Karlsruher Institut für Technologie

EARLI 2018: Topography of research on higher education: Promoting deep conversations
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Student's perspectives on undergraduate research and inquiry – results from qualitative and quantitative studies

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GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

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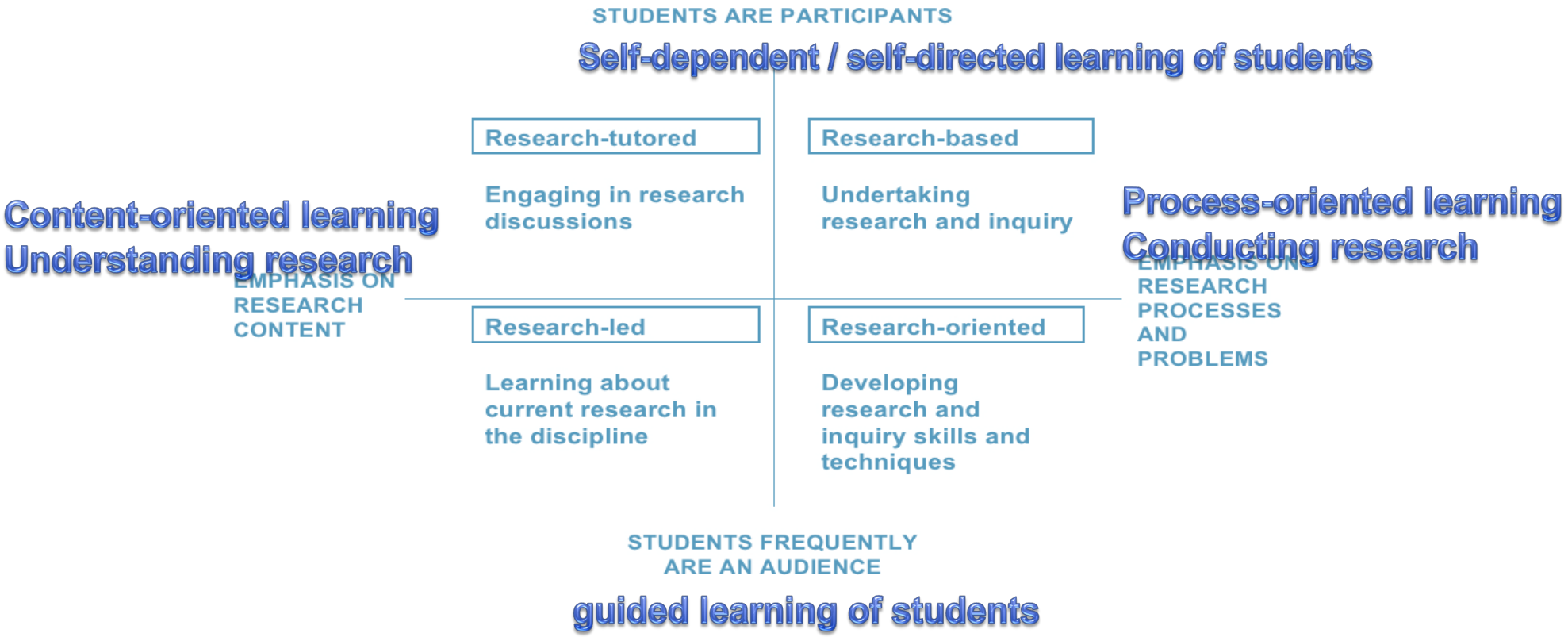
Quantitative and qualitative studies

Quantitative study	Qualitative study
 	
→ two parallel surveys	→ selected interviews
• various didactic elements • judgments of their significance, expectations, reasons and attitudes towards undergraduate research and inquiry	• process experiences (referring to the development of an educational video) • perspectives on undergraduate research and inquiry

Is there empirical evidence for a famous model for undergraduate research and inquiry?

Figure 1.1: The nature of undergraduate research and inquiry



Source: Amended from Healey (2005, 70)

Quantitative study: sample of teachers

N = 550 teachers

Factor analysis

teaching style

- factor 1: conducting research (experience with processes) (6 items, α = ,912)
- factor 2: understanding research (examples, search, results) (5 Items, α = ,831)

explained variance in %: fak. 1 = 55,170;
fak. 2 = 9,538 / total 64,708)

Quantitative study: sample of students

N=1482 students

Factor analysis

- factor 1: learning with research processes
  (6 Items, α = ,890; Var. in % 47,204)

- factor 2: learning with research results
  (4 Items, α = ,708; Var. in % 13,449)

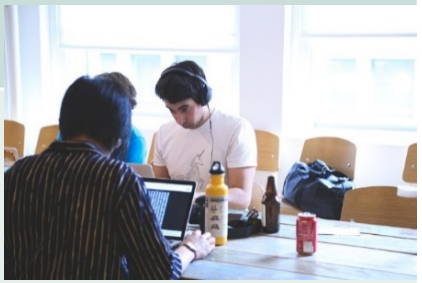
explained variance in % 60,652

Teaching style / expectations towards students‘ learning

factor 1: metacognitive learning	factor 2: guided learning	factor 3: self-directed learning
6 Items, α = ,840	**3 Items, α = ,651**	**2 Items, α = ,624)**
questioning attitude, follow their own questions, deep learning	learning through didactically well-developed material and optimal exam preparation	individual time for learning, learning through own mistakes
explained variance in %, fac. 1=41,628; fac.2=10,859; fac. 3=8,599; total: 61,087)		

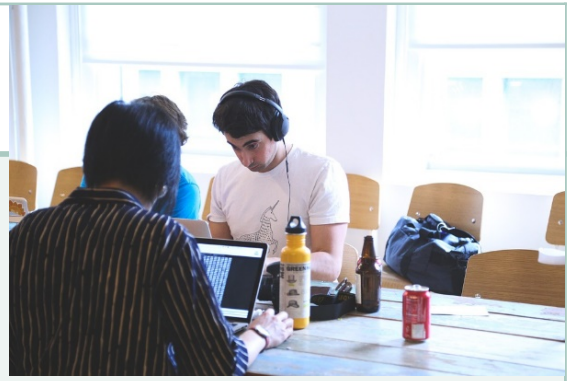
Uses / Learning expectations / learning style

factor 1: self-directed learning	factor 2: guided learning	factor 3: metacognitive learning
6 Items, α = ,779	**5 Items, α = ,718**	**6 Items, α = ,718**
learning through own questions, own mistakes, own searching, individual time for learning	optimal exam preparation, examples, learning through didactically well-developed material, practising and training	acquiring overview, systematic structure, deep learning
explained variance in %, fac. 1=31,021; fac.2=12,719; fac. 3=7,666; total: 51,406)		



Uses / Learning expectations / learning style

self-directed learning

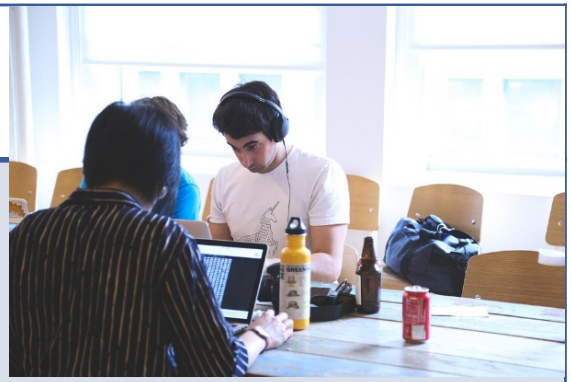


You underestimate the effort needed and you have to know that good communication and coordination in a group are needed to prepare such things. […] ***You have to try yourself out somehow and see in what direction it all goes and learn from things that did not go so well.*** *(Student B)*

Well, you worked yourself into the functions very quickly. We did not get any help, though, ***if we had questions like: "How does it work?" or "How can we install or integrate this?" We just had to find out for ourselves somehow.*** *(Student A)*

Uses / Learning expectations / learning style

guided learning



I think it was a bit abstract at the beginning: You didn't really know what was expected of you, […] when (the lecturer) showed the videos, I don't think that was -, that was just so far away. And then, to work it all out within only one semester ***… I would have wished that she had said a little more concretely what it was that she exactly wanted from us****. (Student B)*

If we had known exactly how to approach a topic and work on it in such a medium, then I think we would have been much faster in committing ourselves to just that topic. *[…] We talked among the fellow students, and everyone kept on saying: "Now, what exactly are we supposed to do now. What are we to do with the topic, how big, how detailed, and so on should that topic be?" That was a bit difficult. (Student C)*

Uses / Learning expectations / learning style

metacognitive learning

***This became clearer to me through the change in perspective, exactly**. Just try to put yourself in the position of the viewer, that's what it's all about. (Student C)*

*To say the truth, I had not yet really dealt with the topic. **But that was the attraction of it all. I said: "Okay, there again I have another field, a new field to learn about."** (Student C)*

***Yes, indeed, I learned again in that seminar that one questions oneself a little bit.** Because, otherwise … I can really only compare this with a textual work or literature research where you just go through it from beginning to end and where you are bound to some frame. You probably have already done this a hundred times but **you have never before created such a video and I think that's why you just have to be a lot more self-critical. And if it doesn't work out, then you have to change it again**. (Student B)*

Guided learning style

predictors:

- rejection of independent learning/study
- learning as „understanding research content“
- slight depreciation of research-driven teaching
- dissatisfaction with the choice of the course/subject of study
- aspiration to making a career

Metacognitive learning style

predictors:

- preference of both learning styles: learning as conducting research processes and learning as understanding research content
- clear interest in subject of study and discipline
- high level of motivation
- expectation to develop analytical skills
- appreciation of a research-driven curriculum

Metacognitive learning style

coefficients[a]						
R^2=,312		non-standardized coefficients		standardized coefficients		
pattern		B	standard-error	Beta	T	sig.
1	(constant)	2,512	0,712		3,530	0,000
	2.6 acquiring research methods	0,304	0,058	0,320	5,280	0,000
	2.11 deep learning	0,131	0,061	0,139	2,156	0,032
	2.12 critical use of information sources	0,119	0,055	0,137	2,183	0,030
	2.14 getting an overview over the subject	0,200	0,072	0,159	2,795	0,006

a. dependent variable: how important was the experience of conducting independently a research project? (N=266)

Summary

What is important for research-driven teaching and learning?

- Metacognitive learning
- Experience of conducting independently a research project
- Interest in the subject matter/discipline

Obstructions for research-driven higher education:

- Expectations towards making a career (→ higher estimation is implicitly indicative for a different socialisation)
- Rejection of independent learning

Further thinking

Yes, I must admit … I asked myself at the beginning, after the first few sessions: ***What is the added value, what is the benefit for my studies?*** *Although … certainly, my personal interest was awakened …, partly. (Student C)*

And then you ask how much do I have to do for these or other credits and how much do I have to do here or there. Meanwhile, everything is much more orderly, well-regulated, or predetermined and prescribed. *So, this is somehow unusual, or, let me put it this way, it's not an everyday thing. (Student C)*

Questions / discussion

Thank you for your attention!

references

Jenkins A and Healey M (2005): Institutional Strategies for Linking Teaching and Research, Higher Education Academy, York.

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Research questions

- Which different learning styles, attitudes, expectations and motives of learning are evidenced by the empirical data?
- Which learning experiences through undergraduate research and inquiry are manifested in the qualitative and quantitative studies?
- What role does metacognition play for students' learning experience?

factor analysis

Items (How important are the following didactic elements?)	factor 1	factor 2
conducting independently a research project	,889	
developing and planning a research project	,886	
developing research questions	,811	
running experiments/small projects	,810	
participating in the work of research projects at the institute/chair	,745	
exploring interrelations in a particular field	,776	,699
participating in excursions	,660	
using examples of research for illustration		,858
researching independently a certain theme (- research content)		,774
familiarising with current research results		,812
acquiring basic knowledge		,683

Teaching style / expectations towards students‘ learning

- factor 1: questioning attitude, follow their own questions, deep learning → metacognitive learning
  (6 Items, α = ,840)
- factor 2: learning through didactically well-developed material and optimal exam preparation → guided learning
  (3 Items, α = ,651)
- factor 3: individual time for learning, learning through own mistakes (2 Items, α = ,624) → self-directed learning

explained variance in %, fac. 1=41,628; fac.2=10,859; fac. 3=8,599; total: 61,087)

Uses/ Learning expectations/ learning style

- factor 1: learning through own questions, own mistakes, own searching, individual time for learning

  (6 Items, α = ,779; Var. in % 31,021) → self-directed learning
- factor 2: optimal exam preparation, examples, learning through didactically well-developed material, practising and training
  (5 Items, α = ,718; Var. in % 12,719) → guided learning
- factor 3: acquiring overview, systematic structure, deep learning

  (6 Items, α = ,718; Var. in % 7,666) → metacognitive learning

explained variance in % 51,406

Guided learning style

coefficients[a]						
R^2=.152		non-standardized coefficients		standardized coefficients		
pattern		B	standard-error	Beta	T	sig.
1	(constant)	,098	,149		,659	,510
	4.1 I prefer clearly structured learning rather than independent learning.	,072	,009	,236	8,488	,000
	factor teaching style: understanding research content	,210	,030	,207	7,043	,000
	factor motives for study: making a career	,207	,027	,217	7,734	,000
	I'm satisfied/dissatisfied with my choice of course/subject of study.	-,025	,013	-,056	-1,987	,047
	I perceive added value in research-driven teaching.	-,041	,011	-,110	-3,666	,000
a. dependent variable: factor use: optimal exam preparation						

Metacognitive learning style

coefficients[a]						
R^2=,249		non-standardized coefficients		standardized coefficients		
pattern		B	standard-error	Beta	T	sig.
1	(constant)	-,289	,108		-2,680	,007
	I perceive added value in research-driven teaching.	,038	,013	,100	2,959	,003
	factor teaching style: conducting research	,290	,028	,294	10,507	,000
	factor reasons for research-driven teaching and learning: motivation and interest	,241	,033	,239	7,316	,000

a. dependent variable: factor use: metacognitive learning style (overview, systematic structure, deep learning)

Metacognitive learning style

coefficients[a]						
R^2=,255		non-standardized coefficients		standardized coefficients		
pattern		B	standard-error	Beta	T	sig.
1	(constant)	-,323	,106		-3,038	,002
	I perceive added value in research-driven teaching.	,041	,013	,107	3,210	,001
	factor reasons for research-driven teaching and learning: motivation and interest	,243	,033	,241	7,421	,000
	factor teaching style: understanding research	,312	,028	,301	10,968	,000
a. dependent variable: factor use: systematic structure, deep learning						

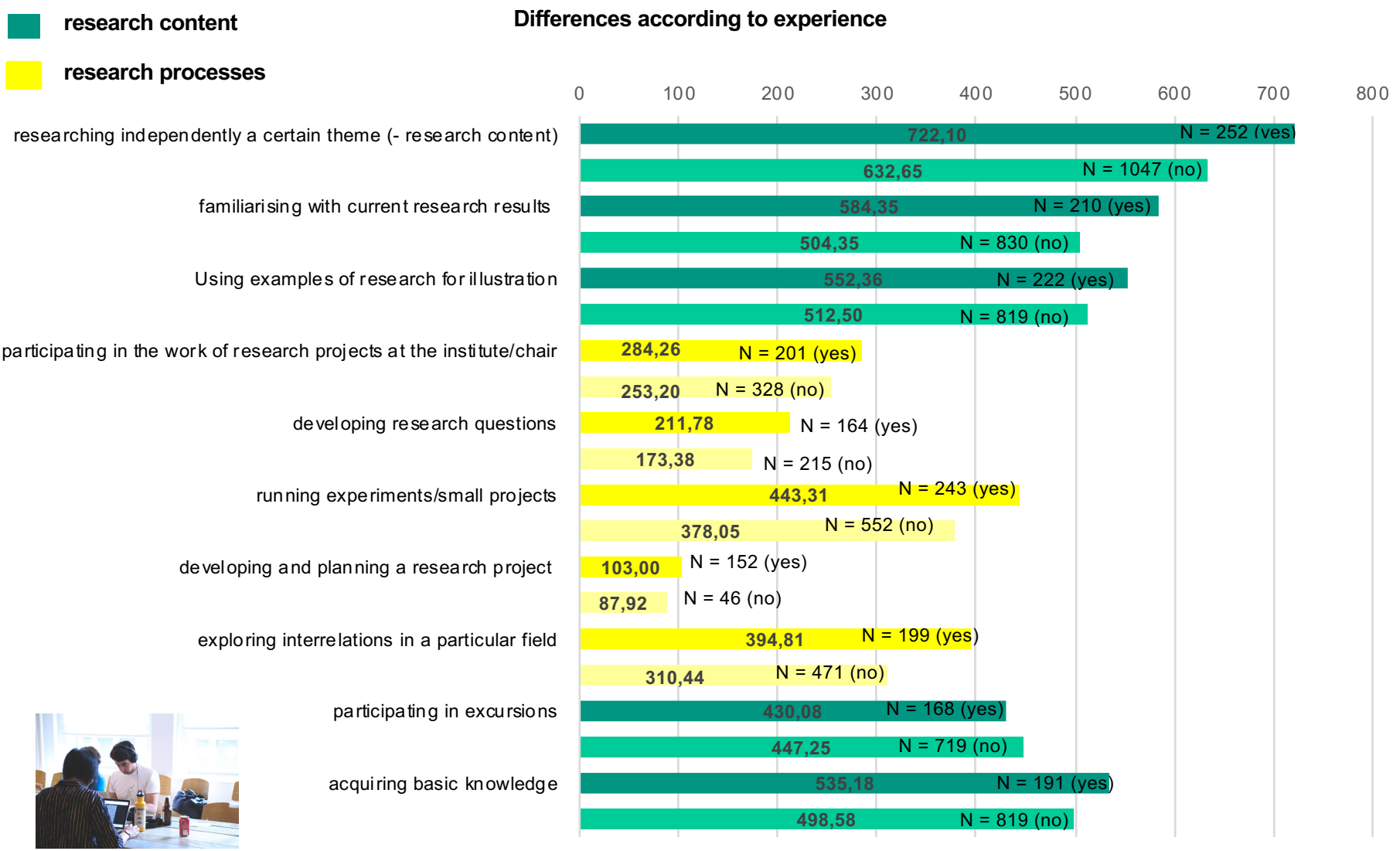
Metacognitive learning style

coefficients[a]						
R^2=,271		non-standardized coefficients		standardized coefficients		
pattern		B	standard-error	Beta	T	sig.
1	(constant)	-,335	,098		-3,416	,001
	I perceive added value in research-driven teaching.	,044	,012	,116	3,817	,000
	factor teaching style: conducting research	,281	,027	,285	10,297	,000
	factor reasons for research-driven teaching and learning: analytical skills	,277	,029	,276	9,460	,000
a. dependent variable: factor use: systematic structure, deep learning						

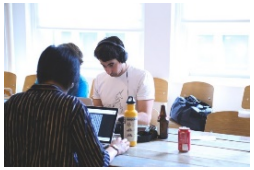
Metacognitive learning style

coefficients[a]						
R^2=,277		non-standardized coefficients		standardized coefficients		
pattern		B	standard-error	Beta	T	sig.
1	(constant)	-,372	,096		-3,856	,000
	I perceive added value in research-driven teaching.	,047	,011	,124	4,149	,000
	factor reasons for research-driven teaching and learning: analytical skills	,277	,029	,276	9,508	,000
	factor teaching style: understanding research	,301	,028	,291	10,734	,000
a. dependent variable: factor use: systematic structure, deep learning						

4) Differences according to experience – U-Test



4) Differences according to experience



Mann-Whitney U-Test – conducting independently a research project Yes or no			
Importance of experience			
	U	*z*	*p*
researching independently a certain theme (- research content)	113753,50	-3,45	0,00*
familiarising with current research results	73742,00	-3,55	0,00*
using examples of research for illustration	83947,00	-1,80	0,07
participating in the work of research projects at the institute/chair	29092,00	-2,47	0,01*
developing research questions	14057,50	-3,50	0,00*
running experiments/small projects	56057,00	-3,90	0,00*
developing and planning a research project	2963,50	-1,63	0,10
exploring interrelations in a particular field	35061,50	-5,26	0,00*
participating in excursions	58058,00	-.834	0,40
acquiring basic knowledge/foundational knowledge	72545,00	-1,61	0,10

*$p < 0.05$; U = Mann-Whitney U.

Lehrstil: Forschung durchführen

Deskriptive Statistiken

Abhängige Variable: Score_Forschung_durchführen

5.1 Wie lange sind Sie schon in der akademischen Lehre tätig?	Mittelwert	Standardabweichung	H
0-3 Jahre	8,7428	1,90212	116
4-7 Jahre	8,8426	1,94692	90
8-11 Jahre	9,1932	1,83173	44
12-15 Jahre	9,3651	1,88103	42
16 und mehr Jahre	9,3882	1,74796	79
Gesamtsumme	9,0283	1,88152	371

Leichter Anstieg über die Klassen (Jahren an Lehrerfahrung).

Lehrstil: Forschung verstehen

Deskriptive Statistiken

Abhängige Variable: Score_Forschung_verstehen

5.1 Wie lange sind Sie schon in der akademischen Lehre tätig?	Mittelwert	Standardabweichung	H
0-3 Jahre	9,7277	1,15416	130
4-7 Jahre	9,6594	1,57418	101
8-11 Jahre	9,8863	1,19683	51
12-15 Jahre	10,1792	1,25018	48
16 und mehr Jahre	10,2440	1,06658	91
Gesamtsumme	9,8936	1,28296	421

Varianzanalyse ist im 2. Fall signifikant, aber die Effektstärke ist gering.

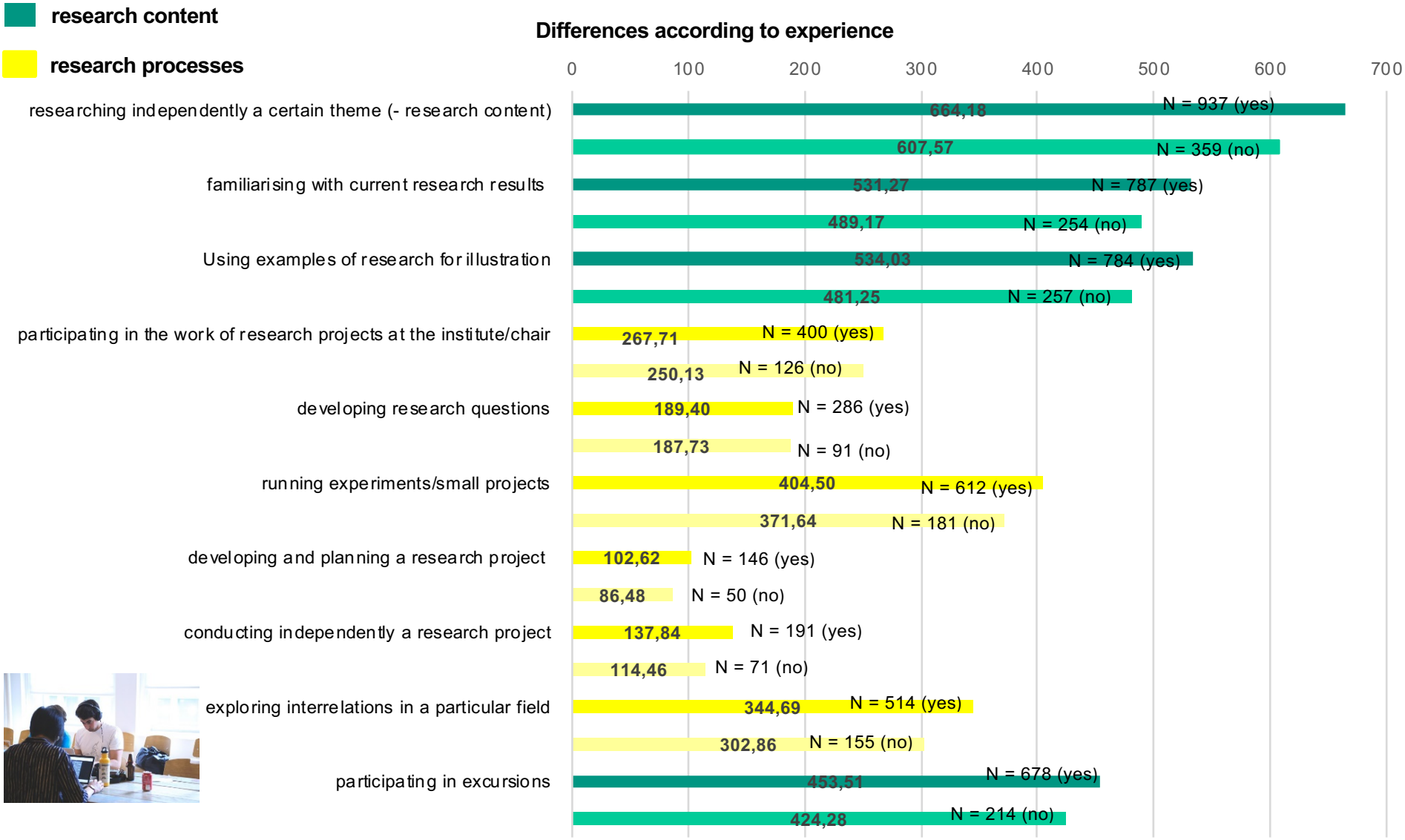
4) Duration of teaching

Modellzusammenfassung						
Modell	R	R-Quadrat	Korrigiertes R-Quadrat	Standardfehler des Schätzers		
1	,319[a]	0,102	0,095	1,45833		

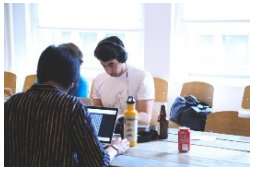
Koeffizienten[a]						
Modell		Nicht standardisierte Koeffizienten		Standardisierte Koeffizienten	T	Sig.
		Regressions-koeffizientB	Standard-fehler	Beta		
1	(Konstante)	1,358	0,423		3,208	0,001
	4.1 Für ein forschendes Lernen sind die Rahmenbedingungen (Räume, Zeit, Ausstattung) nicht gegeben.	-0,056	0,022	-0,110	-2,530	0,012
	4.4 Das Studium soll Erwartungen zukünftiger Arbeitgeber entsprechen.	-0,076	0,022	-0,150	-3,512	0,000
	4.7 Die Studierenden haben ein sehr unterschiedliches Leistungsniveau.	0,135	0,037	0,158	3,619	0,000
	4.16 Meine Lehre schätze ich als forschungsorientiert ein.	0,117	0,027	0,190	4,360	0,000

a. Abhängige Variable: 5.1 Wie lange sind Sie schon in der akademischen Lehre tätig?

4) Differences according to experience – U-Test



4) Differences according to experience



Mann-Whitney U-Test – acquiring basic knowledge/foundational knowledge Yes or no			
Importance of experience			
	U	*z*	*p*
researching independently a certain theme (- research content)	153497,50	-2,48	0,013*
familiarising with current research results	91863,50	-2,00	0,045*
using examples of research for illustration	90527,00	-2,51	0,012*
participating in the work of research projects at the institute/chair	23515,00	-1,23	0,216
developing research questions	12897,50	-0,13	0,895
running experiments/small projects	50796,50	-1,79	0,073
developing and planning a research project	3049,00	-1,81	0,070
conducting independently a research project	5570,50	-2,32	0,020*
exploring interrelations in a particular field	34854,00	-2,41	0,016*
participating in excursions	67791,50	-1,54	0,123

*$p < 0.05$; U = Mann-Whitney U.