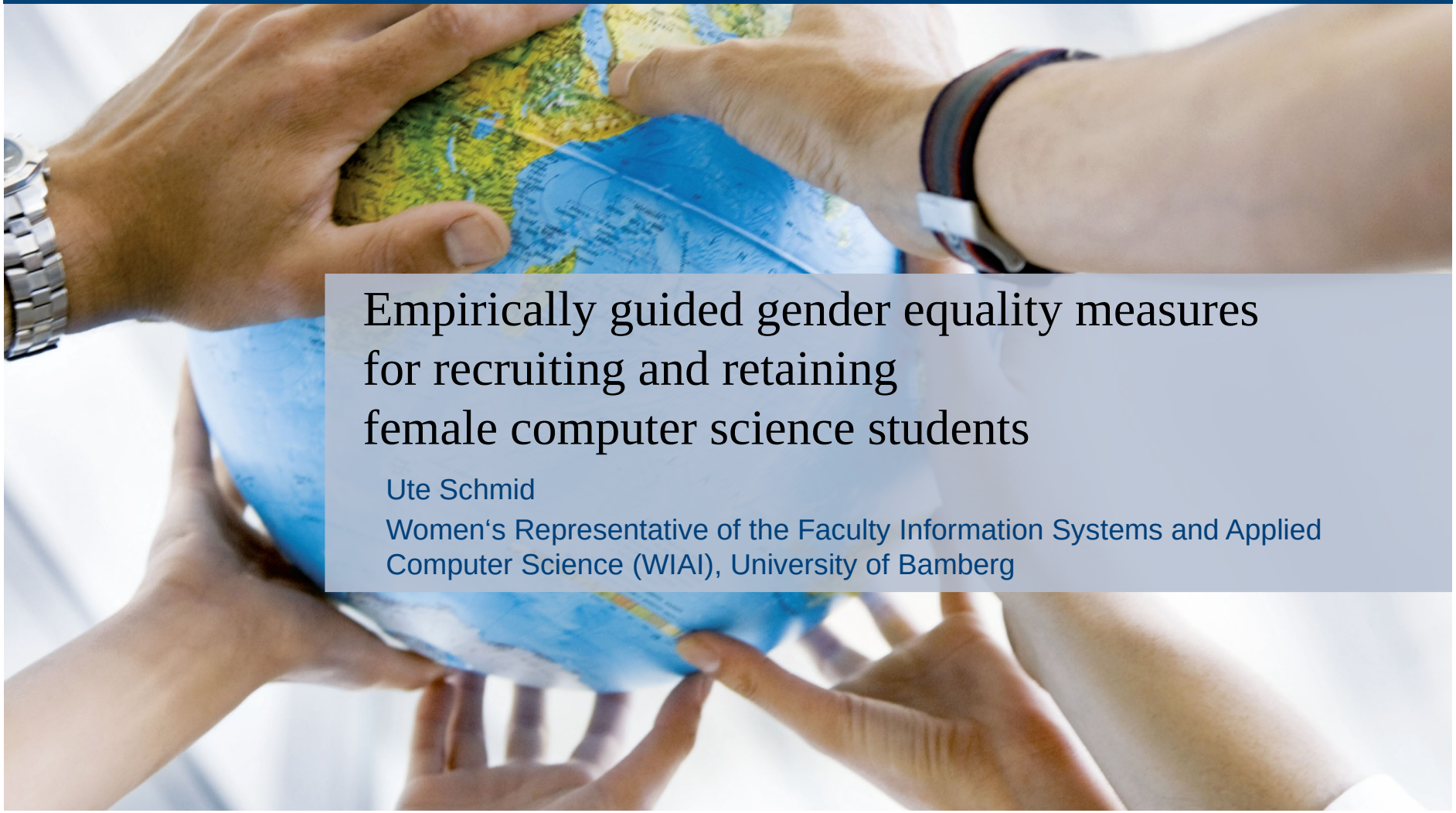
University of Bamberg



# Empirically guided gender equality measures for recruiting and retaining female computer science students

Ute Schmid

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

## Congratulations TU Wien Informatics On 100 Years of Women Studies

## Computing Is Too Important to Exclude Women

- 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)

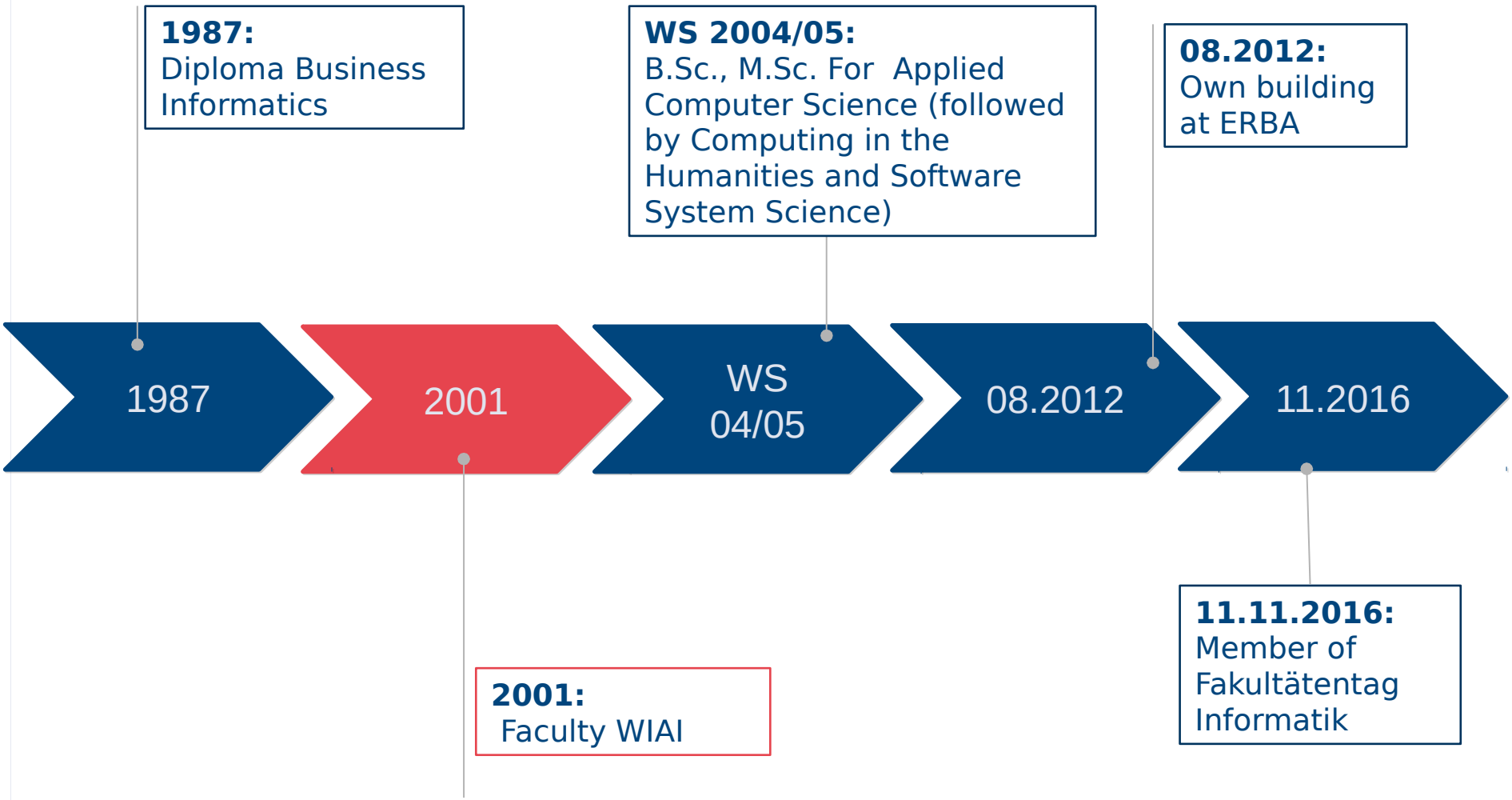
# Outlook

University of Bamberg

- Introducing the Faculty WIAI at University of Bamberg
- Encouraging and Recruting 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
- Lessond Learned (so far ...)

# WIAI@UniBA – A very young CS Faculty

University of Bamberg




Quelle: www.uni-bamberg.de/wiai/geschichte/chronik/ und www.uni-bamberg.de/wiai/geschichte/;
Stand: 10.02.2018

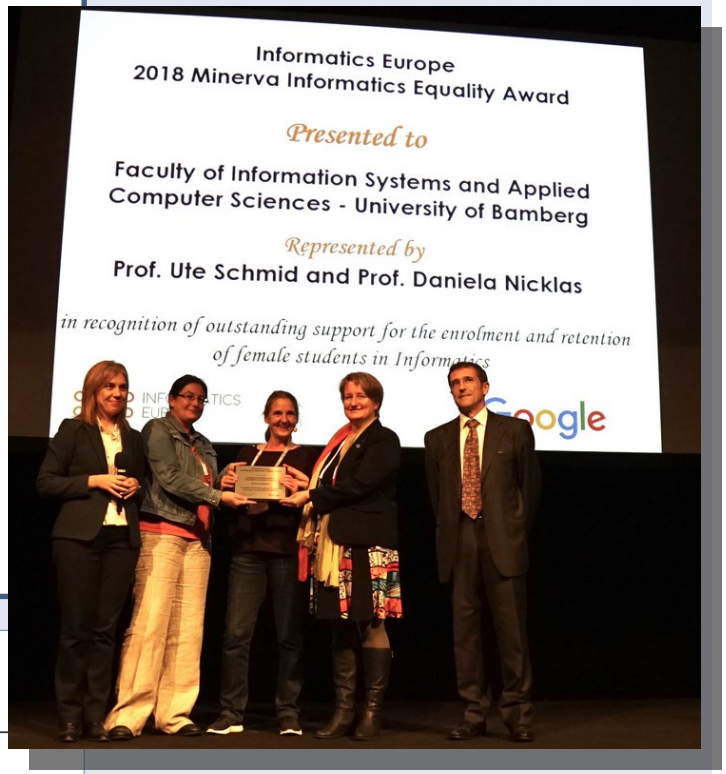
# 2018: Minerva Award



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*

# Study programmes

University of Bamberg

## Master degree programmes

- M.Sc. International Software Systems Science
- M.Sc. Angewandte Informatik
- M.Sc. Computing in the Humanities
- M.Sc. Wirtschafts-informatik
- M.Sc. Virtueller Studiengang Wirtschafts-informatik (VAWi)
- M.Sc. International Information Systems Management
- M.Sc. Wirtschafts-pädagogik (Schwerpunkt WI)

## Bachelor degree programmes

- B.Sc. Informatik: Software Systems Science
- B.Sc. Angewandte Informatik
- B.Sc. Wirtschafts-informatik
- B.Sc International Information Systems Management
- kultur-, geistes- und humanwiss. BA
- Nebenfach Angew. Inform.

Technology

Management
Humanities

# WIAI Studierende im SS19

| Studiengang | Studierende | männliche Studierende | Anteil | weibliche Studierende | Anteil |
|---|---|---|---|---|---|
| B.Sc. Angewandte Informatik | 261 | 203 | 77,8% | 58 | 22,2% |
| B.Sc. International Information Systems Management | 144 | 95 | 66,0% | 49 | 34,0% |
| B.Sc. Software Systems Science | 48 | 39 | 81,3% | 9 | 18,8% |
| B.Sc. Wirtschaftsinformatik | 455 | 333 | 73,2% | 122 | 26,8% |
| M.Sc. Angewandte Informatik | 63 | 40 | 63,5% | 23 | 36,5% |
| M.Sc. Wirtschaftsinformatik | 201 | 145 | 72,1% | 56 | 27,9% |
| M.Sc. Computing in the Humanities | 125 | 42 | 33,6% | 83 | 66,4% |
| M.Sc. WI / Wirtschaftspädagogik | 27 | 12 | 44,4% | 15 | 55,6% |
| M.Sc. International Information Systems Management | 88 | 56 | 63,6% | 32 | 36,4% |
| M.Sc. Software Systems Science | 213 | 161 | 75,6% | 52 | 24,4% |
| Alle Studiengänge | 1625 | 1126 | 69,3% | 499 | 30,7% |

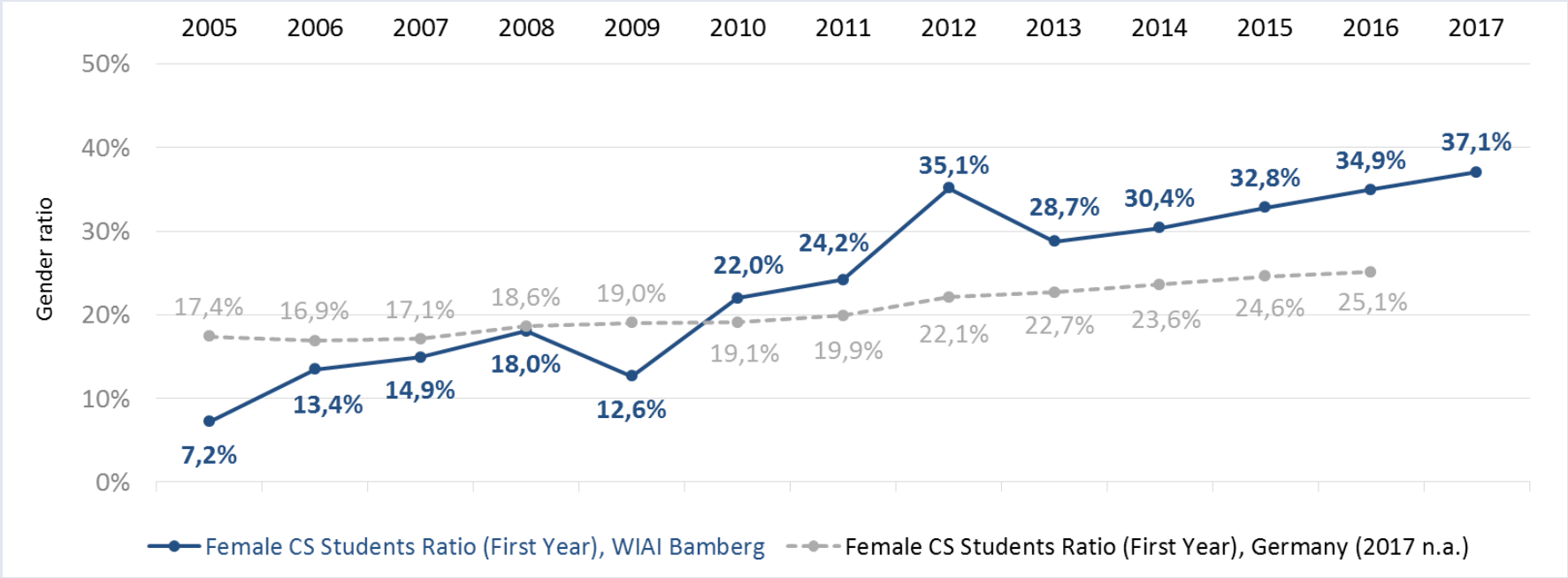
# Erstsemester WIAI Studierende im SS19

| Studiengang | Erstsemester | männliche Studierende | Anteil | weibliche Studierende | Anteil |
|---|---|---|---|---|---|
| B.Sc. Angewandte Informatik | 66 | 45 | 68,2% | 21 | 31,8% |
| B.Sc. International Information Systems Management | 27 | 15 | 55,6% | 12 | 44,4% |
| B.Sc. Software Systems Science | 29 | 22 | 75,9% | 7 | 24,1% |
| B.Sc. Wirtschaftsinformatik | 107 | 64 | 59,8% | 43 | 40,2% |
| M.Sc. Angewandte Informatik | 8 | 4 | 50,0% | 4 | 50,0% |
| M.Sc. Wirtschaftsinformatik | 29 | 18 | 62,1% | 11 | 37,9% |
| M.Sc. Computing in the Humanities | 21 | 3 | 14,3% | 18 | 85,7% |
| M.Sc. WI / Wirtschaftspädagogik | 5 | 4 | 80,0% | 1 | 20,0% |
| M.Sc. International Information Systems Management | 13 | 12 | 92,3% | 1 | 7,7% |
| M.Sc. Software Systems Science | 87 | 69 | 79,3% | 18 | 20,7% |
| Alle Studiengänge | 392 | 256 | 65,3% | 136 | 34,7% |

# Enrolement statistics

University of Bamberg

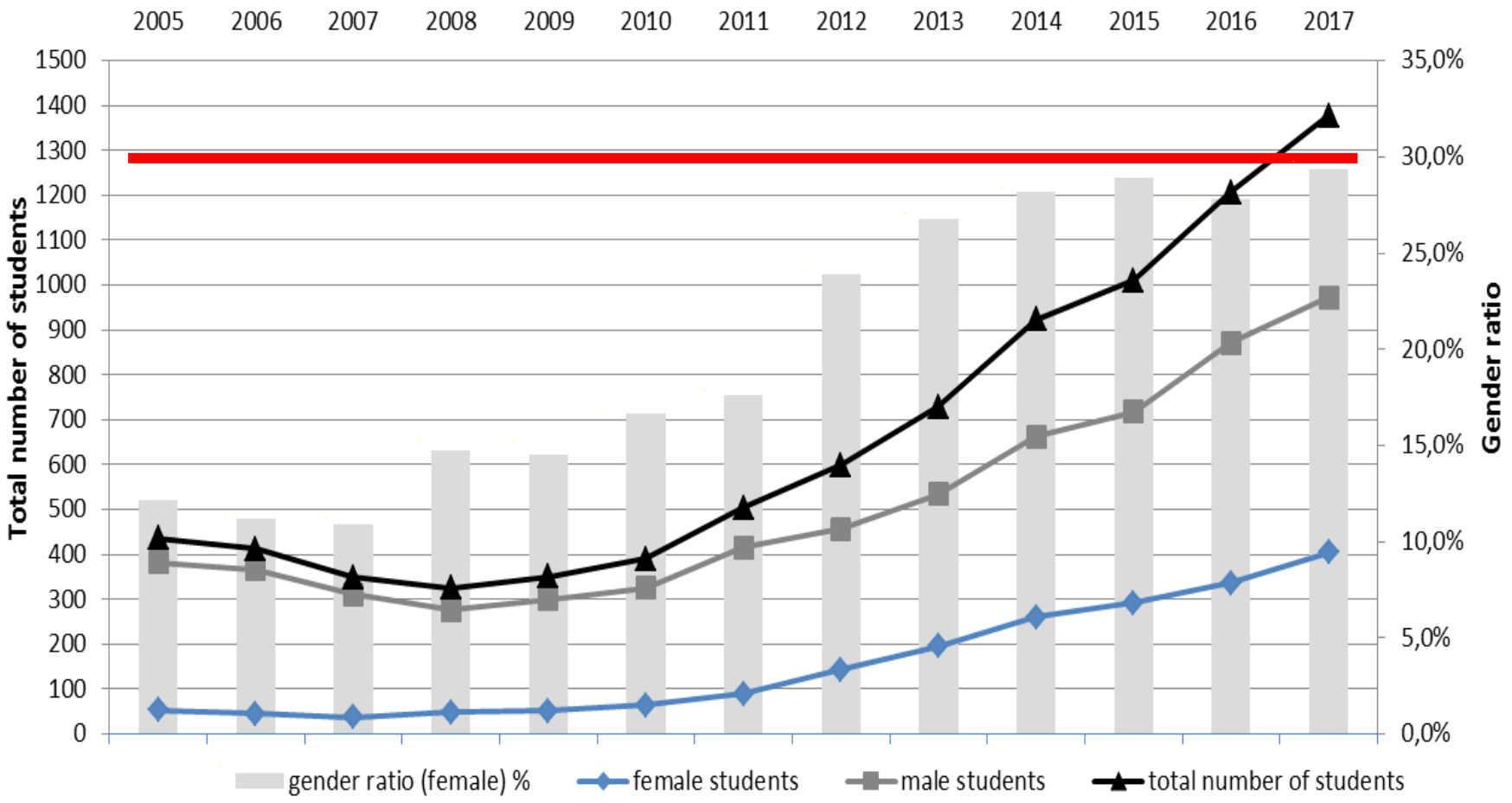
**2017**



# Total student statistics (WIAI)

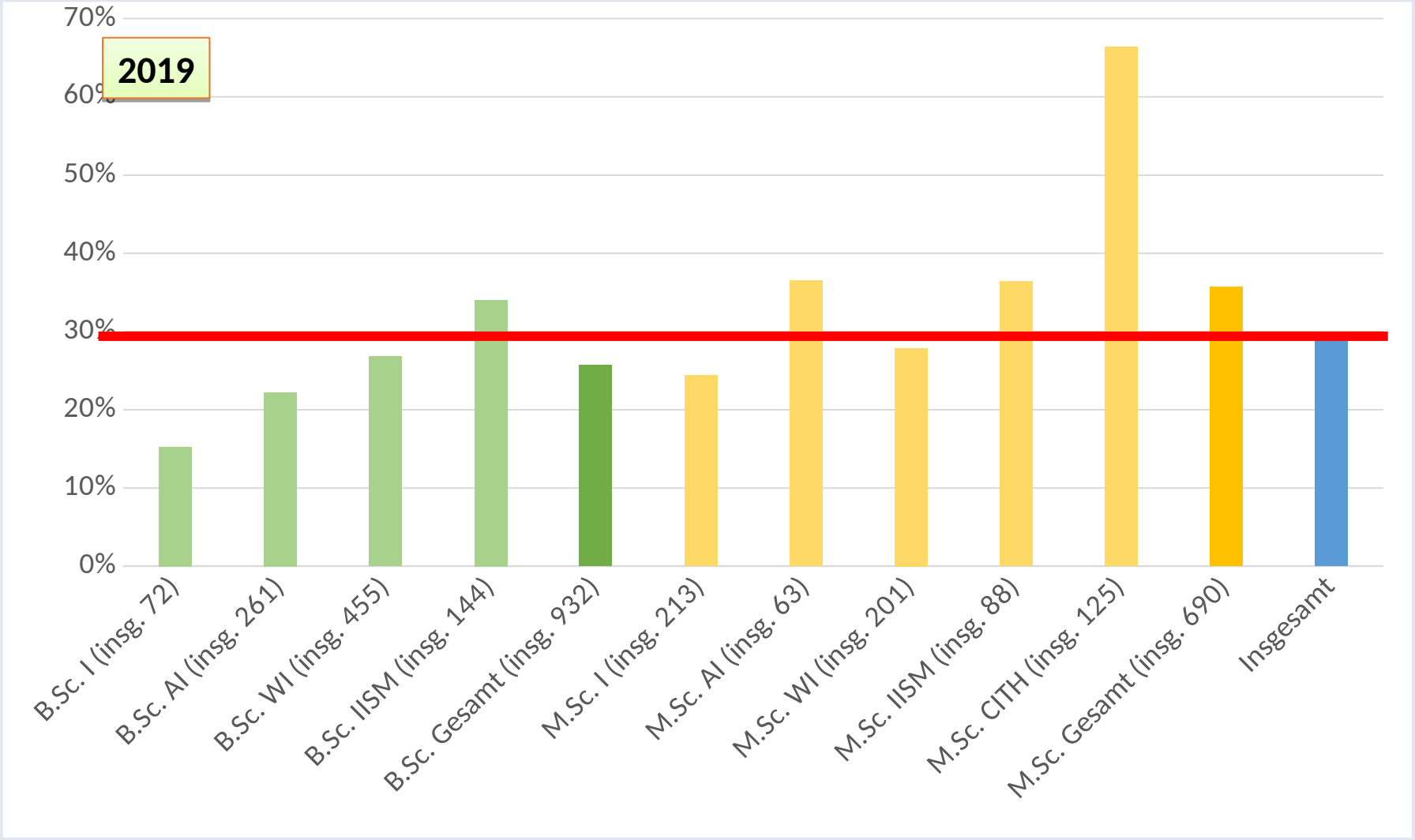
University of Bamberg

**2017**



# Total student statistics (WIAI)

University of Bamberg




Stand: SoSe 2019, Quelle: ZUV-Portal Uni Bamberg, Immatrk. mit Beurlaubung, alle Fachsemester, 1. Studiengang

# Encourage and Recruit

University of Bamberg

2008 2005 2006 2009 2015 2010 2012

for KIDS

MUT MÄDCHEN UND TECHNIK

Girls'Day Mädchen-Zukunftstag

Bamberger Informatik Tag

make IT informatik mentoring

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**

# Elementarinformatik I4Kids

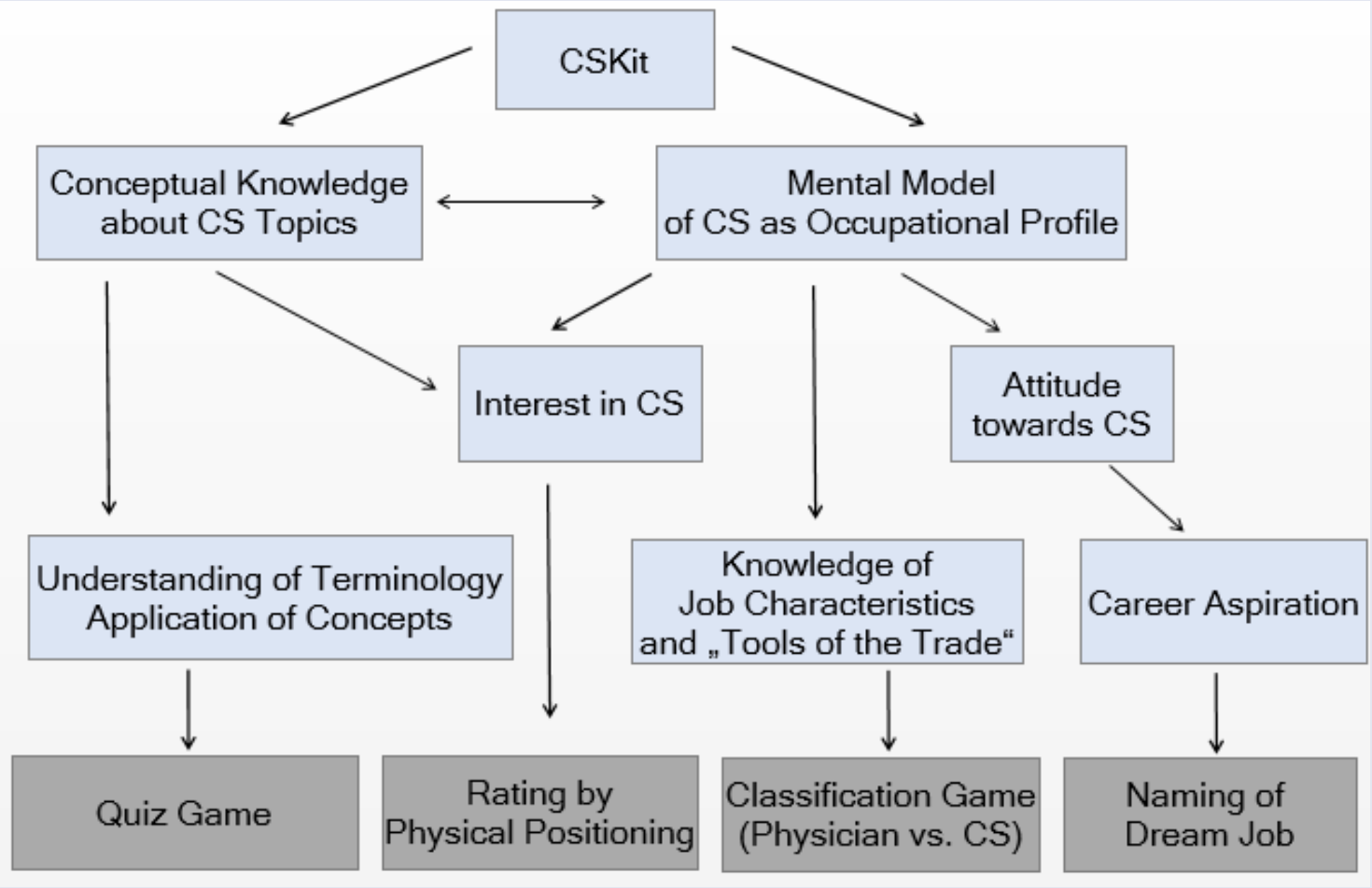
University of Bamberg

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


# Empirical Findings

University of Bamberg

**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 Findings

University of Bamberg

**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

# Observations

University of Bamberg

**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!)

# MUT – Mädchen und Technik

University of Bamberg

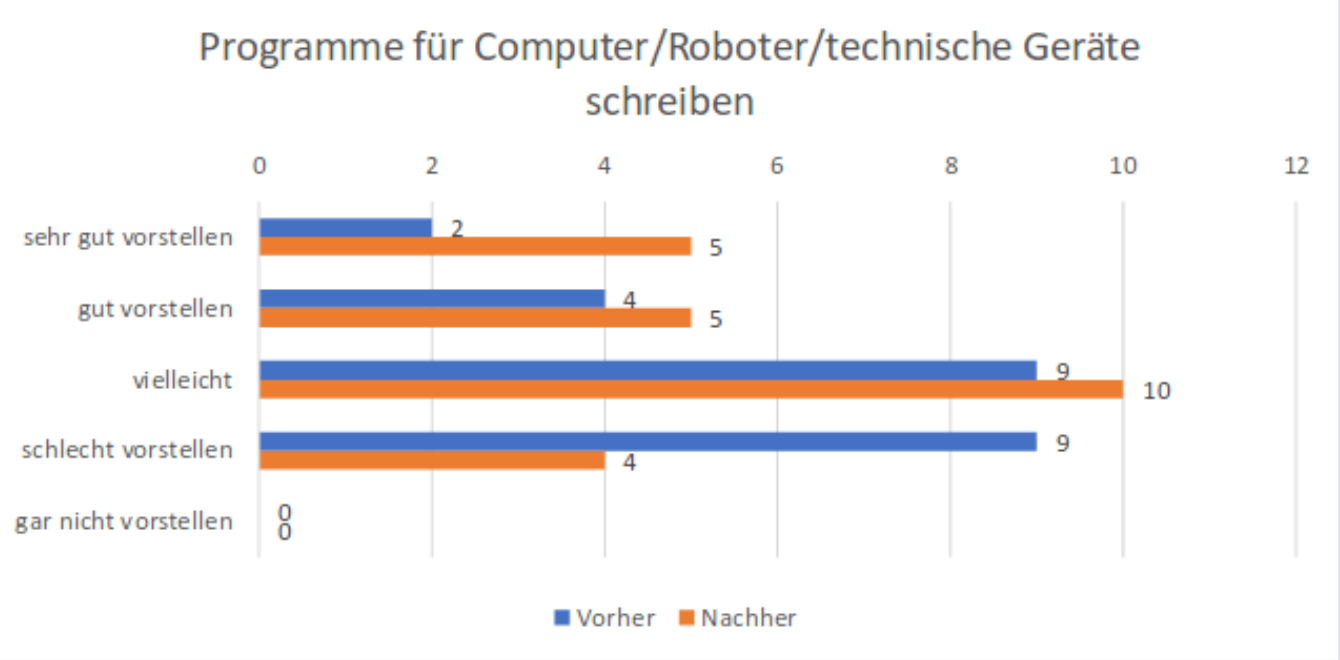


## Holiday workshops for girls from age 10 – 14

# Evaluation MUT/Girlsday

University of Bamberg

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



# Evaluation MUT vs. BIT



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

# make IT Informatik-Mentoring

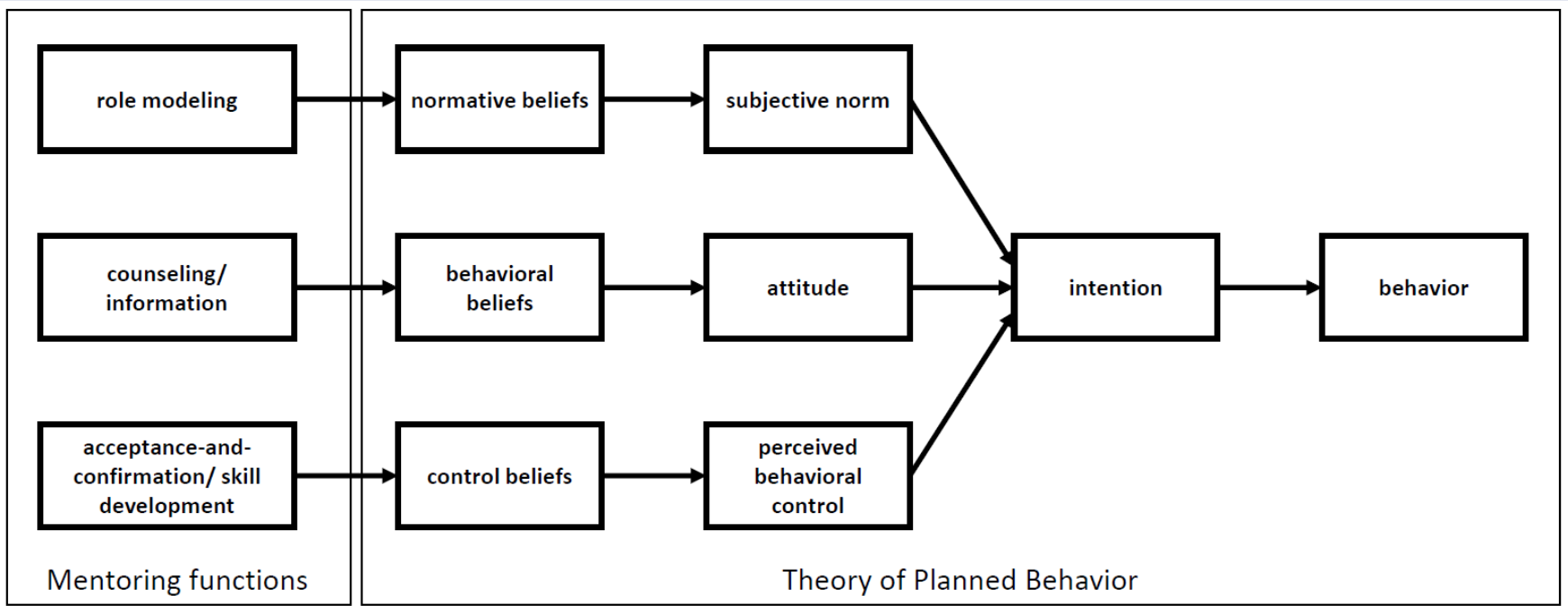
University of Bamberg

## Mentoring for high school students
## Mentors are CS students

# Empirical Findings

University of Bamberg

- 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



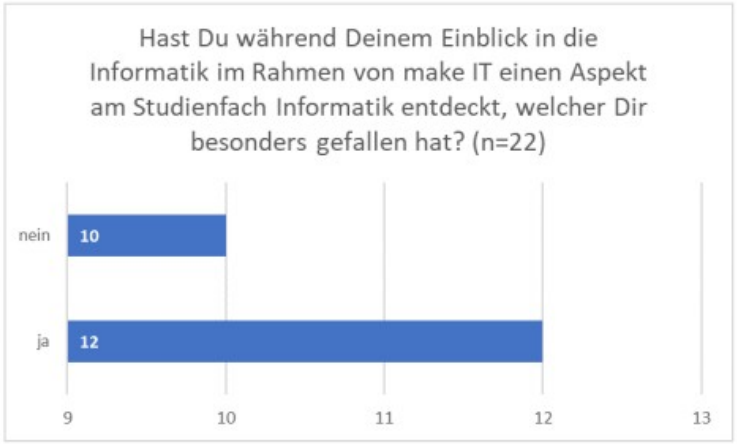
# Empirical Findings

University of Bamberg

Hannah Deininger, Bettina Finzel, Ute Scchmid, 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

University of Bamberg

Teilnahme unserer Studierenden an Nachwuchsprojekten

| Jahr | MuT (w) | Girls Day BA | Girls Day BW | BIT (w) | BIT (m) | makeIT (w) | makeIT (m) | MINT (w) | MINT (m) | Summe BA | Summe Gesamt |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 0 | 0 | 3 | 0 | 1 | — | — | 1 | 4 | 1 | 9 |
| 2012 | 1 | 2 | 8 | 1 | 0 | — | — | 2 | 4 | 4 | 18 |
| 2013 | 2 | 3 | 1 | 0 | 3 | — | — | 4 | 14 | 8 | 27 |
| 2014 | 0 | 2 | 4 | 3 | 2 | — | — | 4 | 4 | 7 | 19 |
| 2015 | 0 | 4 | 1 | 0 | 2 | — | — | 0 | 6 | 6 | 13 |
| 2016 | 0 | 1 | 3 | 0 | 2 | — | — | 4 | 6 | 3 | 16 |
| 2017 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 4 | 5 | 3 | 13 |
| 2018 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 8 |
| 2019 | 2 | 3 | 9 | 0 | 1 | 1 | 0 | 2 | 12 | 7 | 30 |
| Gesamt | 6 | 16 | 32 | 4 | 11 | 3 | 0 | 21 | 60 | 40 | 153 |

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

# Retaining Female Students

University of Bamberg

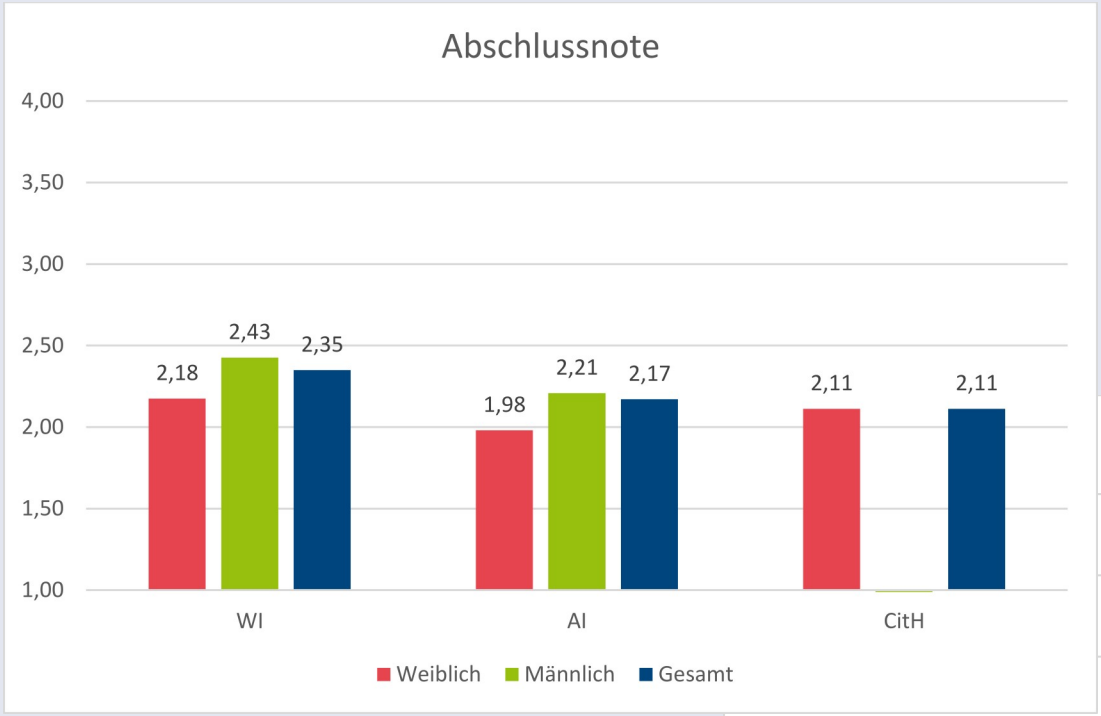
- Female tutors as role models
- Mentoring and Networking (excursions to software companies)
- Seminar Course Gender Aspects of Computer Science

  (since 2015 each summer term)
- CoachNet: Individual coaching for career development
  (Project funded by Adecco and Rainer Markgraf Foundation since 2016)

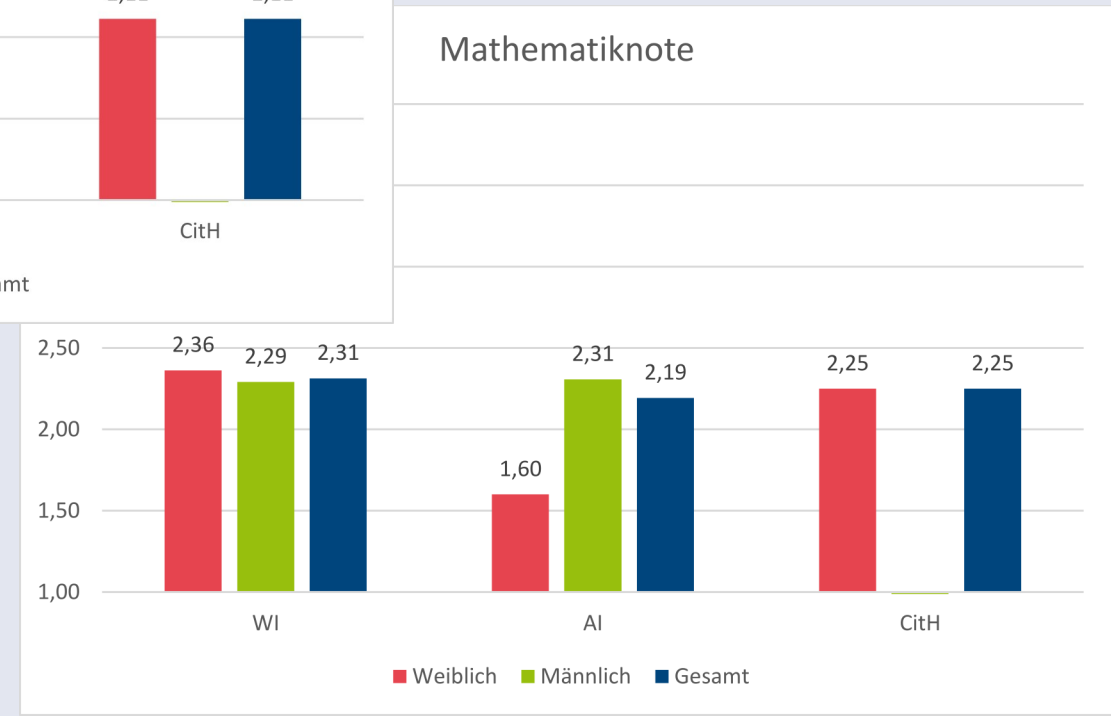


# Study Prerequisits

University of Bamberg




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



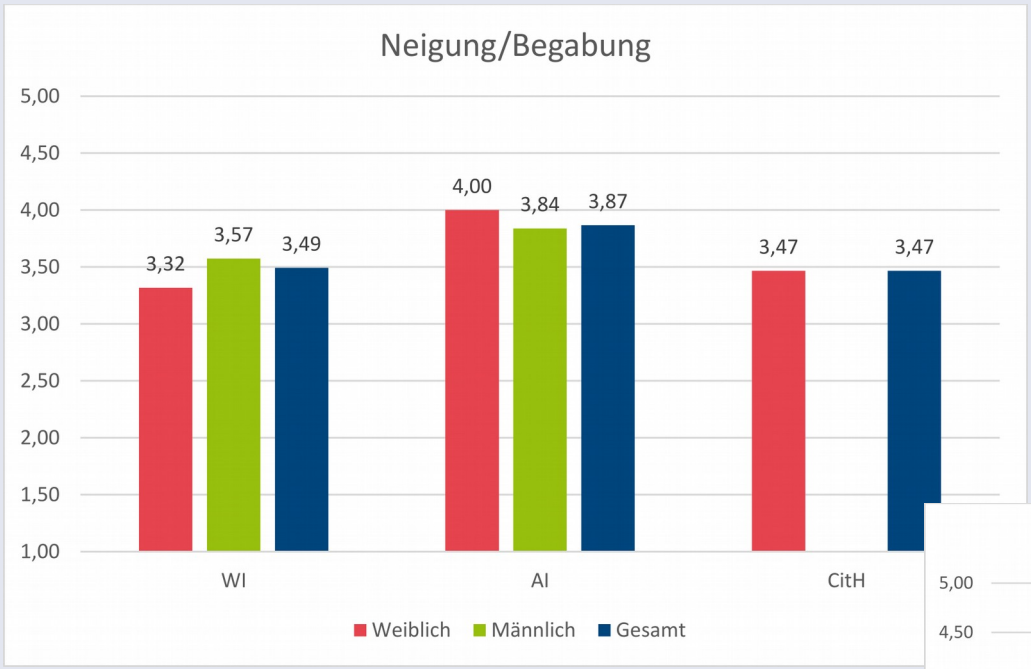

Data from summer 2019:

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

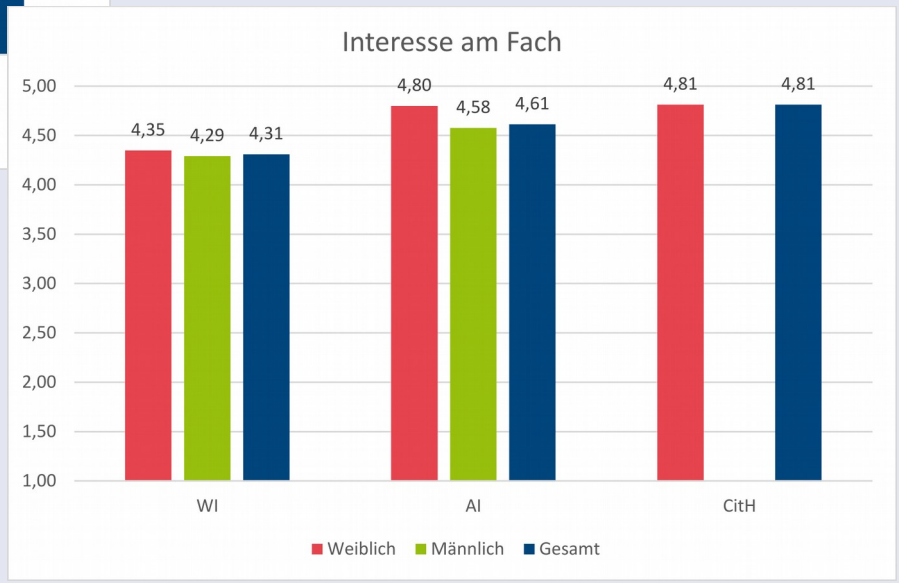
Effects are similar over the years (since 2011)

# Study Motivation

University of Bamberg

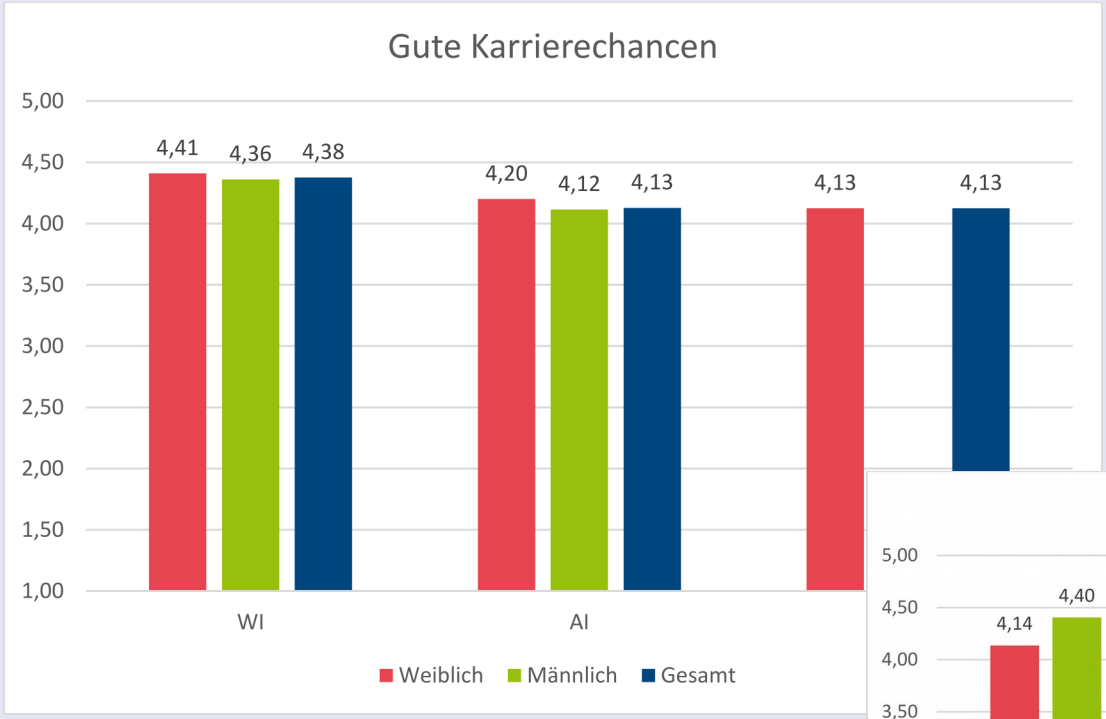



Talent and interest are stronger Motives for CS than for business informatics

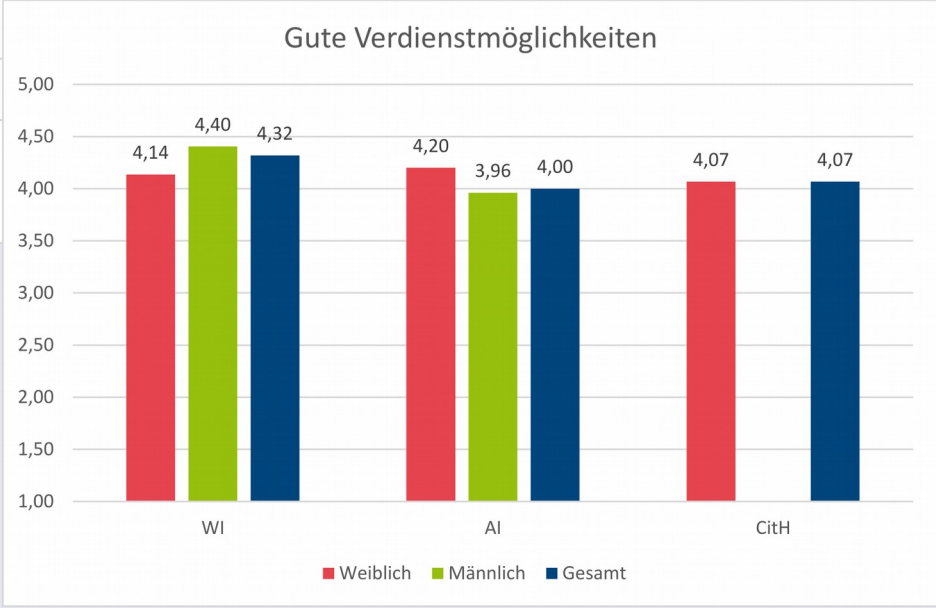


# Study Motivation

University of Bamberg

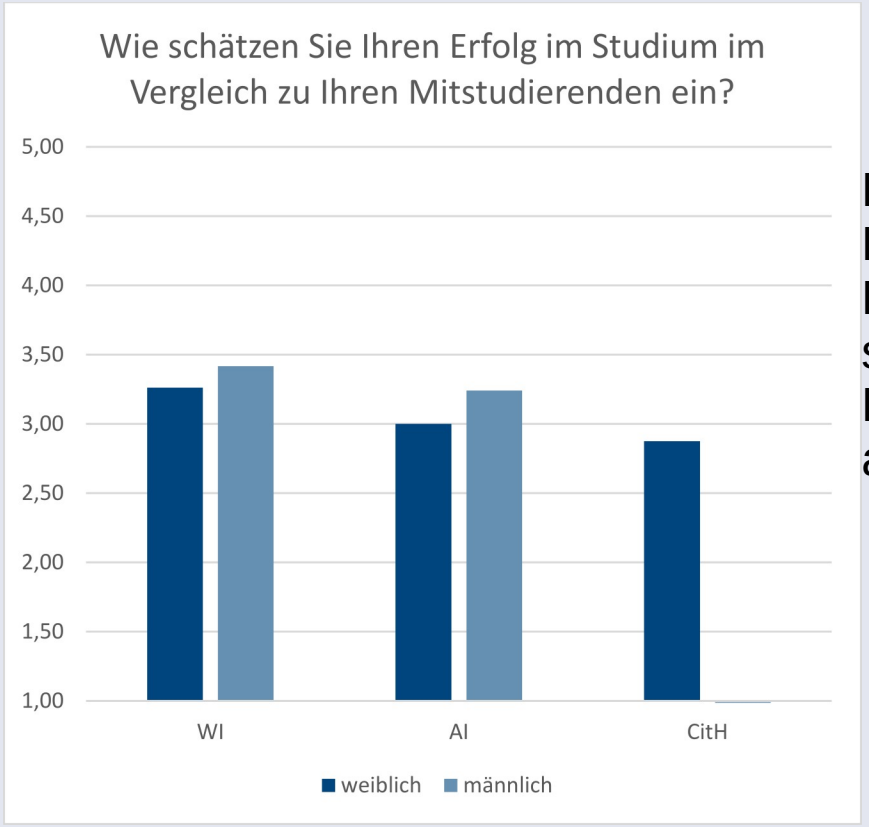



Career opportunities and salary are stronger motives for business informatics than for CS



# Study Self-assesments

University of Bamberg




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

# Image Study

University of Bamberg

## 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)

Questionaire 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

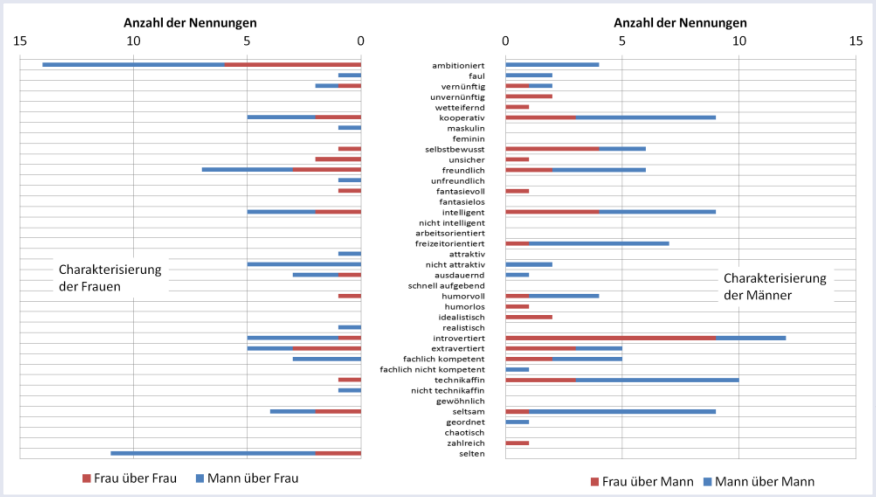
University of Bamberg

## Informatikstudentinnen:
(most frequent adjectives)

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

## Informatikstudenten:
(most frequent adjectives)

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




Semantic differential

# Image Study

**Zeichnung**

| | einer typischen Informatikerin | eines typischen Informatikers |
|---|---|---|
| durch Informatikerin |  |  |
| durch Informatiker |  |  |

# 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

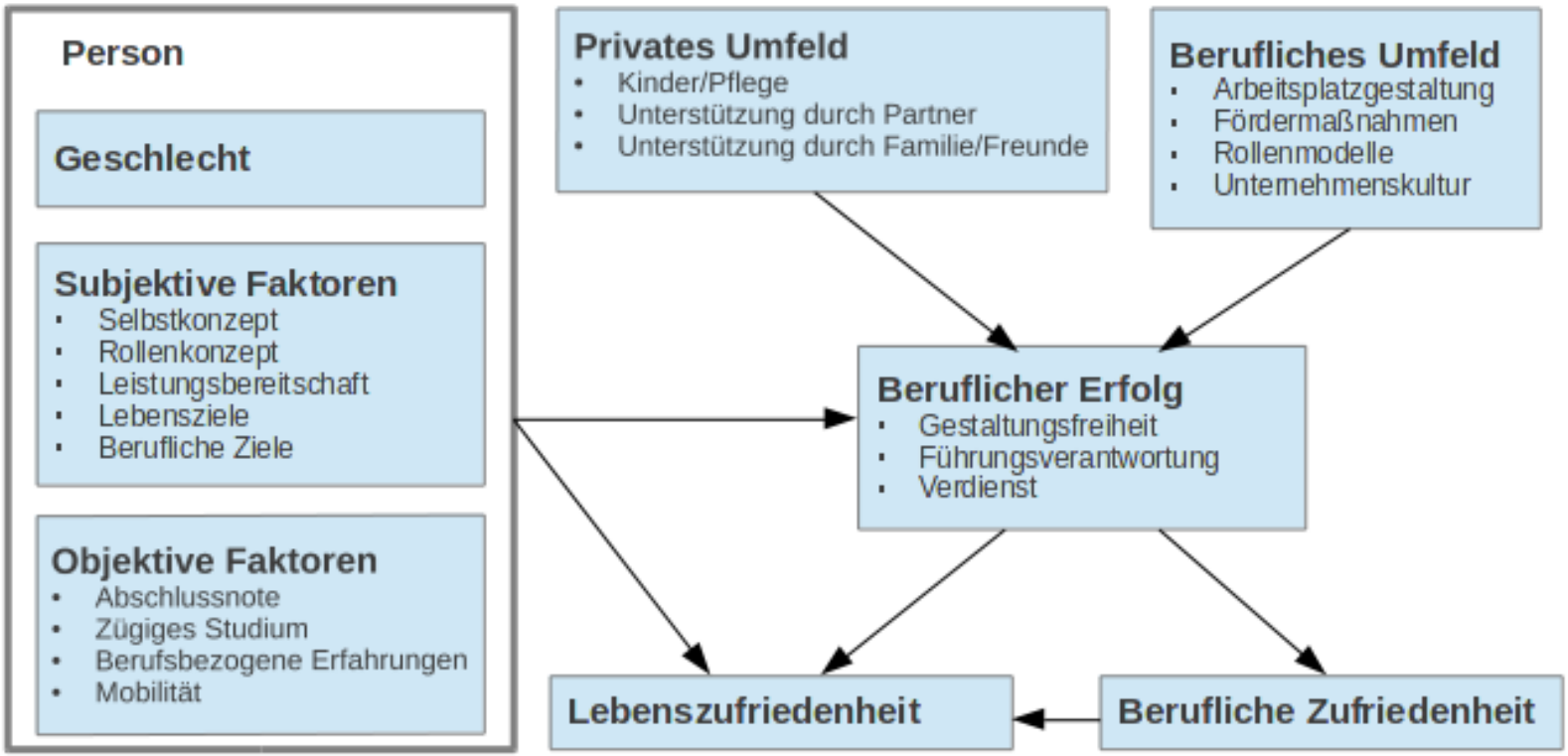
- Main results concerning female students:
  - Significantly better high school math grades than males
  - Mis-match of self image and study success

# Alumnae tracking ... interviews with:

University of Bamberg

Students

Companies

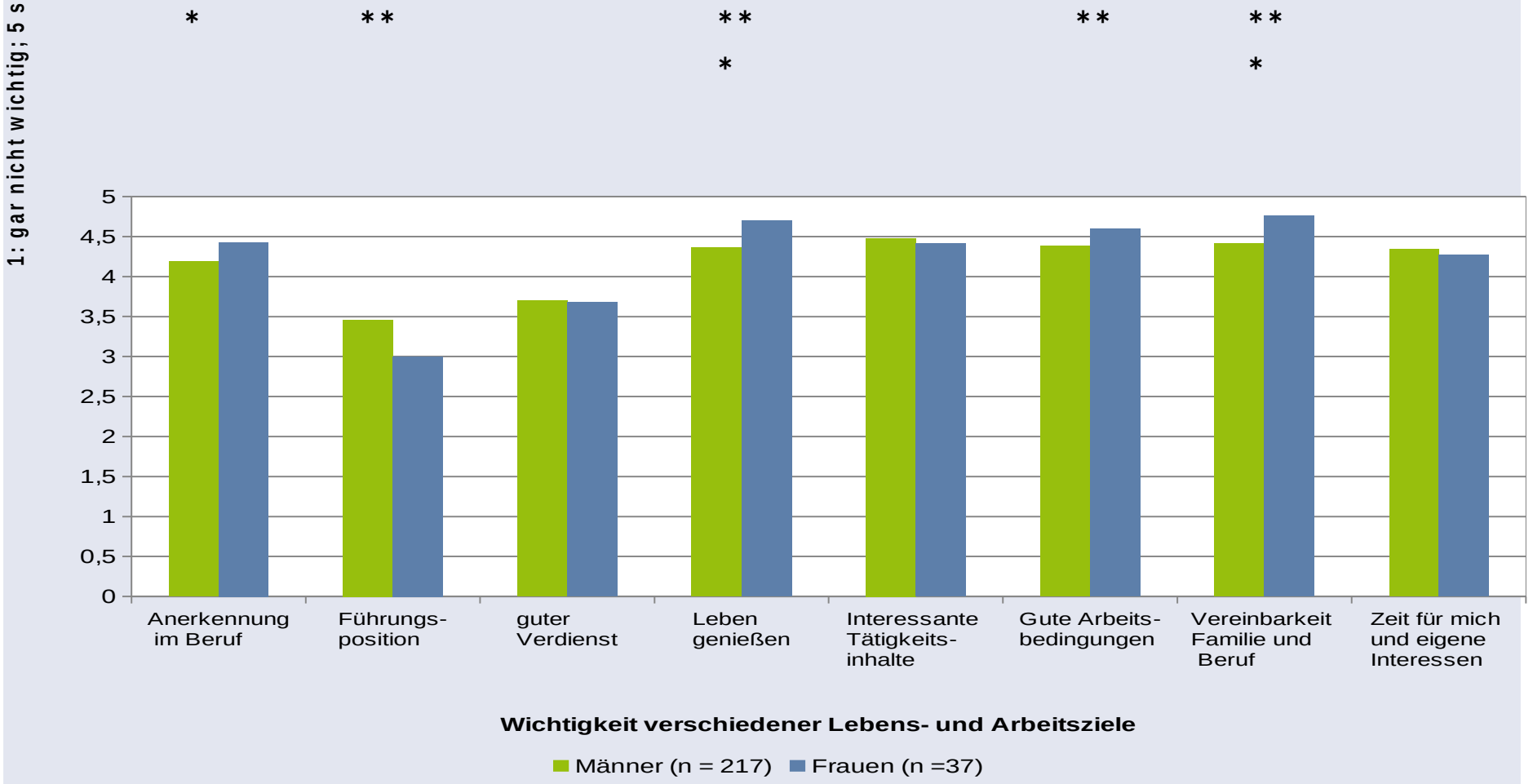



Graduate

# Life goals and work goals

University of Bamberg

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

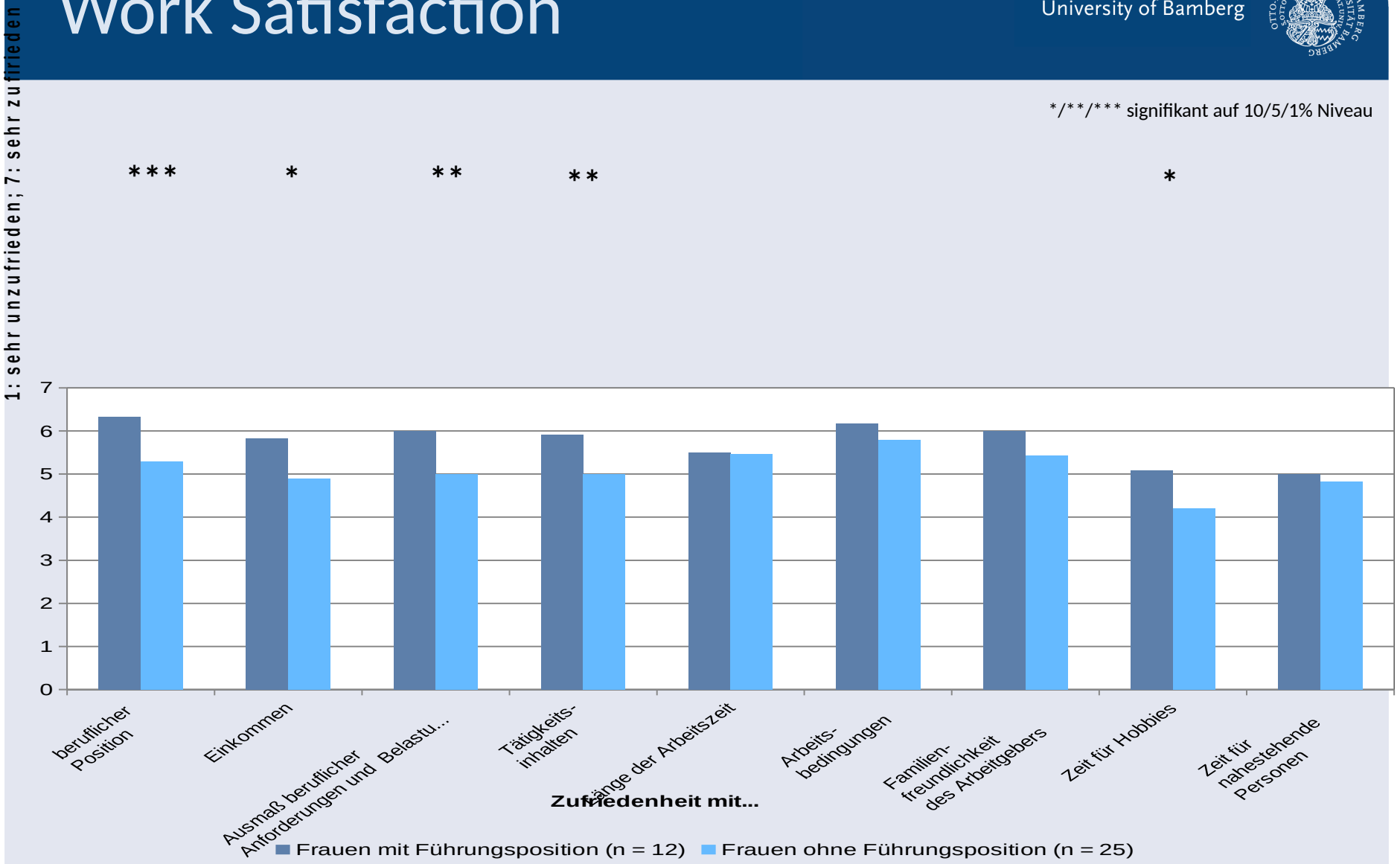



Quelle: Alumnae Tracking, Ehemaligenbefragung, 1. Welle 2013, 2014, 2015

# Work Satisfaction

University of Bamberg

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




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

# Lessons learned … so far

University of Bamberg

- 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
  - NEW 2019: ADA Treff – support of female students in first semesters with technical/programming questions

- Make it a mission for the whole faculty!

# Thank you!

University of Bamberg

- Prof. Dr. Daniela Nicklas for her active support of gender measures since 2014
- Prof. Dr. Kai Fischbach and all other 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
- Bettina Finzel, Hannah Deininger, Franziska Paukner, Sonja Grünauer, Kristina Prümer, Jonas Troles and many more: Team of student assistants
- Sanne Grabisch, Tanja Fiehl, Silvia Förtsch, Romy Hartmann, Laura Folter, and most of all Anja Gaertig-Daugs – Staff members for organizatorial and scientific support

# Read more ...

University of Bamberg


[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-Daugs, “Informatik in der Grundschule,” *Informatik Spektrum*, vol. 41, no. 3, pp. 200–207, Jun. 2018.

[3] S. Förtsch and U. Schmid, “Frauen in der Informatik: Können sie mehr als sie denken? Eine Analyse geschlechtsspezifischer Erfolgserwartungen unter Informatikstudierenden,” *GENDER – Zeitschrift für Geschlecht, Kultur und Gesellschaft*, vol. 10, no. 1, Mar. 2018.

[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-Daugs, 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-Daugs, 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-Daugs, and S. Förtsch, “Neigung entdecken, Informatik studieren, als Informatikerin arbeiten– Vernetzung von Ma\s 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-Daugs, 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-Daugs, S. Förtsch, and U. Schmid, “‘Alumnae Tracking’ - Frauenkarrieren in der Informatik,” vol. 3, 2014.