

A photograph showing several hands of different skin tones holding a small globe of the Earth. The hands are positioned around the globe, with some pointing at specific locations. The background is a light, neutral color.

From Discovery of Own Talent to Professional Confidence --  
Removing Barriers and Strengthening Self-Assurance of Women in  
Computer Science

Ute Schmid

Women's Representative of the Faculty Information Systems and Applied  
Computer Science (WIAI), University of Bamberg



<http://www.cs4fn.org/women/> Lynne Jenkins: <https://slideplayer.com/slide/14391619/>



Credit: Luis Alvarez / DigitalVision / Getty Images

- Let girls and females (and everybody else) discover their inclinations and talents (in STEM, in informatics)
- Allow for freedom of choice for a (STEM) degree of study and career (overcome structural, social, and personal barriers)

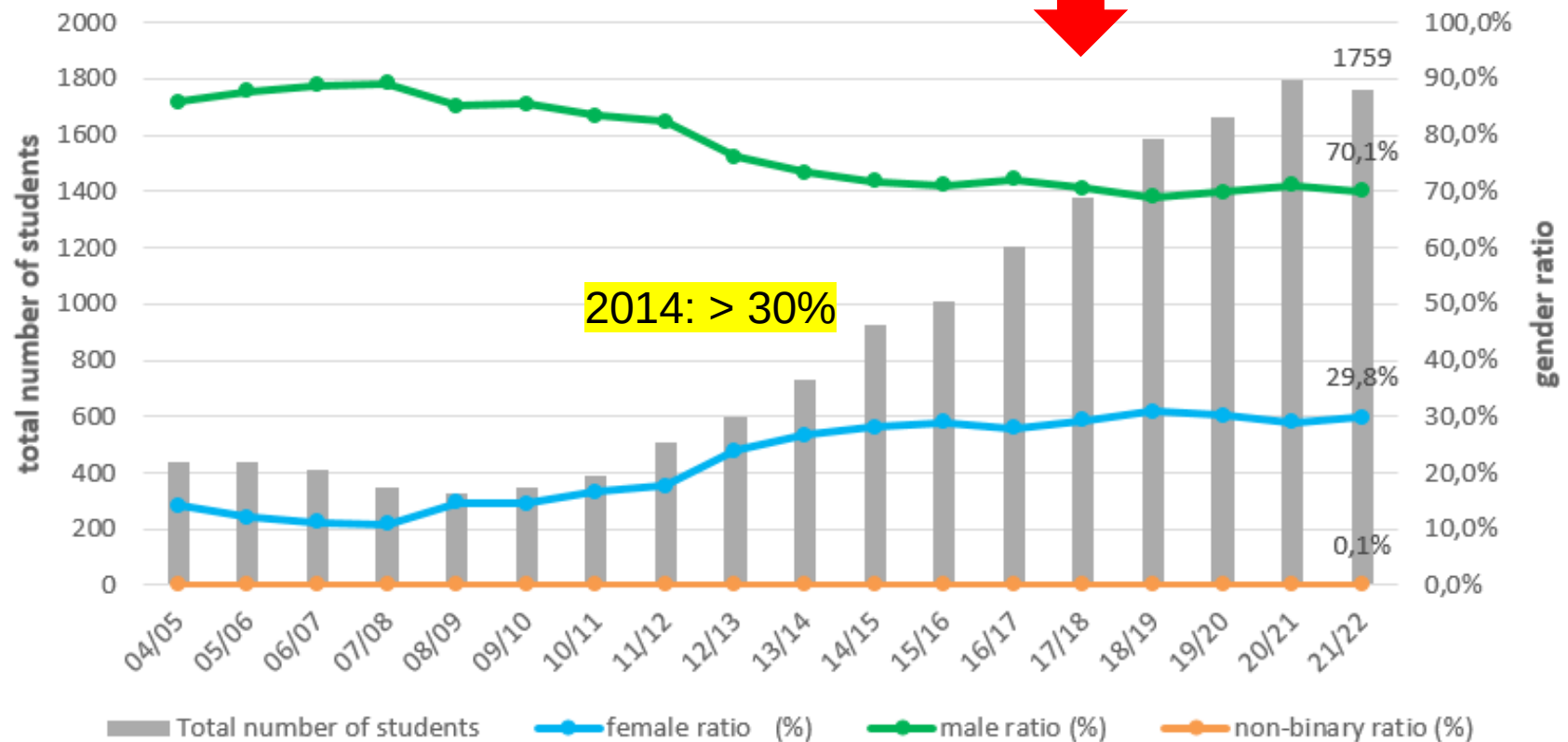


- Introducing the Faculty WIAI at University of Bamberg
- Encouraging and Recruiting Females to Study Informatics
  - Measures
    - Observations and Empirical Findings
- Retaining Female Students
  - Measures
    - Observations and Empirical Findings
- Careers of Women in Informatics
  - Measures
    - Observations and Empirical Findings
- Lesson Learned (so far ...)

# Enrolment statistics

Winter term 2021/2022

Minerva Award  
(2018)





# 2018: Minerva Award

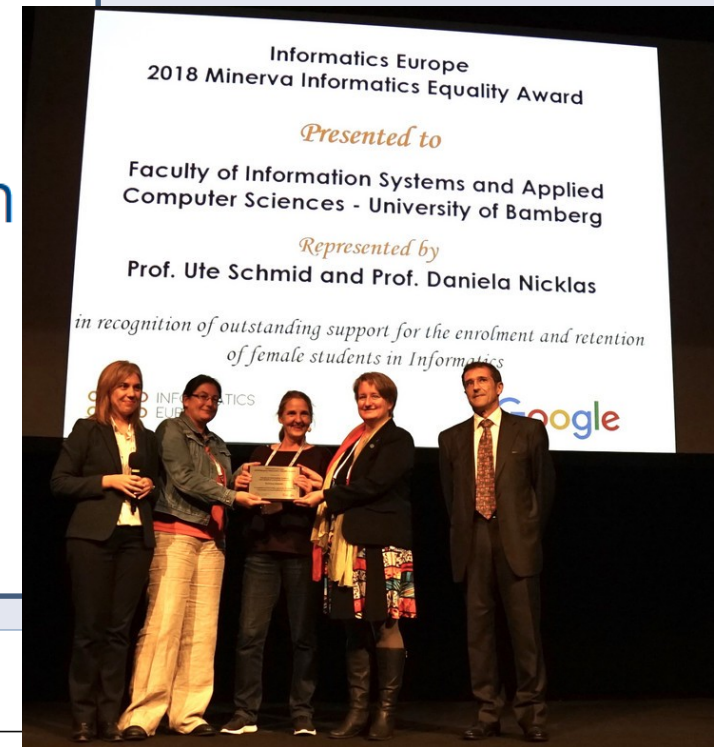
10.10.2018

Europaweit beste Frauenförderung  
in der Informatik. Preis „Minerva  
Informatics Equality Award“ geht an  
die Universität Bamberg

**Die Universität Bamberg bekommt als erste  
Hochschule im deutschsprachigen Raum den  
„Minerva Informatics Equality Award“.**

## The Bamberg CS30 Strategy

*Nomination of the WIAI Faculty (Information Systems and Applied Computer Sciences)  
at the University of Bamberg  
for the Minerva Award 2018*



## Erstsemester WIAI Studierende im WS21/22

Studiengang	Erstsemester	Studierende männlich	Anteil	Studierende weiblich	Anteil	Studierende divers	Anteil
B.Sc. Angewandte Informatik	56	41	73,2%	14	25,0%	1	1,8%
B.Sc. International Information Systems Management	13	10	76,9%	3	23,1%	0	0,0%
B.Sc. Informatik: Software Systems Science	33	26	78,8%	7	21,2%	0	0,0%
B.Sc. Wirtschaftsinformatik	84	58	69,0%	26	31,0%	0	0,0%
M.Sc. Angewandte Informatik	14	10	71,4%	4	28,6%	0	0,0%
M.Sc. Wirtschaftsinformatik	35	27	77,1%	8	22,9%	0	0,0%
M.Sc. Computing in the Humanities	33	11	33,3%	22	66,7%	0	0,0%
M.Sc. Wirtschaftspädagogik / WI	7	3	42,9%	4	57,1%	0	0,0%
M.Sc. International Information Systems Management	18	13	72,2%	5	27,8%	0	0,0%
M.Sc. Software Systems Science	30	21	70,0%	9	30,0%	0	0,0%
Alle Studiengänge	323	220	68,1%	102	31,6%	1	0,3%

21,8%  
on average  
in Germany

# Encourage and Recruit

2008

2005

2006

2009

2015

2010

2012



Online information about role models

Master degree „Computing in the Humanities“

5 - 10

10 - 14

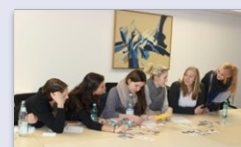
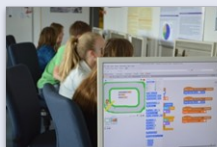
14 - 18

5 - 18

16 - 18

16 - 18

Bachelor graduates



Continuous evaluation of strategy actions

# The Bamberg CS30 Strategy

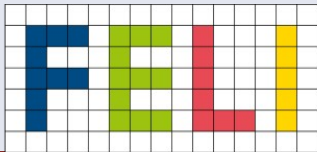


Effects of actions?

Which actions are effective?

**Continuous evaluation  
of strategy action:  
Empirical research**



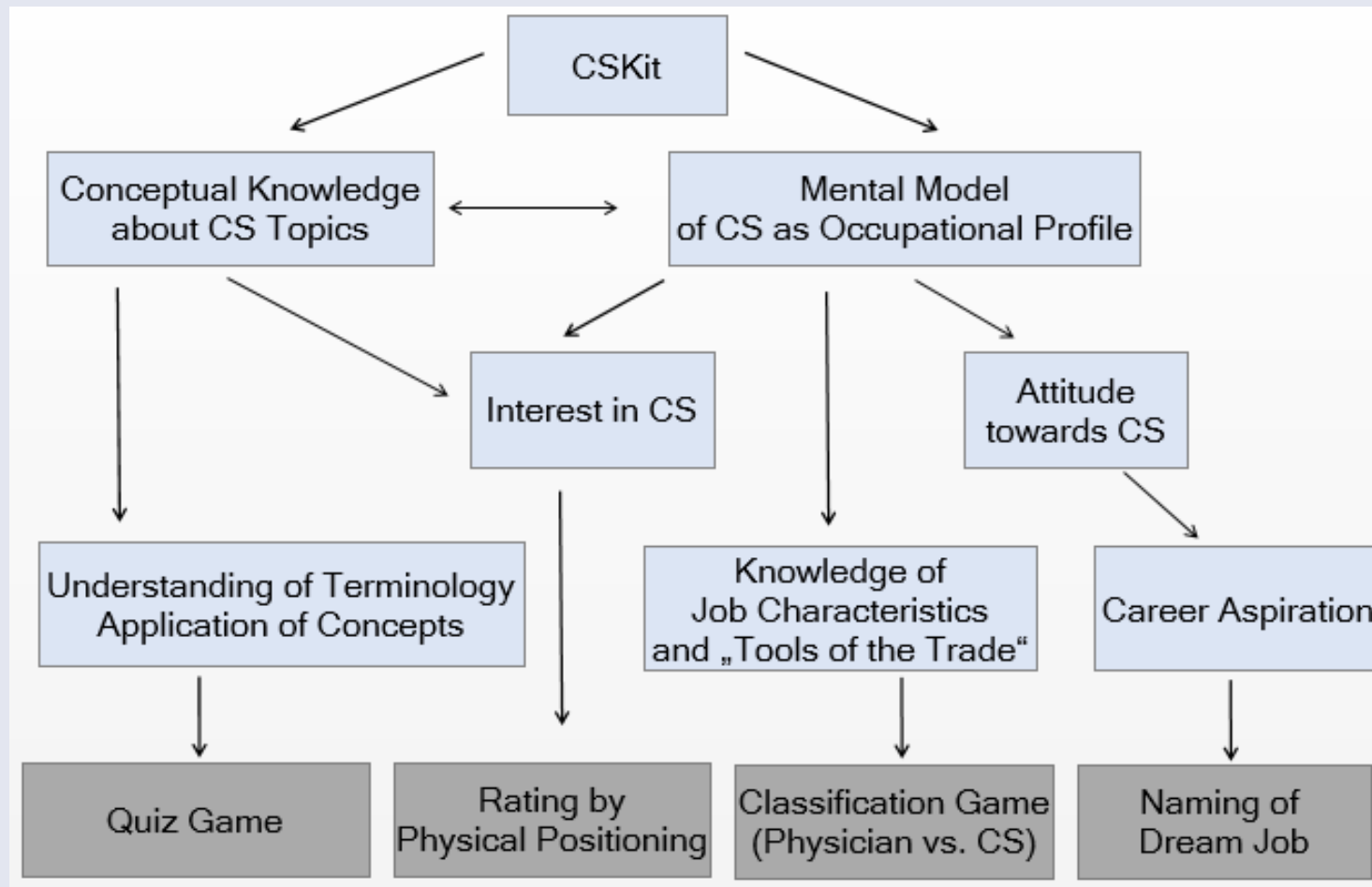


- Experimentierkiste „Informatik“
- Workshop Scratch
- Workshop Digital Poster



# Empirical Findings

**Empirical Evaluation of the Computer Science Experimenter's Kit:** Maike Wolking & Ute Schmid, WiPSCE 2017, Mental Models, Career Aspirations, and the Acquirement of Basic Concepts of Computer Science in Elementary Education



**Empirical Evaluation of the Computer Science Experimenter's Kit:** Maike Wolking & Ute Schmid, WiPSCE 2017, Mental Models, Career Aspirations, and the Acquirement of Basic Concepts of Computer Science in Elementary Education

## **Systematic Observations** (2 kindergardens, 1 primary school)

- Knowledge/preconceptions about job characteristics
- No idea about gender proportions in different jobs
- Rating of Interest Before/After





## Workshops: Programming with Scratch/Digital Poster

- Gender specific strategies
- Can be observed starting about at age 8-9 (3rd grade):
- Girls work planful, boys explore
- Girls program interactive stories, boys program games (introduce variables for scores!)



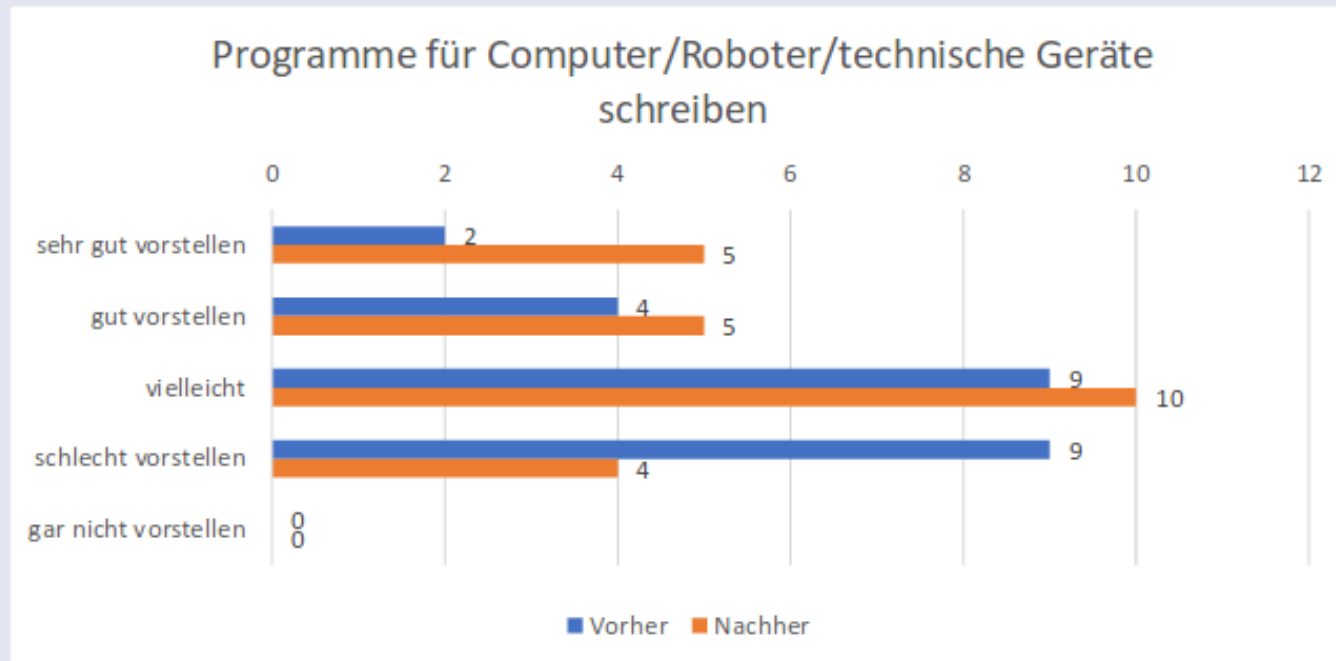
Epilog TU Wien | Daniela Nicklas | University of Bamberg, WIAI



## Holiday workshops for girls from age 10 – 14



Pre-/post questionnaires show robust short-term effects of the measures on changes of attitudes towards informatics



Are specific programs for girls (still) necessary?

*Yes, it seems so:*

- Same workshop offers for MuT (girls only) and BIT (mixed)
- > 50 girls every year at MuT
- > 12-20% girls at BIT





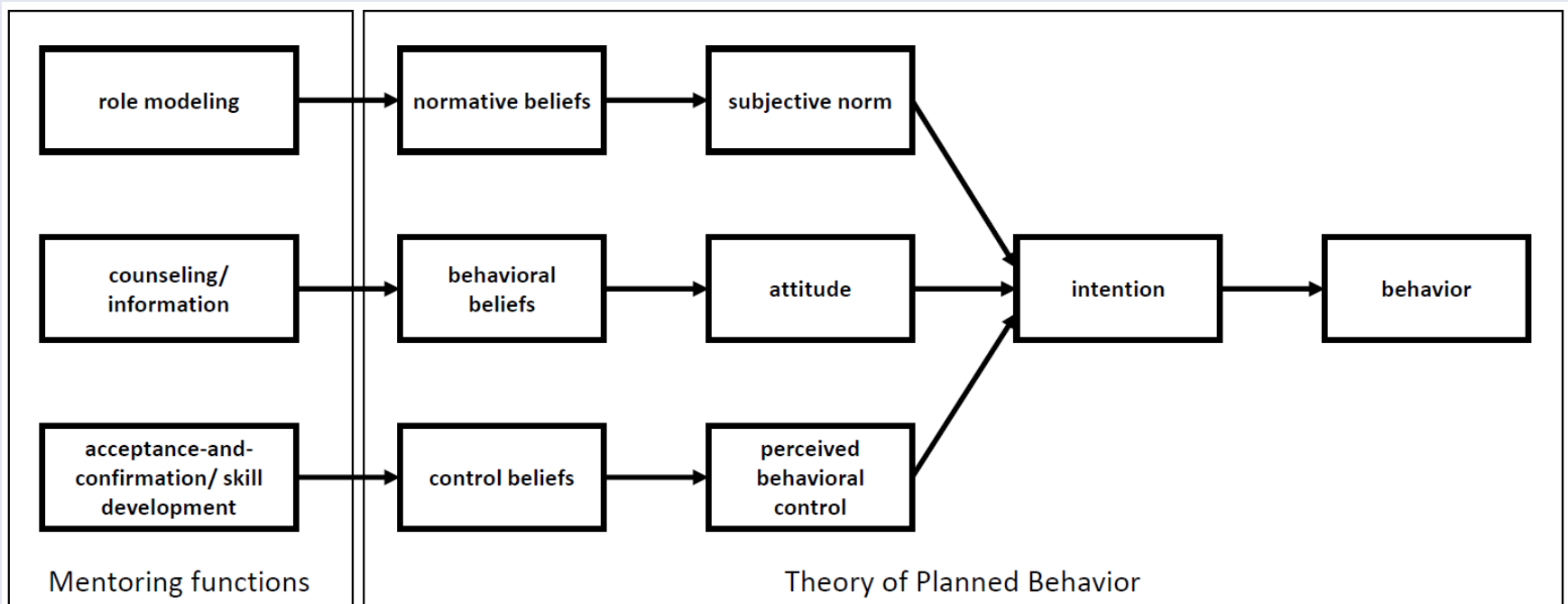
## Mentoring for high school students Mentors are CS students





# Empirical Findings

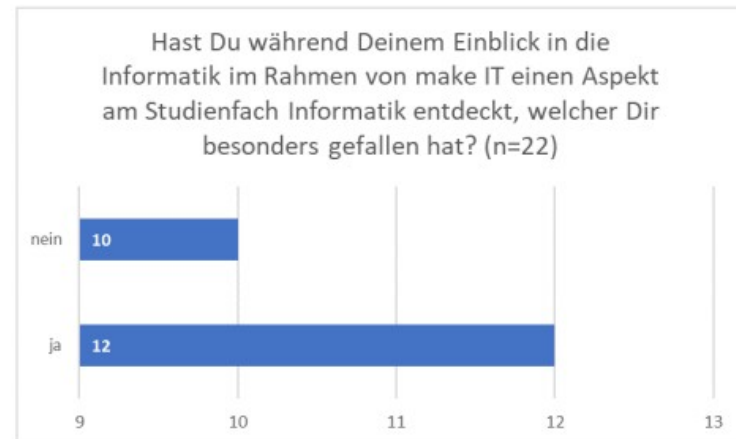
- Bettina Finzel, Hannah Deininger, Ute Schmid, From Beliefs to Intention: Mentoring as an Approach to Motivate Female High School Students to Enrol in Computer Science Studies, GenderIT 2018



Hannah Deininger, Bettina Finzel, Ute Schmid, From Beliefs to Intention: Mentoring as an Approach to Motivate Female High School Students to Enrol in Computer Science Studies, GEWINN 2018

**Table 2: Measures and their assumed effect on mental barriers to study computer science.**

Mentors as role models	Changing the gender-related conceptualization of computer science as un-female towards a gender neutral concept
Specific information about computer science studies and occupational profiles	Providing a rational basis for a study and career decision
Hands-on experience and explicit feedback addressing underestimation and negative beliefs	Realistic assessment of own talents and skills



# From Workshops to Study

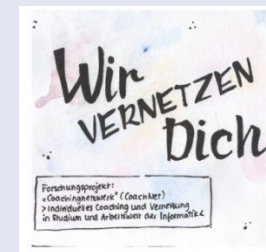
## Teilnahme unserer Studierenden an Nachwuchsprojekten

Jahr	MuT (w)	Girls Day BA	Girls Day BW	BIT (w)	BIT (m)	BIT (w/m)	makeIT (w)	makeIT (m)	makeIT (w/m)	TAO BA (w/m)	MINT (w)	MINT (m)	MINT (w/m)	Summe BA	Summe Gesamt
2011	0	0	3	0	1	1	—	—	—	—	1	4	5	1	9
2012	1	2	8	1	0	1	—	—	—	—	2	4	6	4	18
2013	2	3	1	0	3	3	—	—	—	—	4	14	18	8	27
2014	0	2	4	3	2	5	—	—	—	—	4	4	8	7	19
2015	0	4	1	0	2	2	—	—	—	—	0	6	6	6	13
2016	0	1	3	0	2	2	—	—	—	—	4	6	10	3	16
2017	0	1	1	0	0	0	2	0	2	—	4	5	9	3	13
2018	1	0	2	0	0	0	0	0	0	—	0	5	5	1	8
2019	2	3	9	0	1	1	1	0	1	—	2	12	14	7	30
2020	0	0	5	0	1	1	0	1	1	—	2	3	5	2	12
2021	0	2	41	—	—	5	—	—	3	1	—	—	77	11	129
<b>Gesamt</b>	<b>6</b>	<b>18</b>	<b>78</b>	<b>4</b>	<b>12</b>	<b>21</b>	<b>3</b>	<b>1</b>	<b>7</b>	<b>1</b>	<b>23</b>	<b>63</b>	<b>163</b>	<b>53</b>	<b>294</b>

BA = Bamberg; BW = Bundesweit; w = weiblich; m = männlich; (w/m) = weiblich und männlich gemeinsam; BIT = Bamberger Informatiktag (bis 2014 FreakIT); TAO BA = TAO Schülerforschungszentrum Standort Bamberg; MINT = weitere bundesweite Schüleraktionen aus Mathematik, Informatik, Naturwissenschaft, Technik

# Retaining Female Students

- ↗ Female tutors as role models
- ↗ Mentoring and Networking (excursions to software companies)
- ↗ Seminar Course Gender Aspects of Computer Science  
(since 2015 each summer term)
- ↗ CoachNet: Individual coaching for career development  
(Project funded by Adecco and Rainer Markgraf Foundation 2016-2020)





## Lunch Meet Up

- Weekly virtual meeting during online lecture period (pandemic period)
- For female students, university staff and scientific staff



## Ada Study Space - by women\* for women\*

- Space and time for exchange and support between female\* students, coworking and save space
- More experienced and new female students support each other
- Weekly during lecture period

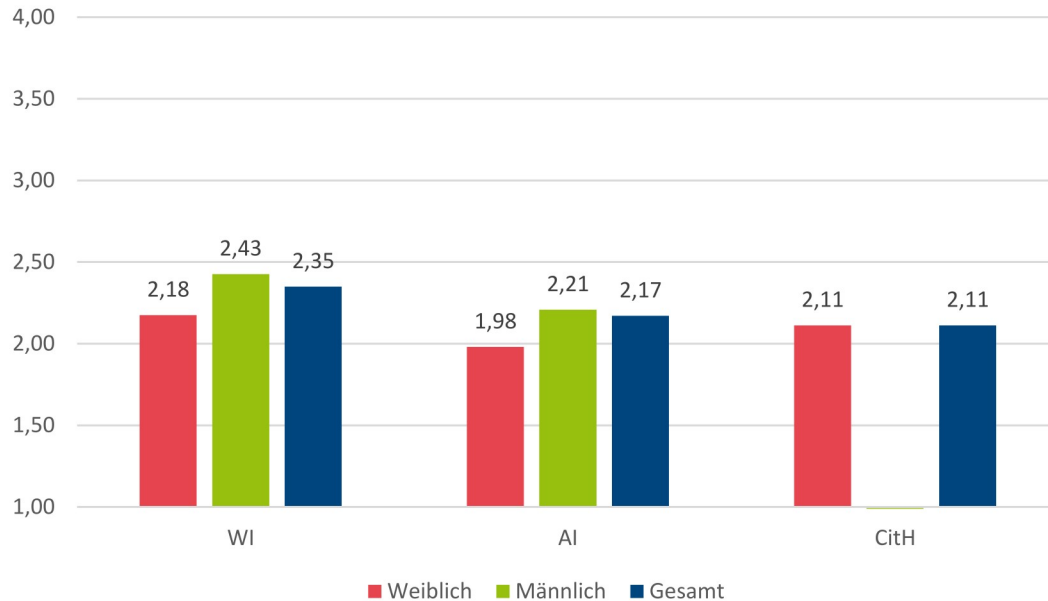


- Video Interviews: female students talk about university life and their course of studies
- Computer Science and Applied Computer Science
- Three central questions:
  - Who are you and how did you get to your course of studies?
  - What do you do besides your studies?
  - What do you like best about your course of studies?



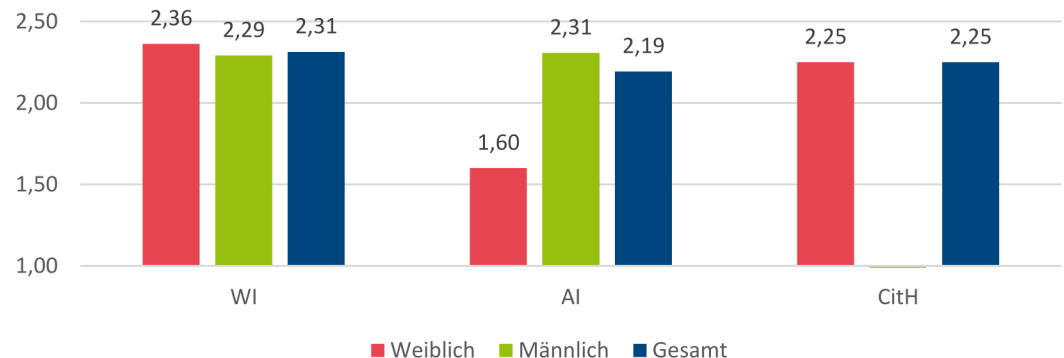
# Study Prerequisites

Abschlussnote



Female students in Applied CS have significantly better grades in mathematics (much better than average in Bavaria)

Mathematiknote



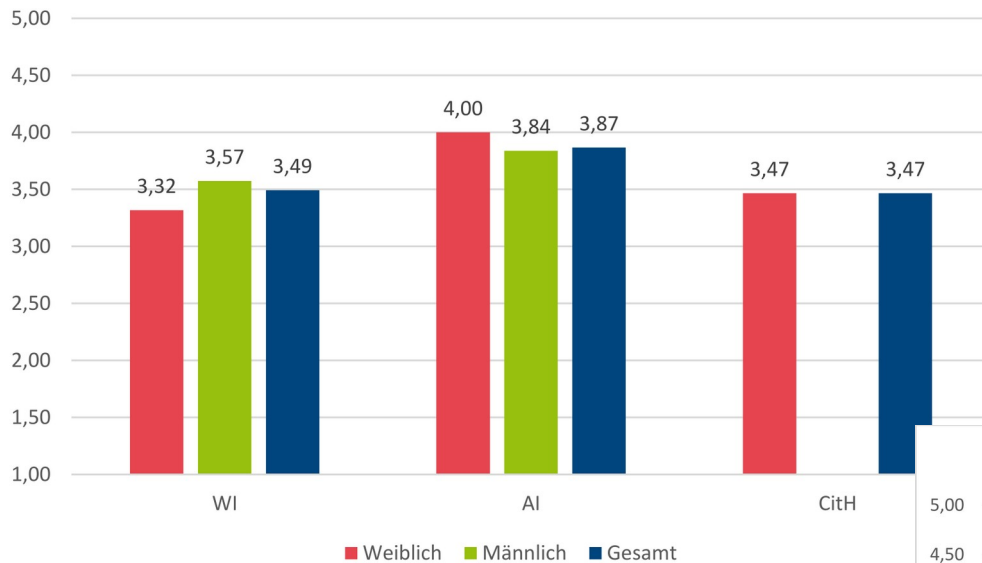
Data from summer 2019:

- WI: 22w, 48m
- AI: 5w, 26m
- CitH: 16w, 0m

Effects are similar over the years (since 2011)

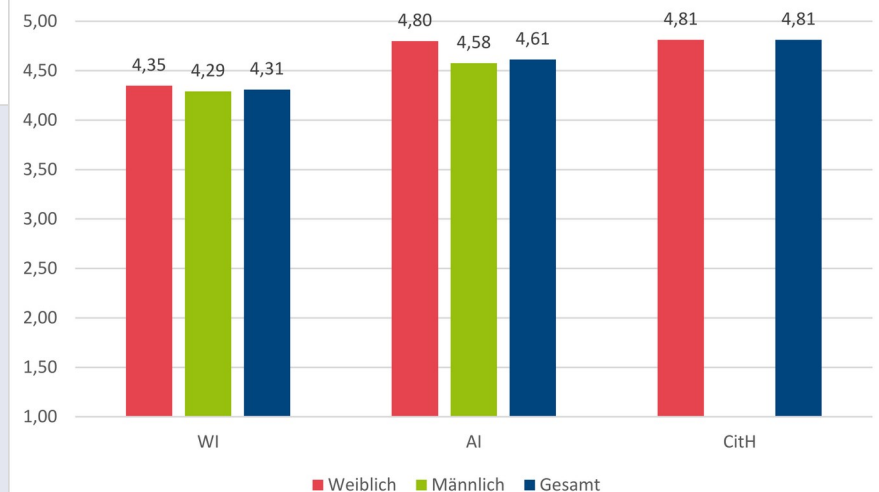
# Study Motivation

### Neigung/Begabung



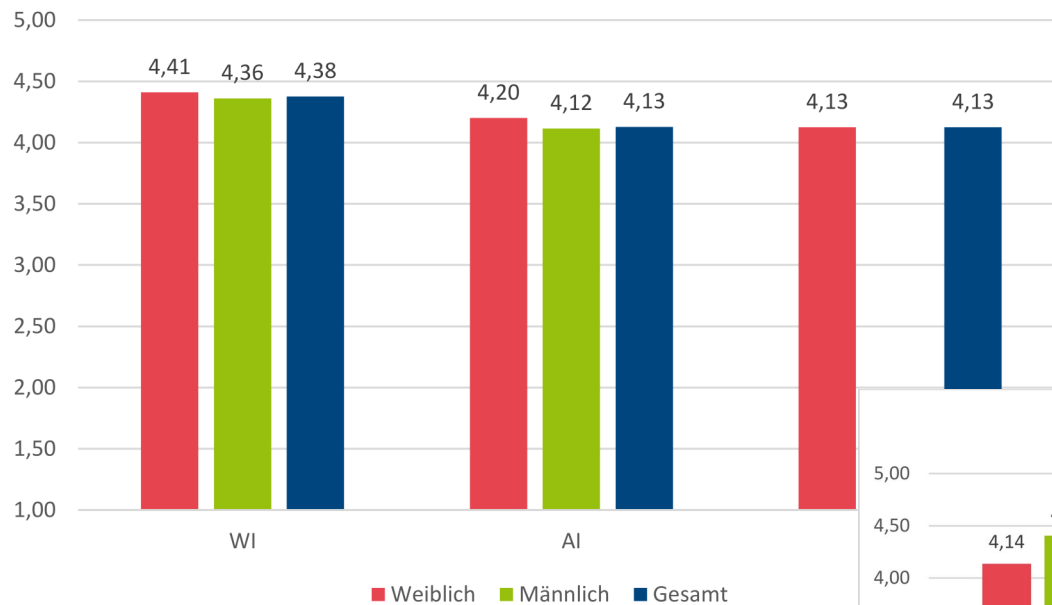
Talent and interest are stronger Motives for CS than for business informatics

### Interesse am Fach



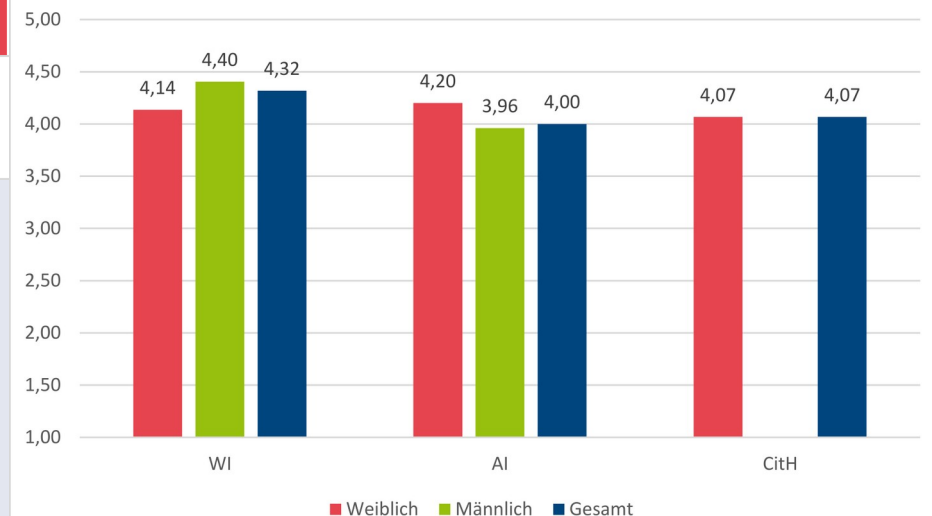
# Study Motivation

## Gute Karrierechancen



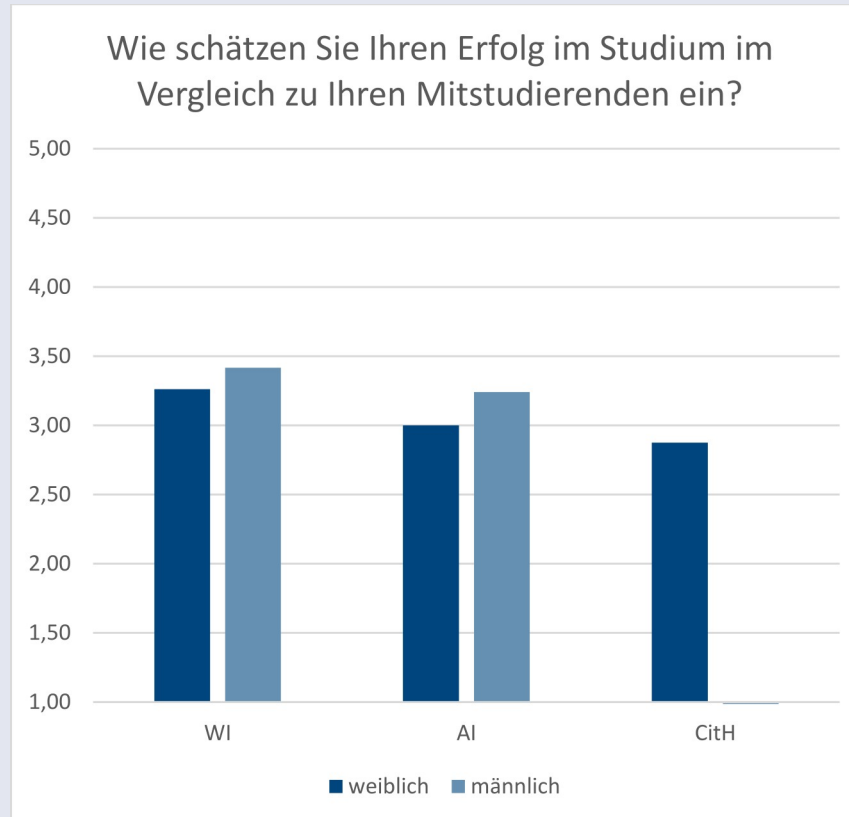
Career opportunities and salary are stronger motives for business informatics than for CS

## Gute Verdienstmöglichkeiten





# Study Self-assessments



Female students  
Rate their own success  
Lower than male  
students  
BUT: grades in intro cs  
are better

## Mutual Perception of male/female students in computer science

**WIAI-Erstsemesterbefragung (2011, 2012)** (Schmid, U. et al., Informatik Spektrum 2015)

Open question: name three typical characteristics of your female/male study colleagues (answers of 30 female, 51 male)

**Seminar „Genderaspekte in der Informatik“ (2015)**

(Grünauer, S. & Knauf, D., 2015)

Questionnaire for students of computer science and education (vf. Meis, L. et al., 1993)

*“Draw a typical female computer scientist.”*

*“Draw a typical male computer scientist.”*

(answers of 29 cs students (7 female) and 30 education students (24 female))

# Image Study

## Informatikstudentinnen:

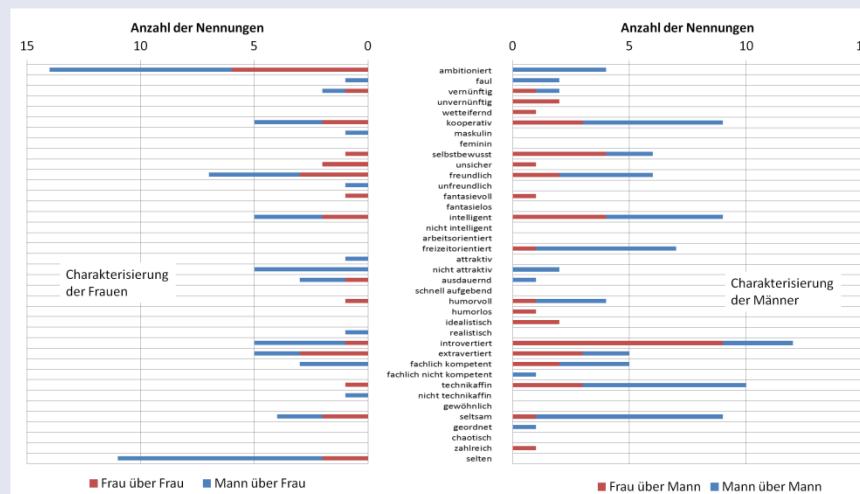
(most frequent adjectives)

- ambitioniert
- selten
- freundlich
- kooperativ
- intelligent
- nicht attraktiv

## Informatikstudenten:

(most frequent adjectives)

- introvertiert
- technikaffin
- kooperativ
- intelligent
- seltsam („nerdig“)



Semantic differential





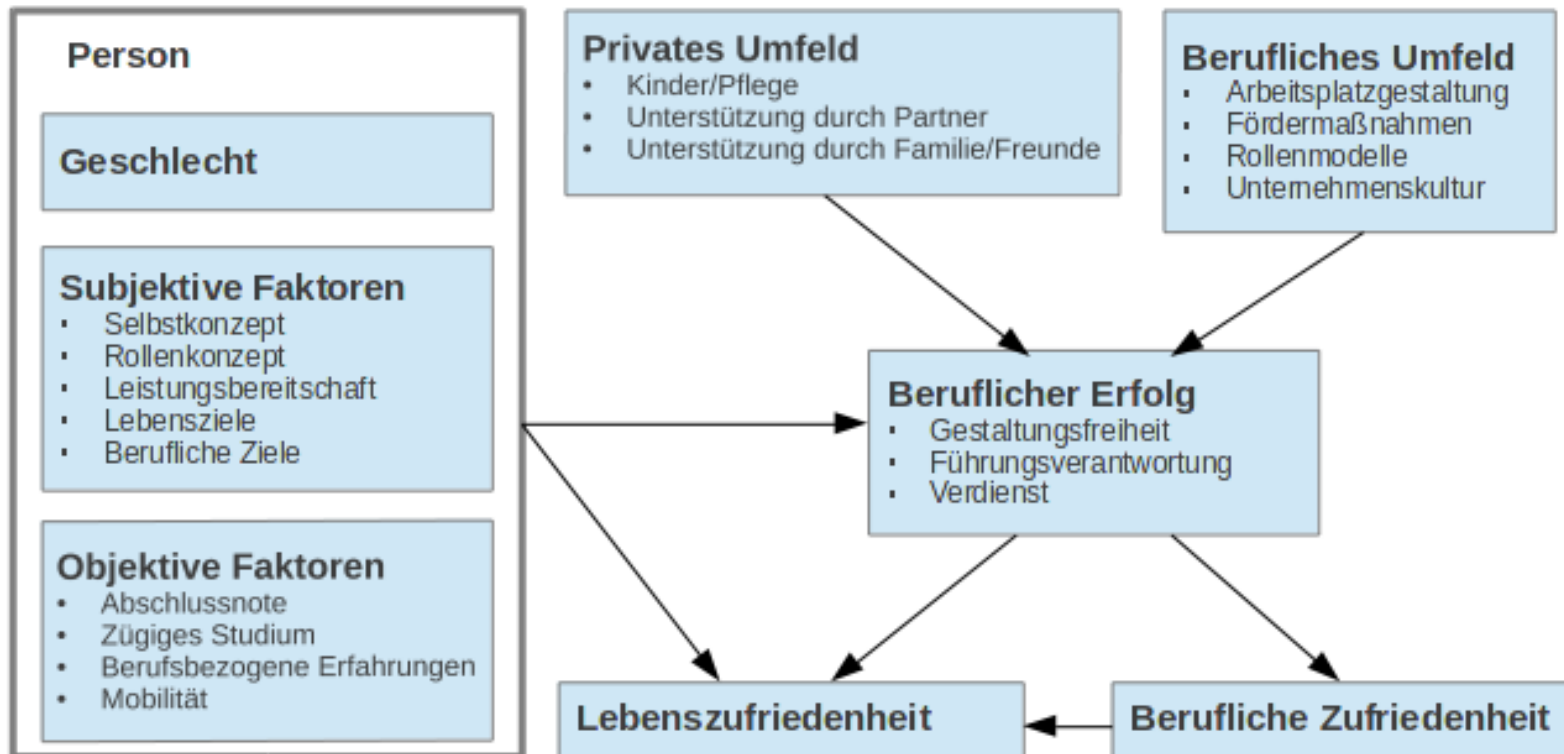
# Research project Alumnae tracking



- └ ESF project, 01.10.2012 - 31.03.2015
- └ Evaluation of female and male careers of computer science students in Bamberg
- └ Covering students and graduates since 2003
- └ Interviews with HRs of over 30 companies
  
- └ Main results concerning female students:
  - └ Significantly better high school math grades than males
  - └ Mis-match of self image and study success

## Students

## Companies

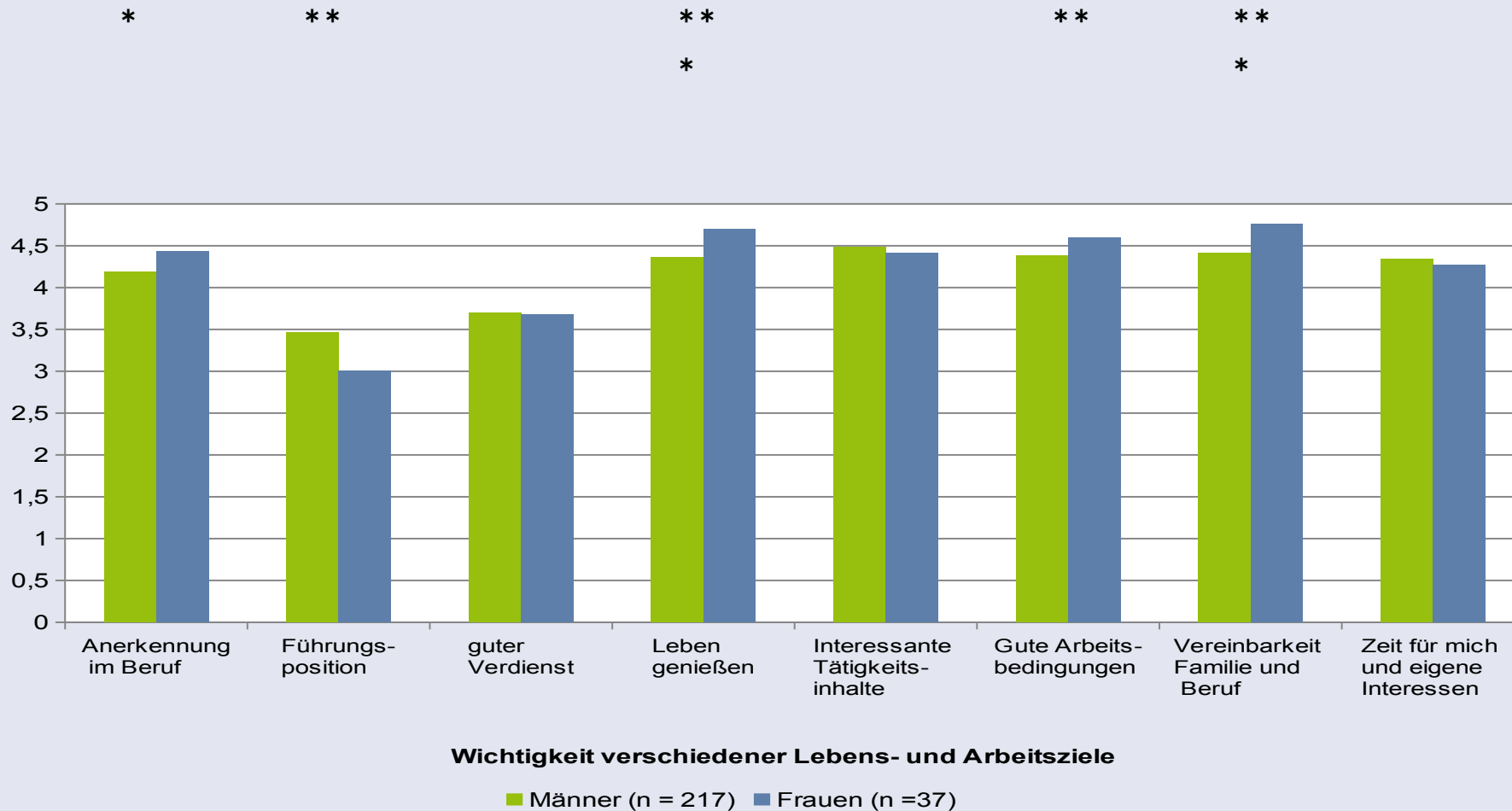


## Graduate

# Life goals and work goals

1: gar nicht wichtig; 5 sehr wichtig

\*/\*\*/\*\* signifikant auf 10/5/1% Niveau

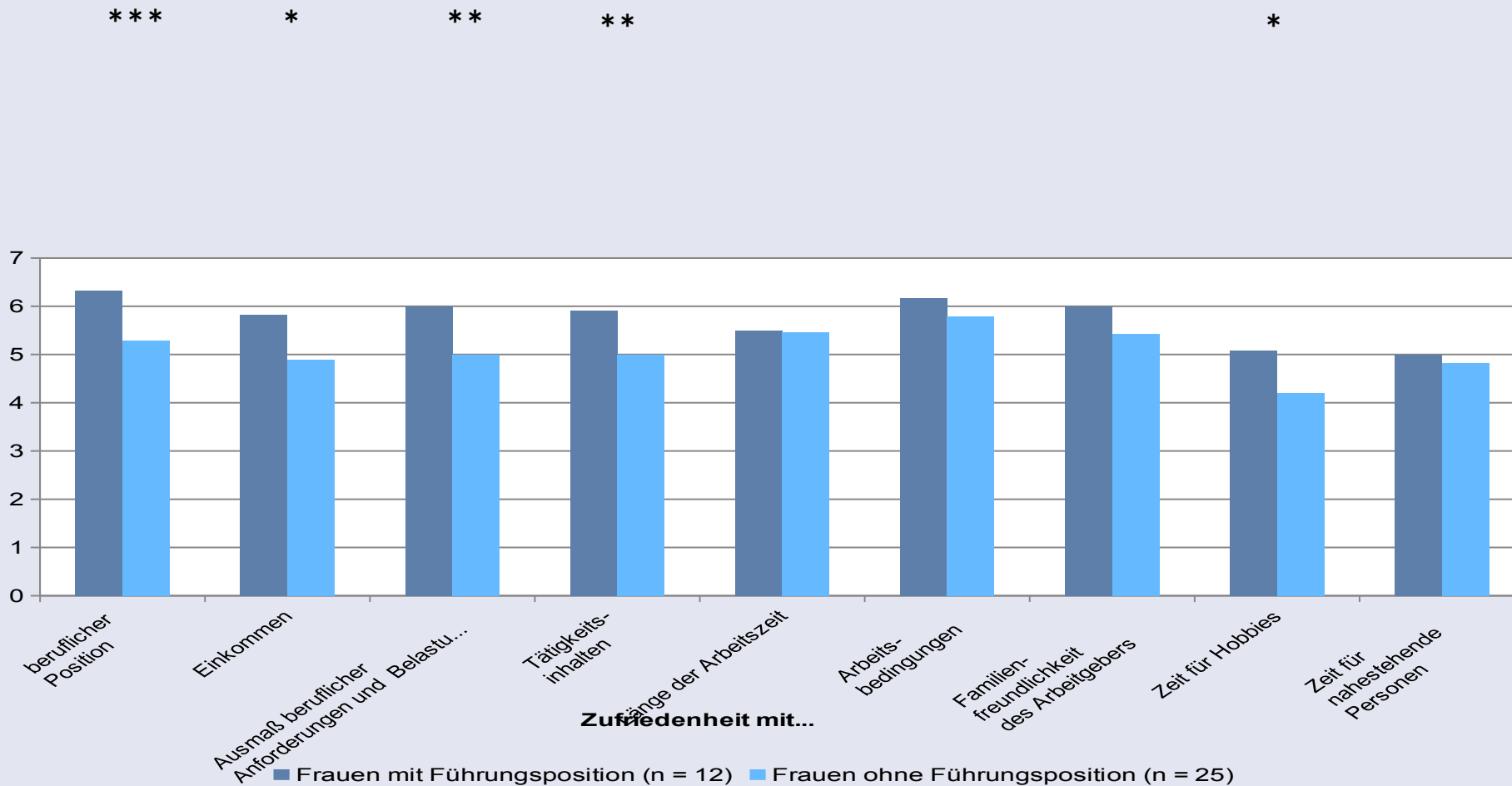


Quelle: Alumnae Tracking, Ehemaligenbefragung, 1. Welle 2013, 2014, 2015

# Work Satisfaction

\*/\*\*/\*\* signifikant auf 10/5/1% Niveau

1: sehr unzufrieden; 7: sehr zufrieden



Quelle: Alumnae Tracking, Ehemaligenbefragung, 1. Welle 2013, 2014, 2015





Wednesday, 26 October 2022


## WIRE-EUGAIN WS - "Attracting & Retaining Female Students from Bachelor and Master to PhD" *(parallel sessions)*

*(Venue: Geomatikum H6)*

Workshop Chairs: Karima Boudaoud, Université Côte d'Azur, Barbora Buhnova, Masaryk University, and Letizia Jaccheri, NTNU.

- 09:00 - 09:10 **Opening and Welcome from the Workshop Chairs**
- 09:10 - 10:30 **Session 1. Working Groups Updates** (Chair: Özge Misirli, Eskisehir Osmangazi University)

# CA19122 - European Network For Gender Balance in Informatics (EUGAIN)

 Downloads

## Working Groups

Number	Title	Leader
1	From School to University	Dr Monica LANDONI ▾
2	From Bachelor/Master Studies to Ph.D.	Prof Erika ABRAHAM ▾
3	From Ph.D. to Professor	Dr Steve KREMER ▾
4	Cooperation with Industry and Society	Ms Fanni BOBAK ▾
5	Strategy & Dissemination	Dr Valentina LENARDUZZI ▾



- └ Start early, keep going
  - └ Actions for all ages to build awareness of computer science as an option
  - └ Only hands-on experience supports change in self-perception
  - └ Build up a network with active teachers
  
- └ Positive effects for everybody
  - └ Before studies: better visibility for CS courses
  - └ During studies: make students aware of gender biases
  
- └ Make it a mission for the whole faculty!

# Thank you!

- Prof. Dr. Daniela Nicklas for her active support of gender measures since 2014
- Many faculty members for their continuous support of our actions (offering workshops, support female students, ...)



- ┐ Caroline Oehlhorn and Daniela Nicklas as Vice Faculty Women Representatives, for supporting actions for female students and university committee work
- ┐ Leonie Ackermann, Clara Morrisey, Alina Tenne, Hannah Feldmann, Bettina Finzel, Hannah Deininger, Sonja Grünauer, Kristina Prümer, Jonas Troles and many more: Team of student assistants
- ┐ Franziska Paukner, Sanne Grabisch, Tanja Fiehl, Silvia Förtsch, Romy Hartmann, Laura Folter, and most of all Anja Gaertig-Daugš – Staff members for organizatorial and scientific support



- [1] B. Finzel, H. Deininger, and U. Schmid, From beliefs to intention: mentoring as an approach to motivate female high school students to enrol in computer science studies. *GenderIT* 2018: 251-260
- [2] U. Schmid, K. Weitz, and A. Gärtig-Daug, "Informatik in der Grundschule," *Informatik Spektrum*, vol. 41, no. 3, pp. 200–207, Jun. 2018.
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- [4] S. Förtsch, "Find the Right Role: Specialist vs. Management Career - Individual Career Coaching for IT Specialists," in *Proceedings of the 4th Conference on Gender & IT*, New York, NY, USA, 2018, pp. 135–137.
- [5] M. Wolking and U. Schmid, "Mental Models, Career Aspirations, and the Acquirement of Basic Concepts of Computer Science in Elementary Education: Empirical Evaluation of the Computer Science Experimenter's Kit," in *Proceedings of the 12th Workshop on Primary and Secondary Computing Education*, New York, NY, USA, 2017, pp. 119–120.
- [6] K. Weitz, A. Gärtig-Daug, D. Knauf, and U. Schmid, "Computer Science in Early Childhood Education: Pedagogical Beliefs and Perceived Self-Confidence in Preschool Teachers," in *Proceedings of the 12th Workshop on Primary and Secondary Computing Education*, New York, NY, USA, 2017, pp. 117–118.
- [7] A. Gärtig-Daug, K. Weitz, M. Wolking, and U. Schmid, "Computer Science Experimenter's Kit for Use in Preschool and Primary School," in *Proceedings of the 11th Workshop in Primary and Secondary Computing Education*, New York, NY, USA, 2016, pp. 66–71.
- [8] U. Schmid, A. Gärtig-Daug, and S. Förtsch, "Neigung entdecken, Informatik studieren, als Informatikerin arbeiten– Vernetzung von Mals snahmen und Begleitforschung an einem Standort," *Frauen machen Informatik. Magazin der GI-Fachgruppe Frauen in der Informatik*, vol. 39, pp. 21–25, 2015.
- [9] U. Schmid, A. Gärtig-Daug, and S. Förtsch, "Introvertierte Studenten, fleißige Studentinnen? – Geschlechtsspezifische Unterschiede in Motivation, Zufriedenheit und Wahrnehmungsmustern bei Informatikstudierenden," *Informatik Spektrum*, vol. 38, no. 5, pp. 379–395, Oct. 2015.
- [10] A. Gärtig-Daug, S. Förtsch, and U. Schmid, "'Alumnae Tracking' - Frauenkarrieren in der Informatik," vol. 3, 2014.