



Universität
Zürich ^{UZH}

Institut für Erziehungswissenschaft

Digitale Transformation ist kein Sprint, sondern ein Marathon

Ein Rückblick auf 25 Jahre Medienintegrationsforschung

Dominik Petko

LELEDIZ, 20.02.2026



Übersicht

- Ein High-Tech-Land mit Low-Tech-Schulen?
- Meine Kriechspur
- Die DigiTraS II Studie
- Schlussfolgerungen



**Ein High-Tech Land
mit Low-Tech Schulen?**

Grüezi

aus einem High-Tech-Land



<https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/rankings/>

Dominik Petko

The 2022 IMD World Digital Competitiveness Ranking

2022 COMPETITIVENESS RANKING

			Score	
01	Denmark		100.00	↗ 3
02	USA		99.81	↘ 1
03	Sweden		99.81	-
04	Singapore		99.48	↗ 1
05	Switzerland		98.23	↗ 1
06	Netherlands		97.85	↗ 1
07	Finland		96.60	↗ 4
08	Korea Rep.		95.20	↗ 4
09	Hong Kong SAR		94.36	↘ 7
10	Canada		94.15	↗ 3
11	Taiwan, China		94.11	↘ 3
12	Norway		93.23	↘ 3
13	UAE		91.42	↘ 3
14	Australia		87.89	↗ 6
15	Israel		87.37	↗ 2
16	United Kingdom		86.45	↘ 2
17	China		86.42	↘ 2
18	Austria		85.35	↘ 2
19	Germany		85.17	↘ 1
20	Estonia		85.06	↗ 5
21	Iceland		84.97	-
22	France		81.42	↗ 2
23	Belgium		81.34	↗ 3
24	Ireland		79.56	↘ 5
25	Lithuania		79.32	↗ 5
26	Qatar		78.37	↗ 3
27	New Zealand		77.44	↘ 4
28	Spain		77.40	↗ 3
29	Japan		76.84	↘ 1
30	Luxembourg		76.47	↘ 8

The IMD World Digital Competitiveness Ranking presents the 2022 overall ranking for the 63 economies covered by the Center. The economies are ranked from the most to the least competitive. The Scores shown to the right are actually indices [0 to 100] generated for the unique purpose of constructing charts and graphics. The final column shows the improvement or decline from the previous year.

The 2024 IMD World Competitiveness Ranking

2024 COMPETITIVENESS RANKING

			Score	
01	Singapore		100.00	↗
02	Switzerland		97.55	↗
03	Denmark		97.07	↘
04	Ireland		91.86	↘
05	Hong Kong SAR		91.49	↗
06	Sweden		90.30	↗
07	UAE		89.75	↗
08	Taiwan (Chinese Taipei)		88.50	↘
09	Netherlands		86.94	↘
10	Norway		86.22	↗
11	Qatar		85.33	↗
12	USA		83.48	↘
13	Australia		81.86	↗
14	China		81.04	↗
15	Finland		80.26	↘
16	Saudi Arabia		79.83	↗
17	Iceland		78.93	↘
18	Belgium		77.87	↘
19	Canada		77.69	↘
20	Korea Rep.		75.92	↗
21	Bahrain		75.27	↗
22	Israel		74.98	↗
23	Luxembourg		73.70	↘
24	Germany		72.74	↘
25	Thailand		72.51	↗
26	Austria		72.13	↘
27	Indonesia		71.52	↗
28	United Kingdom		70.82	↗
29	Czech Republic		70.21	↘
30	Lithuania		69.89	↗

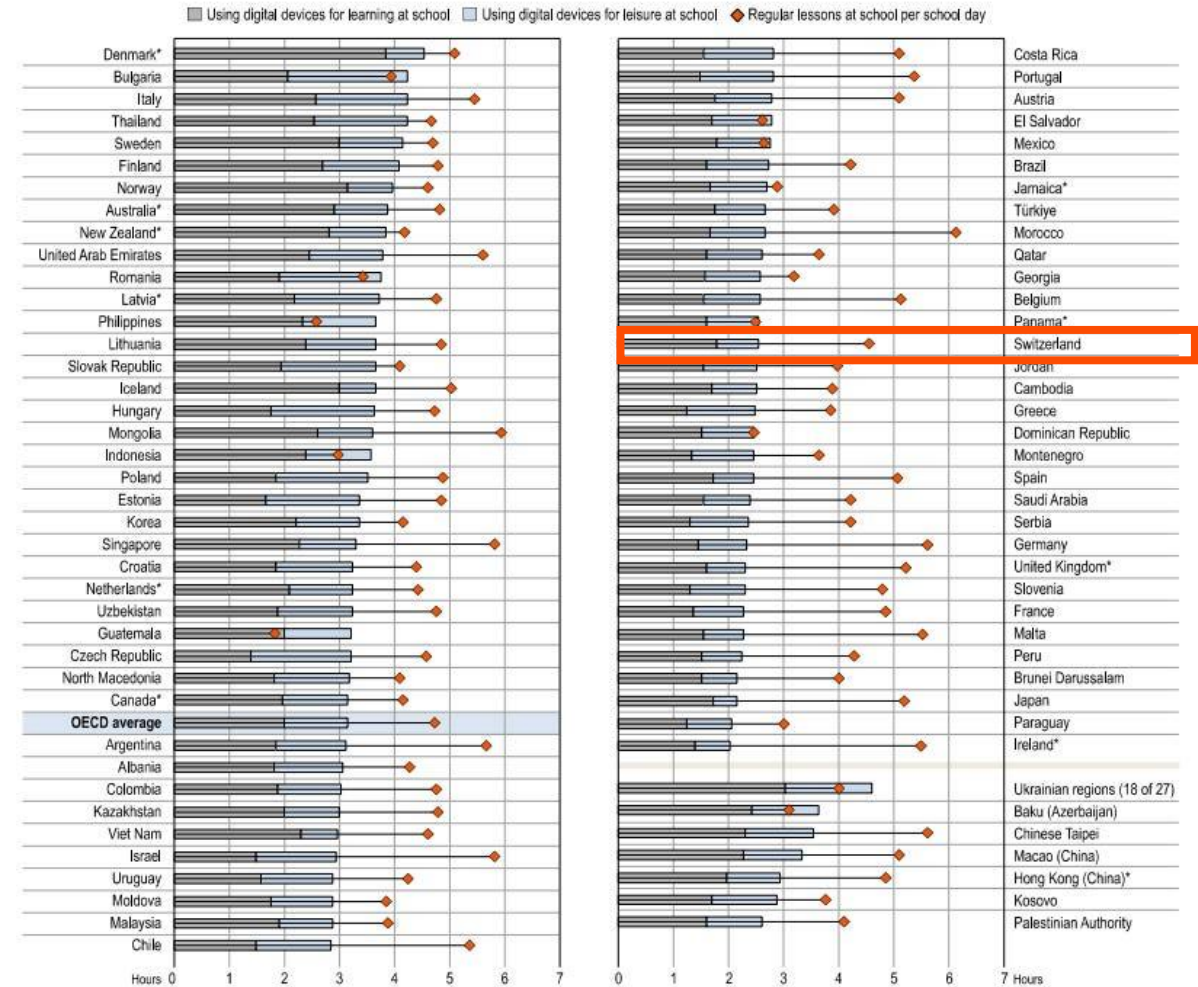
The IMD World Competitiveness Ranking presents the 2024 overall ranking for the 67 economies covered by the WCI. The economies are ranked from the most to the least competitive. The Scores shown to the right are actually indices (0 to 100) generated for the unique purpose of constructing charts and graphics. The final column shows the improvement or decline from the previous year.

Schweizer Low-Tech-Schulen?

- Seltener Einsatz in Schulen auch noch in PISA 2022
- Negative Korrelation zwischen Computernutzung und Leistung

Figure II.5.15. Time spent at school in regular lessons and on digital devices

Time spent per day by students (in hours)



Notes: Only countries and economies with available data are shown.

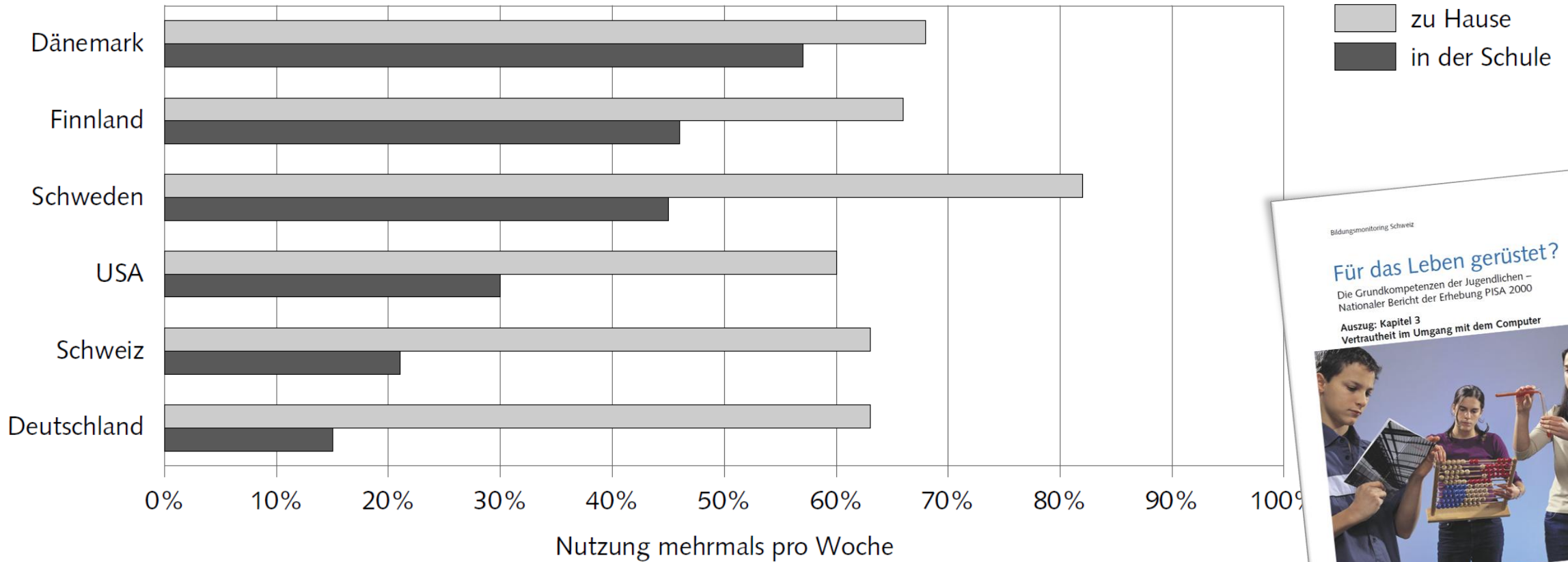
Time spent in regular lessons at school per school day refers to the time spent in regular lessons per school week divided by five (with the assumption there are five days per school week).

Countries and economies are ranked in descending order of the time spent using digital devices at school for both learning and leisure.

Source: OECD, PISA 2022 Database, Annex B1, Chapter 5.

Low-Tech seit PISA 2000

Abbildung 3.3: Computernutzung von 15-Jährigen nach Nutzungsort im internationalen Vergleich



Forschungsfragen

- Was sind die Kernfaktoren für eine vermehrte Nutzung digitaler Medien in Schulen?
- Wie entsteht nicht nur eine häufigere sondern eine qualitätsvolle Mediennutzung?
- Was können wir tun, um die Situation zu verbessern?

Meine Kriechspur



Wollen - Wissen – Werkzeuge (2008)

- Anzahl Computer im Klassenzimmer
- Fähigkeiten von Lehrpersonen zum Unterrichten mit digitalen Medien
- Überzeugungen von Lehrpersonen, dass sich Lernen damit verbessert

Table 4. Impact of key factors on the frequency of classroom computer use. ***p < 0.001

	Beta	T	SigT
Number of computers in the classroom	0.37	15.42	***
Teachers didactic ICT skills	0.36	16.28	***
Teachers positive beliefs on effects	0.17	7.35	***

$R=0.644, R^2=.415, F(3,1180)=279.37***$

N=1322 Schweizer Lehrpersonen aller Schulstufen

Petko, 2008

Oversold – Underused Revisited: Factors Influencing Computer Use in Swiss Classrooms

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Hypotheses and Methods

It is a well known phenomenon that computers, although readily available in classrooms, are rarely used for teaching and learning (Cuban, 2001; Korte & Hüsing, 2006). Switzerland, in particular, is one of the countries with the biggest gap between computer use at home and in school (OECD, 2006). To improve this situation, a 5 year nationwide project was launched in 2002. The goals of the project were to equip schools with computers and high-speed internet, produce suitable e-content, and train expert teachers who can train their colleagues. In 2007, a representative survey measured the improvements (N=712 school administrators and N=1322 teachers from all levels; Barras & Petko, 2007).

Based on the model of Viherä and Nurmela (2001), the use of information technology is expected to be positively associated with (1) access to computers, (2) specific competence, and (3) specific motivation. The variables are based on self-report items from the teacher questionnaire. Each variable has been differentiated into several sub-categories. Reported variables are measured by 5-point Likert scales with a minimum reliability of 0.80 (Cronbach's alpha). The sample has been separated into

Wollen – Wissen – Werkzeuge + konstruktivistische Überzeugungen (2012)

- Anzahl Computer im Klassenzimmer
- Fähigkeiten von Lehrpersonen zum Unterrichten mit digitalen Medien
- Überzeugungen von Lehrpersonen, dass sich Lernen damit verbessert
- Allgemeine konstruktivistische Überzeugungen
- Klassenlehrperson

Table 4
Results of the multiple linear regression analysis predicting the frequency/variety of classroom ICT use with a reduced set of variables.

Model	R^2	Adj. R^2	F	B	SE	β	t	p
	.60	.60	$F(5,318) = 96.10^{***}$					
Constant				-.04	.19		-.22	.826
Computers: # in classroom				.09	.01	.27	7.24	.000
Competence: teaching with ICT				.27	.02	.46	11.41	.000
Belief: ICT improves learning				.17	.03	.19	5.07	.000
Form teacher/head of class				.22	.05	.18	4.72	.000
CLES: overall index				.11	.04	.09	2.55	.011

Dependent variable: Classroom use of ICT: 1 = never – 5 = almost every day (Mean Index of 20 Items, Cronbach's $\alpha = .90$).

*** F -Value is significant at the $p < .001$ level; Cohen's $f = 1.51$; $N = 324$.

$N = 357$ Schweizer Sekundarschullehrer
Petko, 2012

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Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations

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ABSTRACT

The 'will, skill, tool' model is a well-established theoretical framework that elucidates the conditions under which teachers are most likely to employ information and communication technologies (ICT) in the classroom. Past studies have shown that these three factors explain a very high degree of variance in the frequency of classroom ICT use. The present study replicates past findings using a different set of measures and homes in on possible subfactors. Furthermore, the study examines teacher affiliation for constructivist-style teaching, which is often considered to facilitate the pedagogical use of technology in constructivist-style teaching, and the combined frequency and diversity of technology use. The study's survey of 357 Swiss secondary school teachers reveals significant positive correlations between will, skill, and tool variables and the intensity of classroom ICT use. Computer and teaching. A multiple linear regression model was used to identify relevant subfactors. Five factors account for a total of 60% of the explained variance in the classroom when: (1) teachers consider Internet applications to be more often used by teachers in their classroom teaching; (2) more computers are readily available; (3) the teacher is more competent in using ICT for teaching; (4) the teacher is more convinced that themselves to be a form teacher and responsible for the class; (5) the teacher more often employs constructivist forms of computers improve student learning; and (5) the teacher more often employs constructivist forms of teaching and learning. The impact of constructivist teaching was small, however.

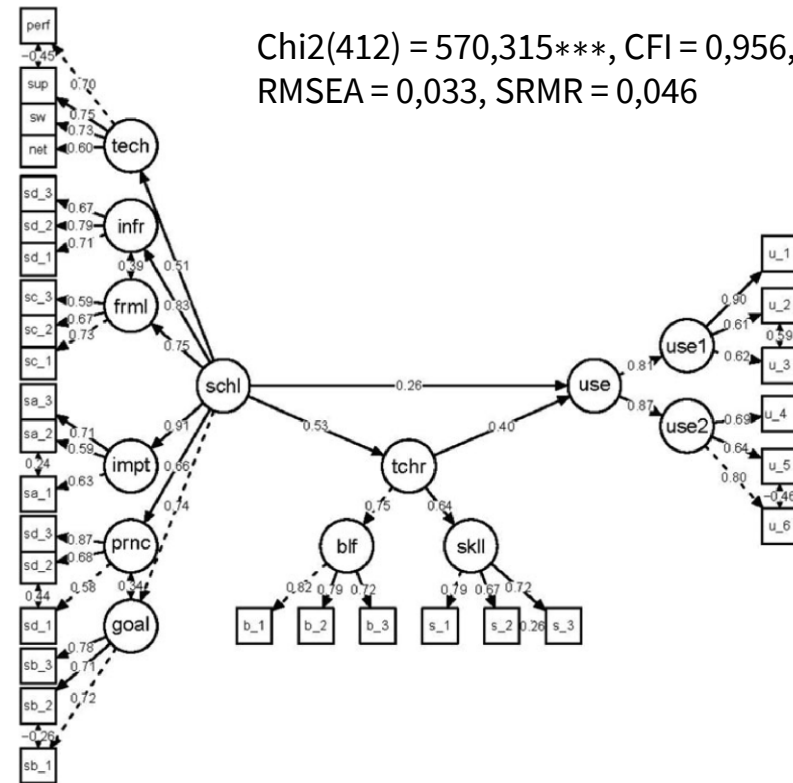
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1. Introduction

Despite the availability of computers and Internet connections in many schools, it is often noted that such technology is seldom employed in actual teaching practice (Korte & Häising, 2006; Shewbridge, Ikeda, & Schleicher, 2006). Given the high level of importance ascribed to information and communication technologies (ICT) in current discussions about education policy (e.g. Delors, 1998; Korte & Salganik, 2003), educational researchers need to address why so many schools have been so slow to adopt digital technology, and why so many teachers remain skeptical about integrating digital technologies in their classroom teaching or remain raters in classroom have been oversold by promoters and process, fueled by popular

Schulkultur + Wollen – Wissen – Werkzeuge (2018)

- Unterstützende Schulleitung
- Strategische Bedeutung
- Formeller Austausch zwischen Lehrpersonen
- Informeller Austausch zwischen Lehrpersonen
- Gesamtschulische technische Ressourcen



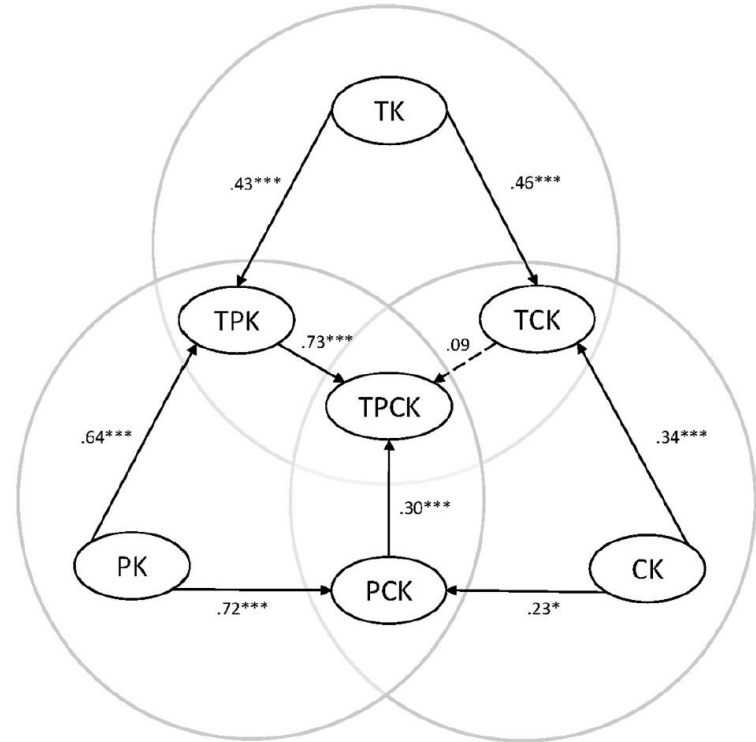
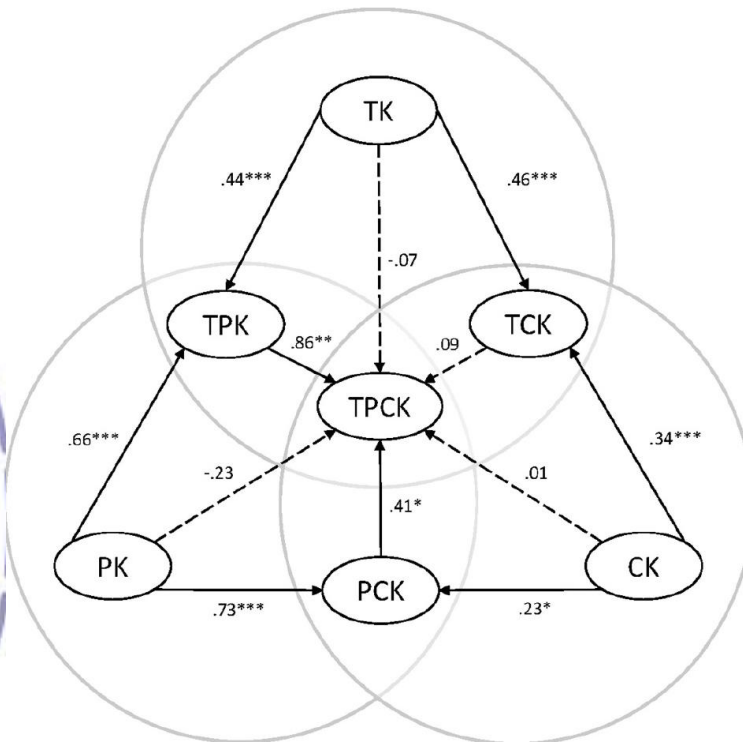
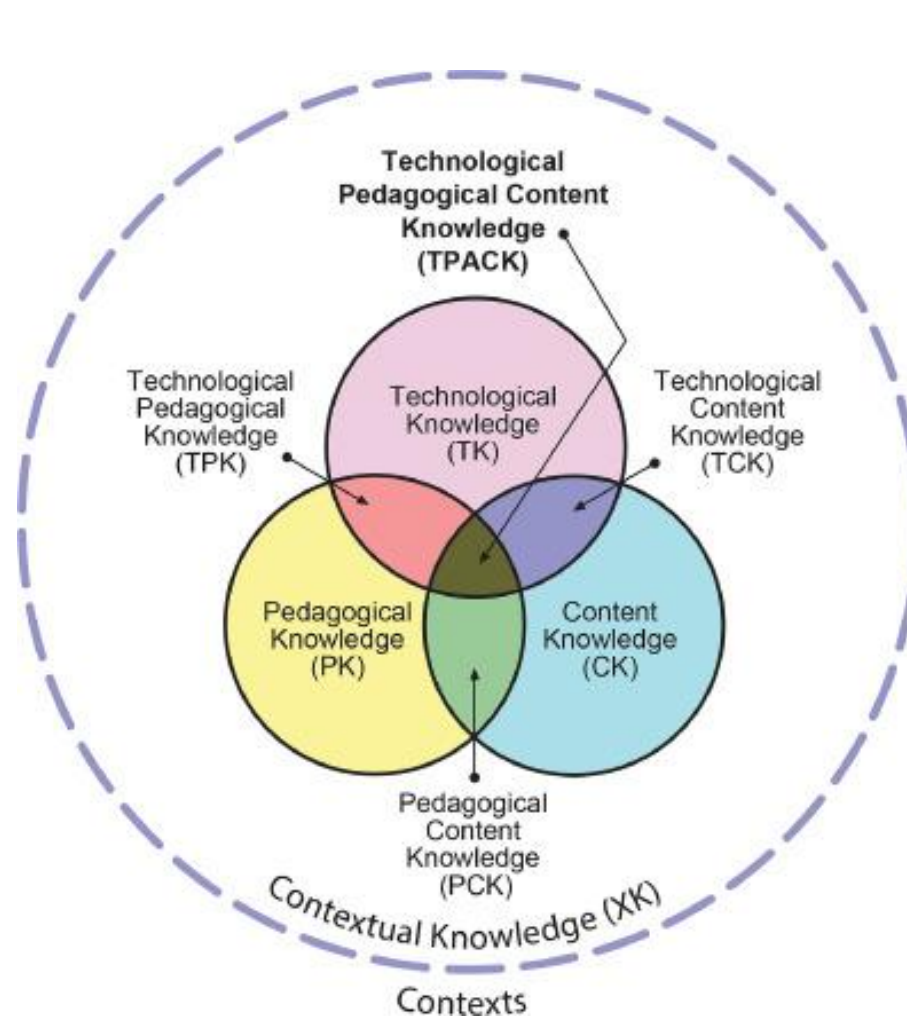
Chi2(412) = 570,315***, CFI = 0,956, TLI = 0,950,
RMSEA = 0,033, SRMR = 0,046

N = 349 Schweizer Primarschullehrpersonen

Figure 2. Structural equation model with standardized coefficients.

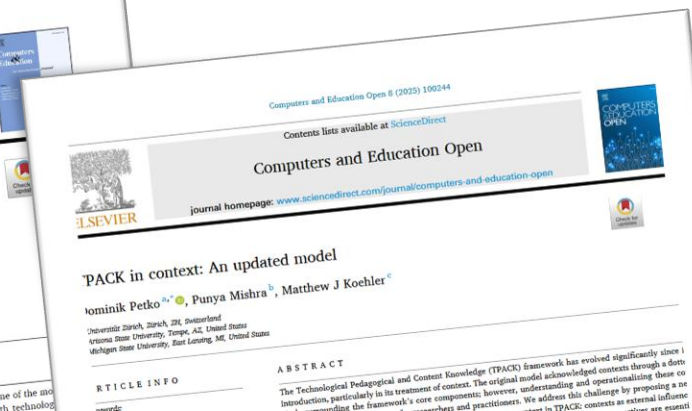
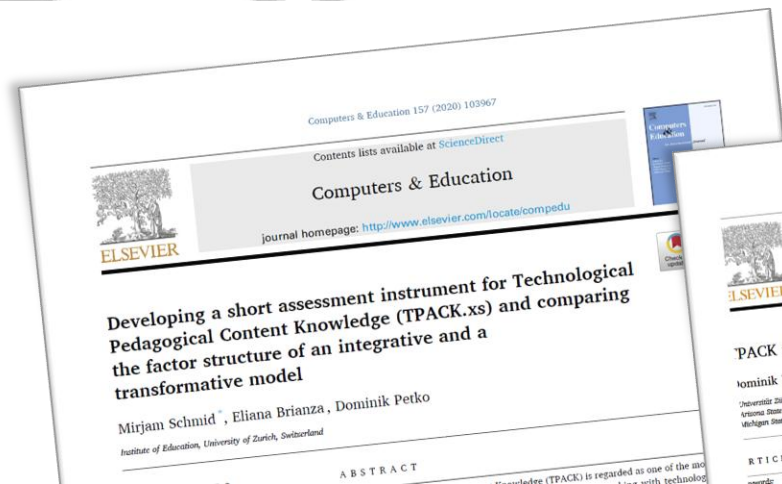


Technological Pedagogical Content Knowledge (2020, 2025)



N = 117 angehende Gymnasiallehrpersonen

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Nutzungshäufigkeit digitaler Medien und PISA Testleistungen (2017)

- Nutzungshäufigkeit für Freizeit Zwecke zuhause (-)
- Nutzungshäufigkeit für schulische Zwecke zuhause (+)
- Nutzungshäufigkeit in der Schule (-)
- Nutzungsqualität in der Schule (+)

N = 294991 15-Jährige aus 39 Bildungssystemen

Table 3. Standardized Regression Coefficients (β) and Explained Variance (R^2) for Each Country Predicting the Achievement Scores for the PISA Domain Mathematics.

	ENTUSE	HOMSCH	USESCH	ICTATTPOS	R^2
QCN	-0.670***	0.395***	-0.475***	0.092**	.277
SGP	-0.103**	0.608***	-0.750***	-0.169***	.262
HKG	-0.132**	0.899***	-0.558***	-0.014	.235
TAP	-1.189***	0.870***	-0.292**	0.133*	.266
KOR	-1.244***	1.865***	-1.005***	1.022***	.215
MAC	-0.009	0.093***	-0.041***	0.022**	.348
CHE	-0.191***	0.060	-0.372***	0.268***	.356
NLD	-0.298***	1.481***	-1.179***	-0.028	.351
EST	-0.102***	0.009	-0.116***	0.010	.233
FIN	-0.382***	0.095*	-0.292***	0.100***	.235
POI	-0.171	-0.324***	-1.035***	-0.154	.290

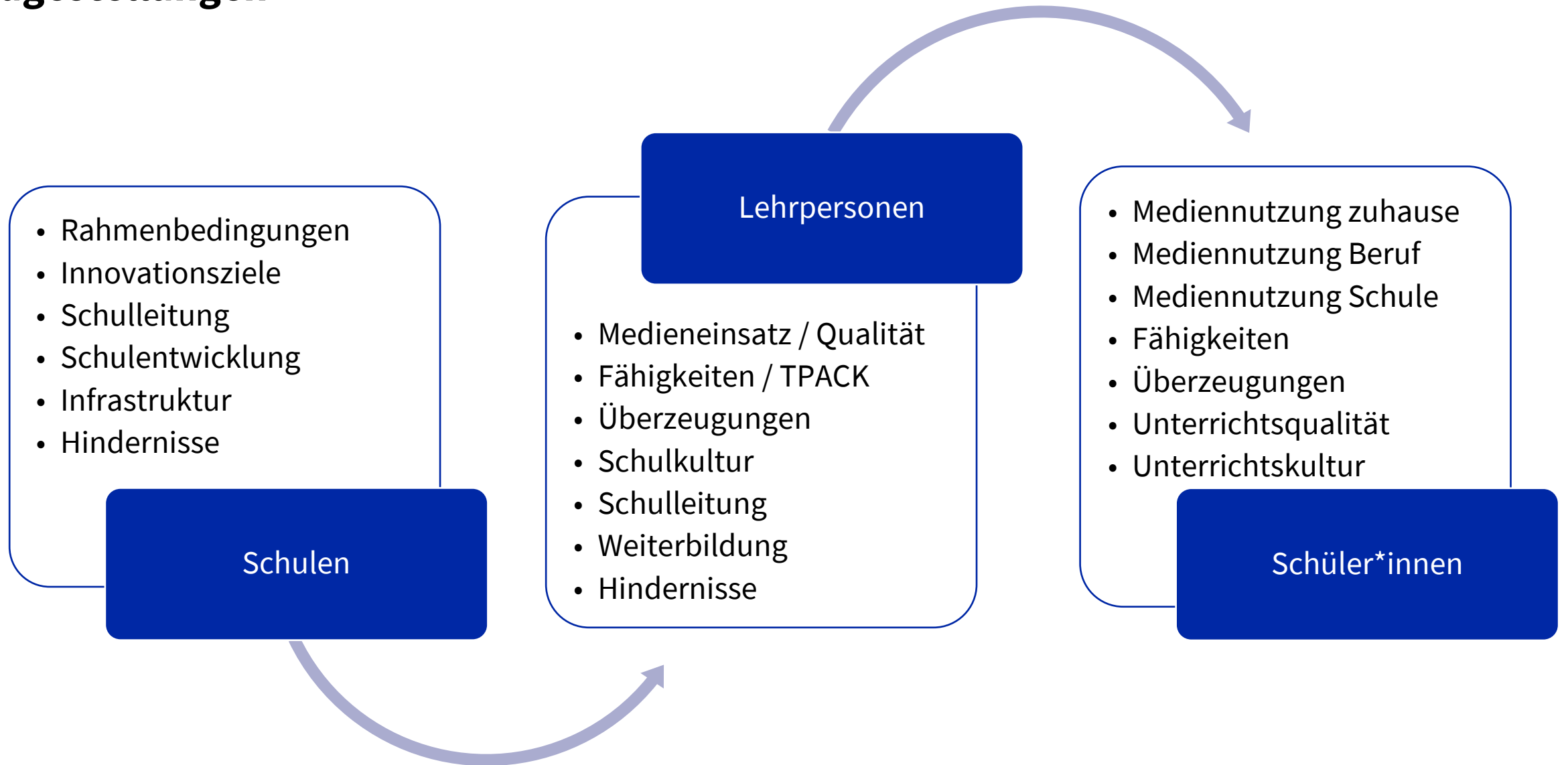


Abstract

In large-scale international assessments such as the Programme for International Student Assessment (PISA), the Trends in International Mathematics and Science Study (TIMSS), or the Progress in International Reading Study (PIRS), research has struggled to find positive associations between the frequency of educational technology use in schools and student achievement. While computer use at home showed a tendency for positive correlations with test scores, computer use in schools did not. Following a different approach, the study reanalyzes PISA 2012 data by combining frequency of use and positive perceptions with regard to educational technology as predictors for student test scores. When controlling for influential sociodemographic factors, results indicate that positive attitudes toward educational technology are associated with higher test scores in the large majority of countries. As positive attitudes are likely to be a result of positive experiences, it seems reasonable to conclude that it might be quality instead of quantity of educational technology use that matters.



Fragestellungen



Das DigiTraS II Projekt

- Projekt im Nationalen Forschungsprogramm 77
- Kooperation von Universität Zürich und IUFFP Lugano
- Unterstützt durch EDK, SBFI und das Bundesamt für Statistik
- 01.08.2020 – 31.12.2024



<https://tinyurl.com/digitras2report>



Methoden und nationale Stichprobe

- Repräsentative Erhebungen zum Stand der digitalen Transformation der Sek II
- Fallstudien von hoch digitalisierten Schulen

Hauptbefragungen 2021/2022

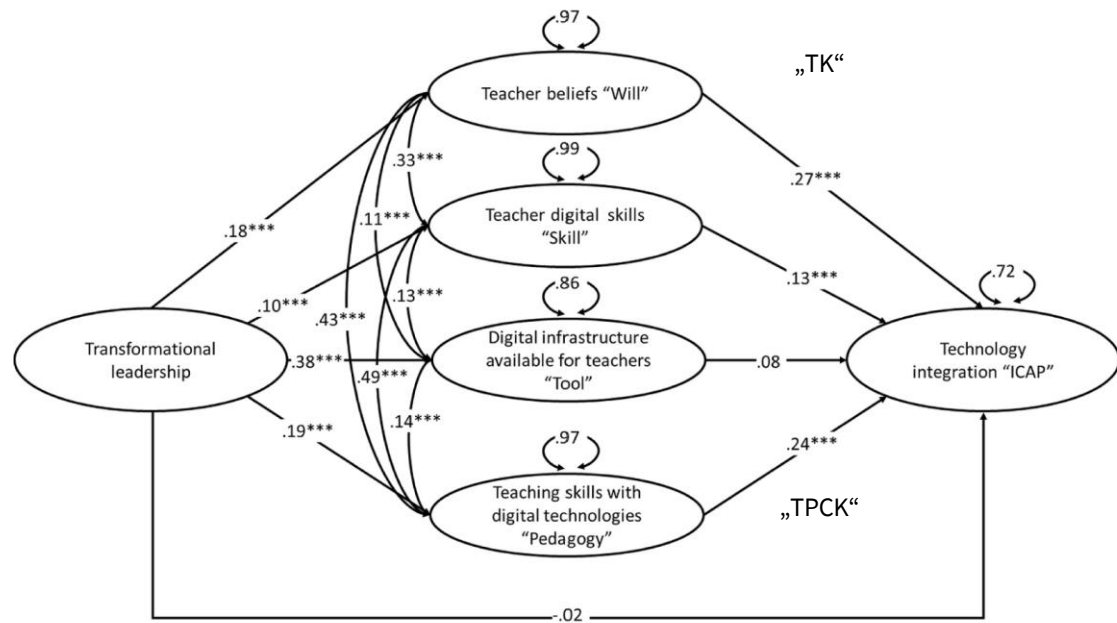
- N = 225 Schulleitungsmitglieder (80 Gymnasium, 24 Fach/Berufsmaturität, 121 Berufsbildung)
- N = 2248 Lehrpersonen (939 Gymnasium, 394 Fach/Berufsmaturität, 915 Berufsbildung)
- N = 8933 Schüler*innen (2942 Gymnasium, 1223 BMS/FMS/HMS/IMS, 4768 Berufsbildung)

Vertiefungsstichprobe 2023/2024

N = 2357 Schüler/innen (736 Gymnasium, 319 Fachmaturität, 1302 Berufsbildung)

Schulleitung → Lehrpersonen → Unterricht (2025)

- Schulleitung: Attraktive Ziele, breite Beteiligung
- Fähigkeiten von Lehrpersonen zum Unterrichten mit digitalen Medien (TPACK)
- Überzeugungen von Lehrpersonen, dass sich Lernen damit verbessert (Mehrwerte)
- Qualität der Nutzung digitaler Medien im Unterricht (ICAP)

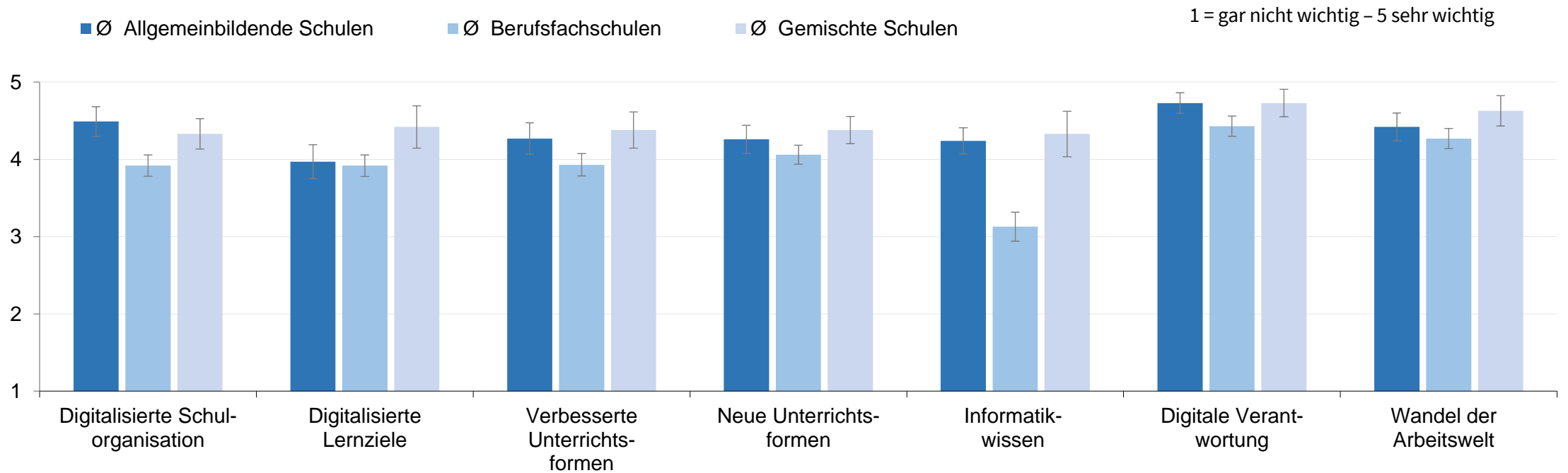


N = 2247 Swiss upper secondary teachers; Schmitz et al., 2023



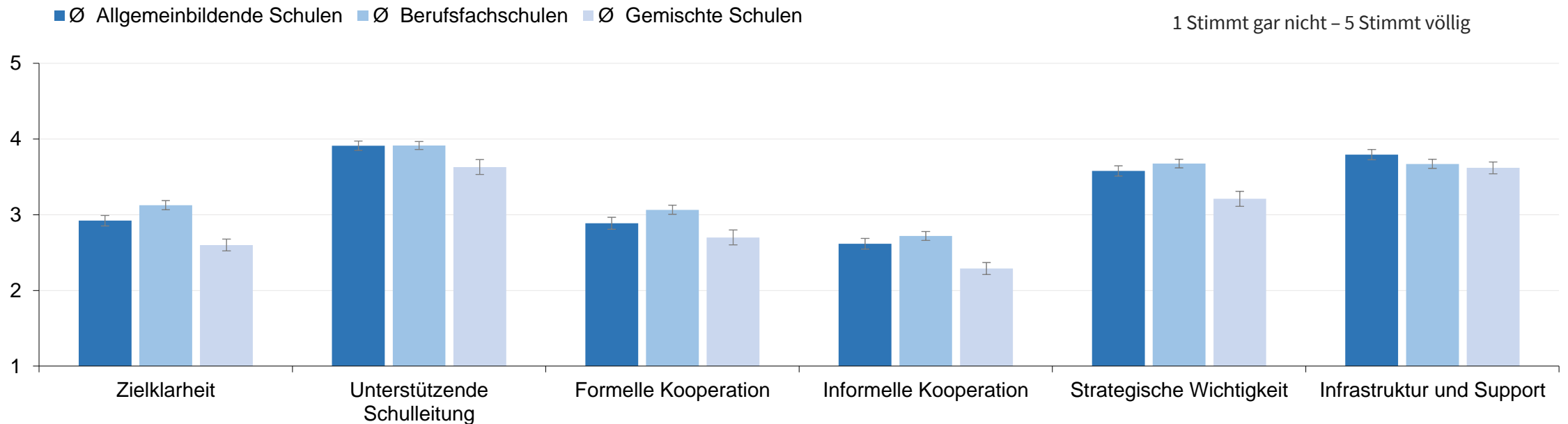
Digitalisierungsziele aus Sicht der Schulleitungen

- Hohe Wichtigkeit unterschiedlicher Digitalisierungsziele



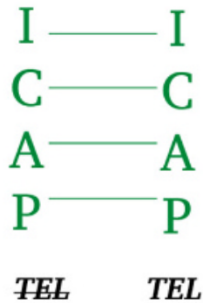
Digitale Schulkultur aus Sicht von Lehrpersonen

- Schulleitungsunterstützung, Infrastruktur und strategische Wichtigkeit werden eher positiv gesehen
- Zielklarheit bei Lehrpersonen unklar; Kooperation zwischen Lehrpersonen ausbaufähig

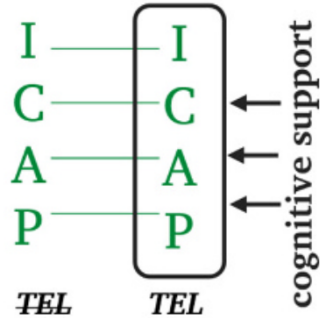


Wann lernen Schülerinnen besser mit digitalen Medien? SAMR + ICAP

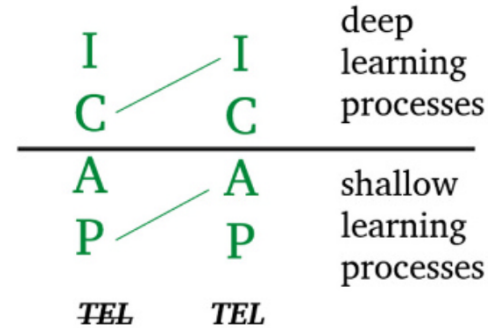
Substitution



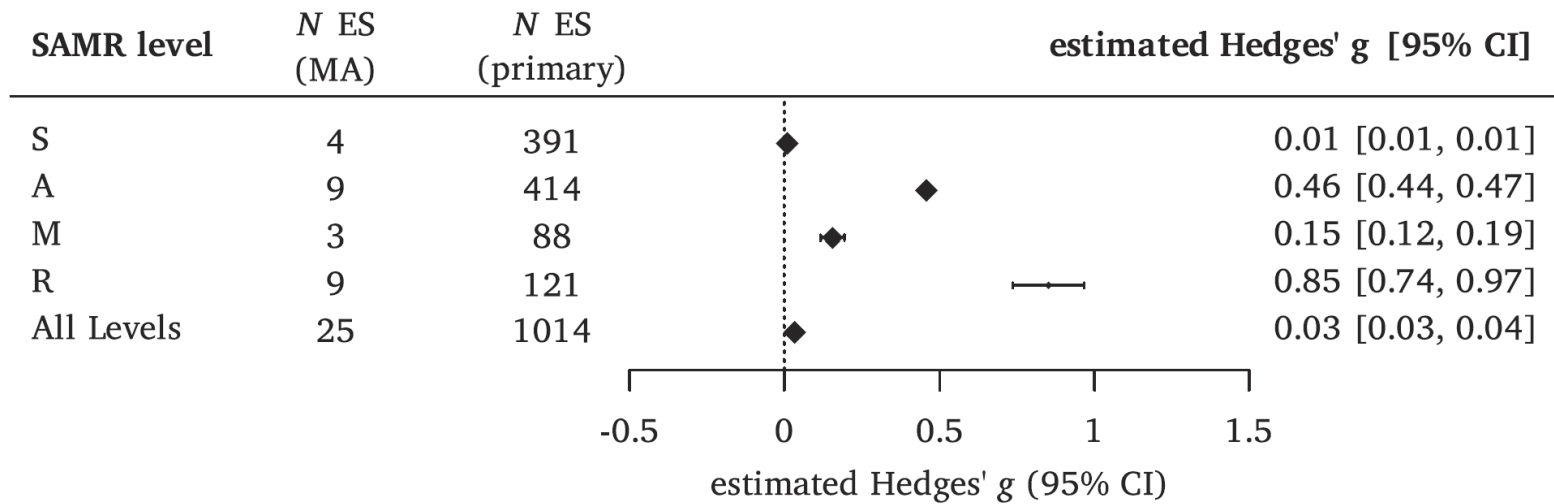
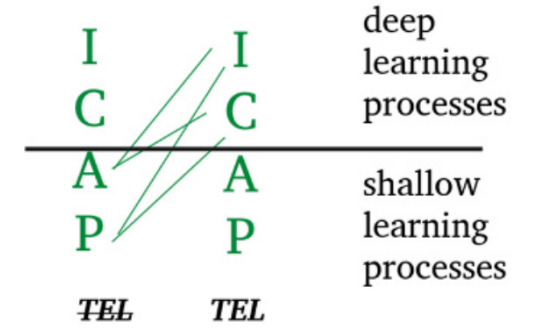
Augmentation



Modification



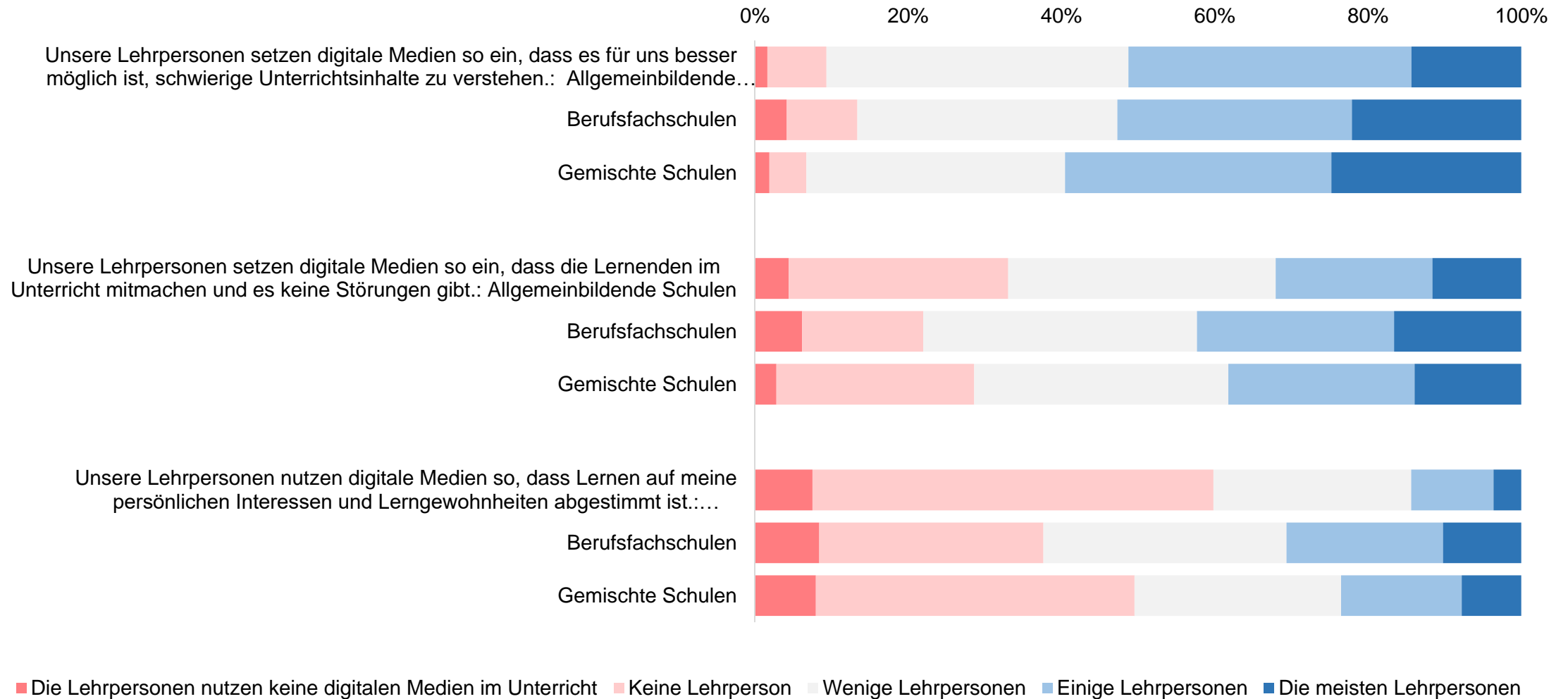
Redefinition



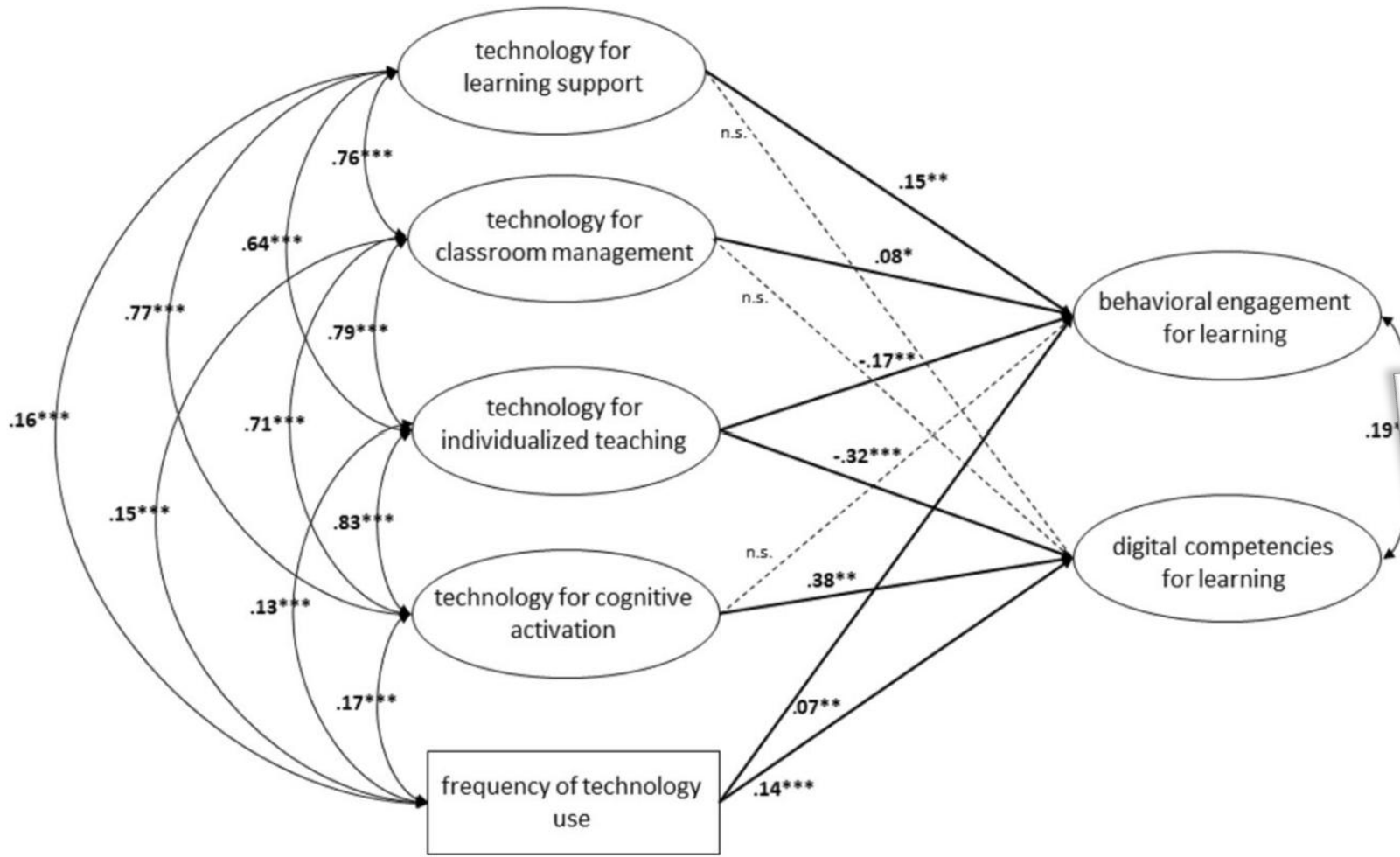
Sailer et al., 2024



Digitale Unterrichtsqualität aus Sicht der Schülerinnen und Schüler



Qualität der Mediennutzung ist lernwirksam



$\chi^2(150) = 683.851, p < 0.001, CFI = 0.97, TLI = 0.97, RMSEA = 0.04, 90\% CI [0.04, 0.04], SRMR = 0.03$

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Quality of technology integration matters: Positive associations with students' behavioral engagement and digital competencies for learning

Tessa Consoli¹ · Maria-Luisa Schmitz² · Chiara Antonietti³ · Philipp Gonon¹ · Alberto Cattaneo³ · Dominik Petko¹

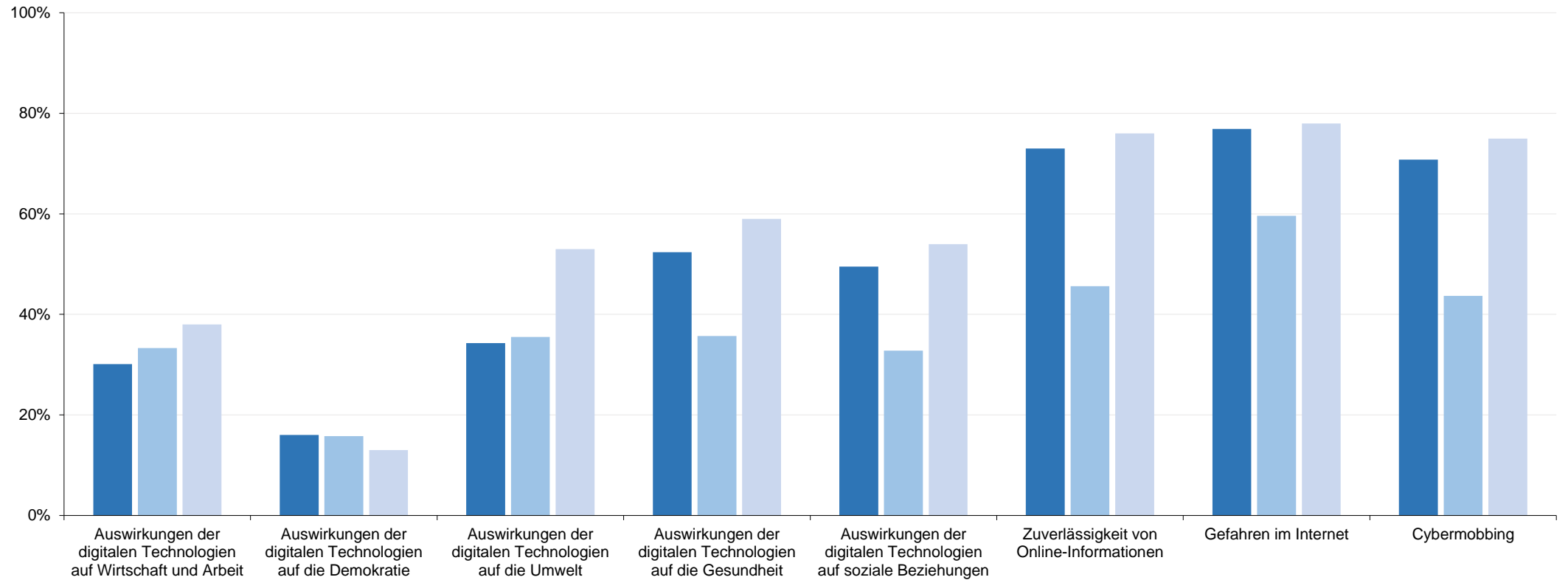
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Abstract

Despite extensive research on technology's potential to enhance teaching, large-scale studies often report mixed or negative impacts of technology use at school on student learning achievements. This ambiguity is often attributed to previous large-scale studies focusing more on the frequency rather than the quality of technology integration in the classroom. To further investigate this issue, our study developed the Technology Integration Quality Scale (TIQS) to measure students' perceptions of technology integration across different dimensions of teaching quality: support for learning, classroom management, individualized teaching, and cognitive activation. Using a sample of 2,281 students from 29 upper secondary schools in Switzerland, we validated the TIQS through exploratory and confirmatory factor analyses. We also employed cluster-robust structural equation modelling to examine how both the frequency and perceived quality of technology integration predict students' digital competencies and behavioral engagement for learning. The results showed that digital competencies and behavioral engagement were significantly more variance than the frequency of technology use. Moreover, the quality of technology integration (as measured by the TIQS) was a significant predictor of both digital competencies and behavioral engagement for learning.

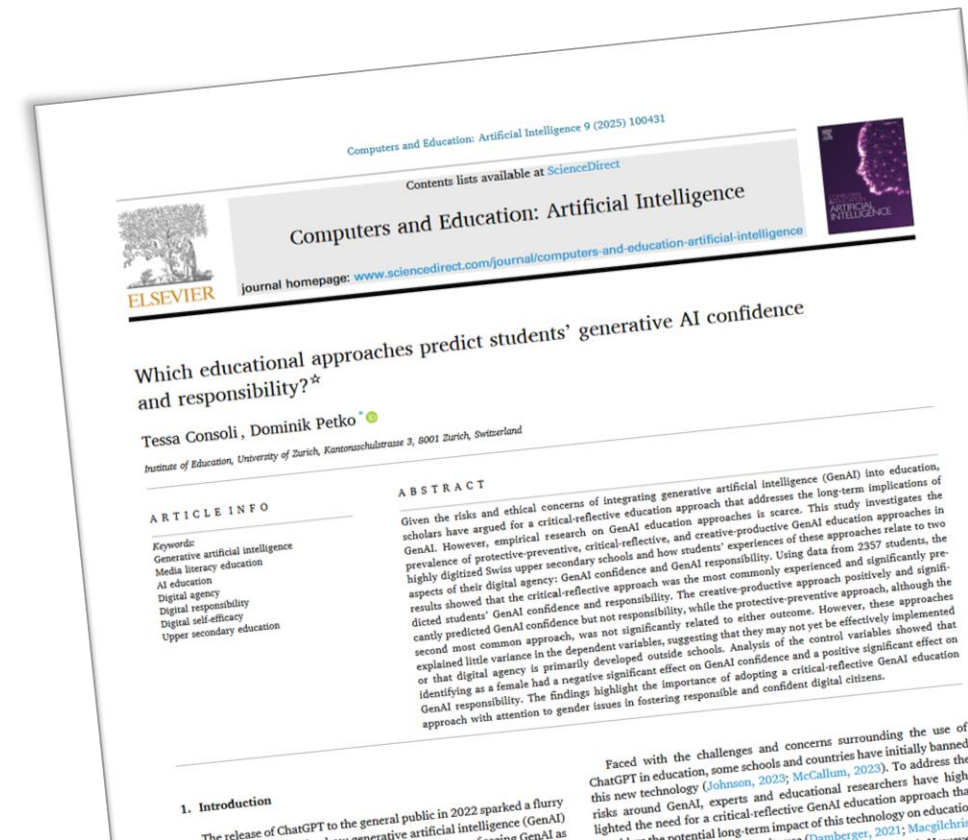
Vermittlung digitaler Kompetenzen im Unterricht aus Schüler/innensicht

- Unmittelbare Gefahren werden oft im Unterricht thematisiert
- Komplexe und indirekte Auswirkungen selten



Wie reagieren die Lehrpersonen auf KI?

- 16% erleben von den meisten Lehrpersonen KI-Verbote
- 28% werden von den meisten Lehrpersonen ermutigt, kritisch über generative KI nachzudenken (-> bessere Fähigkeiten)
- 13 % werden von den meisten Lehrpersonen zum Lernen mit KI ermutigt (-> positivere Einstellungen)
- 20% geben an, dass ihre Schule Regeln für die Verwendung von KI in der Schule hat



Top 10 Digitalisierungshindernisse aus Sicht der Lehrpersonen

	2022/2023
1. Mangelnde Vorbereitungszeit der Lehrpersonen	35%
2. Fehlende passende Lernsoftware und digitale Lerninhalte	28%
3. Fehlende digitale Unterrichtskonzepte/Modelle	27%
4. Andere Unterrichtsgewohnheiten	26%
5. Keine ersichtlichen Vorteile	23%
6. Fehlende Kompetenzen der Lehrpersonen	22%
7. Verfügbarkeit von pädagogischem Support	21%
8. Fehlende Hardware für Lehrpersonen	20%
9. Fehlende Schülerkompetenzen	20%
10. Mangelndes Interesse der Lehrpersonen	16%

(Niederer & Frey, 1990)

12. Die grössten Probleme

Aus der Sicht der Lehrer und Informatikverantwortlichen in den Schulen ergibt sich folgende Prioritätenliste. Zunächst für alle Schulen zusammen:

1. Die verfügbare Hard- und Software ist in zahlreichen Fällen bereits veraltet.
2. Es fehlt an Zeit, um Lektionen zu entwickeln und auszuprobieren.
3. Es gibt nicht genügend Geräte.
4. Es fehlt an unterrichtsbezogenen Programmen. Zudem sind die Handbücher oft schwer verständlich.
5. Lehrerwissen für Einsatz des Computers fehlt.

Schlussfolgerungen



Empfehlungen für Lehrpersonen

- Qualität statt nur Quantität: Spürbare Verbesserung des Unterrichts anstreben
- Mehr aktives, konstruktives und interaktives Lernen mit digitalen Medien ermöglichen
- Fachspezifische Besonderheiten berücksichtigen (TPACK)
- Breiten Fokus bei Vermittlung digitaler Kompetenzen haben, inkl. KI

Empfehlungen für Schulleitende

- Transformationale Schulentwicklung: Veränderung auf ein attraktives Ziel ausrichten
- Formelle und informelle Zusammenarbeit zwischen Lehrpersonen fördern
- Kreative und innovative Ideen von Lehrpersonen unterstützen

Empfehlungen für Entscheidungsträger

- Stabile, sichere (und souveräne) digitale Basisinfrastruktur bereitstellen
- Zeitliche Ressourcen für die digitale Transformation ermöglichen

Wandel der Unterrichtskultur im Zeitalter umfassender Digitalisierung

- Informationstechnik verstehen
- Mit Informationstechnik leben und arbeiten lernen
- Die „geistig Unberechenbaren“ schulen
- Musisch-künstlerischen Bereich ausbauen
- Menschlichkeit vermitteln



Haefner (1982)

Vielen Dank für Ihr Interesse!

<https://tinyurl.com/digitras2report>

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Institute of Education

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AND TRAINING
Swiss excellence in vocational
education and training



**Trasformazione digitale
nelle scuole secondarie
superiori**

Rapporto finale del
Progetto DigiTraS II

Dominik Petko
Alberto Cattaneo
Philipp Gonon
Chiara Antonietti
Tessa Consoli
Miria Hartmann
Konstantinos Michos
Maria-Luisa Schmitz

77
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**Transformation numérique
dans le degré secondaire II**

Rapport final du projet DigiTraS II

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77
Transformation numérique
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**Digital Transformation in
Upper Secondary Schools**

Final Report of the
DigiTraS II Project

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Digital Transformation
National Research Programme

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**Digitale Transformation
der Sekundarstufe II**

Schlussbericht des
DigiTraS II Projektes

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Vielen Dank!

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