How do pre-service teachers approach the challenges arising with generative AI in schools?

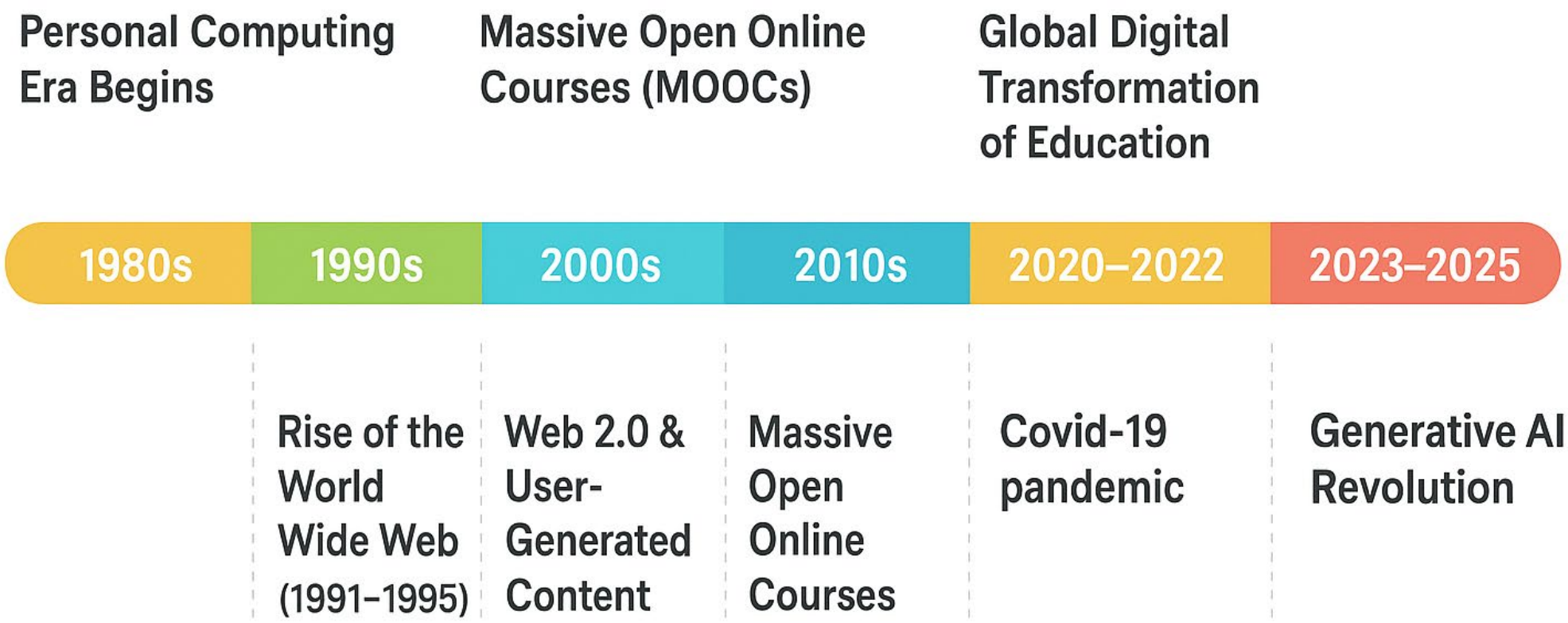
Christoph Schneider
Lothar Müller
Frederick Johnson

Contributing:
Pia Sader

Universität Trier

EAPRIL 2025 Valletta - 27. Nov

Milestones of digital technology in education and society



Milestones of digital technology in education and society

Public launch of ChatGPT: „Disruptive Educational Technology“ (Frith, 2023, p. 198)?

„Web 2.0“ first mentioned

Facebook counts 1 billion users

Personal Com… Era Begins

…Open On… (MOOCs)

…tal …ation of Education

1980s | 1990s | 2000s | 2010s | 2020–2022 | 2023–2025

First GUIs (Apple Mac, Atari ST, Amiga…)

Windows 3.1 (breakthrough)

Rise of the World Wide Web (1991–1995)

Web 2.0 & User-Generated Cont…

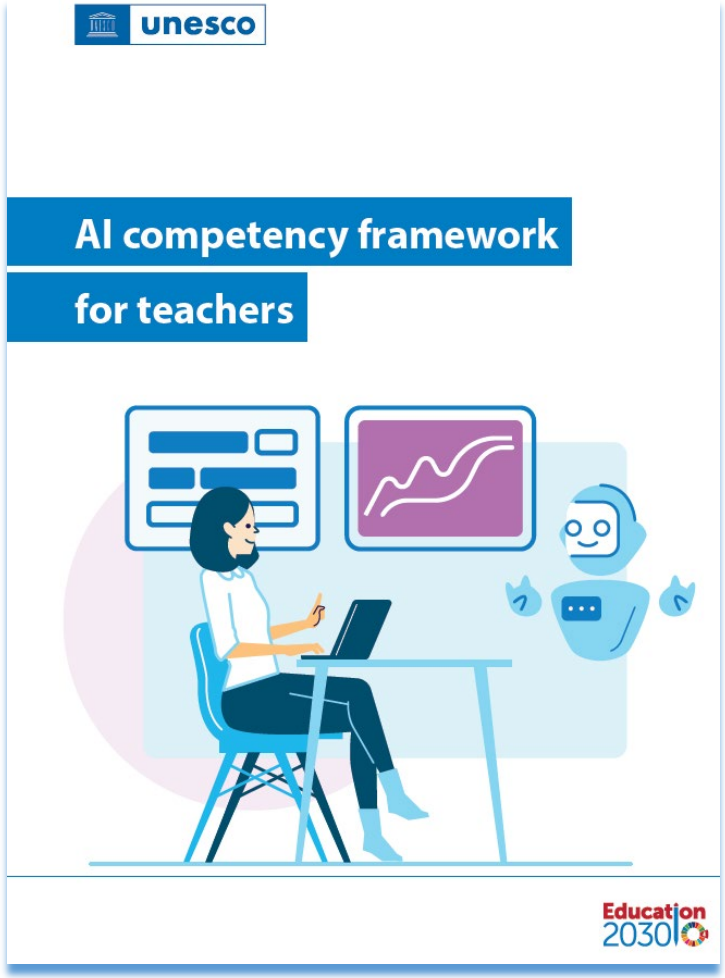
Facebook counts 100 million users

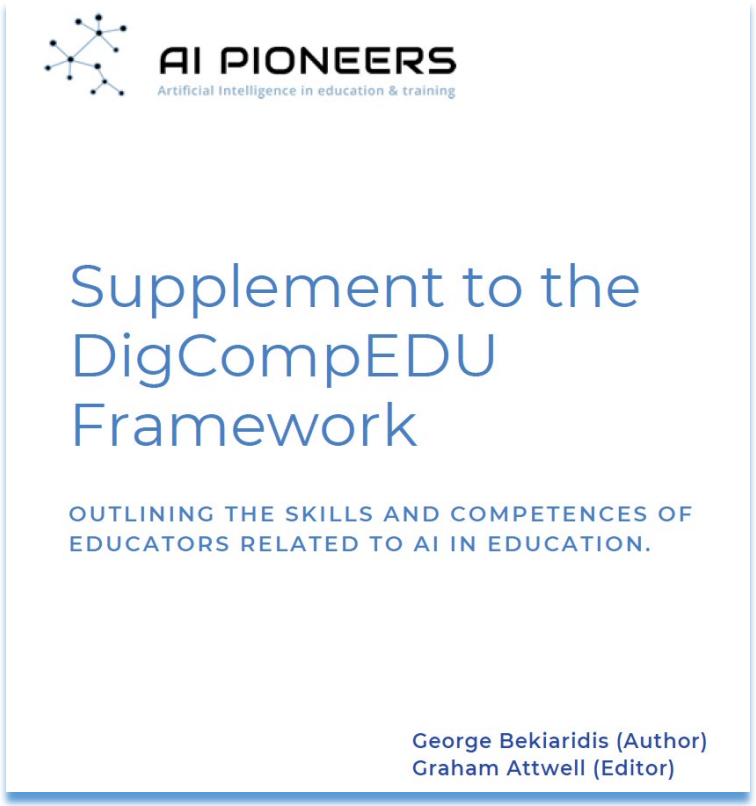
Massive Open Online

Covid-19 pandemic

Emergency Remote Teaching (Bozkurt & Sharma, 2020)

What are teachers' challenges in the era of generative AI?





AI Competency Frameworks for Teachers (e.g., UNESCO, 2024)

Aspects	Progression		
	Acquire	Deepen	Create
1. Human-centred mindset	Human agency	Human accountability	Social responsibility
2. Ethics of AI	Ethical principles	Safe and responsible use	Co-creating ethical rules
3. AI foundations and applications	Basic AI techniques and applications	Application skills	Creating with AI
4. AI pedagogy	AI-assisted teaching	AI–pedagogy integration	AI-enhanced pedagogical transformation
5. AI for professional development	AI enabling lifelong professional learning	AI to enhance organizational learning	AI to support professional transformation

UNESCO (2024, p. 22)

rameworks for Teachers
NESCO, 2024)

Deepen

	TEACHER COMPETENCY	CURRICULAR GOALS (CG) (Teacher t… programm…		CONTEXTUAL ACTIVITIES
AI pedagogy	4.2 AI–pedagogy integration: Teachers are able to adeptly integrate AI into the design and facilitation of student-centred learning practices to foster engagement, support differentiated learning and enhance teacher–student interactions, with the aims of promoting empathy, as well critical thinking and problem-solving skills among students.	CG4.2.1 Des… learning stra… videos of ex… learning pra… to analyse t… learning pro… interactions… outcomes, a… emotional l… understandi… the appropr… their uses, a… with variabl… teachers' sel… learning act… or facilitate… CG4.2.2 Dee… impact of A… to discuss se… or conduct … impacts of A… thinking an… interactions… outcomes; a… emotional l… topics; guid… the benefits… learning act… CG4.2.3 Sup… deployment… knowledge … the needs o… and assessm… guide teach… principles to…		

Create

	TEACHER COMPETENCY	CURRICULAR GOALS (CG) (Teacher training or support programmes should …)	LEARNING OBJECTIVES (LO) (Teachers can …)	CONTEXTUAL ACTIVITIES (Teachers can demonstrate the following attitudinal or behavioural changes)
Ethics of AI	2.3 Co-creating ethical rules: Teachers are able to champion the ethics of AI through critical advocacy, leading discussions and actions that address ethical, sociocultural and environmental concerns in the design and use of AI, and contributing to the co-creation of ethical rules for AI practices in education.	CG2.3.1 Foster inquiry into the social impact of AI by organizing teachers' research-based reviews of the social impact of selected AI tools; encourage teachers to take part in and evaluate how these tools affect local economies, social justice and climate change, as well as risk exacerbating discrimination against, and exclusion of, certain linguistic and cultural communities or groups with special needs; organize dialogues or debates based on the findings. CG2.3.2 Enhance critical examination of existing users' guidance published by AI providers by inviting teachers to evaluate selected tools on their potential to risk marginalizing people with disabilities, amplify social discrimination, and threaten linguistic and cultural diversity; compare users' guidance against the likelihood of negative impacts; gather feedback and draft notes of feedback on how to revise the users' guidance. CG2.3.3 Upgrade knowledge on AI ethics and skills to guide further iterations of ethical rules and standards; guide teachers to search for and review multistakeholder…	LO2.3.1 Critically analyse the social impact of AI from both the global and local perspectives and gain insights into the potential impact of emerging AI technologies on social equity, inclusion, linguistic and cultural diversity, institutional and individual safety and security, and the intellectual and social development of children as well as on planetary well-being. LO2.3.2 Assess the appropriateness and sufficiency of guidance for users of a specific AI tool against the ethical risks rooted in its design and the potential social controversies caused by its use, and frame recommendations for remedying or improving the guidance accordingly. LO2.3.3 Solidify the view that regulations on AI ethics must be designed by and for human stakeholders; advocate for and participate in the…	**Localized global view on the social impact of AI:** Holistically review the social impact of AI on individual human rights and development, economic activity, social justice and planetary well-being; translate the global view into local implications to investigate AI's effects on society. **Spotlighting ethical gaps in users' guidance:** Audit the claims made by the providers of selected AI tools and the terms stated in their users' guidance against a full list of risks and social impacts. Monitor potential threats or harms to users, especially children, students with disabilities and vulnerable groups. Assume responsibility for reporting these and filing complaints with providers and regulators (e.g. data protection authorities). **Master teachers as advocates of AI ethics:** Play active roles in launching awareness campaigns on the ethics of AI, interpreting ethical principles, sharing knowledge on relevant regulations, promoting dialogues on AI safety and work with communities to revise existing regulations and/or develop new…

	Create
…ity	Social responsibility
…	Co-creating ethical rules
	Creating with AI
…ration	AI-enhanced pedagogical transformation
…ning	AI to support professional transformation

The world today's pre-service teachers grew up in

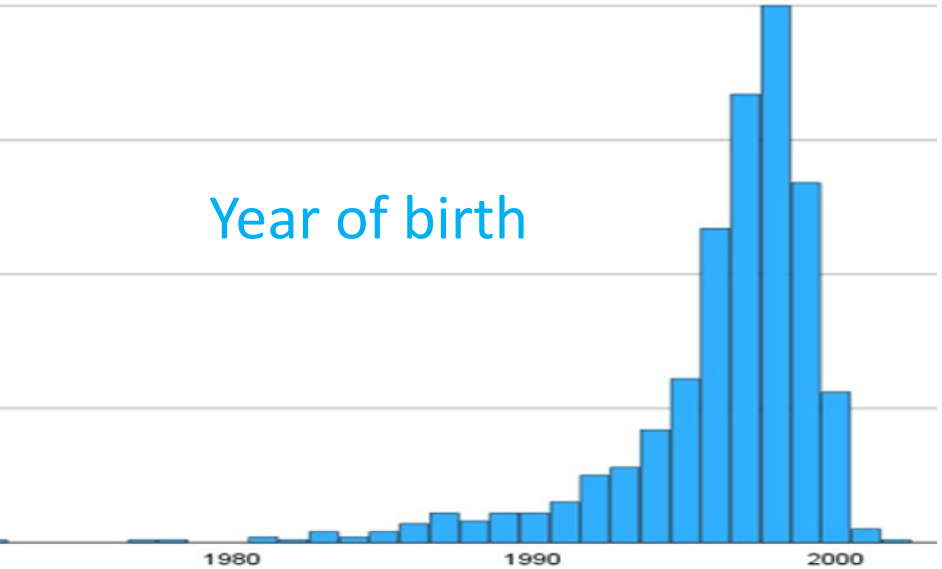
First GUIs (Apple Mac, Atari ST, Amiga…)

„Web 2.0" first mentioned

Facebook counts 1 billion users

Public launch of ChatGPT: „Disruptive Educational Technology" (Frith, 2023, p. 198)?

1980s | 1990s | 2000s | 2010s | 2020–2022 | 2023–2025



Facebook counts 100 million users

Emergency Remote Teaching (Bozkurt & Sharma, 2020)

Emerging Research on Teachers' Views on AI

Research on relations between overall views on digital (or digitally supported) teaching and learning on AI-specific features is a new field:

- Positive associations have been found between general digital competence beliefs and attitudes and their AI-specific counterparts (Lucas et al., 2024; Galindo-Domínguez et al., 2024).

- AI-related attitudes are linked to usage and intention to use AI (Zhang et al., 2023; Runge et al., 2025; Kaplan-Rakowski et al., 2023; Wang et al., 2021).

Research Questions

1. How are pre-service teachers' *overall* views on digital technology structured?
   - These views have been acquired across the whole life-span
   - Views refer to both competence (self-ratings) and attitudes, instruments widely available
   - Method: exploratory factor analysis on scale level
2. How are pre-service teachers' views on teaching and learning with AI structured?
   - Generative AI in schools is (only) a recent issue
   - Items on AI-specific competence (self-ratings) and attitudes were developed in dialogue with *preparatory service* teacher educators
   - Method: exploratory factor analyses on item level
3. **How do overall digital views (RQ1) impact AI-specific views (RQ2)?**
   - Method: structural equation modelling, with exploratory elements
   - Data are cross-sectional, BUT: temporal sequence implies a causal order

Methods and Study Design

Research Context and Sample

German Teacher Education embraces two stages:

- 1st stage : university-based full BA/MA programme, typically 5-6 years, focus on theory
- 2nd stage: 'preparatory service' guided by ministry-run training institutes, 1 ½ yr., focus on practice
- Coherence between stages is vividly proclaimed, but incomplete in reality
- As training institutes are not scientific institutions, most research on TE is on 1st stage

Project Outline and Rationale

- Bring (future) teachers' digital competence forward, based on evidence from survey
- Quantitative online survey on pre-service teachers in 2nd stage, 2nd stage practitioners were involved in designing instrumentation in bottom-up approach

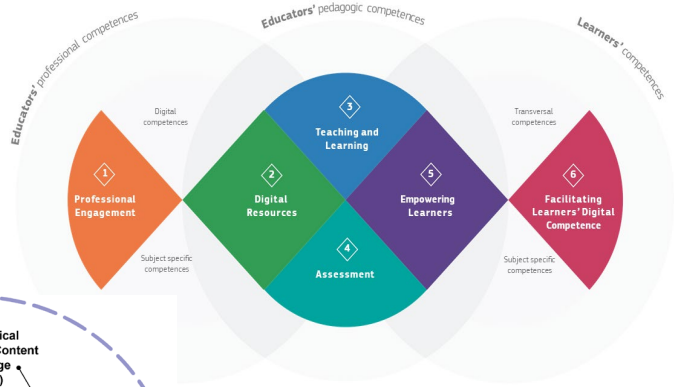
Sample characteristics (in first measurement occasion, voluntary participation)

- ***N* = 918** PST, out of 1625 (56%) ; 76.5 % females / 23.2 % male; MD age 27 yr. (P_{10} = 25, P_{90} = 32)
- 60.8 % of sample aiming at primary education, 3.5 % at lower secondary, 36.4 % at full secondary
- Content domains: most frequently German (50.9%), Mathematics (24.4 %), English AFL (19.6%)

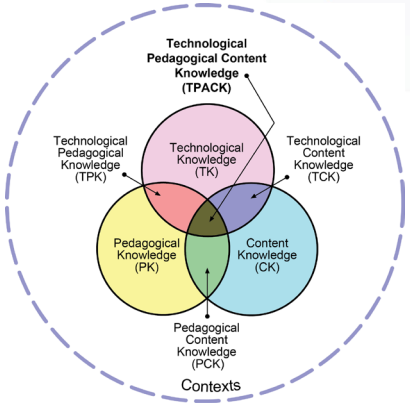
Findings

Instruments on overall views on digitalization (RQ 1)

- Self-rated competence based on DigCompEdu:
  Quast et al. (2023), seven scales; e.g.: ‘lesson planning’, ‘facilitating students’ digital competence’



- Self-rated competence based on TPACK:
  TK-related scales from TPACKxs; Schmid et al. (2020):
  TK, TCK, TPK, ans TPCK



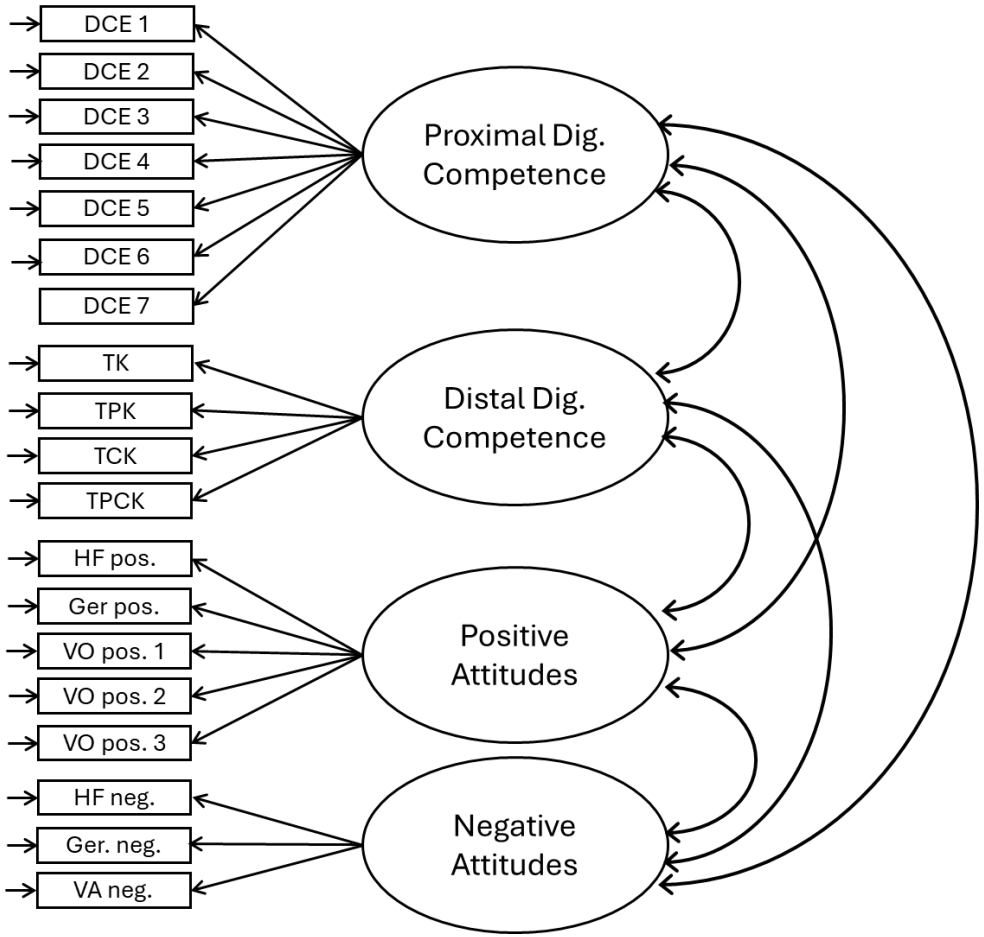
- Attitudes towards teaching and learning with digital technology:
  scales from Hawlitschek & Fredrich (2018, adapted), Gerick et al. (2018), Rubach & Lazarides (2019) expressing both positive and negative attitudes

RQ 1: Structure of overall views on digitalization

EFA on scales from established instruments yielded four factors:

(Principal axis factoring, all primary loadings > .40, all secondary loadings < .40)

- Factor 1: All DigCompEdu scales ("**Proximal digital competence**")
- Factor 2: "**Positive attitudes**" (across instruments)
- Factor 3: All (technical) TPACK scales ("**Distal digital competence**")
- Factor 4: "**Negative attitudes**" (across instruments)



Instruments on AI-related views (RQ 2)

For two reasons, we did not draw upon established scales on AI:

- First, no such scales were available in German in early 2024
- Second, project outline had it that second-stage teacher education practitioners were involved in survey instrumentation in a bottom-up approach

Items compiled in dialogue were heuristically assigned to three categories:

- Self-ascribed AI **competence**
- **Attitudes** towards using generative AI school and classroom
- (Individual) **Intentions** to use AI

RQ 2: Structure of AI-specific views

Items were submitted to EFA category-wise

Category I - Attitudes: Two factors (covering 63.8 % of item variance)

- “Positive potentials of (generative) AI”
- “Apprehensions concerning AI”

Category II – Competence: One factor (covering 50.8 % of item variance)

- “AI-specific competence”

Category III - Intentions: Two factors (covering 67.3 % of item variance)

- “AI-intention: facilitate lesson planning”
- “AI-intention: fostering students’ learning”

RQ 2: Structure of AI-specific views

Items were submitted to EFA category-wise

Category I - Attitudes: Two factors (covering 63.8 %

- "Positive potentials of (generative) AI"
- "Apprehensions concerning AI"

By rofessionally applying AI, the quality of teaching and learning in the classroom is fostered.

Category II – Competence: One factor (covering 50.8 % of item variance)

- "AI-specific competence"

Category III - Intentions: Two factors (covering 67.3 % of item variance)

- "AI-intention: facilitate lesson planning"
- "AI-intention: fostering students' learning"

RQ 2: Structure of AI-specific views

Items were submitted to EFA category-wise

Category I - Attitudes: Two factors (covering 63.8 % of

- "Positive potentials of (generative) AI"
- "Apprehensions concerning AI"

The regular use of AI thwarts students' willingness to exert effort.

Category II – Competence: One factor (covering 50.8 % of item variance)

- "AI-specific competence"

Category III - Intentions: Two factors (covering 67.3 % of item variance)

- "AI-intention: facilitate lesson planning"
- "AI-intention: fostering students' learning"

RQ 2: Structure of AI-specific views

Items were submitted to EFA category-wise

Category I - Attitudes: Two factors (covering 63.8 % of item variance)

- "Positive potentials of (generative) AI"
- "Apprehensions concerning AI"

Category II – Competence: One fac

- "AI-specific competence"

I know how to formulate prompts and commands in AI tools in order to achieve specific outcomes.

Category III - Intentions: Two factors (covering 67.3 % of item variance)

- "AI-intention: facilitate lesson planning"
- "AI-intention: fostering students' learning"

RQ 2: Structure of AI-specific views

Items were submitted to EFA category-wise

Category I - Attitudes: Two factors (covering 63.8 % of item variance)

- "Positive potentials of (generative) AI"
- "Apprehensions concerning AI"

Category II – Competence: One factor (covering 50.8 % of item variance)

- "AI-specific competence"

Category III - Intentions: Two factors (cov

- "AI-intention: facilitate lesson planning"
- "AI-intention: fostering students' learning"

I use AI to prepare the contents of my teaching units

RQ 2: Structure of AI-specific views

Items were submitted to EFA category-wise

Category I - Attitudes: Two factors (covering 63.8 % of item variance)

- "Positive potentials of (generative) AI"
- "Apprehensions concerning AI"

Category II – Competence: One factor (covering 50.8 % of item variance)

- "AI-specific competence"

Category III - Intentions: Two factors (covering 67.3 % of it

- "AI-intention: facilitate lesson planning"
- "AI-intention: fostering students' learning"

I pay attention that my tasks for students regularly encourage them to use AI

RQ 2: Structure of AI-specific views

Category I - Attitudes:

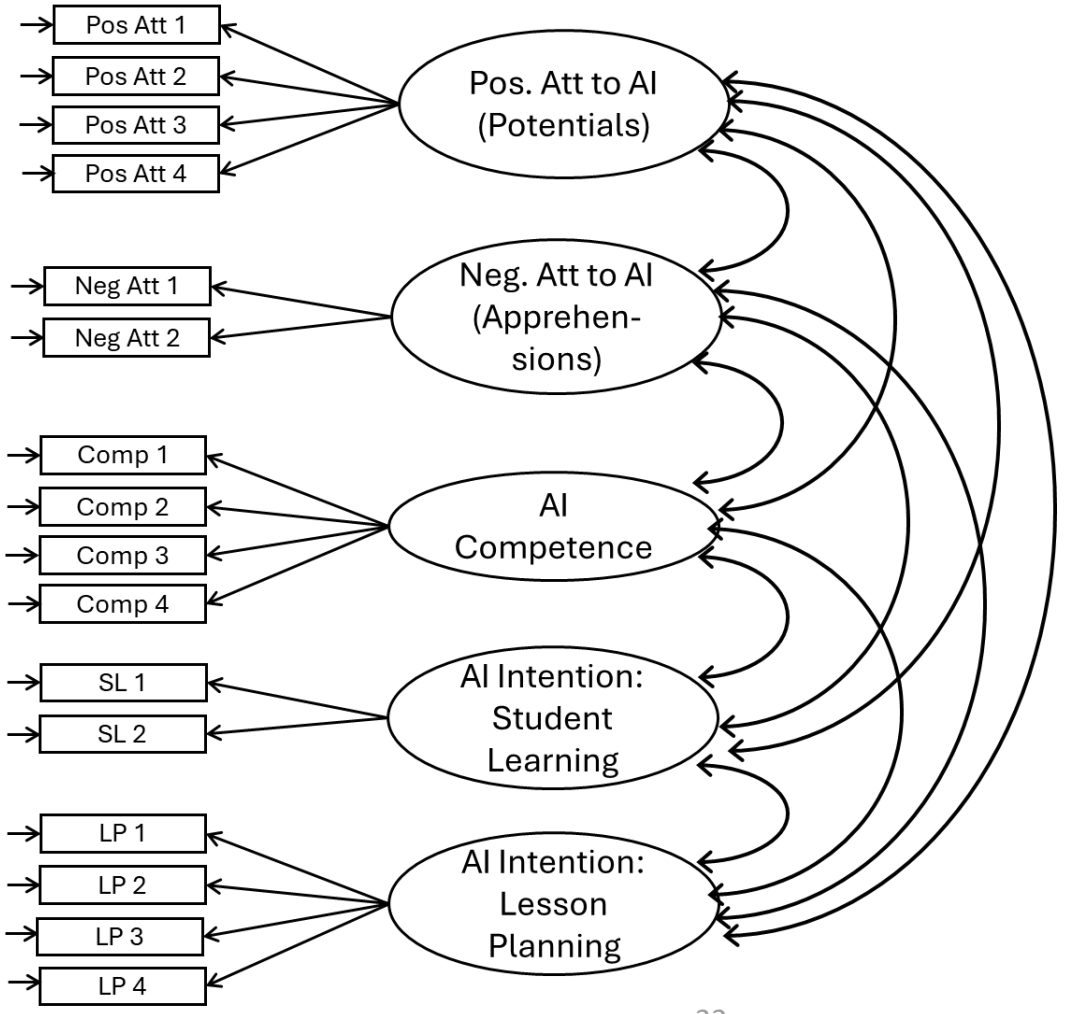
- "Positive potentials of (generative) AI"
- "Apprehensions concerning AI"

Category II – Competence:

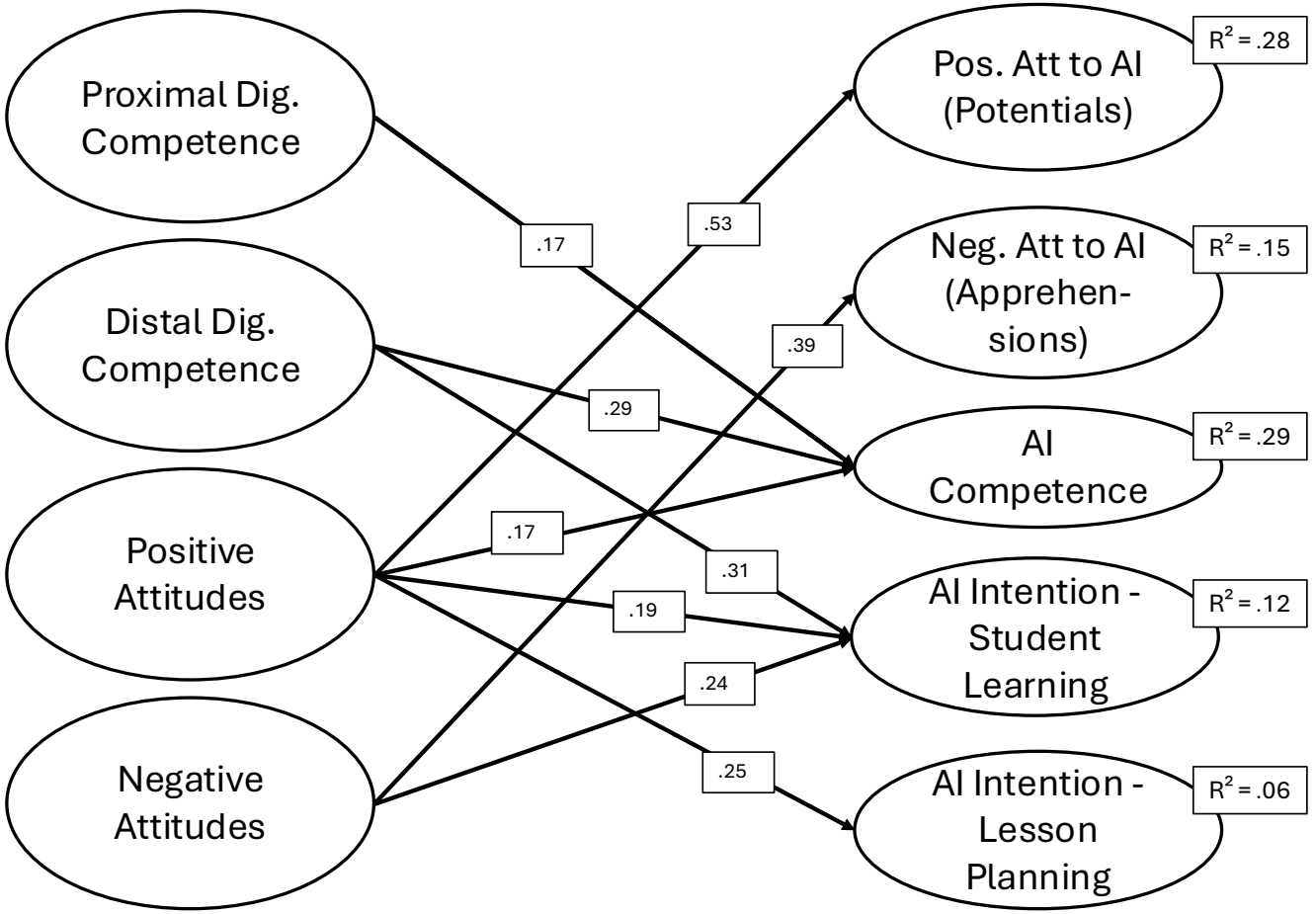
- "AI-specific competence"

Category III - Intentions:

- "AI-intention: facilitate lesson planning"
- "AI-intention: fostering students' learning"



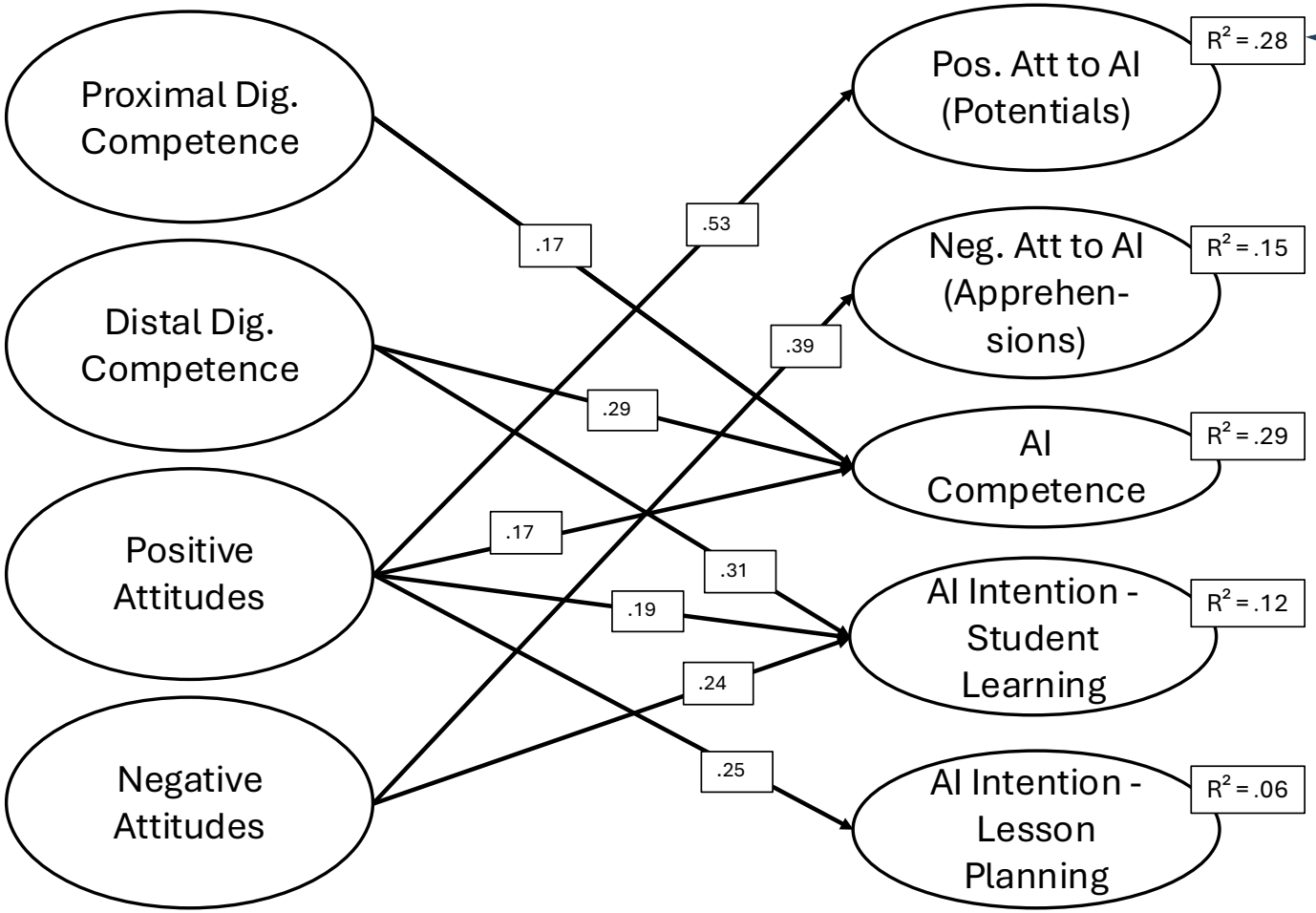
RQ 3: Impact of overall digital views on AI-specific views



X^2 = 2042.3, df = 528, CFI = .913, TLI = .902, RMSEA = .056, SRMR = .061

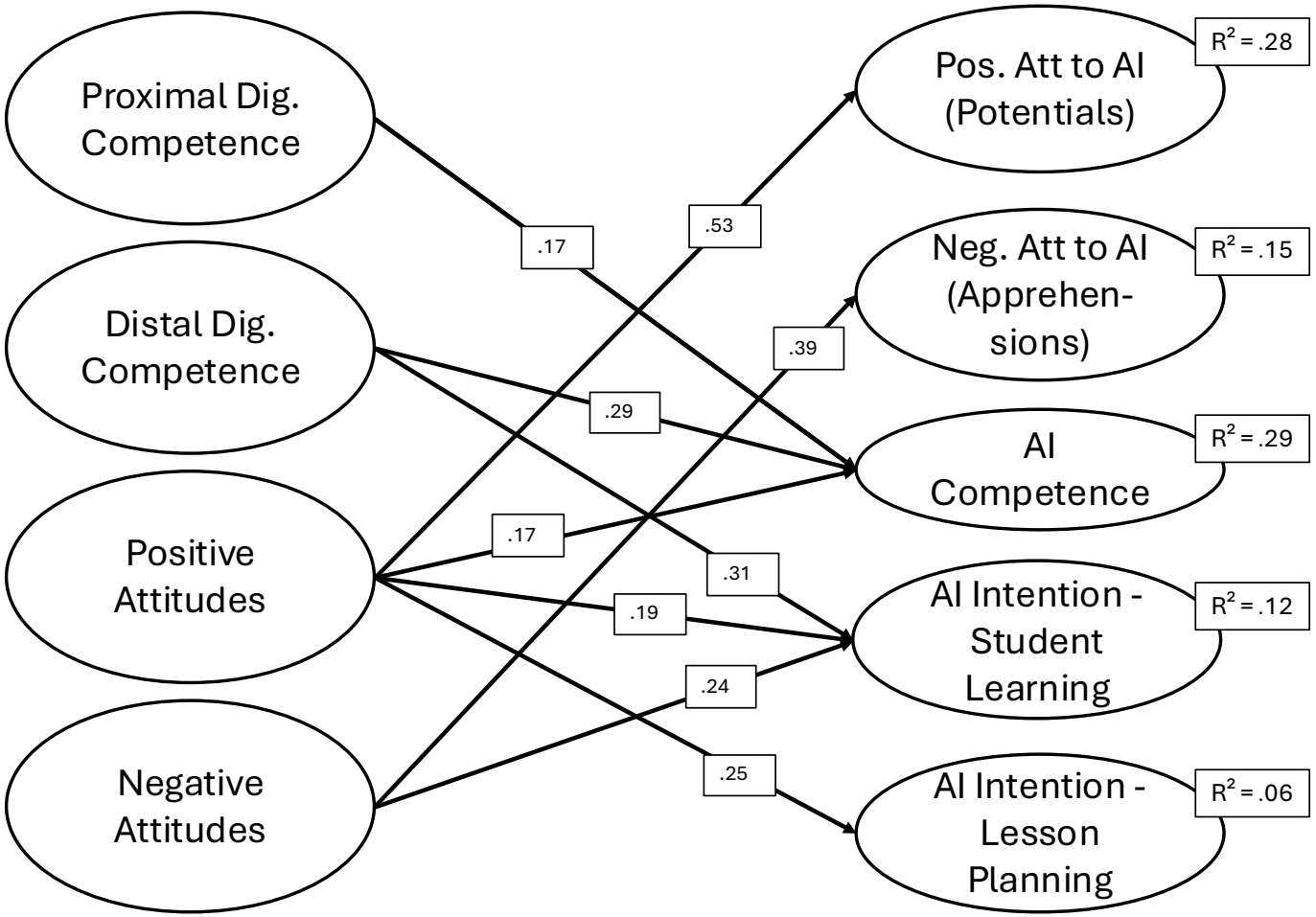
Discussion: What can we learn from this?

Summing up the pattern of influence on AI views



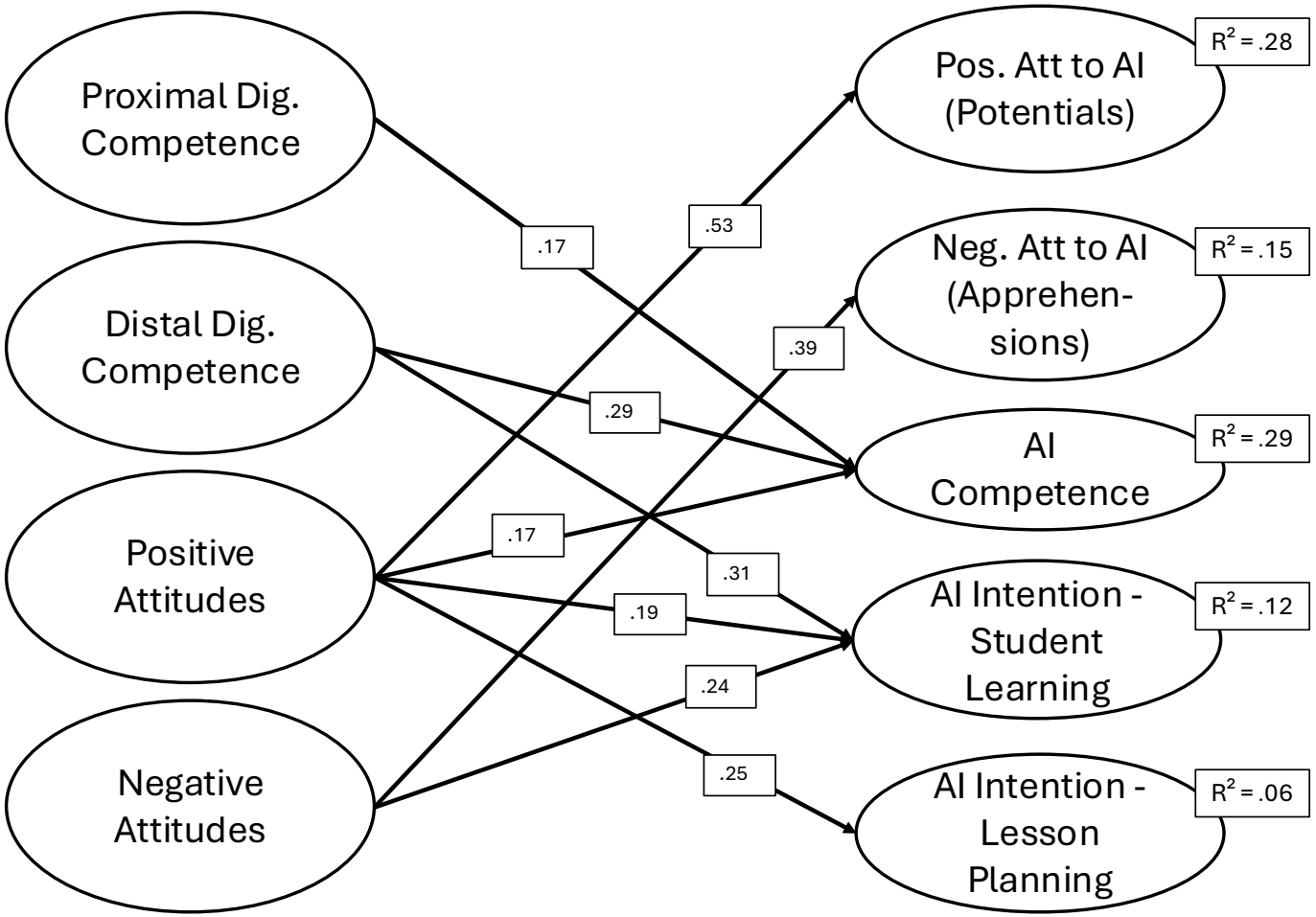
Positive attitudes to AI solely depend on overall positive attitudes

Summing up the pattern of influence on AI views



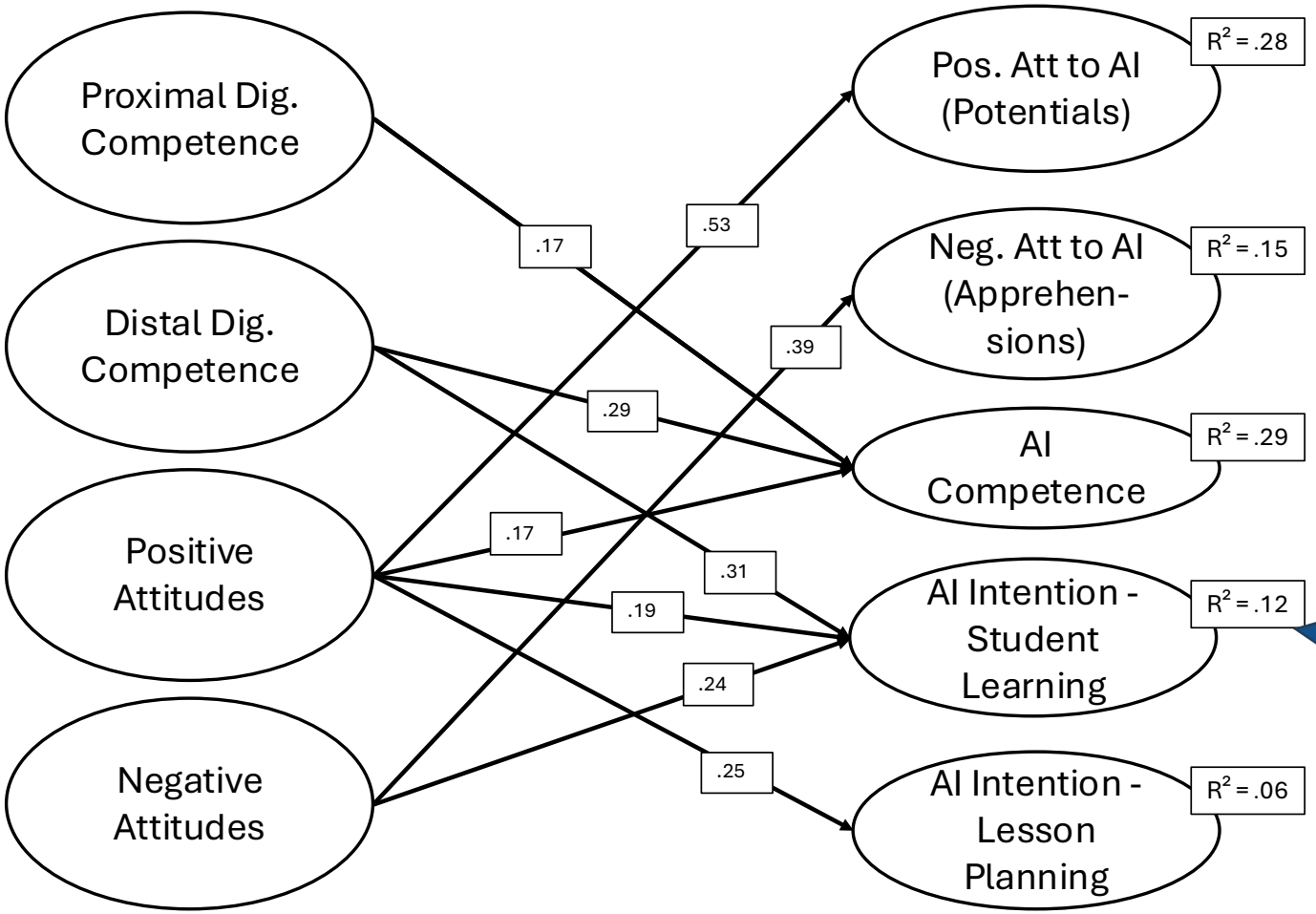
The same is true for negative attitudes to AI

Summing up the pattern of influence on AI views



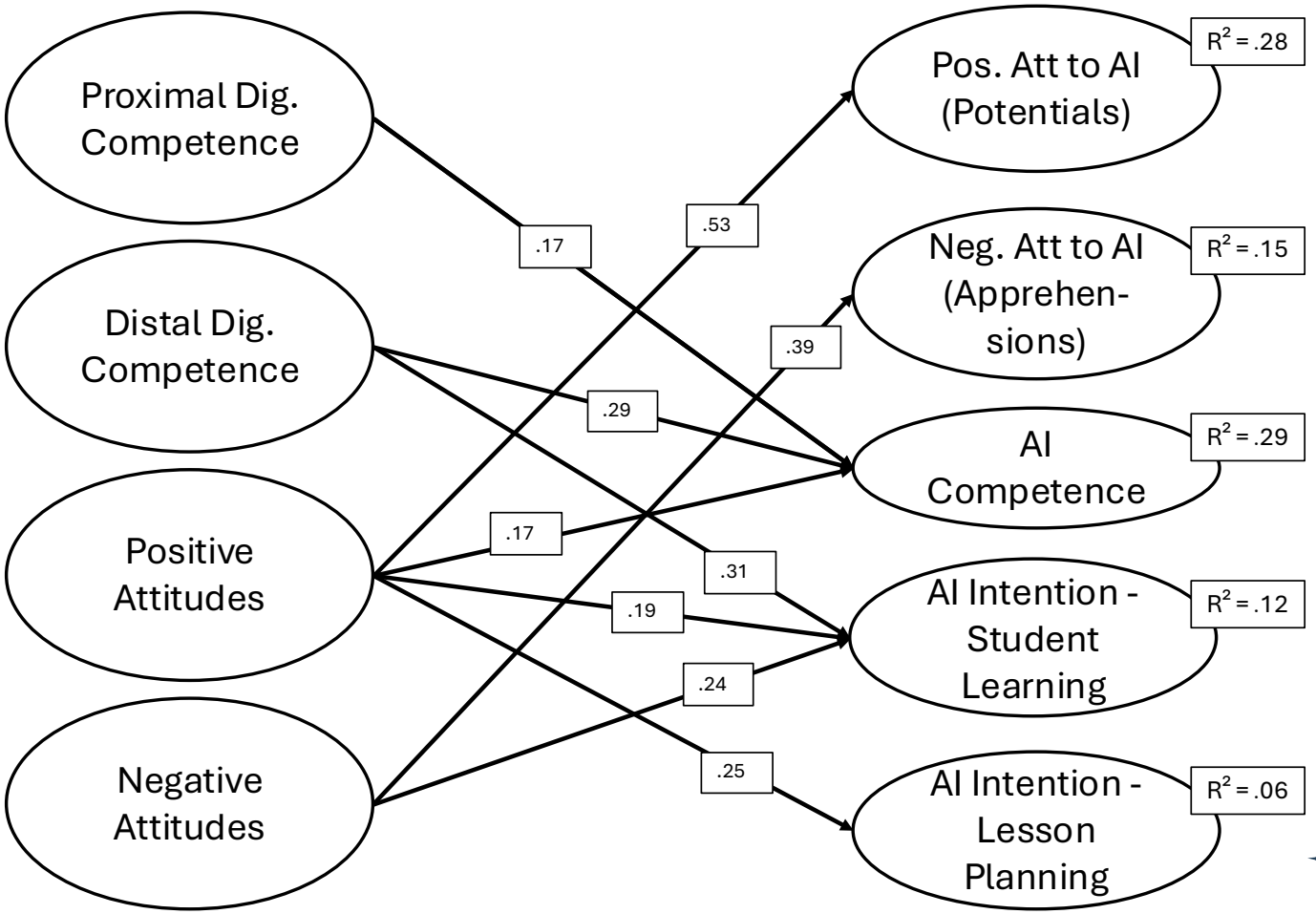
Depends on proximal AND distal competence (plus positive attitudes)

Summing up the pattern of influence on AI views



To actually use AI in student learning requires distal competence plus a deepened/critical view on digitalization on a whole

Summing up the pattern of influence on AI views



This intention is, in contrast, only fuelled by positive attitudes

(Possible) Take-Home-Messages

Attitudes to AI in schools do not “fall from the sky” but depend on attitudes towards digitalization on a whole.

> This may, in turn, suggest that teacher education curricula do not necessarily have to develop pathways to specifically reflect on AI, instead a “sound” understanding of digital teaching and learning should be envisaged.

(Perceived) **competence in AI** does depend on both proximal and distal competence (plus positive attitudes).

> Hence, (future) teachers’ “ordinary” digital competence should be brought forward in TE programmes in the first place.

Most importantly, PST’s **intention to actively use AI in the classroom** to ameliorate students’ learning requires abstract (distal) mastery plus a differentiated approach to digital technology (seeing both benefits *and* risks).

> TE programmes should, in consequence, address *both* aspects.

Thank you!

Christoph Schneider
Lothar Müller
Frederick Johnson

Contributing:
Pia Sader

Universität Trier