

Abb. 1 : Basiskonzeptwürfel , Fögele, J. & Mehren, R. (2021), S. 50, In: Praxis Geographie 5-2021

Augmented Reality in der geographischen Bildung

Forschungsstand und Anwendungsgebiete

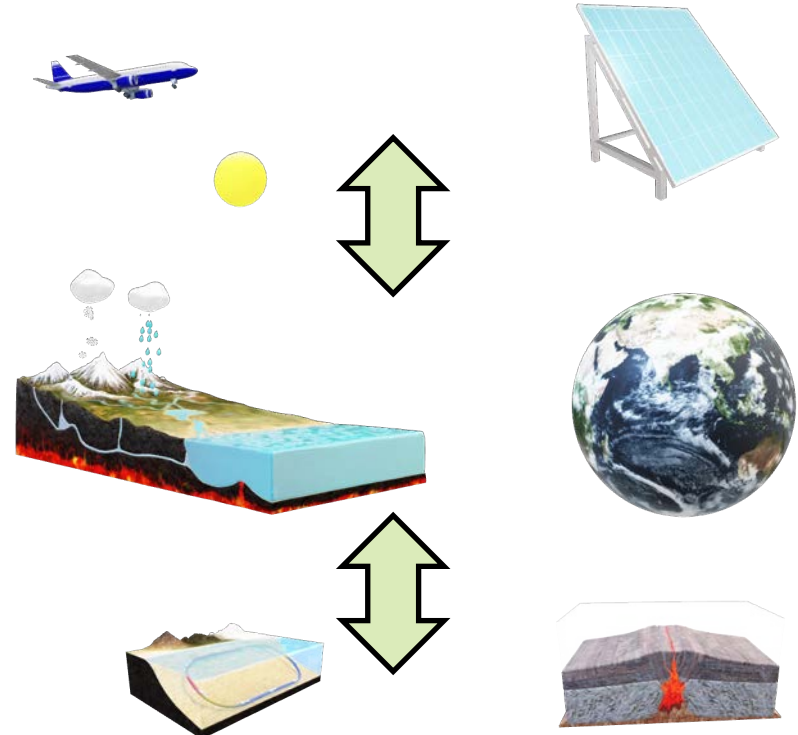
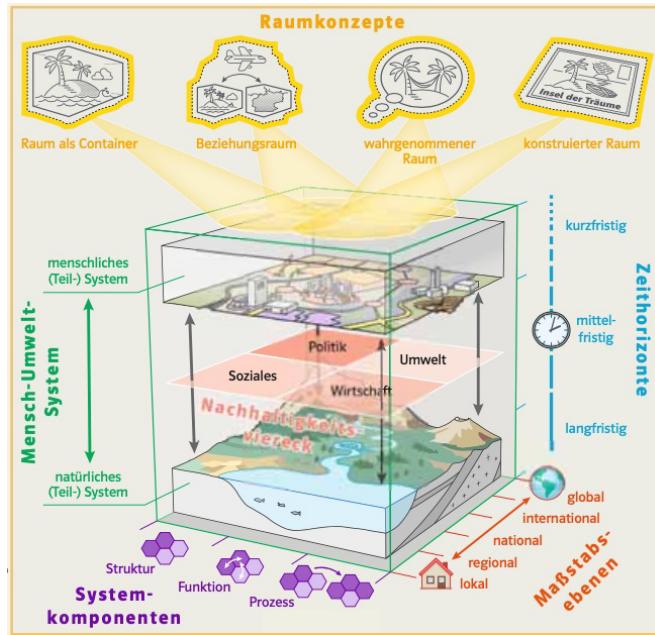
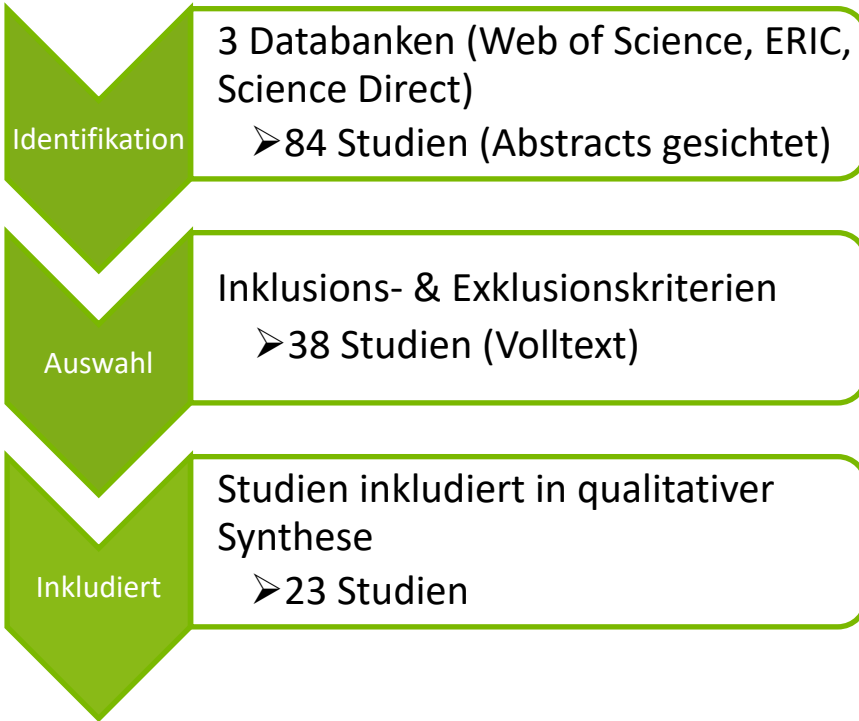
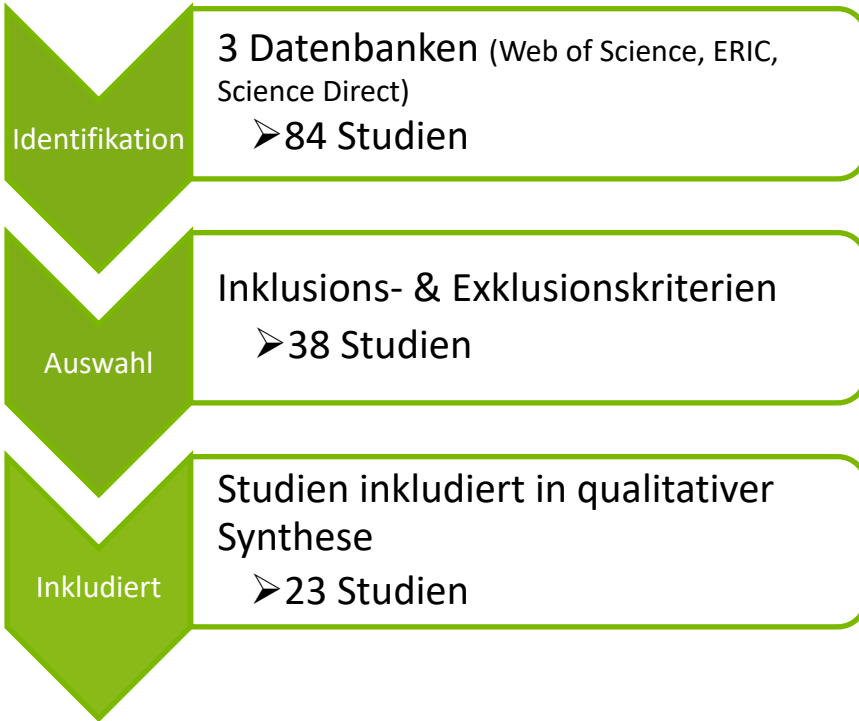


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- **RQ 1: Thematischer Fokus**
- **RQ 2: Methodik**
- **RQ 3: AR-Technologie**
- **RQ 4: Affordanzen**
- **RQ 5: Instruktionale & pädagogische Legitimation**
- **RQ 6: Effekte & Herausforderungen**

Thematic focus

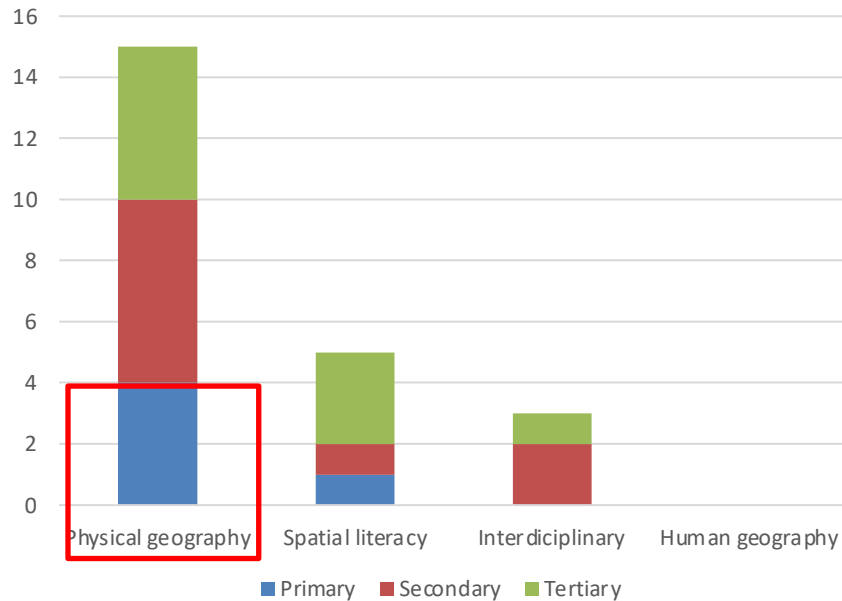


Abb. 2 : PlanetarySystemGO, Costa et al. 2018, S.9

Thematic focus

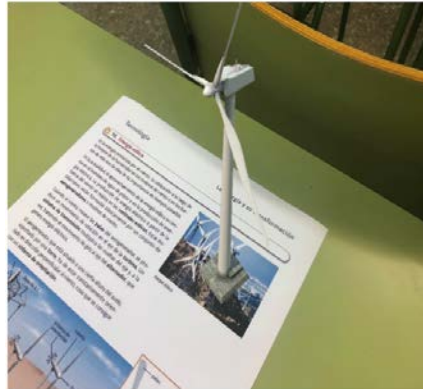
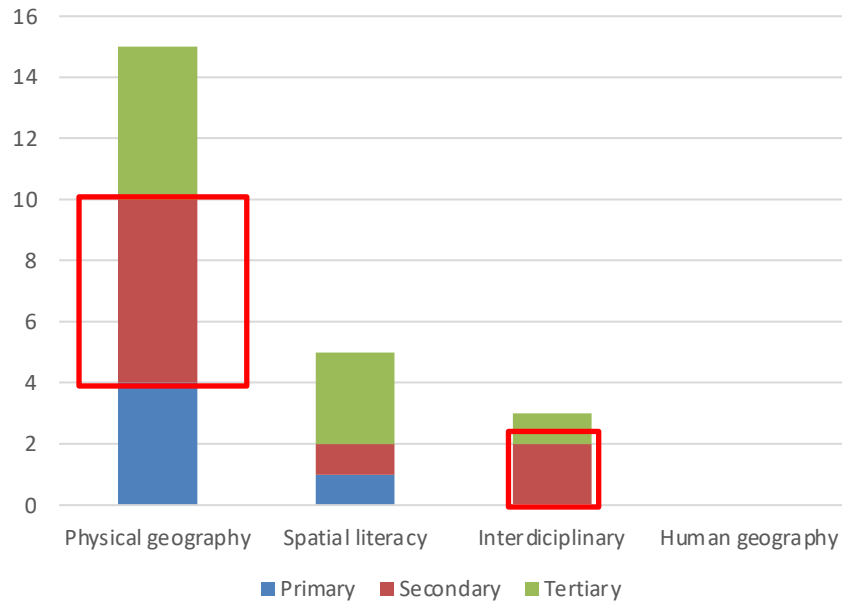


Abb. 3 : Arbeitsblatt Windkraft, del Cerro Velasquez & Morales Mendez 2018, S.9

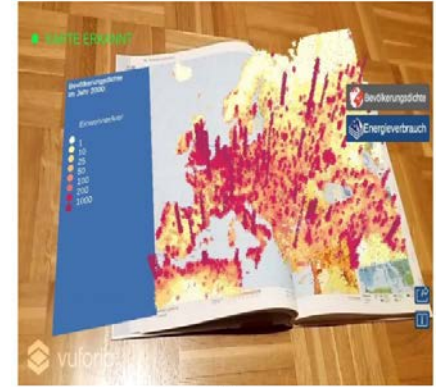


Abb. 4 : AR Erweiterung Atlas, Schnürer et al. 2020, S. 8

Thematic focus

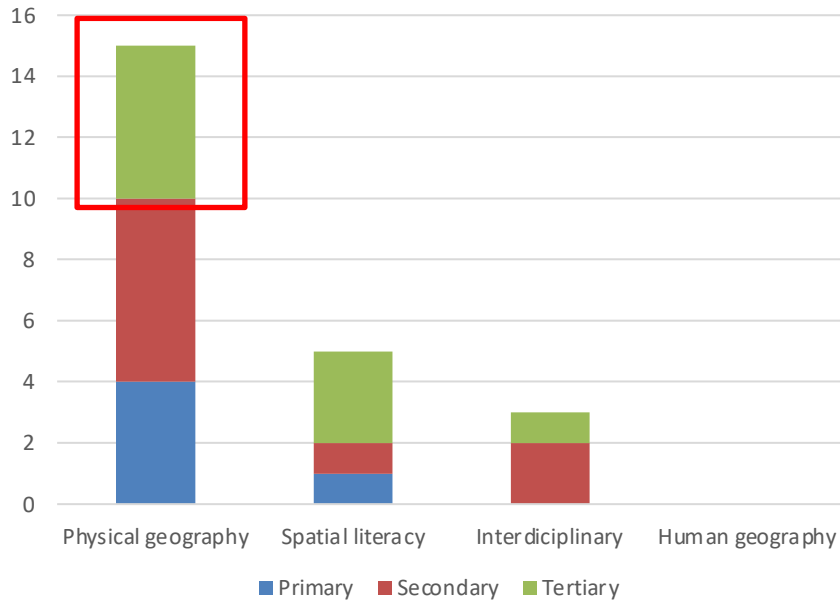
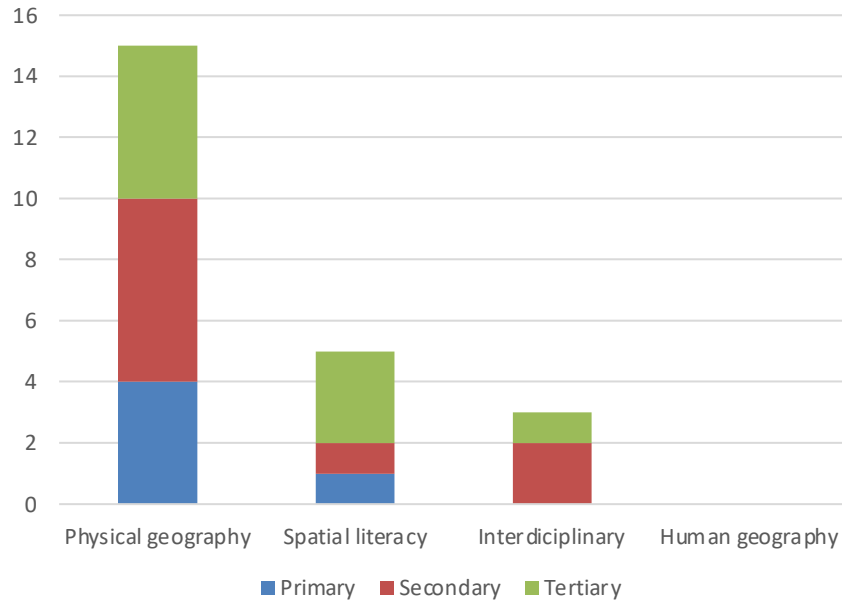


Abb. 5 : MAR App, Putra et al. 2021, S. 127

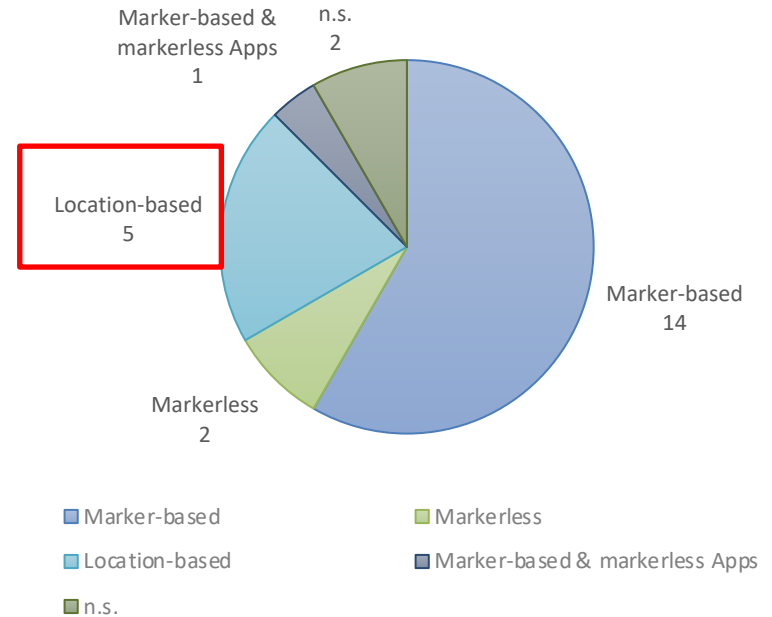


Abb. 6 : Grand Canyon Expedition: Geologic Time, Bursztyn 2017, S.5

Thematic focus



AR Types



AR Affordances (Wu et al. 2013)

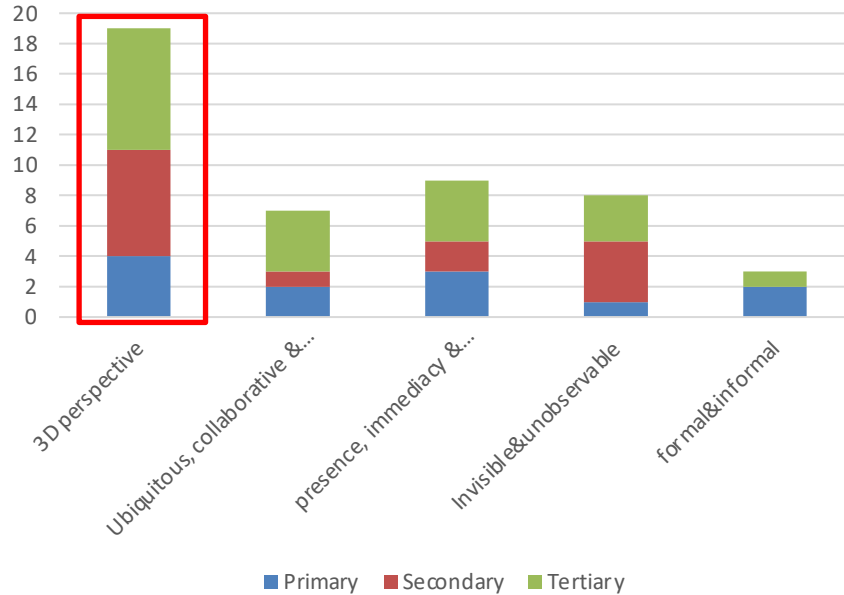


Abb. 7 : AR Oyster Learning System, Hsieh 2021, S.8

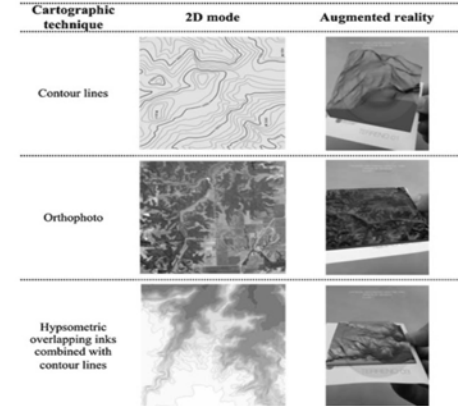
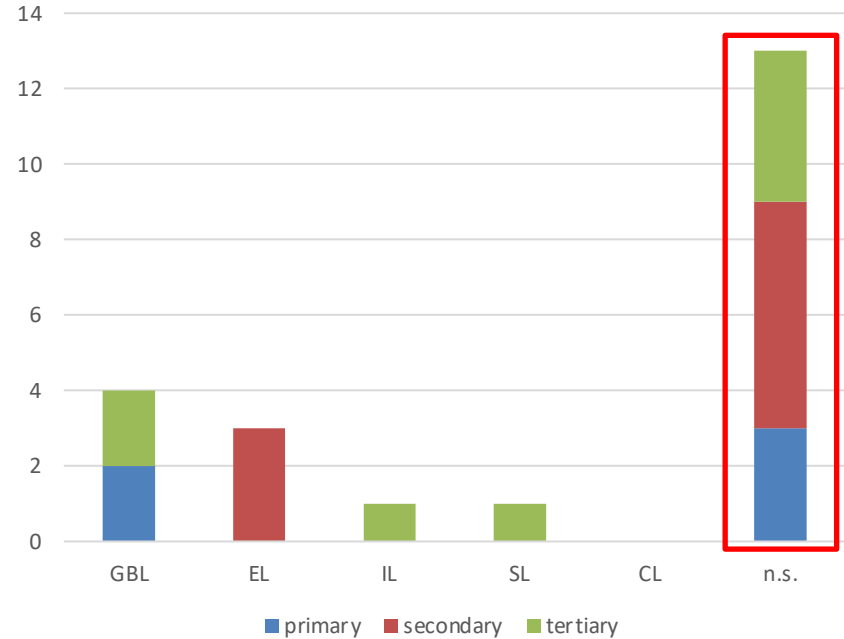


Abb. 8 : 2D und 3D Repräsentationen des Reliefs, Carrera et al. 2018, S.76

	AUTHOR & YEAR	3D MODELS	3D INTERACTION	VIDEO /ANIMATION	GRAPHICS /IMAGES	AUDIO	TEXT	LINKS
PRIMARY	Herpich et al. (2018)				X		X	
	Morales & Garcia (2018)	X						
	Vahldick & Bittencourt (2019)	X						
	Costa et al. (2020)	X					X	
	Hsieh (2021)	X	X					
SECONDARY	Chen & Wang (2015)	X			X			
	Kyza & Georgiou (2018)			X	X		X	
	Velasquez & Mendez (2018)	X	X	X	X			X
	Liu et al. (2019)	X	X	X		X	X	
	Adedokun-shittu et al. (2020)	X						
	Al Shuailli et al. (2020)							
	Rim-Huh et al. (2020)	X		X				
	Schnürer et al. (2020)	X			X		X	
	Xiao et al. (2020)	X					X	
	Bursztyn (2017ab)			X	X		X	
TERTIARY	Carrera et al. (2017)	X						
	Chatel & Falk (2017)			X		X	X	X
	Davis (2017)				X		X	
	Carrera et al. (2018)	X						
	Turan et al. (2018)	X			X	X		
	Syawaludin et al. (2019)	X		X				
	Putra et al. (2021)	X						

Pedagogical approaches



Interaction possibilities

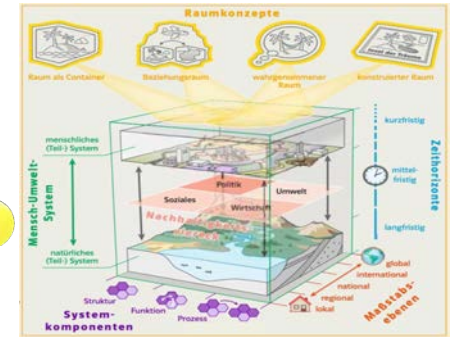
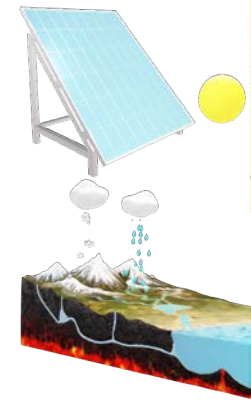
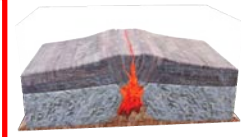


Abb. 10 : Basiskonzeptwürfel , Fögele, J. & M ehren, R. (2021), S. 50, In: Praxis Geographie 5-2021

Abb. 9 : Interaktionsmöglichkeiten mit AR-Inhalten in der geographischen Bildung
Quelle: In Anlehnung an Ducasse (2020), S. 343

	BENEFITS OF AR ENHANCED INTERVENTIONS	NUMBER
PRIMARY	Motivation / Engagement	3
	Performance Improvement	3
	Enjoyment	2
SECONDARY	Performance improvement	5
	Interest	5
	Satisfaction	3
TERTIARY	Motivation	4
	Performance improvement	3
	Interest	2

	CHALLENGES OF AR ENHANCED INTERVENTIONS	NUMBER
PRIMARY	Hardware & Software usability	3
	Scaffolding / Feedback	1
	Technical requirements	1
SECONDARY	Hardware & Software usability	3
	Scaffolding / Feedback	3
	Interaction possibilities	2
TERTIARY	Hardware & Software usability	1
	Technical requirements	1

Education for Spatial Citizenship

(Jekel, Gryl & Schulze 2015)

Reflexive Kompetenzen (bzgl. AR)

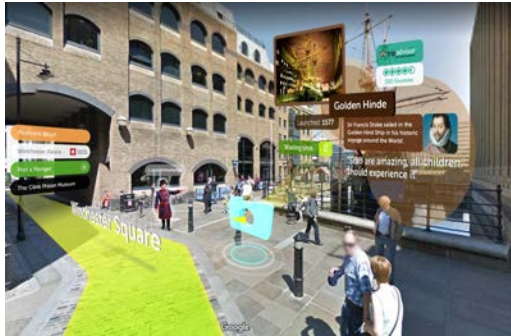


Abb. 11: AR Commercialization
Quelle: Blippar @ Twitter



Abb. 12: Visions for sustainable development
Quelle: Tagesspiegel

Technologische und methodische Kompetenzen
(zum Einsatz von AR)

Kommunikation und Partizipation (mit AR)

Implikationen des Reviews für AR-Interventionen für die geographische Bildung

- Web-AR-Applikationen
- Nutzung der spezifischen Affordanzen von AR
 - 3D Interaktion & multimediale Erweiterung
 - Kontextualisierung von AR-Lernmaterialien in der realen Welt
- Legitimation der instruktionalen und pädagogischen Vorgehensweise
- Fokus “higher thinking skills“
- Vermittlung methodischer & reflexiver Kompetenzen

Design und Evaluation einer AR-Lerneinheit

Thematischer Fokus

- Mensch-Umwelt-System
 - Warum stockt der Ausbau von Windkraftanlagen in NRW?

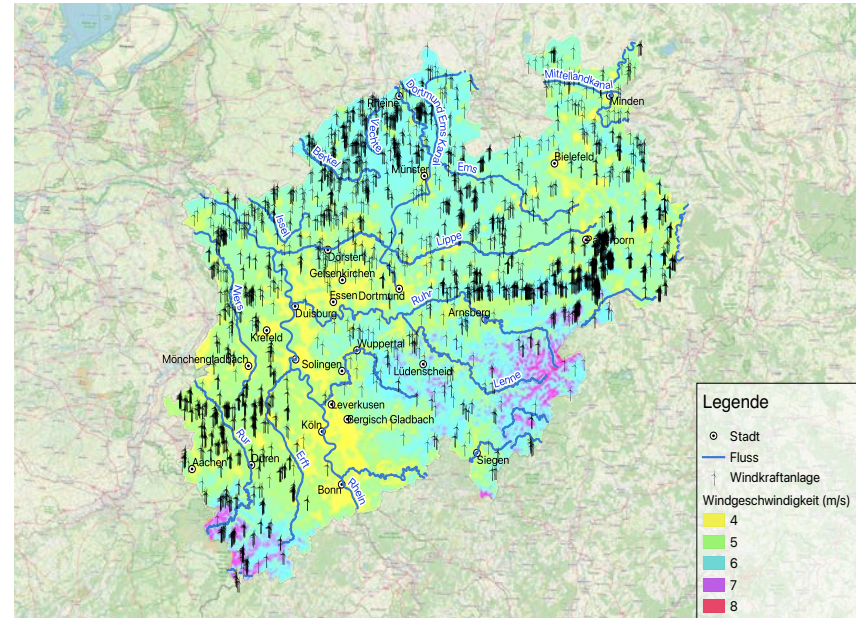


Abb. 13: Windgeschwindigkeiten & Windkraftanlagen in NRW
Quelle: QGIS, eigene Illustration

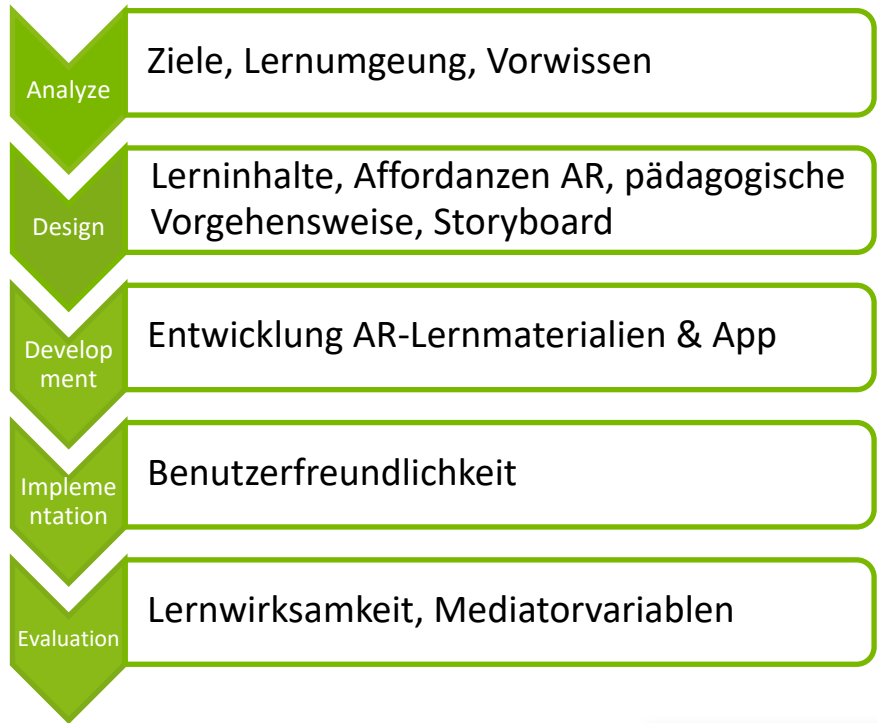
Design und Evaluation einer AR-Lerneinheit

Thematischer Fokus

- Mensch-Umwelt System

Instruktion

- ADDIE



Design und Evaluation einer AR-Lerneinheit

Thematischer Fokus

- Mensch-Umwelt System

Instruktion

- ADDIE

Pädagogische Implementation

- Kollaboratives Lernen

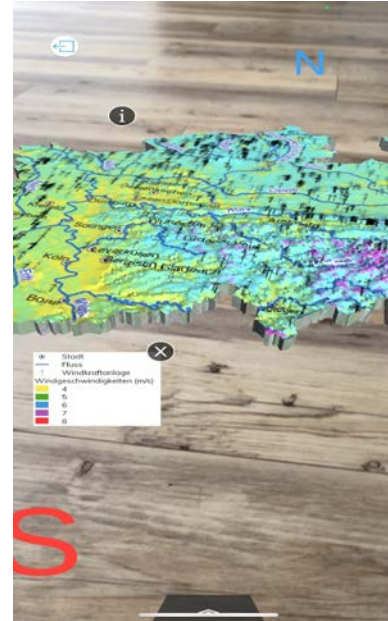


Abb. 14: Karte
Windgeschwindigkeiten NRW
Quelle: Innoclass

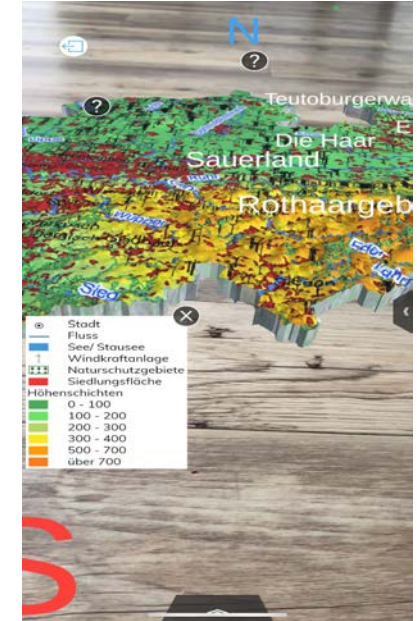


Abb. 15: Topographische Karte
NRW
Quelle: Innoclass

Design und Evaluation einer AR-Lerneinheit

Thematischer Fokus

- Mensch-Umwelt System

Instruktion

- ADDIE

Pädagogische Implementation

- Kollaboratives Lernen

AR Technologie

- Tablet / Smartphone
- Markerless AR
- App Innclass (iOS)



Abb. 16: Nutzeroberfläche

Quelle: Innclass

Design und Evaluation einer AR-Lerneinheit

Thematischer Fokus

- Mensch-Umwelt System

Instruktion

- ADDIE

Pädagogische Implementation

- Kollaboratives Lernen

AR Technologie

- Markerless (iOS)

AR Design

- **Mayer's CTML principles**
 - Spatial contiguity
 - Temporal contiguity
 - Signaling principle
 - Modality principle
 - Segmenting principle



Video 1: Windkraftanlage
Quelle: Innoclass



Video 2: Karte Eifel
Quelle: Innoclass

Design und Evaluation einer AR-Lerneinheit

Thematischer Fokus

- Mensch-Umwelt System

Instruktion

- ADDIE

Pädagogische Implementation

- Kollaboratives Lernen

AR Technologie

- Markerless (iOS)

AR Design

- Mayer's CTML

Empirie

- Quasi-experimental design

Implementation

Sekundarstufe I
Stichprobe: ca. 50 SuS
Mixed Method

Evaluation

Lernprogression
→ "higher thinking skills"
Mediatorvariablen
→ Kognitive Belastung
→ Motivation (IMS)

Zukunftsperspektiven

- Niederschwellige Autorensysteme (OER) für (Web-)AR-Anwendung essentiell
- Evaluation Lernprozess- & Lernwirksamkeitsvariablen im Kontext von “higher thinking skills”
- Raum als zentrales Forschungsobjekt von AR-Anwendungen (in der geographischen Bildung)
- Förderung methodischer und reflexiver Kompetenzen in einer „Kultur der Digitalität“ (Stalder, 2016) von großer Bedeutung für alle Bildungslevel

Bursztyn, N., Walker, A., Shelton, B. & Pederson, J. (2017). Assessment of student learning using augmented reality Grand Canyon field trips for mobile smart devices. *Geosphere*, 13(2), 260–268. <https://doi.org/10.1130/ges01404.1>

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Costa, M. C., Manso, A., & Patrício, J. (2020). Design of a mobile augmented reality platform with game-based learning purposes. *Information*, 11(3), 127. <https://doi.org/10.3390/info11030127>

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Ducasse, J. (2020). Augmented Reality for Outdoor Environmental Education. In V. Geroimenko (Eds) *Augmented Reality in Education* (pp.329-352). Springer Series on Cultural Computing. Springer, Cham. https://doi.org/10.1007/978-3-030-42156-4_17

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Hsieh, M.-C. (2021). Development and Application of an Augmented Reality Oyster Learning System for Primary Marine Education. In *Electronics* 10(22), 2818. <https://doi.org/10.3390/electronics10222818>

Mayer, R. E. (2021). *Multimedia learning* (Third edition). Cambridge University Press.

Putra, A. K., Sumarmi, S., Sahrina, A., Fajrilia, A., Islam, M. N., & Yembuu, B. (2021). Effect of mobile-augmented reality (MAR) in digital encyclopedia on the complex problem solving and attitudes of undergraduate student. *International Journal of Emerging Technologies in Learning (IJET)*, 16(07), 119. <https://doi.org/10.3991/ijet.v16i07.21223>

Schnürer, R., Dind, C., Schalcher, S., Tschudi, P. & Hurni, L. (2020). Augmenting Printed School Atlases with Thematic 3D Maps. *Multimodal Technologies and Interaction*, 4(2), 23. <https://doi.org/10.3390/mti4020023>

Wu, H.-K., Lee, S. W.-Y., Chang, H.-Y., & Liang, J.-C. (2013). Current status, opportunities and challenges of augmented reality in education (Bd. 62, S. 41–49). <https://doi.org/10.1016/j.compedu.2012.10.024>

Abb. 11: <https://mixed.de/blippar-totgeglaubtes-ar-startup-meldet-sich-zurueck/>

Abb. 12: <https://www.tagesspiegel.de/berlin/bergmannstrasse-wird-autofrei-6600748.html>

Vielen Dank für ihre Aufmerksamkeit

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René Schmidt | Bergische Universität Wuppertal



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