is used by our internal conference. We schedule a call for paper phase and a review process. Thereby the conference proceedings consist of only fully reviewed papers. Also the conference proceedings are printed with a citable ISBN. Students with highly scored papers will present their research results during the conference. In addition a poster session is established in the Applied Research Conference for student paper contributions with lower scores. The poster session is organized following the Open Space approach as given in [18].

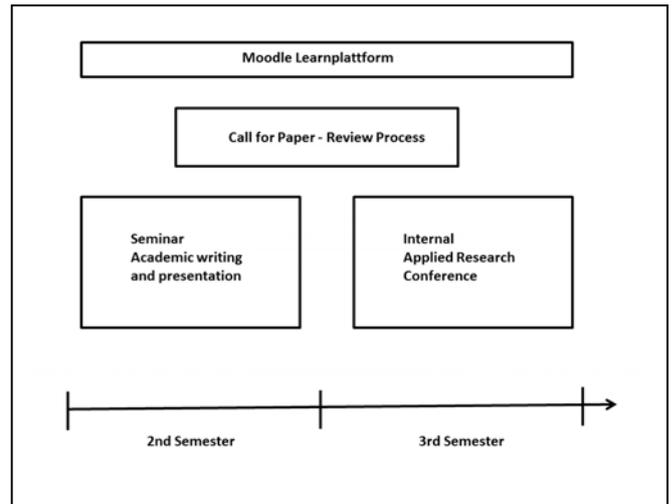


Figure 3. Sequential arrangement of the seminar “Academic writing and presentation” and the Applied Research Conference as internal conference with review process. The learn platform Moodle is used for exchange between supervisors and research master students

#### 3.2 Lessons learned

Students and the professor shared responsibility for all that happened. Our experiments in 2011 in a real setting, involving courses with many students, also showed that internal conferences in higher education, supported by appropriate strategies, is not only possible, but an interesting option to create valuable educational contexts that maximize students’ participation and learning.

The process required effort, but this effort was rewarding and promoted participation and learning.

University teachers and students realize the potential impact Moodle may bring to their daily instruction and management.

The learner is to be encouraged to acquire knowledge and skills in a self-regulated manner. Learning as a process is, according to the catalogue of Arnold [21], also the development of self-competence. In this way the student develops the ability to motivate his or herself for life-long learning.

The sustainability of the students’ competence development is proved by the following criteria [7]:

- The student is able to design his or her own role using the learning environment and to apply problem-solving-strategies.
- The students are self-directed and able to organise the learning process actively. Knowledge is created by the individual learner (by teamwork exercises,

individual research work, interview by the instructor, project work in cooperation with other learners).

- The students create the objects of learning constructively in their minds. Practice tasks and sample solutions are designed (see chapter 1, Background).
- The process of learning is situative. During the seminar “Academic Writing and Presentation” the learning students stay in a realistic situation by solving concrete problems. Applicable knowledge is created in a situation close to the reality of professional life so that inert knowledge is avoided (see Figure 3).
- Reflection and in-depth study of the theoretical essentials follows the practical task (in this specific case: an applied research task).

This way of proceeding is by John Dewey [22] the “father” of project learning: Human experiences originate from the interaction of experiencing and producing actions. Hence knowledge is created by action. The learner shows interactive behavior experimenting curiously. This means interactive pedagogy.

The five steps of interactive pedagogy are:

1. Practical action and primary experiences.
  2. Problem related and reflectional thinking.
  3. Rendering information material accessible.
  4. Construction of working hypothesis.
  5. Testing and validating the hypothesis by practical action.
- Learning through social interaction: brain research results can be described in an integrative interpretation [23]. In this respect, the holistic approach of processing information cerebrally confirms the constructivist viewpoint of didactics [24]. Caine depicts twelve principles of learning-teaching in [25]. Principle two is: “The brain is social.” i.e. a learning process which includes social interaction is effective. The cooperation of the learners in small-sized groups as study community is superior to individual learning.
  - Learning is action-oriented. This means physical motion, the use of as many senses as possible and the being involved of both body and mind while learning.

This S-A-V-I-learning is characterized:

- Somatically: learning by action and motion.
- Auditively: learning by speaking and listening.
- Visually: learning by observing and imagination.

- Intellectually: learning by problem solving and monitoring the process.

All four forms have to be realized if optimal conditions for learning are required. A supervised project work appertains especially to S-A-V-I-learners.

The spider chart in Figure 3 shows the different criteria of sustainability in competence development. The distribution is the result of a survey among instructors and research master students.

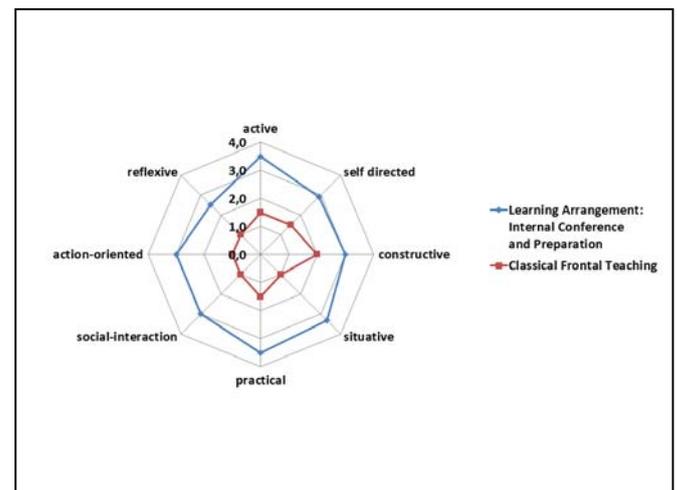


Figure 2. Criteria of competence development in the seminar “Academic writing and presentation” and the following internal conference (data from a survey among teaching staff and students)

## 4 Outlook

After the first Applied Research Conference, the described learning arrangement proves that it is a useful experimental laboratory to introduce young academic research master students to “Academic Writing and Presentation” and corresponding internal conferences.

Students emphasize the advantage of self-directed and active learning during the seminar. This was justified by a survey among instructors and research master students.

The integration of the learn platform Moodle into the seminar concept and the conference preparation has provided a more engaging learning environment.

The success lies in the awareness and willingness of the professor and the students.

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