



INHERE 2018

LEARNING THROUGH
INQUIRY IN HIGHER
EDUCATION:
CURRENT RESEARCH
AND FUTURE CHALLENGES

Munich March 8th-9th 2018

BOOK OF ABSTRACTS

Learning through Inquiry
in Higher Education:
Current Research and
Future Challenges
(INHERE 2018)

Munich, 08.-09.03.2018

Book of Abstracts



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Sponsorship: The INHERE 2018 conference was funded by the
Federal Ministry of Education and Research (BMBF)
under grant number O1PB14004.

SPONSORED BY THE



Federal Ministry
of Education
and Research

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Preface

Dear Colleagues,

Welcome to Munich and the INHERE 2018 Conference!

What started in Potsdam in 2013 as a national conference on inquiry-based learning has become a national research project and a firm network of academics across institutions. The hosting *ForschenLernen* project encompasses Fachhochschule Potsdam, University of Applied Sciences (FH Potsdam), Humboldt-Universität zu Berlin (HU Berlin), and Ludwig-Maximilians-Universität München (LMU Munich).

We welcome you all on behalf of the three partner universities, and in the name of the entire national trace research program of the German Federal Ministry of Education and Research (BMBF). Our joint research project, *ForschenLernen* (an acronym meaning inquiry-based learning) forms part of the trace research that accompanies the *Qualitätspakt Lehre* (QPL) program, a national initiative by the German Government to enhance the quality of teaching in higher education.

The INHERE conference signals the completion of the *ForschenLernen* project. For more than three years we have investigated the question: *How do different types of research-based teaching shape students' competences?* The resulting activities have included quasi-experimental studies, research into learning mechanisms, as well as an assessment of the university context of inquiry-based learning.

We particularly welcome our international guests. We are proud to have the opportunity to discuss our research findings with some of the most distinguished scholars in the fields of Teaching Research, Instruction, and Undergraduate Research. Let's all enjoy this two-day international exchange and dialogue on how conducting research affects learning processes among students and how we can foster the interplay of research, teaching and learning.

Harald Mieg, Wolfgang Deicke, Frank Fischer, Martin Fischer & Jan Zottmann

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Keynotes

01

Broadening the Theory of Undergraduate Research: Assessing Benefits to Institutions, Communities, and Regions

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Although much of the recent discourse on undergraduate research benefits has focused on students' cognitive growth, positive affect, and professional advantage, assessments of benefits to academic institutions, communities and regions are now beginning to emerge. These benefits accrue through both economic and social gains, and can be inferred through the numbers of projects that engage the community, as well as fund-raising that is associated with undergraduate research activity, and undergraduate research outcomes that may lead directly to technology transfer and business creation. Several lines of evidence will be presented to support the theory of undergraduate research with respect to its broader benefits: (1) growth and diversification of inter-disciplinary undergraduate research communities that generate robust campus-based learning contexts; (2) economic impact of institutes and conferences, such as the Council on Undergraduate Research's National Conference on Undergraduate Research, and, (3) the rise of undergraduate research's contributions to addressing societal needs.

Please cite as: Ambos E. Broadening the Theory of Undergraduate Research: Assessing Benefits to Institutions, Communities, and Regions. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc01.

DOI: 10.3205/18inhere01, URN: urn:nbn:de:0183-18inhere016

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere01.shtml>

02

Building effective and engaging instruction; does inquiry learning alone suffice to do the job?

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Active or engaged learning is currently getting much attention because it engages students and research shows it to be an effective form of (science) learning. Despite this, there is also data, e.g., PISA 2015, suggesting that inquiry learning is not associated with improved student performance. In this presentation I will seek for a reconciliation between these contradictory stances and present evidence that the success of inquiry (and other forms of instruction) is not an "all or none" issue but that that successful and attractive instruction requires a delicate balance between different teaching and learning approaches, both within a lesson and within a curriculum. Inquiry learning with online laboratories fits very well with this approach and in the presentation, I will focus on the advantages of online laboratories and discuss the inquiry processes of students and how these can be actively supported by technological means in the form of focused, flexible, and adaptive online scaffolds but also how expository instruction plays a complementary role. An introduction will be given to the Go-Lab ecosystem which is built around a federation of online labs (www.golabz.eu) and that offers opportunities to create effective learning experiences for students with inquiry at the centre but with a clear eye on complementary instructional approaches.

Please cite as: de Jong T. Building effective and engaging instruction; does inquiry learning alone suffice to do the job?. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc02.

DOI: 10.3205/18inhere02, URN: urn:nbn:de:0183-18inhere022

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere02.shtml>

03

Research on undergraduate research: What do we know about the benefits of undergraduate research?

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Undergraduate research is a high-impact educational practice and an engaged form of learning. While it is acknowledged that faculty, institutions and students benefit from undergraduate research (UR), much of the research on the benefits of UR have focused on student learning outcomes. Benefits are typically reported within three domains: cognitive and intellectual growth; professional skill development and advancement (including academic achievement and education attainment); and personal growth and development. Given the numerous reported benefits of undergraduate research, many institutions are seeking to enhance and expand their undergraduate research programs by developing summer research programs, expanding honors and independent research opportunities, and integrating research into the curriculum. Associated with this increase is a need to better understand the effectiveness of undergraduate research and related activities. During this talk, the author will summarize research on undergraduate research and provide an overview of the research strategies that have been utilized. This will include a discussion of assessment approaches and their limitations (e.g., reliance on self-report, lack of experimental

controls, limited assessment of cognitive outcomes). Strategies for developing a sustainable assessment plan for UR that focuses on student learning and evaluation of program effectiveness will be described.

Please cite as: Larson S. Research on undergraduate research: What do we know about the benefits of undergraduate research?. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc18inhere03.

DOI: 10.3205/18inhere03, URN: urn:nbn:de:0183-18inhere035

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere03.shtml>

04

Preparing Students for Independent Inquiry Learning

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Inquiry instruction can exploit the multiple, often conflicting ideas that students have about personal, societal, and environmental dilemmas and promote coherent understanding. Effective inquiry instruction supports the process of predicting, testing, distinguishing, and refining ideas about complex topics such as economic disparity or health decision-making. To illustrate, this talk describes successful inquiry activities for undergraduate research experiences, virtual laboratories, and combinations of virtual and physical activities. The talk highlights technologies that strengthen inquiry by supporting revision of arguments, evaluating undergraduate projects, and integrating physical and virtual investigations. These studies suggest ways to prepare students for independent inquiry learning.

Please cite as: Linn M. Preparing Students for Independent Inquiry Learning. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc04.

DOI: 10.3205/18inhere04, URN: urn:nbn:de:0183-18inhere041

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere04.shtml>

Short Communications

05

Investigating Scientific Reasoning & Argumentation and Statistical Literacy in Higher Education: The Role of Domain and Study Progress

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Introduction: Inquiry-based learning appears to be a promising approach to support university students in the acquisition of skills related to scientific reasoning & argumentation (SRA), including the ability to evaluate scientific evidence and to draw evidence-based conclusions [1], [3]. This study examined differences in students' SRA skills and statistical literacy, i.e. the ability to use and understand statistical numbers [2], depending on domain and study progress.

Methods: SRA skills and statistical literacy were analyzed in a quasi-experimental 2x3 study with N=212 students from three domains (social sciences, medicine, economics) and in different stages of their studies (undergraduate vs. graduate). We developed an online test inventory for the assessment of statistical literacy based on validated measurement tools. For the assessment of SRA skills, a decision-making scenario was utilized.

Results: Regarding statistical literacy, differences were observed between the domains, $F(2,211)=10.86$, $p=.000$, partial $\eta^2=.095$. Social sciences students scored lower ($M_{\text{Social Sciences}}=10.96$, $SD=4.94$) than students from medicine ($M_{\text{Medicine}}=14.32$, $SD=4.63$) and economics ($M_{\text{Economics}}=13.20$, $SD=4.44$). We found an interaction between domain and study progress, $F(2,211)=4.31$, $p=.015$, partial $\eta^2=.04$. Medicine students scored higher in the undergraduate phase ($M_{\text{Medicine}}=15.23$, $SD=4.21$; $M_{\text{Economics}}=12.15$, $SD=4.21$), economics students scored higher in the graduate phase ($M_{\text{Economics}}=15.38$, $SD=4.19$; $M_{\text{Medicine}}=13.40$, $SD=4.90$). Regarding SRA skills, students did not differ across domains, $F(2,202)=.070$, $p=.932$. We found a main effect for study progress in social sciences and economics, $F(1,122)=5.82$, $p=.017$, partial $\eta^2=.05$. In these domains, students scored lower in the graduate phase ($M=10.49$, $SD=4.74$) than in the undergraduate phase ($M=12.47$, $SD=3.86$).

Discussion: In general, students in economics and medicine demonstrated stronger skills in statistical literacy than social sciences students. The cross-sectional results suggest a decline of statistical literacy and SRA skills between undergraduate and graduate phase, indicating an urgent need to foster these skills during university studies.

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DOI: 10.3205/18inhere05, URN: urn:nbn:de:0183-18inhere058

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere05.shtml>

06

Trajectories of Change in Pre-service Teachers' Perceptions of Student Misbehavior in the Classroom

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This qualitative study investigates the trajectories of change in pre-service teachers' perceptions of student misbehaviors that they plan to address in their classroom management plan. The research question is as follows: How do pre-service teachers' perceptions of student classroom misbehavior change as a result of an inquiry-based classroom management course that they take? Data were collected from twenty-four pre-service teachers enrolled in a Classroom Management Course at an international university in Northern Cyprus in Spring 2016. A writing prompt was administered at the beginning and end of the classroom management course to collect data from the participants. Data were exposed to content analyses. The results of qualitative data analyses indicated that the pre-service teachers' perceptions of student classroom misbehaviors that they planned to address as part of their classroom management plan changed as a result of the new knowledge, skills, and experiences they gained in the inquiry based classroom management course. The findings indicated that although the pre-service teachers mostly had a tendency to plan to address either too serious and thorny misbehaviors (e.g., plagiarism, cheating), or too specific misbehaviors (e.g., use of cell phone) before they took the course, their conceptualization and definition of student misbehaviors went through alteration at the end of the course. Their responses became more sophisticated and they started to elaborate more on student misbehavior according to (a) the context in which it would appear,

(b) its frequency of happening, (c) severity, and (d) its possible effects on students, wider audience, and teaching and learning processes. In line with this, the results further indicated that although trajectories of change for pre-service teachers showed variation, the classroom management course based on inquiry based learning provided the pre-service teachers with knowledge, skills, and competencies of effective classroom management.

Please cite as: Can I, Gokalp G. Trajectories of Change in Pre-service Teachers' Perceptions of Student Misbehavior in the Classroom. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc06.
DOI: 10.3205/18inhere06, URN: urn:nbn:de:0183-18inhere064
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere06.shtml>

07

The Institutional Framework of Inquiry-Based Learning (IBL) in German Universities and Universities of Applied Sciences

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The study is part of the trace research project “ForschenLernen” and aims to enhance the understanding of how institutional conditions influence the design and success of Inquiry-Based Learning (IBL). Little is known about the effects of different kinds of IBL implementation at the organizational level in higher education. The main questions are: Is there a difference between more centralized management of IBL (top-down) compared to a structure primarily shaped by the faculties (bottom-up)? Which conditions are applicable to foster IBL and to incorporate practical research into the curriculum? Conversely: What are the organizational constraints; and is there some mode of collaboration or cooperation between student-led research and research projects conducted by university staff?

A qualitative survey was conducted among educational institutions participating in the “ForschenLernen” IBL project during the years 2016 and 2017. The survey comprised two waves of telephone interviews with one staff member at each partner university. All respondents were familiar with their university's overarching structure as well as the development of IBL in their institution over the past years.

This short communication will present and discuss the initial survey findings. It becomes evident that measures for the organizational implementation of IBL have to consider disciplinary differences and the highly individual characteristics of each institution. The survey responses also show that a strategy for successfully incorporating IBL on a sustained basis must identify highly motivated personnel and support their work through crucial resources such as time, finance, and an appropriate degree of autonomy. In terms of collaboration between student research and projects conducted by university staff, it became evident that collaboration is more common in the natural sciences than in the social sciences and humanities.

Please cite as: Dinter J. The Institutional Framework of Inquiry-Based Learning (IBL) in German Universities and Universities of Applied Sciences. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc07.
DOI: 10.3205/18inhere07, URN: urn:nbn:de:0183-18inhere079
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere07.shtml>

08

An integrative model for “teaching-based inquiry”? Advancing the debate of how to link teaching and research for the mutual benefit of students and scholars

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As a result of systemic constraints in German academia (e.g., the pressure to publish or the increasing national and international competition for external funding), some scholars have been reluctant to invest additional resources for the enhancement of their students' competencies in inquiry-based forms of teaching. In order to overcome the talk of seemingly contradicting imperatives, the author of this contribution has discussed the concept of “teaching-based inquiry” (“lehrendes Forschen”), comprising three approaches of how scholars may efficiently integrate their teaching into their research without neglecting effective student learning [1]. Based on these approaches, this presentation will introduce the audience to an integrative model which aims to support scholars in meeting both objectives: The enhancement of student learning and the use of teaching for advancing the scholars' academic career. The model rests on a pragmatic, experience-based approach and responds to significant needs of the academic practice. By outlining different procedures for teaching-based inquiry, it motivates researchers to recognize the connection of teaching and research as a distinct project with the need for its own resources. The model is flexibly adaptable to specific research contexts and could play an important part in the broader discussion of how the famous Humboldtian vision of a unity of teaching and research could be revitalized [2], [3].

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Please cite as: Fischer M. An integrative model for “teaching-based inquiry”? Advancing the debate of how to link teaching and research for the mutual benefit of students and scholars. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc08.

DOI: 10.3205/18inhere08, URN: urn:nbn:de:0183-18inhere086

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere08.shtml>

10

Encouraging student-driven clinical research in Germany: The CHIR-Net SIGMA network

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Introduction: Evidence should define and guide modern clinical care, yet many relevant questions in surgical practice remain unconfirmed by data. Meaningful clinical research however is challenging to conduct and its overall infrastructure in Germany was – until recently – considered poor as compared to other leading countries. While this has been significantly improved following the establishment of the Studienzentrum der Deutschen Gesellschaft für Chirurgie (SDGC) and the surgical clinical trial network CHIR-Net, limited focus has been put on training and recruitment of medical students to become competent clinician scientists.

Methods: To address these challenges, the CHIR-Net has established a student-initiated clinical trial network (SIGMA; Student-Initiated German Medical Audit) in 2017. Inspired by initiatives from the United Kingdom, this network enables students to participate in academic research projects and serves as exchange platform between students and physicians. As part of the SIGMA network, students contribute to national multi-center trials while improving clinical and research skills and gaining an insight into clinical academia.

Results: To ensure continuing comprehensive clinical research in surgery, the CHIR-Net aims to establish SIGMA in Germany, which is embedded in both the national CHIR-Net as well as pan-European and international frameworks.

SIGMA has the following objectives:

- Creation of a national multicenter network of medical students and associated clinician scientists
- Training of medical students in methodology, regulatory affairs and ethical conduct.
- Design, initiation, conduction, analysis and publication of prospective multicenter clinical trials initiated by medical students.

Conclusions: SIGMA is a product of strong collaboration between clinical scientists and medical trainees, enabling students to contribute to high-quality clinical trials. Additionally, participants are offered extensive training to support the next generation of research-active clinicians. Starting in 2018, SIGMA will perform its first multicenter observational study in Germany and be part of a multi-national trial in 13 European countries, Australia and New Zealand.

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DOI: 10.3205/18inhere10, URN: urn:nbn:de:0183-18inhere102

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere10.shtml>

11

Assessing Student Learning in Undergraduate Research Programs

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Undergraduate research is considered a high impact practice that increases rates of student retention, engagement and graduation. However, limited data are available on effective program elements and associated student learning. The IUPUI Center for Research and Learning (CRL) directs various undergraduate research programs that are course independent. Students from all disciplines are encouraged to engage in research although the great majority are STEM and health science majors. A model to qualitatively and quantitatively assess student learning in all CRL programs was implemented in the fall of

2015. Program activities were aligned with IUPUI's six Principles of Undergraduate Learning (PULs), which clearly define student learning outcomes. Achievement of these PULs has not been systematically assessed in undergraduate research despite the fact that five of these principles (communication, critical thinking, application of knowledge, intellectual depth, and ethics) align very well with the student research experience. While enrolled in a CRL program students have to submit structured written project reports, complete a Responsible Conduct of Research online module, write a reflective essay, and present their project as a poster at a campus-wide conference. A standard survey for both students and mentors is being used for quantitative student and program assessment. As of today we have surveyed 302 students and 105 mentors. Students ranged from freshmen to seniors with 58% reporting that they had engaged in research for the first time. Data collected as well as select excerpts from student essays will be presented to demonstrate student learning in undergraduate research.

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DOI: 10.3205/18inhere11, URN: urn:nbn:de:0183-18inhere118

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere11.shtml>

13

Looking underneath the umbrella. About the variance of meanings of ‚Learning by research‘

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Looking through (at least part of) the literature on ‚learning by research‘ in both English and German one has got to assume that this or similar wordings like “research-based learning”, “undergraduate research” altogether form but an “umbrella” concept which hides quite different notions of the activities and processes involved.

This paper is to prove this assumption by examining, interpreting and comparing a selection of representative and influential publications in both languages with regard to the question, whether and to which extent identical terms are used for different designs and practices of “Learning by research”/“Forschendes Lernen” and viceversa. Former attempts for clarification (as e.g. by [1], [2], [3] are to be noted, but are as will be shown not strictly applied.

Concluding from the results it will be argued that a more precise terminology in this field will be needed. In order to know exactly what we are talking about when we resume evaluations of ‚research-based learning‘ (esp. in meta-analyses), recommend implementations or write curricula it is necessary to come to different names or at least indicators for different activities which so far are subsumed under the same vague term as e.g. “research based learning” – and to apply them. Related suggestions will be explained and discussed.

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Please cite as: Huber L. Looking underneath the umbrella. About the variance of meanings of ‚Learning by research‘. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc13.

DOI: 10.3205/18inhere13, URN: urn:nbn:de:0183-18inhere136

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14

“MoBi4all” – live from the lab and back

Dorothea Kaufmann

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“Becoming a researcher” is the main goal of students of Molecular Biotechnology at Heidelberg University. This is impossible without direct access to cutting edge Science. Therefore, we restructured our Bachelor program to fit these needs. Our concept “MoBi4all” consist of 3 parts: In the seminar “Frontiers in Molecular Biotechnology” students get the chance to meet scientists from all fields working in the greater Heidelberg area. This approach gives undergraduate students the chance to get insight into lab techniques, everyday problems and how to solve them from the people actually conducting research themselves. Furthermore, these talks give the students the chance to meet future supervisors for their research internships in their 5. semester.

The second part of “MoBi4all” are research internships: Here, the students become members of a lab for 2 weeks and are fully integrated into everyday work. Usually one 1-2 students will be hosted per lab which makes it possible for them to work on their own small projects individually. This is a novel approach as students are usually in groups of 45 and more during their lab rotations and do not get individual projects at all. The practical lab work is combined with special lectures in small groups in the focus field of the students. The students are encouraged to raise questions about their own projects and engage in scientific discussions.

Part three of “MoBi4all” is our intensive mentoring program. Apart from everyday help our undergraduate students receive scientific mentoring from older students or alumni. Informal fireside chats are held twice per semester with members of the academic staff, posing an ideal chance for students to showcase their own research.

“MoBi4all” has been running successfully for 3 years and is a concept which can be easily adapted by other programs both in Natural and Social Sciences.

Please cite as: Kaufmann D. “MoBi4all” – live from the lab and back. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc14. DOI: 10.3205/18inhere14, URN: urn:nbn:de:0183-18inhere149
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15

“I can’t tell where the journey will end, but I know where to start”: Learning through inquiry-based internships in Bachelor of Psychology

Karina Karolina Kedzior

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Learning through inquiry is a new buzz-word in higher education. Universities attempt to utilise this method of teaching to deliver high-quality education. However, learning through inquiry is difficult to implement with too few instructors and too many students in large undergraduate programs. Internships, required to graduate with a bachelor’s degree, provide a window of opportunity to introduce undergraduate students to research. The aim of this study is to describe the experiences of an undergraduate student (“Chris”) who completed an inquiry-based, three month long, internship in psychology. The data were collected using a written evaluation form.

Chris started the internship after first year of studies under my supervision. The internship tasks included data collection and analysis, co-writing of a scientific paper, preparation of a conference poster, and learning to conduct peer-reviews. Overall Chris “learned how to structure a scientific study, to handle long and complicated texts and (...) the data” and realised “how much time it [research] involves”. The internship tasks gave Chris the feeling that “even this early on (...) I really can do something (...): apply the theoretical stuff I learned in my studies in “real [scientific] life””. Chris appreciated working mostly independently although would rather focus on the topic of own choice. Chris noted that the internship could also help with future studies in that “own research projects (...) will be structured better and the reports won’t be as hard as (...) before the internship”.

Inquiry-based internships provide students with the necessary tools to initiate a research project and critically interpret scientific evidence. Independent work simulates the real scientific practice, improves students’ confidence in own skills, and can help to identify own topics of interest. Longitudinal studies are required to empirically investigate the impact of inquiry-based internships on further academic performance and a choice of graduate studies or career.

Please cite as: Kedzior KK. “I can’t tell where the journey will end, but I know where to start”: Learning through inquiry-based internships in Bachelor of Psychology. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc15. DOI: 10.3205/18inhere15, URN: urn:nbn:de:0183-18inhere155
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere15.shtml>

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Fostering of theory application competences in student teachers: Effects of an inquiry-based seminar concept and instructional support during testing on qualities of applicable knowledge

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Theory application competences for the explanation of complex school situations are a key skill for teachers. The present study therefore investigates how these competences can be fostered within an inquiry-based seminar concept during teacher training. A theory application training with authentic example scenarios and preselected theories was introduced first to provide basic theory application competences. The training presented typical theory selection and application errors to foster negative knowledge on these errors and their avoidance. In the second seminar phase, inquiry learning was implemented by a seminar concept which required students to research scientific educational theories, models, and concepts on their own to apply them in the theoretical reconstruction and reflection of biographical learning and teaching experiences. Didactically, this inquiry-based seminar concept integrated blended learning with fading of instructional support and explicit references to negative knowledge acquired during the initial training. N=135 student teachers were assigned to four experimental conditions. The seminar concept (inquiry-based vs. regular) and the availability of instructional support with regard to theory selection during testing (with vs. without) were varied experimentally. The participants’ explanations in two separate test

scenarios were analyzed with regard to the underlying structure, automation and elaboration level as qualities of knowledge [1] at the start and end of the second seminar phase. As expected, explanations in the inquiry-based seminar concept were superior with regard to the structure of knowledge. Furthermore, participants in the inquiry-based seminar required less time for their explanations, which points toward an improvement in knowledge automation, and were superior in the elaboration level of knowledge. The availability of instructional support during testing also improved the structure and elaboration level. The results demonstrate the usefulness of inquiry-based learning in the context of theory application training in teacher education and provide insights for further training measures.

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DOI: 10.3205/18inhere16, URN: urn:nbn:de:0183-18inhere160

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere16.shtml>

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Empirical evidence for research-driven teaching and learning

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Within the field of research-driven learning and teaching, distinctions of methods or formats are often indicated by adjectives such as “research-based”, “research-oriented” or “research-led” etc. However, empirical evidence for these concepts and distinctions was not yet achieved.

Surveys completed by teachers and students at the Karlsruhe Institute of Technology (KIT) in 2016, were used as a basis for exploring especially the distinction of the teacher-centered vs. student-centered formats as well as the opposites of focusing research content or research processes (cf. [1]). The samples consist of 1482 students and 550 teachers. Both were asked about their experience with formats, their expectations, reasons and attitudes towards research-driven higher education. The analysis then focused on: the use of particular didactic elements such as informing students about research or challenges to plan and conduct independently a research project; furthermore, the importance of this experience from a subjective point of view and reasons for estimating this experience. Finally, students’ motives for enrolling to university courses and teachers’ general attitudes towards teaching were assessed.

Empirical evidence can be reported for both, students and teachers, that the subjective relevance of learning with research content differs from learning through research processes. Factor analyses were used to extrapolate these two teaching and learning formats and similarly, patterns of expectations, motives and attitudes. Thus, the distinction between a metacognitive learning style and a learning behavior which is dependent on teacher’s guidance could be confirmed. Moreover, given opportunities to experience undergraduate research have an influence on student’s learning strategies and their estimation of challenges conducting research on their own. To enhance the quality of these results, further investigations are planned on the basis of a panel survey.

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DOI: 10.3205/18inhere17, URN: urn:nbn:de:0183-18inhere175

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere17.shtml>

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A Novel Approach for the Analysis of Scientific Reasoning and Argumentation in Clinical Case Discussions

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Introduction: Scientific reasoning and argumentation (SRA) has been described as a compound of scientific discovery, scientific argumentation, and the understanding of the nature of science [1], [5]. This pilot study aimed to investigate SRA skills of medical students participating in Clinical Case Discussions (CCD), a peer teaching format designed to foster SRA activities such as evidence evaluation or hypothesis generation (cf. [2]).

Methods: We recruited 15 volunteer medical students ($M_{\text{age}}=22.9$ years, $SD=2.2$ years; 66% female; $M_{\text{study year}}=3.7$, $SD=0.9$) of LMU Munich in the clinical phase of their studies (3rd to 6th year). These students participated in three CCD sessions which followed an admission-, discussion-, and summary-sequence respectively. CCD sessions typically lasted 90 to 120 minutes. Discussions were videotaped as well as audio-recorded and then transcribed. A content-analytic SRA coding-scheme that had previously been applied in the domain of social work [3] was adapted for the medical education context.

Results: Overall, participants in the CCD engaged themselves predominantly in SRA activities evidence generation (EG, 34%), communicating/scrutinising (CS, 26.2%), questioning (Q, 22.4%) and evidence evaluation (EE, 12.4%). The peer-teachers were drivers of EG, CS and Q, whereas students engaged mostly in EE, hypothesis generation (HG), drawing conclusions (DC), and problem identification (PI).

Discussion: Our pilot study demonstrated that an in-depth analysis of SRA activities is feasible. The successful adaptation of a content-analytic SRA coding scheme from the domain of social work further supports the notion of a cross-domain validity of SRA activities as introduced in the framework by Fischer and colleagues [2]. The CCD triggered valuable SRA activities, underlining that this may be an appropriate teaching format to teach clinical reasoning skills to medical students as clinical reasoning can be seen as a specific kind of SRA [4].

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Please cite as: Lenzer B, Ghanem C, Weidenbusch M, Fischer M, Zottmann J. A Novel Approach for the Analysis of Scientific Reasoning and Argumentation in Clinical Case Discussions. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018).* München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc18. DOI: 10.3205/18inhere18, URN: urn:nbn:de:0183-18inhere181

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere18.shtml>

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Learning theory through practice: Publishing of undergraduate research in psychology

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Introduction: Research methods and statistics are mandatory modules in Bachelor of Psychology programs in Germany. Due to limited resources only some parts of the modules can be designed with an active, student-focused teaching approach. Undergraduate students interested in research were invited to take part in a 'real' re-search project as an extracurricular activity and/or for their internship at the department of methods and statistics. The participants were actively involved in the research process as well as publishing of the results. The aim of this study is to assess how students evaluate their learning experiences through the research process as well as publishing of their research.

Methods: The evaluation was conducted after publishing of the projects using semi-standardized interviews and a five-item questionnaire scored on a five-point Likert scale (1 - strongly disagree to 5 - strongly agree). Data regarding item 2 ('Publishing helped me to better understand contents from modules, such as methods and statistics') were assessed using descriptive statistics and qualitative data were content-analyzed.

Results: Students reported that publishing helped them with learning of module contents (item 2: mean 4, mode 5, range: 2-5). The qualitative data show that the students gained various practical skills, such as designing a questionnaire and conducting statistical analyses, improved their ability to read scientific papers and conduct literature searches. Regardless of the time investment, the students reported being highly motivated to work on the publications and being more confident in own skills.

Discussion: Undergraduate research is an effective learning and teaching method in Bachelor of Psychology. In the process of publishing students learn to transform the mainly theoretical knowledge they gain in their studies into practical know-how. Furthermore, publishing gives an insight into work of active researchers. Thus, if adequate resources are available, publishing of undergraduate research projects could be implemented in teaching in psychology programs.

Please cite as: Meixner J, Gerkenmeier I, Kedzior KK. Learning theory through practice: Publishing of undergraduate research in psychology. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018).* München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc19.

DOI: 10.3205/18inhere19, URN: urn:nbn:de:0183-18inhere199

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere19.shtml>

How do concepts of research affect inquiry-based learning?

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Research differs depending on discipline, as does the implementation of undergraduate research. Thus, the type of research conducted within a field will most likely also impact inquiry-based learning. In our experience, undergraduate research is less common in fields such as architecture or business administration, but common yet quite different in social work vs. biology. The question is: Are these differences related to categorical differences in understanding and conducting research?

We attempt to identify a typology of research that is more or less independent of the classification of disciplines. Starting with a paper by the German Council of Science and Humanities (Wissenschaftsrat, 2012), we identified eight types of research: (1) empirical data collection; (2) experimentation; (3) hermeneutical interpretation; (4) concept- and theory-building; (5) developing professional standards; (6) simulation; (7) engineering prototypes; and (8) design.

The types of research can be based on different forms of cognition – for instance, conceiving of concept- and theory-building as research. The typology is based on some presuppositions or conceptual decisions: (i) to include the development of professional standards as a type of research; (ii) to differentiate research in engineering from design, the latter being guided by esthetic principles.

We reviewed several standard interdisciplinary works on inquiry-based learning [1], [2], [3] in order to assess the kinds of inquiry-based teaching induced by different types of research. We found, for instance, that empirical data collection and simulation provide easily accessible methodologies for students wishing to conduct undergraduate-level research, particularly in disciplines where undergraduate research is less common (e.g., theology).

The presented work forms part of the trace research project *ForschenLernen* (<http://www.fh-potsdam.de/forschenlernen>).

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DOI: 10.3205/18inhere20, URN: urn:nbn:de:0183-18inhere205

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere20.shtml>

Inquiry-based learning: lecturers' and universities' perspectives

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Inquiry-based learning has long been a prominent topic within higher education. Current research often focuses on the didactical principles of inquiry-based learning and discusses students' learning mechanisms as well as beneficial learning settings. Even though these debates are fruitful, they tend to neglect the influence of lecturers and the university on how inquiry-based learning is conducted. Although lecturers are typically fairly independent in their teaching, they are still embedded in organisational structures. This regulatory framework may affect their understanding of inquiry-based learning and promote or hinder courses, which aim at learning by research. In our presentation, we therefore try to complement existing debates by highlighting lecturers' perceptions and practices of inquiry-based learning in order to understand the realization, effects and institutionalization of such teaching concepts within universities.

Our findings are based on ongoing work within the research project FLOAT (*Forschendes Lernen aus Perspektive von Organisation und Akteuren*/Inquiry-based learning: lecturers' and universities' perspectives, financed by InStudies/BMBF). We present preliminary results of 20 semi-structured interviews with lecturers and organizational representatives involved in inquiry-based learning at Ruhr-University Bochum, a university that explicitly promotes such learning formats. Within our presentation, we will (a) highlight key motivational aspects of lecturers to participate in inquiry-based learning, (b) elaborate their perceptions and practices of inquiry-based learning and (c) derive the organizational influences on inquiry-based learning.

Please cite as: Mojescik K, Richter C, Pflüger J. Inquiry-based learning: lecturers' and universities' perspectives. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc21.

DOI: 10.3205/18inhere21, URN: urn:nbn:de:0183-18inhere219

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere21.shtml>

Scientific Inquiry in Health Sciences Education: Analyzing Junior Faculty's Teaching Portfolios

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Background: Assistant professors in the health sciences (108 participants from biomedicine, clinical medicine, dentistry, sports, nursing and public health) submitted their teaching portfolio as part of the requirement for a pedagogical course for university teachers at Aarhus University, Denmark. The course introduced participants to concepts and methods to create constructive alignment and activating teaching and to a teaching portfolio as a means of reflecting upon inquiry and teaching.

Design: This study investigated assistant professors espoused beliefs about the role of scientific inquiry in teaching and supervision of students. The study was a discourse analysis of participants' written portfolios (each 1-10 pages).

Results: Scientific inquiry was constructed by participants as a means to increase students' motivation (e.g. to pursue a scientific career), emotions (e.g. curiosity) or as a mean to increase students' deep learning. A large group of participants took a disciplinary stand to inquiry: They saw the laboratory as an important site of learning inquiry in biomedicine or they taught about scientific findings in order to translate findings from biomedicine to clinical medicine. A small group of participants expressed the view that students need meta-cognitive skills to develop scientific inquiry. Furthermore, they subscribed to a minimally guided inquiry model whereby students should learn to question their own findings. Even fewer participants perceived of scientific inquiry in terms of a more systematic approach to higher-level thinking. Thus although participants cited one or more constructivist educational theorists, they did not express a well-articulated notion of inquiry and they provided limited concrete examples on how to design a conducive learning environment around inquiry or critical thinking.

Discussion: The value of this study is that it might enable educational developers to give junior faculty better guidance on teaching and specific feedback on their teaching portfolio in particular in regards to the design of learning activities that might use scientific inquiry as means and end in higher education.

Please cite as: Musaeus P. Scientific Inquiry in Health Sciences Education: Analyzing Junior Faculty's Teaching Portfolios. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc22.

DOI: 10.3205/18inhere22, URN: urn:nbn:de:0183-18inhere221

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere22.shtml>

Research-Oriented Learning in Teacher Education by Professional Simulation

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Introduction: In teacher education there is a major discrepancy between theory and practice more precisely between research and learning-practice at university and classroom practice on the one hand and scientific knowledge at University and the need for professional knowledge to act at school on the other hand (cf. [1]).

Methods: The goal of the presentation is to introduce simulation to integrate theories and practices by research-oriented learning.

To reduce complexity we simulate classroom practice at university on the one hand and put students into simulated classroom practice at university on the other hand. This simulation-model is the basis for research-oriented learning and teaching (cf. [2]). Thus students can proof their understanding of scientific knowledge in action and give scientific-based reasons for their actions.

Results: Stages of simulation are: 1) preparation of the setting, 2) cooperation contract, 3) simulation, 4) reflexion on habitus, 5) evaluation (cf. [3]).

Research-oriented learning within simulation is an opportunity to improve professional teacher education inclusive learning by doing (cf. [4]).

Discussion: I will show: Research-oriented learning can help to relate both forms of knowledge.

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DOI: 10.3205/18inhere23, URN: urn:nbn:de:0183-18inhere236
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How do students learn through research? – Operating between know-how, methods, and attitudes

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The academic-didactic concept of research-oriented teaching strives to include students in the scientific cognitive processes in such a manner that they can actively (participate in) research. This way, students should (better) manage to adapt a scientific approach [1] that is characterised by an independent, methodologically substantiated, and reflective approach. These teaching and learning settings are challenging for all involved actors and at various levels [2], which led me to question how students perceive their own learning situation, which learning strategies they develop, and how they organise their learning processes and master the subject matter.

Within the sub-project “Learning” of the BMBF-supported cooperative project ResearchLearning, I have selected a qualitative research design, which is based on the Grounded Theory methodology [3]. The research data are gathered from group discussions [4] and problem-oriented interviews (Witzel 2000) with students from various institutes of higher education, various Master’s and Bachelor’s degree programmes of the social sciences and humanities in 2015 and 2016.

The analytical background of the subject-scientific theory of learning [5], with its theoretical conceptualisation of the analytical categories of the defensive vs. the expansive learning rationale patterns, allowed me to work out three central learning rationale types. The starting point for student learning processes are various problems of action, which can range from knowledge acquisition to the development of methodological competences and the development of a scientific identity, and are therefore related to distinct learning interests and challenges. Crucial differentiation criteria for the systematisation of the student learning strategies are the degree of reflective capacity and the assumption of responsibility for a student’s own learning process.

Related to this, the question arises to which extent detailed knowledge regarding student learning strategies and patterns might aid the consulting support of student learning processes.

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DOI: 10.3205/18inhere24, URN: urn:nbn:de:0183-18inhere248
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere24.shtml>

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Explorative vs classical practical course – How to inspire scientific thinking in medical students

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Introduction: Recently, the skills of medical students in scientific thinking have been identified as an important and timely issue in medical education. Scientific thinking cannot be imparted by classic lectures, but require active involvement of students in courses. We modified a practical course in physiology. A study was designed to test whether the new course facilitates scientific thinking without impairing physiological knowledge transfer.

Methods: The study group consisted of 214 first year medical students of the Medical Faculty of Heidelberg University. Written consent for participation in the study was obtained from all participants. The group was randomly divided into 2 equal-numbered groups (traditional vs. modified course). Subject of both courses was a laboratory experiment in skeletal muscle physiology. In the traditional course the students addressed topics already presented in lectures. In the modified course students dealt with the same topics as in the traditional course, but the experiment was extended to include one issue not taught before. When working on this issue, the students were instructed in scientific thinking by the teacher. Both courses were run in parallel. Thereafter, all participants filled a questionnaire with 8 multiple choice questions, addressing the physiological background of the experiments, and 1 open question, addressing 4 criteria of scientific methodology.

Results: Physiological knowledge in both groups did not differ ($F(1)=0.28$, $p=0.60$). Scores in scientific thinking in the modified course were higher ($M=1.42$, $SD=1.05$) than in the traditional course ($M=1.11$, $SD=0.60$) with $F(1)=6.97$, $p<0.01$, $\eta^2=0.03$.

Discussion: Our study demonstrates that small adjustments of courses in medical education can facilitate scientific thinking without impairing knowledge transfer. However, the level of scientific thinking was still quite low. Thus, the teaching of these principles should be improved.

Please cite as: Schubert R, Zavaritskaya O, Eckel J, Schüttpez-Brauns K. Explorative vs classical practical course – How to inspire scientific thinking in medical students. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc25.

DOI: 10.3205/18inhere25, URN: urn:nbn:de:0183-18inhere252

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere25.shtml>

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Developing international networks of undergraduate inquirers in higher education

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Although there are some reports of international undergraduate research or inquiry-based initiatives, most involve students travelling to another country to do fieldwork. In this initiative – the Matariki Undergraduate Research Network (MURN), 20-30 undergraduate researchers across several countries (Australia, New Zealand, Canada and the United Kingdom) was established. We aimed to explore the logistics, benefits and challenges of developing and implementing such a network.

Mixed methods were used to determine faculty and student experiences of the network. There was a survey of “student assessment of their learning gains” [1], (<https://www.salgsite.org/about>), a survey of faculty experiences, and collection of data through research diaries and conversations with students and faculty.

The network was developed quickly in a six-month period, assisted by a face-to-face meeting of programme leaders from each institution. Teaching in a global classroom was a unique aspect of this initiative, as undergraduates from a range of disciplines learnt about inquiry in higher education. Students were then supervised locally on projects relating to internationalisation of higher education.

The most challenging aspect of this initiative was teaching across time zones and academic year differences. All participants reported a range of benefits typical of engagement with inquiry-based learning, and faculty in particular enjoyed interacting with international colleagues. However, the students were disappointed there was not much interaction with their international peers, except for some who met at an international conference.

To develop a sustainable international network of inquirers we recommend a credit-bearing programme, partnering in similar time zones and academic years, requiring collaborative projects across institutions, letting students determine the best way to connect online, and providing a conference experience that brings the inquirers together.

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DOI: 10.3205/18inhere26, URN: urn:nbn:de:0183-18inhere267

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Research-related formats at universities in Germany

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Within the large national project ‘ForschenLernen’, funded by the Federal Ministry of Education and Research, my research has been conducted in one of the sub projects called “Formats”. The main prospect was to find out how the approach of research-related learning and teaching is implemented at universities and what terms are used in this context. ‘One of the main problems in the discussion about the research-teaching nexus is that the term is used for many different kinds of ‘activities’ in the university and that many different words are used for the same activity’ [7]. There are divers systematisations by field experts like Huber [3], Reinmann [5], Tremp & Hildbrand [6], Healey & Jenkins [2] or Brew [1], providing a structure for these terms. This survey (Stang, Huber) aims to create an overall concept and enrich the discussion with concrete formats for the use in courses. In pursuance of developing a systematisation for research-related courses (formats), 17 German universities have been surveyed. Substantial documents were identified by means of document analysis. The subsequent classification and evaluation of the documents was conducted through qualitative content analysis [4] and resulted in a typology of research-related formats. They main formats are: Teachers’ research project as frame for students’ project work, Students’ research

projects within the scope of courses and Students' research projects independent of courses. These are defined by characteristic parameters such as course form or student and teacher activities. As part of the presentation I will offer a brief summary of the format selection created to portray how research-based learning is currently practiced in higher education. In this regard specific university examples will provide a profound insight. A wide variety of features such as multidisciplinary and third-party collaborations may be developed within these individual formats. Furthermore they can be used by different target groups like teachers, university administrators or curriculum developers and benefit communication, coaching processes, discussions or localization of courses.

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Please cite as: Stang T. Research-related formats at universities in Germany. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018).* München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc27.

DOI: 10.3205/18inhere27, URN: urn:nbn:de:0183-18inhere270

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere27.shtml>

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Problems of Evidence-based Educational Practice and Approaches to Fostering Educational Literacy

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This theoretical contribution begins with a short reflection about the complex character of educational objects of research and with a critical evaluation of the often constructed medicine - education analogy with respect to current evidence-based perspectives. The low quality of the educational knowledge base and the necessary "Generalisierungs-Konkretions-Dilemma" (generalization-concretion dilemma; [1]) contribute to repeatedly bemoaned gaps between theory and practice and inevitable problems of evidence-fit. This problematic situation is not at all resolved by the provision of new meta-analyses that are sometimes naively considered as a kind of panacea in this context. Furthermore, it is aggravated by the repeatedly described lack of educational literacy that can be diagnosed in teacher students and teachers. Starting from this problem analysis, a more modest conception of evidence-oriented educational practice is outlined [3] focusing more on the evaluative and reflective nature of educational evidence [2]. In addition, current conceptions and components of educational literacy and prevailing intervention approaches are sketched and critically evaluated. The presentation ends with a brief discussion of future approaches to foster educational literacy, for example by integrating evidence-oriented perspectives and teacher know-how using specific evidence-oriented heuristics and evidence-presentation formats or by small intervention experiments as a specific kind of inquiry learning.

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DOI: 10.3205/18inhere28, URN: urn:nbn:de:0183-18inhere286

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere28.shtml>

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Using metaphors in the beginners' courses to promote competencies in higher education

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This study set out to investigate the usefulness of metaphors as a means for students in their first semester to learn through inquiry in higher education. One of the aims of teaching in the beginners' courses is promoting competencies to manage academic work and to work in research groups: To undergraduates who are unfamiliar with the academic field this often seems

a complex task. It can thus be suggested that adequate methods should be used to reduce complexity. Following experiential education approaches, the metaphor of domino was introduced to the students and they were asked to create a domino rally. Hypotheses were that playful learning offers a low-threshold start into the academic practice (e.g. setting research goals like planning the direction of the rally before actually starting to build it), that the engagement in metaphorical use of domino would promote transfer competence, and that it would strengthen the motivation to work in groups. Hence, the research question was: Is it possible to promote the understanding of the scientific working context and to encourage learning in groups in higher education via the metaphor of a domino rally? Data for this study were collected using short questionnaires after every seminar. The majority of those who responded to the questions felt that they gained confidence and knowledge in how the academic field “works” and reported an increased level of motivation and new ways to approach problems. The results suggest that creating a domino rally is a way to induce (self-) reflection and is easy to transfer. This research will serve as a base for future studies. For instance, it would be interesting to assess the effects of other metaphors (in other settings or contexts), to adapt the approach to conventional lectures and seminars or to replicate the method in advanced semesters.

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DOI: 10.3205/18inhere29, URN: urn:nbn:de:0183-18inhere292

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere29.shtml>

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Which competencies can be acquired through research-based learning? – Results from a pre-post analysis in 74 university courses

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Introduction: Research-based learning is widely regarded as a panacea when looking for demanding and stimulating didactic formats in higher education settings. It has been suggested to improve a wide array of research-related competencies [1] and is thus recommended to be experienced by any undergraduate student [2]. However, whether research-based learning is as effective as postulated has not been systematically examined.

Procedure: In the BMBF-funded project “ForschenLernen” we employed a two-step procedure to examine the effectiveness of research-based learning in the social sciences. First, relevant research-related competencies were identified by means of expert interviews (N=20). The resulting model of research competence includes both cognitive (e.g. methodological knowledge) and affective-motivational aspects (e.g. uncertainty tolerance and research interest). In a second step, the potential of research-based learning to alter these competencies was examined. A pre-post measurement was conducted in N=74 research-based courses (one- and two-semester long courses) at 10 German universities. Different types of research-based learning were identified and used for further analysis.

Results: Results show that research knowledge increases over the course ($p < 0.001$; $d = 0.24$), whereas most affective-motivational research competencies decrease (e.g. finding joy in conducting research, $p > 0.05$; $d = 0.10$). A factor analysis on different characteristics of the courses rendered five different types of research-based learning. Positive effects were greatest for courses of the type “real research” (courses that were closest to professional research practice). The biggest negative changes were observed for courses that used research-based learning to teach research methods.

Discussion: Some types of research-based learning proved effective to develop cognitive research competence. These results provide recommendations on how to design effective research-based learning courses. However, affective-motivational competencies could not be fostered, possible explanations for this finding will be discussed.

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Please cite as: Wessels I, Rueß J, Deicke W, Jenßen L. Which competencies can be acquired through research-based learning? – Results from a pre-post analysis in 74 university courses. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc30.

DOI: 10.3205/18inhere30, URN: urn:nbn:de:0183-18inhere308

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere30.shtml>

Research on Inquiry-based Learning in Teacher Education

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Inquiry-based Learning is considered as a long-standing tradition in teacher education. For a few years this approach has been also linked to the curricular requirements of long-term internships (cf. [1]). Although there are many implementation types (cf. [2]) there is no accordance with the current empirical findings (cf. [3]). Presently, the research on Inquiry-based Learning is largely unexplored (cf. [4]). A comprehensive analysis is still pending. The following lecture addresses that point. Based on previous empirical findings a systematic collation and analysis of current empirical results about Inquiry-based Learning are achieved by a content-analytical view. The following questions will be covered:

1. What is the focus of Inquiry-based Learning surveys and their assessment instruments and how valid are they?
2. Which key success factors can be found through the analysis?

Regarding the focus on the analysis two basic implementation variants of Inquiry-based Learning can be distinguished:

(A) Inquiry-based Learning without connection to practical studies in school

(B) Inquiry-based Learning with connection to practical studies in school, differentiated according to the kind of internship

The results of the analysis show that the research is still in its infancy and essential questions have not been answered. The analysis also emphasizes that the instruments of investigation are insufficient and could only show sections of the Inquiry-based Learning up to now. So far, only limited or isolated statements about the key success factors can be made.

The results of the analysis lead to consequences concerning the research. The lecture ends with specific instructions and critical hints regarding the orientation for future research such as the adaption and standardization of survey instruments as well as a stronger orientation towards longitudinal analysis and pre-post surveys. For future research attention should also be paid to aspects like multiple perspectives and methodological triangulation.

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Please cite as: Weyland U, Fichten W. Research on Inquiry-based Learning in Teacher Education. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018).* München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc31.

DOI: 10.3205/18inhere31, URN: urn:nbn:de:0183-18inhere311

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere31.shtml>

Orientation and Motivation by Combining Research Based Learning and Orientation Studies

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Research-based learning encourages students to engage with different topics and subjects in a motivating learning environment. The orientation program MINT^{grün} at Technische Universität Berlin offers two semesters for open choices of teaching modules including a series of specially designed project laboratories covering topics such as robotics, construction, environmental research, programming, mathematics, gender studies and chemistry [1]. The project laboratory chemistry (OPL Chem) follows the concept of research-based learning and allows students to define the aim of the project after participating in impulse talks which report on the experiments conducted by the previous cohort. The opportunity of the free choice motivates the students to pick topics of their interest. To date students tend to pick topics related to sustainability and current environmental issues such as decontamination of oil spills on water, production of biological plastics, the decomposition of plastic, quantification of heavy metals in tap water, investigation of electric producing bacteria or optimization of the oxygen generation by algae. It was also reported in literature that free-choose learning research promotes environmentally sustainable attitudes and behaviour [2]. In addition, a series of teaching videos were developed for this laboratory including theoretical fundamentals, preparation of samples, the configuration of complex setups, safety instructions and handling of programs for the correct data evaluation. Such videos were identified as helpful tools to reduce the effort for supervision during the project period while the quality of the experimental work of the students was clearly rising [3], [4]. OPL Chem allows the students to publish their own experimental results as self produced videos and internet blogs, in support of their written protocols. In that way a sustained pool of videos of various experiments was established for the public.

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DOI: 10.3205/18inhere32, URN: urn:nbn:de:0183-18inhere325
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere32.shtml>

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Student-Centered Learning Environment for Self-Regulated Project-Based Learning in Higher Education: A Qualification/Selection Study

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Self-Regulated (SRL) and *Project-Based (PBL)* among others are innovative pedagogical approaches fostering a multitude of critical strategies for success in the twenty-first century. Students drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge [1]. Moreover, *Student-Centered Learning Environments (SCLE)* could hold potential to serve as fun and inspiring workshop settings, where students can engage in exciting Project-Based activities that integrate required curriculum material, while also simulating some aspects of real world “epistemic” contexts, challenging students to gain a richer understanding of learning material and processes in a more situated, relatable way [2].

Nevertheless, the implementation of SCLE still a baffling problem for the online pedagogical designers despite the large landscape of sophisticated educational tools and strategies offered by the most of the *Learning Management Systems (LMS)*.

Accordingly, this paper presents an ongoing work of the Implementation of a proposed *Integrated Framework for Self-Regulated Project-Based Learning (SRPBL)* suitable for SCLE in *Higher Education*. For this purpose, we propose a *Qualification/Selection Study* of the usage of LMS as SCLE; by trying to respond to the Research Question:

How to Qualify and Select a LMS as a SCLE for SRPBL in Higher Education?

Therefore, the study is inspired from the “QSOS” Method [3]. The general process can be applied with different granularities. This makes it possible to adapt to the level of detail desired in the Qualification and Selection process as well as to proceed by iterative loops for each of the four steps. Briefly, the QS Method takes place in following four stages:

- **Define** LMS Generic/Specific Criteria;
- **Evaluate** LMS Criteria (Rating);
- **Qualify** LMS Criteria (Weighting);
- **Compare and Select** a LMS (Flexible Selection).

Finally, we adopted a *Flexible Selection*: It allows selecting the convenient LMS according to the Pedagogical, Environmental and Institutional considerations.

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Please cite as: Zarouk MY, Restivo F, Khaldi M. Student-Centered Learning Environment for Self-Regulated Project-Based Learning in Higher Education: A Qualification/Selection Study. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018).* München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc33.
DOI: 10.3205/18inhere33, URN: urn:nbn:de:0183-18inhere337
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere33.shtml>

The Humboldtian Ideal of Higher Education – Undergraduate Research-based Learning in Political Science

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Undergraduate research within study programs have gained considerable relevance in teaching Political Science in the past few years. Yet, most of these programs are optional and are implemented at the end of the curriculum in the last year of study. At Zeppelin University, scholars of Political Science and Public Administration are cooperating with other faculties to implement the Humboldtian ideal of higher education in combining research and study in an obligatory first year undergraduate research project called Zeppelin-Year and the Humboldt-Year in the final stage of study.

This paper aims to answer the questions on how fields of research by scholars can be combined with research project of undergraduate students of Political Science and Public Administration. Furthermore, there is a high effort to administrate the Humboldtian ideal of higher education between scholars and students. Therefore, the second question is how this ideal can be brought into a shape that is administrable and more importantly studyable. The final question covers the fact that students and scholars of Political Science and Public Administration are cooperating with the faculties of Communication & Cultural Science as well as Economics in an interdisciplinary approach to find solutions for academic problems. So, new interdisciplinary teaching and learning formats have to be established. To answer the questions above we will evaluate the research based learning formats Zeppelin-Year and Humboldt-Project by analyzing surveys of students, scholars and administrative staff from 2012 onwards.

Our findings show that while the Zeppelin Project isn't evaluated that positive by the students and the academic staff. However the Humboldt Year has a much more positive reputation within the students. Therefore, our careful conclusion is that there is a learning process between the Zeppelin Project and the Humboldt Year as it was intended at the implementation of both modules into the study programs.

While the Zeppelin Project and the Humboldt Year was conceptualized for study programs in social sciences, we are convinced that this model is transferable to other study programs.

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Please cite as: Zettl C, Nikolopoulos I. The Humboldtian Ideal of Higher Education – Undergraduate Research-based Learning in Political Science. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc34. DOI: 10.3205/18inhere34, URN: urn:nbn:de:0183-18inhere346

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere34.shtml>

Posters

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Executive functions as moderators of the worked example effect on statistical reasoning – A replication study

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A prerequisite for sophisticated statistical reasoning is that students learn to apply statistical concepts [1] and make sound methodological decisions. For prospective researchers, such skills are essential to successfully participate in research communities during and after university education. Instructional support, like worked examples, helps students to master such complex learning tasks. However, there is a number of factors that influence the effectiveness of worked examples [3]. We conducted this study with 234 undergraduate university students in the context of learning statistics to identify such factors. This study is a replication of an earlier study by Schwaighofer et al. [2] and addressed the research question whether the effect of worked examples on applied statistical and methodological knowledge is moderated by working memory capacity and shifting ability, two core cognitive functions that are relevant for learning [4]. Based on previous findings we assume that worked examples are more beneficial for learners with low shifting ability. Regarding working memory capacity, we expect that the effect of worked examples is only moderated if learners were under time pressure. Worked examples are possibly more beneficial for learners with low working memory capacity and low shifting ability as they reduce demands on these cognitive functions with combining relevant information and reasoning from a problem statement and learning materials [2]. The study was conducted in settings closely resembling how students normally study. Materials were taken from the curriculum and represent authentic tasks for students of social sciences programs as well as tasks researchers tackle in their daily business. Results of this study will inform us about the significance of corecognitive functions namely within the context of scaffolded learning, and how considering these individual differences between learners might inform how best to design and implement support.

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Please cite as: Bichler S, Fischer F, Bühner M. Executive functions as moderators of the worked example effect on statistical reasoning – A replication study. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc35.

DOI: 10.3205/18inhere35, URN: urn:nbn:de:0183-18inhere359

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere35.shtml>

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Inquiry-Based Learning in Higher Education Statistics: Effects on Students' Self-Efficacy, Attitudes, and Achievement Emotions

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Despite its importance in the age of big data, many students do not like statistics [4]. An instructional approach to change this situation could be the implementation of inquiry-based learning (IBL) in statistics classes, especially tutorials. IBL has been shown to improve students' view of mathematics [1] and showed positive effects on students' self-efficacy [3] and attitudes [2]. In this project, we investigated how an IBL intervention in a Master's level statistics class affects students' self-efficacy to learn statistics, their attitudes towards statistics, as well as their achievement emotions [5]. Our main research questions were:

- Does IBL lead to an increase in students' self-efficacy, positive attitudes, and positive achievement emotions to learn statistics?
- Are self-efficacy, attitudes, and achievement emotions positively correlated in the context of statistics?

The intervention spanned five statistics tutorials. Students were assessed at the beginning (N=20) and at the end (N=8) of the intervention, using three Likert-type questionnaires from existing literature, which were slightly adapted to the context.

Students showed higher levels of self-efficacy to learn statistics ($d=1.10$), more positive attitudes ($d=0.94$) and achievement emotions ($d=1.42$) at the end of the intervention. Pairwise comparisons revealed a significant correlation only between attitudes and achievement emotions at the pre-test ($\rho=.85$, $p<.001$), while the other correlations were non-significant.

Despite the small sample size, results underline the positive influence of IBL on students' self-efficacy, attitudes, and achievement emotions towards statistics, which is in line with prior research [3]. Our results expand previous research by

analysing the relation among the three variables, showing a high, significant relation between attitudes and achievement emotions during the IBL sessions.

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DOI: 10.3205/18inhere36, URN: urn:nbn:de:0183-18inhere363

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere36.shtml>

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Case representation scaffolds improve diagnostic efficiency in 4th-5th year medical students: a randomized controlled laboratory study

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Introduction: Understanding diagnostic competence and how it can be fostered is a major challenge in medical education research. Although different strategies to improve diagnostic accuracy have been investigated, little is known about students' diagnostic efficiency operationalized as correct diagnoses per time. Following the theoretical bases, scaffolds for case representation could be a promising approach to make the diagnostic process of intermediate medical students more efficient. The aims of this study were to measure the effects of case representation scaffolding on the diagnostic efficiency and to investigate the diagnostic processes of medical students in an electronically based learning environment.

Methods: Clinical case processing of 88 4th and 5th year medical students was analyzed in a randomized, controlled laboratory study. Cases with medical encounter dyspnea were provided in an electronic learning environment (CASUS). Students could freely choose the time, amount and sequence of clinical information. Diagnostic efficiency was operationalized as the number of correct diagnoses divided by the time needed for diagnosing.

Results: During processing of the assessment cases efficiency was significantly improved by the representation scaffolding (M=20.8 minutes (SD=7.15), M=24.6 (SD=7.42), p=.01) with an intermediate effect size of Cohens d=0.5. The diagnostic accuracy, however, did not differ between both groups. CASUS enabled analysis of the diagnostic process of the participants which differed between the groups regarding the sequence of clinical information and the time spent on different diagnostics.

Discussion and Conclusion: For the first time, diagnostic efficiency as part of the diagnostic process of medical students has been studied economically and standardized by an electronic learning environment (CASUS). This provides the opportunity of further research in the area of the diagnostic process. Furthermore, intervention by scaffolding for case representations significantly improved diagnostic efficiency of 4th and 5th year medical students.

Please cite as: Braun L, Zottmann J, Wirth S, Fischer M, Schmidmaier R. Case representation scaffolds improve diagnostic efficiency in 4th-5th year medical students: a randomized controlled laboratory study. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc37.

DOI: 10.3205/18inhere37, URN: urn:nbn:de:0183-18inhere375

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere37.shtml>

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Training Concept: Efficient and Strategic Reading of Academic Texts

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Learning through inquiry requires students to self-regulate their learning behavior as well as related cognitions and motivational resources in order to gain new knowledge and develop relevant competencies. These competencies include being able to deal with relatively challenging academic texts as the primary source of information in research. Since this is one of the basic prerequisites for lifelong learning, students should be supported to develop a high level of reading comprehension and to manage their reading activities in a professional and efficient way. However, support for students is frequently reduced to speed reading trainings. These trainings usually focus on speeding up visual language processing via certain exercises to improve oculomotor control and to suppress subvocalization, i.e. the 'inner reading voice'. These exercises are conducted with

the aid of isolated words and numbers or easy non-fictional texts. Comprehension is intended to be measured by single or multiple choice questions which aim at memorizing single facts. In sum, this has little to do with the challenges (and goals) of academic reading. Therefore, the research question was: How should an academic reading training look like in order to be tailored to the specific needs of students dealing with research literature? To answer this question, a new two-day program was developed which is directly based on psychological and linguistic research. Particular emphasis was put on the following leading perspectives: a) reflection on individual reading attitudes and (use of) strategies, b) considering different phases of the reading process as the prototypical form of self-regulated learning, c) promoting metalinguistic knowledge, d) combining efficient skimming and deep reading of real academic articles. So far, the training has been tested informally with a small group of students. The poster will focus on theoretical aspects of the new training concept.

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Please cite as: Czech H. Training Concept: Efficient and Strategic Reading of Academic Texts. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc38.

DOI: 10.3205/18inhere38, URN: urn:nbn:de:0183-18inhere381

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere38.shtml>

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The Role of Epistemic Beliefs in Supervisory Relationships

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Introduction: Personal epistemology (i.e. beliefs and assumptions about knowing and knowledge) affects intellectual development, learning and education. The system of individual beliefs about the nature of knowledge and learning is known as epistemic beliefs (EB; [2]). Although the majority of research on EB has been conducted in an academic context, they may also be of importance in the context of organizations, because these beliefs may influence supervisory and collaborative relationships at the workplace. For instance, if a supervisor possesses a more sophisticated personal epistemology, he is more likely to welcome multiple perspectives and try to understand supervisees rather than trying to change them [1], [3].

Methods: There is a lack of empirical EB research in the organizational context, so our study aimed to investigate (a) the influence of supervisors' EB on supervisees' EB, (b) potential moderating effects of culture, and (c) identify further factors that potentially affect these relationships. A literature search was conducted via EBSCOhost (ERIC and PsycINFO databases), yielding 2,833 potentially relevant publications. Title and abstract screening were followed by full-text critical appraisal and 40 studies were finally included into the analysis. Although EB research in the organizational context is gaining popularity, the majority of the studies found still investigated teacher-student relationships.

Results & Discussion: Study results indicate that supervisors' EB indeed have a strong effect on the development of supervisees' EB. Moreover, they can affect supervisees' meta-cognitive strategies as well as reasoning and argumentations skills. EB should thus be addressed in educators' and trainers' programs as it is apparently important for instructors to understand their own beliefs and how these may influence their supervisees. Cultural aspects and social factors (e.g. educational level, socio-economic status, life experience) should also be taken into account as potential moderators of the relationship of collaborating supervisors' and supervisees' EB.

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Please cite as: Dudko Y, Ouellette D, Zottmann J, Fischer M. The Role of Epistemic Beliefs in Supervisory Relationships. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc39.

DOI: 10.3205/18inhere39, URN: urn:nbn:de:0183-18inhere395

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere39.shtml>

FLIK. A concept for successfully instructing inquiry-based learning in compact seminars “en bloc”

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Guidelines for instructing inquiry-based teaching formats usually assume seminars with regular (bi-) weekly classroom sessions to be most effective for supervising and enhancing students' research projects (e.g., [1]). But what if either structural imperatives (e.g., external instructors, time constraints of the study program) or the instructor's individual preferences call for conducting the seminar as a compact course “en bloc” – with only few but all-day classroom sessions? Is it still possible to teach inquiry-based learning courses? And how to ensure effective student learning? The author has instructed several seminars on inquiry-based learning as a compact course. In his poster presentation, he reflects upon his seminars by presenting the experience-based concept “FLIK”. FLIK is an acronym for inquiry-based learning en bloc (“Forschendes Lernen in Kompaktform”). The concept resulted from the author's experience and the qualitative analysis of feedback from various seminars, and aims at providing scholars with a set of concise and action-oriented recommendations for guiding students successfully through the span of their research projects with only a small number of classroom sessions.

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Please cite as: Fischer M. FLIK. A concept for successfully instructing inquiry-based learning in compact seminars “en bloc”. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc40.

DOI: 10.3205/18inhere40, URN: urn:nbn:de:0183-18inhere401

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere40.shtml>

Humboldt reloaded – perennial effect study, interdisciplinary projects, summer school and teaching coaching for research-based learning

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“To get students enthusiastic about scientific research right from the start” this is the aim of the initiative “Humboldt reloaded” at the University of Hohenheim. So far, between the winter semester 2011/12 and the summer semester 2017 in almost 900 student research projects, Humboldt reloaded has been able to convey this enthusiasm and attitude for scientific research in the disciplines of agricultural, natural and economic sciences to about 3.600 Bachelor students.

To what extent this form of research-orientation in undergraduate studies is advantageous for students will be examined in the context of an accompanying effect study. The study will be completed in 2020. Methodologically, the study is based on a combination of so-called “subjective” and associated “objective” student data. With respect to “subjective” data, students' self-assessments will be elicited through questionnaires and summarized with regard to their competences. On the other hand, “objective” data will be collected by the administration of the university itself. Objective data include, for example, examinations and final grades of the students. Through the combination of these two types of data, a comprehensive understanding of the effect of research-orientation in undergraduate studies is to be achieved.

Beginning with winter semester 2016/2017 three additional components: interdisciplinary projects, an international inquiry-based summer school for undergraduates and a teaching coach for Humboldt reloaded lecturers, have been complementing the project portfolio. These supplementary components are intended to advance learning and teaching by research, facilitate a link to the students' reality after university and provide an orientation and guidance for teachers in a more and more challenging academic teaching environment. In order to maintain the positive effects perceptible by all involved parties and promoted by the new components, the long-term goal of Humboldt reloaded is the implementation of research-based learning and teaching in the curriculum of the University of Hohenheim.

Please cite as: Gerstenberg J, Reinmuth E, Sand J, Stefani AM, Frank C. *Humboldt reloaded – perennial effect study, interdisciplinary projects, summer school and teaching coaching for research-based learning*. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc41.

DOI: 10.3205/18inhere41, URN: urn:nbn:de:0183-18inhere412

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere41.shtml>

Active open online learning: A practical approach to improving statistical literacy among learners

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Background: With the rise of technology in educational design, massive open online courses (MOOCs) are becoming more popular to facilitate teaching and learning, emphasizing open-access, interactive, and self-paced instruction. Such platforms have been invoked to improve statistical education among students and researchers. While the current work assesses individual learners, it speaks to a larger concern within psychology, namely the replicability crisis (OSC, 2015), raising doubts about methodological & statistical rigour among psychologists and social scientists. In light of overwhelming prevalence rates of p-value misinterpretations [1], [2], [3], research is warranted in pinpointing statistical misconceptions, and developing means to improve statistical literacy – goals that should be tackled in unison.

Methods: Pre-/posttest design is implemented within Daniël Lakens' 8-week MOOC "Improving your statistical inferences", which fosters practical understanding of statistical concepts through use of mixed instructional methods, including video lectures and hands-on assignments (e.g., R simulations). The current research evaluates the effectiveness of this applied approach when teaching correct interpretations of p-values, confidence intervals (CIs), and Bayes Factors (BFs). 3 measurement timepoints (14 True/False questions), serve as proxies of prior knowledge (in week 1), immediate improvement (across weeks 1-4), and retention (in week 8). Repeated-measures ANCOVA and regression analyses are used to evaluate effects of course participation on learning, with additional separate analyses for each concept (p-values, CIs, BFs). Demographics and confidence ratings are measured.

Results & Discussion: Study is currently in the online data collection phase. Based on our pilot findings, we expect accuracy rates to correlate with confidence levels and self-rated statistical expertise. Results will be discussed in relation to conceptual knowledge gain vs. applied learning, and how each form of inferential reasoning might inform the other. The presented research aims to instill a more positive outlook on the matter of improving statistical literacy, using practical hands-on learning platforms that may cultivate inquiry-based learning processes.

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DOI: 10.3205/18inhere42, URN: urn:nbn:de:0183-18inhere429

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere42.shtml>

Investigating the (Local) Archive. Student Motivation through Research-based Learning – A Case-Study from History

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In evaluations of history courses at Heidelberg, students tend to articulate a vague dissatisfaction with the practical relevance of what they learn in class. Student feedback shows that the students largely do not perceive their course-activities to be particular disciplinary practices. This has two main reasons: a) the skills practiced in class that are essential for historians (reading, writing, arguing, criticizing etc.) are hardly explicitly framed as such; and b) students very rarely do research on the ground themselves, but have to rely on published (source)material. The paper suggests that this dissatisfaction can effectively be resolved by conceptualizing courses focusing on research and inquiry [1], [2] that make use of (local) archives to investigate (unknown) histories. The case-study presented here depicts a course dealing with the seemingly marginal topic of "Indian students in Heidelberg at the beginning of the 20th century".

Relying on the findings drawn from this course-experiment that is based on students in autonomous, yet intertwined "research-groups" conducting their own research in local archives, I will argue that in the discipline of history in particular, a research-based approach to teaching throughout a whole semester is perfectly suited to foster self-determination and thereby intrinsic motivation among the students [3]. As a result, the students are assuming responsibility in an extraordinary manner, while becoming active partners in a common and original project. Furthermore, the explicit nature of skills and methods practiced in class is directly translated to "real" historical work in the archives. The latter is directly transferred into production of written knowledge that is accessible online. This makes the process of learning through inquiry visible and measurable.

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This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere43.shtml>

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Preparing teacher students for learning by research: Fostering students' methodological skills through inverted classroom

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At most German universities, a practical term at school including empirical inquiry-based project work is compulsory for teacher students (MSW, 2009). Preceding the practical phase students attend seminars to acquire basic methodological skills and get support with their research projects [1]. The aim of this project work is to educate academically skilled staff (cf. Baumert & Kunter, 2006) adopting a so-called researcher's attitude (MSW, 2010). This essential component of professionalism (Kullmann, 2011; Fichten, 2010a) can only be raised if students are satisfied with their research process and outcome and if they do not perceive themselves as methodologically incompetent (Fichten, 2010b). An adequate level of perceived competence can possibly be reached via intensive methodological preparation (ibid.).

"Inverted classroom" (cf. Großkurth & Handke, 2016) offers the advantage of shifting the "passive" knowledge acquisition to preparatory video-based self-study (e.g. Tolks et al., 2016). Thus, lecture time can be used "actively" for exercises, questions and discussions with direct reference to the students' research projects. This shift offers the ideal infrastructure for students' project work as a form of "inquiry-based learning" (cf. Love et al., 2015). It allows for an individual match of the skills students need for planning and conducting research projects with the skills they actually have - which is the basis for a high perception of competence [2], [3]. The resulting finer grasp of methods is supposed to lead to a more self-determined quality of motivation (cf. [4]; Hidi & Harackiewicz, 2000; Krapp, 1999). On the long term, this can lead to the adoption of a researcher's attitude (cf. Fichten, 2010b).

Therefore, we plan to improve students' methodological preparation through "inverted classroom". As dependent variables we focus on students' self-determined quality of motivation, methodological skills and the quality of their project reports. When a high quality of instruction is guaranteed, the impact of the empirical inquiry-based project work can be the focus of the next evaluative step.

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Please cite as: Mertens C, Schumacher F, Basten M. Preparing teacher students for learning by research: Fostering students' methodological skills through inverted classroom. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc44. DOI: 10.3205/18inhere44, URN: urn:nbn:de:0183-18inhere445
This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere44.shtml>

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The Zeppelin Project. Undergraduate research at Zeppelin University

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The Zeppelin Project is a module in the first and second semester of study, which is obligatory for all undergraduate study programs at Zeppelin University. As part of this module students must develop a research question within small groups and elaborate this question by using scientific theories and methods. During the conceptualization and implementation of the research project students will be monitored by lecturers of introductory courses and method workshops. Each group will also be intensely supported by an academic supervisor.

Furthermore, the Zeppelin Project is designed as a interdisciplinary module. Within the introductory courses all students receive input from a political science, economics, sociological as well as communication and cultural science perspective embedded in the annual motto of the Zeppelin Project. Within their research projects students are free to decide if they want to elaborate their research question in a subject-specific or multidisciplinary way.

The resume of our six-year experience with the Zeppelin Project in the field of undergraduate research within the orientation phase of the study is as follows: The high effort for students as well as for lecturers perhaps does not pay off immediately. But positive effects on autonomous scientific working and the deliberate design of the further study can be perceived in the course of studies.

Please cite as: Nikolopoulos I, Zettl C. The Zeppelin Project. Undergraduate research at Zeppelin University. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc45.

DOI: 10.3205/18inhere45, URN: urn:nbn:de:0183-18inhere456

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere45.shtml>

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Implications of multiperspectivity and social reflexivity in planning (developmental) research processes with stakeholders

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Science is confronted with the notion to not only finding solutions for problems raised by society, but also to evoke transformative learning processes and social change [1]. From this perspective, research is interlinked in real-world settings to deduce adequate options for action for the people involved and to produce new knowledge and visions for a better life. In short, research has to deal with ill-structured problems in social settings. Therefore, Nowotny et al. [1] describe the relationship of science and society not only reciprocal, but rather interwoven. The challenge lies in fostering the dialogue of all stakeholders within a specific situative setting to conduct research together. It entails a normative account: Researchers as well as stakeholders are asked to take over responsibility and to distribute expertise in social settings to foster developmental processes, which are uncertain in nature: Diverse perspectives, assumptions, goals and expectations of all involved in the research process might come into conflict and have to be questioned and negotiated.

If higher education wants to qualify students for the aforementioned demands, learning at the university should support critical engagement in ill-structured problems. Therefore, the authors argue for a learning environment that combines elements of research-based learning and service learning from an angle of multiperspectivity. The poster represents a selection of critical incidents that can be identified in such complex research processes to deduce possible options of support. This is especially helpful for teachers in higher education. The challenges were deduced by an analysis of courses, which were conducted by teaching staff at Kiel University consulted by the authors. Furthermore, the poster offers a definition of social reflexivity to address the question on how to address the challenges of ambiguity and uncertainty.

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DOI: 10.3205/18inhere46, URN: urn:nbn:de:0183-18inhere469

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere46.shtml>

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Evidence-based practice: Norms of evidence production in different disciplines

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Evidence-based practice requires that practitioners base their decisions on the best evidence currently available. Researchers therefore need to identify and disclose the most robust evidence that can be transferred into practice. To this end, what counts as sound evidence is constantly debated and negotiated within the scientific communities.

In this project, we study which types of evidence are commonly reported in scholarly publications across three different disciplines (medicine, education, and economics). Also, we will investigate if particular forms of evidence production have become more dominant than others in the past 20 years.

Building on Crombie's [1] and Hacking's [2], [3] work on scientific reasoning styles and evidence production, we developed an analytical instrument (coding scheme) to identify and systematically collect the most salient features of the different processes of evidence production. These features tap specific aspects of the assumptions, designs, methods and objectives of the studies under investigation. By means of a cluster and latent class analysis, we will then empirically determine the different

types of evidence production commonly adopted and accepted within the scientific communities of the three disciplines included in the analysis of this project. The preliminary results of the piloting phase will be presented at INHERE 2018.

The development of this analytical instrument will constitute a powerful tool to investigate the dynamic and social process of evidence production. Additionally, our study will allow to draw important conclusions on the norms of evidence production in science. These will allow to start a discussion on how evidence norms in science relate to evidence norms in practice.

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Please cite as: Scappucci G, Osterhaus C, Fischer F. Evidence-based practice: Norms of evidence production in different disciplines. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc47.

DOI: 10.3205/18inhere47, URN: urn:nbn:de:0183-18inhere471

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere47.shtml>

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Impact assessment of inquiry based learning: Why we need additional research beside student learning

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"How effective is inquiry based learning in teaching?" is a often raised and central question to be answered by evaluation and research into teaching and learning.

If you look more closely, there are already difficulties with the term effect. Beywl [1] distinguishes between three forms: a) impact assessment, b) impact modelling and c) empirical proof of efficacy and effectiveness as intended effect.

We would like to use the poster primarily to address the main question on which level inquiry based learning is assessed in recent projects. Starting with 19 different projects in the Qualitätspakt Lehre (QPL) and Qualitätsoffensive Lehrerbildung (QOLB) programmes, we investigate what are the objectives of the projects studied and what goals and effects of inquiry based teaching and learning are reported on. Our findings are based on data from qualitative interviews with the responsible person of the program and document analyses of curriculums and project papers. In particular, we are interested in what is being evaluated and how inquiry based learning is evaluated, i. e. which perspectives actors take on inquiry based learning. This implies that we do not address research orientation exclusively as a didactic method for higher education but as a holistic concept for universities that will effect several levels of university [2]. Such an approach also has an impact on research, which does not only consider the learning success of students, but indicates the need for e. g. organizational research as well.

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Please cite as: Schiefner-Rohs M, Lübcke E. Impact assessment of inquiry based learning: Why we need additional research beside student learning. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc48.

DOI: 10.3205/18inhere48, URN: urn:nbn:de:0183-18inhere485

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere48.shtml>

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Empirical assessment of approaches to learning methods in psychology

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Introduction: Research Methods is a mandatory course in any Bachelor of Psychology program in Germany. We use a research-oriented, student-based teaching approach to promote active learning and a deep understanding of the material. This study aims to assess the learning approaches used by students in our course.

Methods: Following a written informed consent, 84 third-semester psychology students (80% female, mean±SD age of 23±4 years, 56%<22 years) enrolled in Research Methods participated in the study. The learning approaches (deep, DA; strategic, SA; surface, SAA) were assessed using a 24-item pen-and-paper Approaches and Study Skills Inventory for Students (ASSIST-

24-German) on a 5-point Likert scale (1=strongly disagree to 5=strongly agree). Self-rated performance in the course was assessed on a 9-point scale (1=poor to 9=excellent).

Results: Learning approaches differed statistically significantly among the students (repeated measures ANOVA, $F(2; 164)=8.61$, $p<.01$, $\eta^2=.10$). DA (13.60 ± 2.39) was used significantly more than SAA (12.04 ± 2.50 ; $p<.01$). Learning approach depended on age. DA was used more by older (≥ 22 years) than younger (< 22 years) students ($p=.042$). Younger students used more SA than SAA ($p=.007$) while older students used more DA than SAA ($p=.002$). Higher performance rating was related to significantly higher SA ($r=.44$, $p<.01$, $n=84$). The reliability of ASSIST-24-German was acceptable (Cronbach's α of .74 for DA, .80 for SA, .64 for SAA).

Discussion: When confronted with research in teaching, students use the deep rather than the surface learning approaches although the differences in approaches were small in the current study. Deep learning is more common in older students while younger students learn predominantly strategically. Strategic approach is related to higher satisfaction with own performance because it could be helpful to pass the course. Future research should investigate if and how learning approaches change over time if research is incorporated in teaching in psychology.

Please cite as: Seehoff H, Gerkenmeier I, Kedzior KK. Empirical assessment of approaches to learning methods in psychology. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc49.

DOI: 10.3205/18inhere49, URN: urn:nbn:de:0183-18inhere498

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere49.shtml>

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The interplay of motivational and cognitive factors during the explanation of pedagogical situations by prospective teachers

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Within this project we investigate initial levels of inquiry learning – that is, the identification and explanation of problems in pedagogical situations. This complex process may be influenced by cognitive as well as motivational aspects.

Studies on learning highlight a relation between motivational factors such as epistemic aims and interest and the quality of thinking processes [1], [2]. For instance, people tend to prefer information that supports existing beliefs over information that challenges beliefs [1], [3]. Besides, current theoretical models assume that thinking patterns become apparent in argumentative structures, i.e. in texts [4].

Aim of this presentation is to analyse the relation between motivational factors and thinking patterns that are shown by teacher-students. Our research questions are (1) which argument structure can be identified in texts by teacher students, and (2) how are these structures related to prospective teachers' interest for the topic?

To answer these questions, we analysed learning diaries of 50 teacher students during the course of a long-term internship (83% female, AgeM=26.23). Students were asked to describe and explain a relevant school situation based on theory and evidence from educational research, and to draw conclusions on their own learning.

The learning diaries are analysed using qualitative content analysis. The coding is done by two independent raters based on (1) argumentative structure (according to theoretical constructs of Toulmin, 1958, [5]), and (2) motivational factors like interest in a situation (according to Hidi & Renninger, 2011).

Initial analyses show that three out of four students are able to construct complete argumentations (including arguments and conclusions). Further analyses of motivational aspects and their relation to argument structure will follow, in order to clarify the importance of motivational factors for the explanation of challenging situations.

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Please cite as: Trempler K, Hartmann U. The interplay of motivational and cognitive factors during the explanation of pedagogical situations by prospective teachers. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc50.

DOI: 10.3205/18inhere50, URN: urn:nbn:de:0183-18inhere504

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere50.shtml>

The nature and use of (health) design in inquiry-based learning. A case study

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The literature on inquiry-based learning usually assumes an understanding of inquiry based on ideal-typical cycles of empirical educational and social research [5]. However, more recent research has suggested a greater openness of inquiry-based learning regarding the “factual variety” of research approaches [4], which should thus be taken into account when conceptualizing concrete seminars of inquiry-based learning.

Among other examples of alternative scientific accesses, Owen [2] proposed that "Design" differs from conventional science both in terms of its procedure and its outcomes. As design also differs from “normal” social scientific research, the question arises of whether design competencies from the side of the students need to be encouraged by alternative forms of instruction. At a theoretical level, there have been thoughts on the development of a both scientific and creative capacity of problem-solving [1].

This presentation complements these theoretical efforts by an applied perspective and presents a case study from a university seminar on health design [3]. More specifically, the students had the opportunity to learn inquiry-based by tackling distinct social challenges of the German healthcare system with the method of design thinking. While instructing the course for more than three years and based on the careful analysis of the students' feedback at the end of each course, the author strived for a continuous improvement of the seminar's individual sessions in order to achieve the systematic training of the necessary design competencies. The presentation describes the didactic measures which lead to a high degree of student satisfaction and also to the enhancement of the author's own (doctoral) studies.

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Please cite as: Fischer M. The nature and use of (health) design in inquiry-based learning. A case study. In: *Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018)*. München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc51.

DOI: 10.3205/18inhere51, URN: urn:nbn:de:0183-18inhere514

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere51.shtml>

Project Laboratories and tu projects – Project based inquiry learning at the Technical University of Berlin

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At the Technical University (TU) of Berlin students have the possibility to design their own research and teaching in so called Project Laboratories [<http://www.projektwerkstaetten.tu-berlin.de>] and tu projects. The Project Laboratories have been established at TU Berlin in consequence of a student's strike to improve study conditions in 1985. Based on this idea, the tu projects have been additionally funded by the German Federal Ministry of Education and Research since 2012. They comprise a similar methodological orientation and content while including a stronger focus on involving first-year students. Until today, more than 150 of these self-organized project-courses have been conducted. Currently there are more than 25 projects running in parallel.

The courses are independently initiated, designed and led by students. Their methodology ranges from preliminary project based learning up to strictly conducting the whole process of learning through research. The practical orientation of the program facilitates the accessibility for students with varying backgrounds and activates their inquiring mind while teaching important key competencies.

The projects are scientifically supported by specialist areas and by TU Berlin's science shop kubus concerning all other issues. Each semester, interested students can submit their ideas. If accepted, two tutors are funded for two years to conduct the project. They are obliged to hand in mid-term and final reports. Participating students have the possibility to obtain study credit points.

The overall topic of the program is to foster sustainability issues and to activate socially useful and environmentally friendly thinking and acting. The interdisciplinary projects deal with issues and apply methods which are insufficiently represented in the officially teaching standards. The participating students test innovative teaching, learning and research concepts. Approved

good practice courses or successful elements can be subsequently transferred into the official standard of teaching at TU Berlin.

Please cite as: Haas A. Project Laboratories and tu projects – Project based inquiry learning at the Technical University of Berlin. In: Learning through Inquiry in Higher Education: Current Research and Future Challenges (INHERE 2018). München, 08.-09.03.2018. Düsseldorf: German Medical Science GMS Publishing House; 2018. Doc52.

DOI: 10.3205/18inhere52, URN: urn:nbn:de:0183-18inhere524

This article is freely available from <http://www.egms.de/en/meetings/inhere2018/18inhere52.shtml>

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