A Systematic Literature Review on Technology Acceptance Research on Augmented Reality in the Field of Training and Education

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RESUMÉ

Stefan Graser, M.Sc

Academic Career

2017 – 2020	**Bachelor of Arts** (B.A.) Industry / Industrial Management* *dual study program at cooperative state univsersity
2020 – 2021	**Master of Science** (M.Sc) Digital Management & Transformation
Since October 2021	**Scientific Researcher & Doctoral Candidate** CAEBUS | RheinMain University

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CENTER FOR ADVANCED E-BUSINESS STUDIES

CAEBUS
Center for Advanced E-Business Studies

RheinMain University of Applied Sciences

Prof. Dr. Stephan Böhm

Professor:
Telecommunication & Mobile Media

Focus CAEBUS:
E-Business Technologie

Research:
Media Innovations, interactive media technologies, technology acceptance, mobile media, conversational interfaces, user-centered design, digital transformation, technology and innovation management, e-business, mobile business

Prof. Dr. Peter Winzer

Professor:
Telecommunication-/ Mediaeconomy & Controlling

Schwerpunkt CAEBUS:
E-Business Economy

Research:
5G, mobile communications, mobile business, media economics, media innovations, innovation management, E-Business

Stefan Graser, M.Sc.

Dissertation - Topic:
User Experience of Mobile Augmented Reality

Research:
user centered design, user experience, technology accepatance, innovationmanagement, e-Business, digital transformation

Jasmin Ebert, M.A.

Dissertation - Topic:
User preferences and willingness to pay of privat consumers for 5G in german mobile market

Research:
5G, mobile communications, mobile business, media economics, media innovations, innovation management

IWEMB – WORKSHOP ON ENTREPRENEURSHIP IN ELECTRONIC AND MOBILE BUSINESS

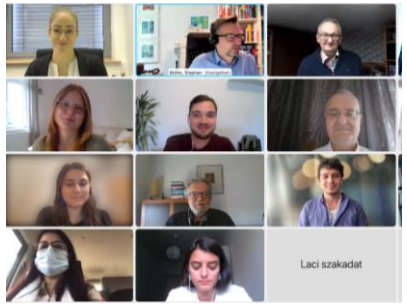
- 6th IWEMB at Leipzig University, Germany on 6th/7th October 2022 (hybrid)
- Joint initiative of CAEBUS and the International College of the National Institute of Development and Administration (ICO NIDA) in Bangkok
- Goal: Bring together researchers from institutions around the world to discuss current research findings on electronic and mobile business & entrepreneurship
- The findings will be published, conference proceedings will be indexed and listed in bookstores/library catalogs.
- Further information at **www.iwemb.org**

Researchers invited to contribute!

Beginning of Oct 2023 | Bangkok, Thailand

2018 – Wiesbaden, Germany

2019 – Tønsberg, Norway



2020/21 – Online

2022 – Hybrid/Leipzig

AGENDA

1. Introduction & Related Research
2. Methodology
3. Results
4. Conclusions & Managerial Implications

MOTIVATION

- Emergence of new, innovative technologies, e.g. Augmented Reality AR *(Irshad & Rambli 2018)*

  → Question about **factors influencing user acceptance**

- AR has great potential for improving Education and Training *(Billinghurst & Duenser 2012)*

  → learning **more effectively**

  → improves **quality of content**

→ Insights and current state about **Technology Acceptance Research of Mobile AR**

AUGMENTED REALITY

Definition:

"AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. Therefore, ***AR supplements reality****, rather than completely replacing."* *(Azuma, 1997)*

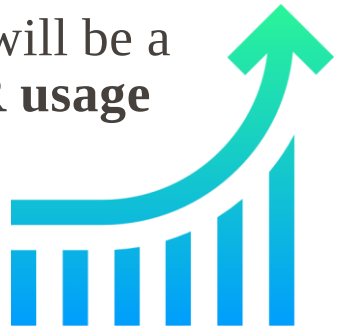
Applying Augmented Reality in Training and Education *(Billinghurst & Duenser 2012)*:

→ One of the most applied fields

→ Potential to improve the quality as well as learn activity

AR has been able to achieve a great deal of public interest in recent years:

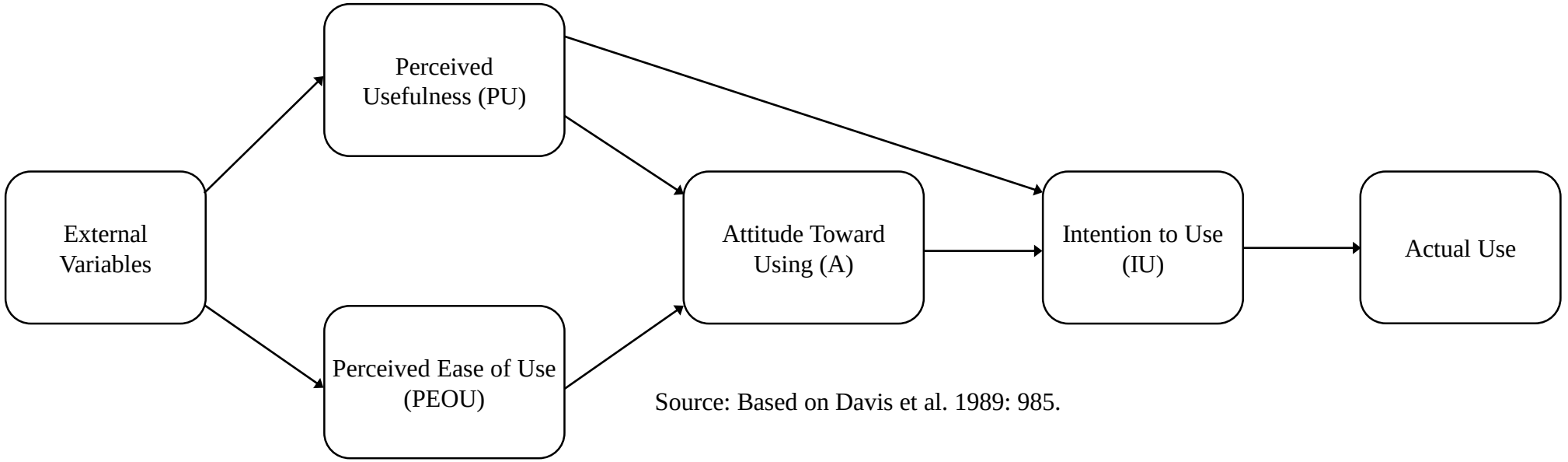
- **In 2021**, there were **0.82 billion MAR-using devices** in circulation *(Boland, 2021)*
- According to the latest data, there will be a global increase to **1.7 billion MAR usage devices by 2024** *(Boland, 2021)*



TECHNOLOGY ACCEPTANCE RESEARCH

- One of the most frequently researched topics in information systems research *(Venkatesh, 2006)*

- Davis' (1985) TAM is probably the best-known acceptance model *(Roßnagel, 2009)*
  Has been tested in many empirical studies *(Roßnagel, 2009)*



Source: Based on Davis et al. 1989: 985.

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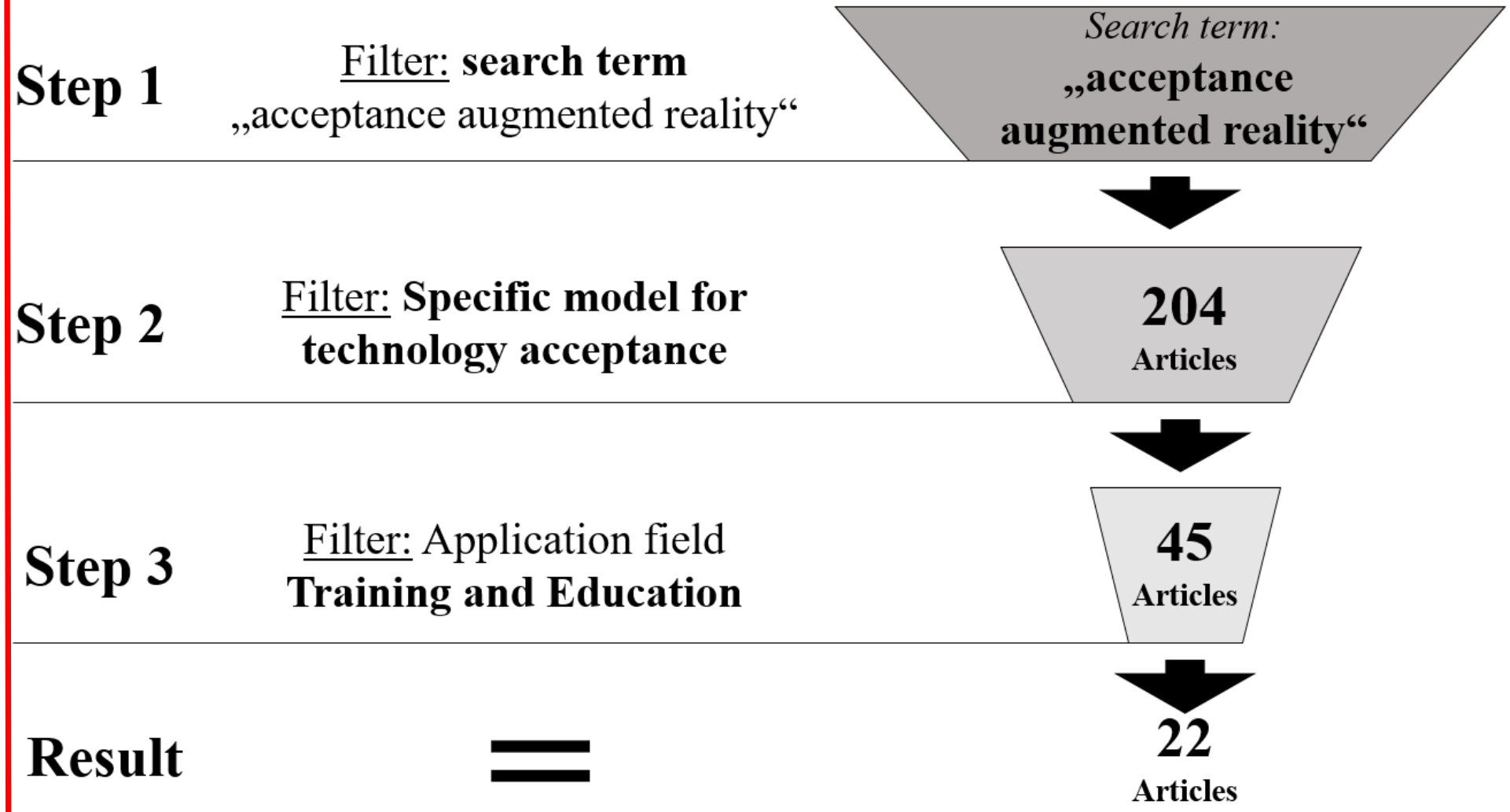
RESEARCH CRITERIA

- ***Research Objectives*** → What was the aim of the research, which AR systems, applications and devices was used?
- ***Sample Data*** → Whats the geographic origion of the research paper?
- ***Research Methods*** → Which evaluation method was used in the research paper?
- ***Technology Acceptance Model*** → Which technology acceptance model was used?
- ***Model Extension and Variables*** → Which extension were made including new variables?

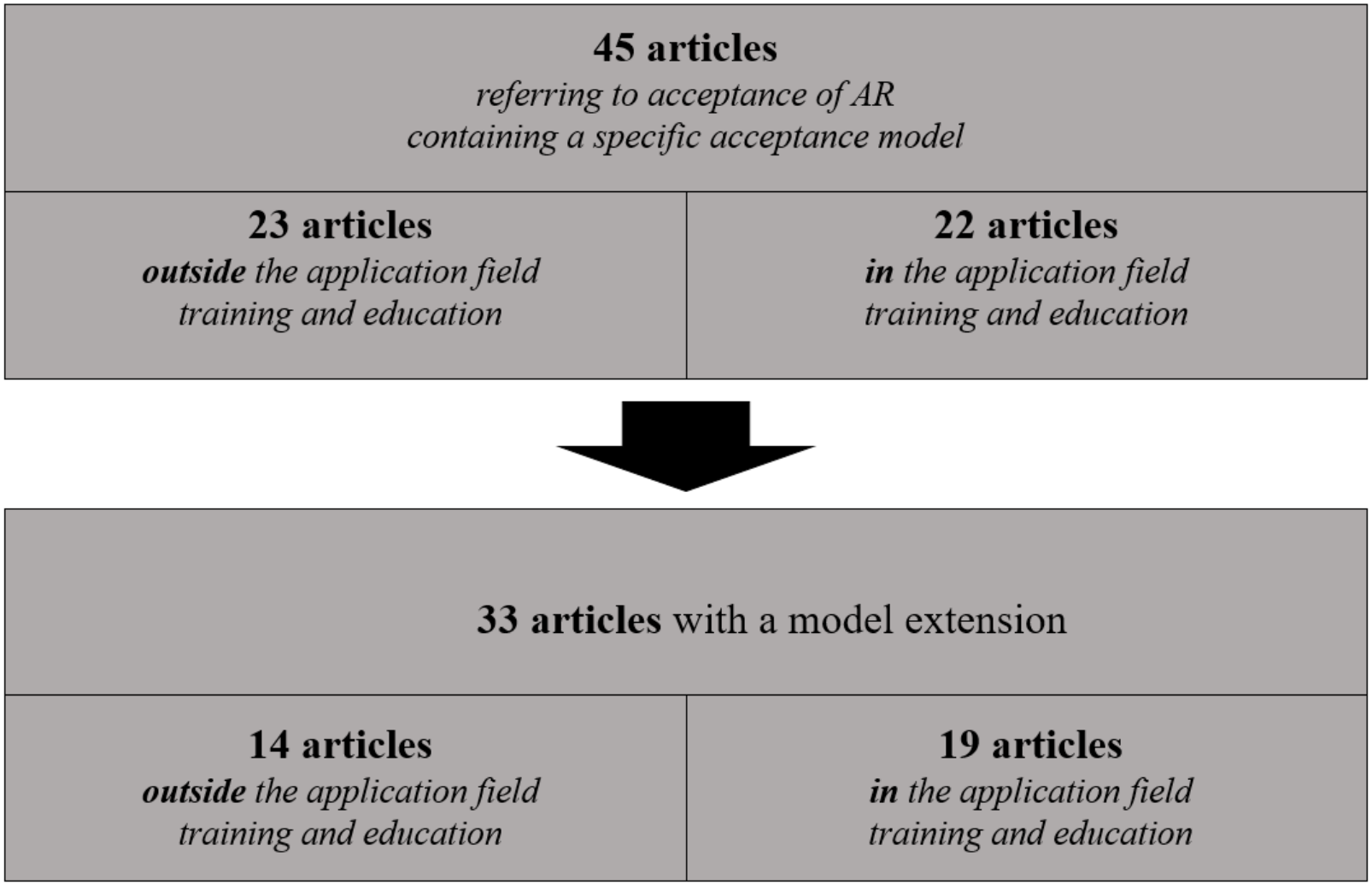
LITERATURE REVIEW

Databases:

- Google Scholar
- Science Direct
- Springer
- Emerald
- ACM Digital Library
- EconBiz
- IEEE



LITERATURE REVIEW



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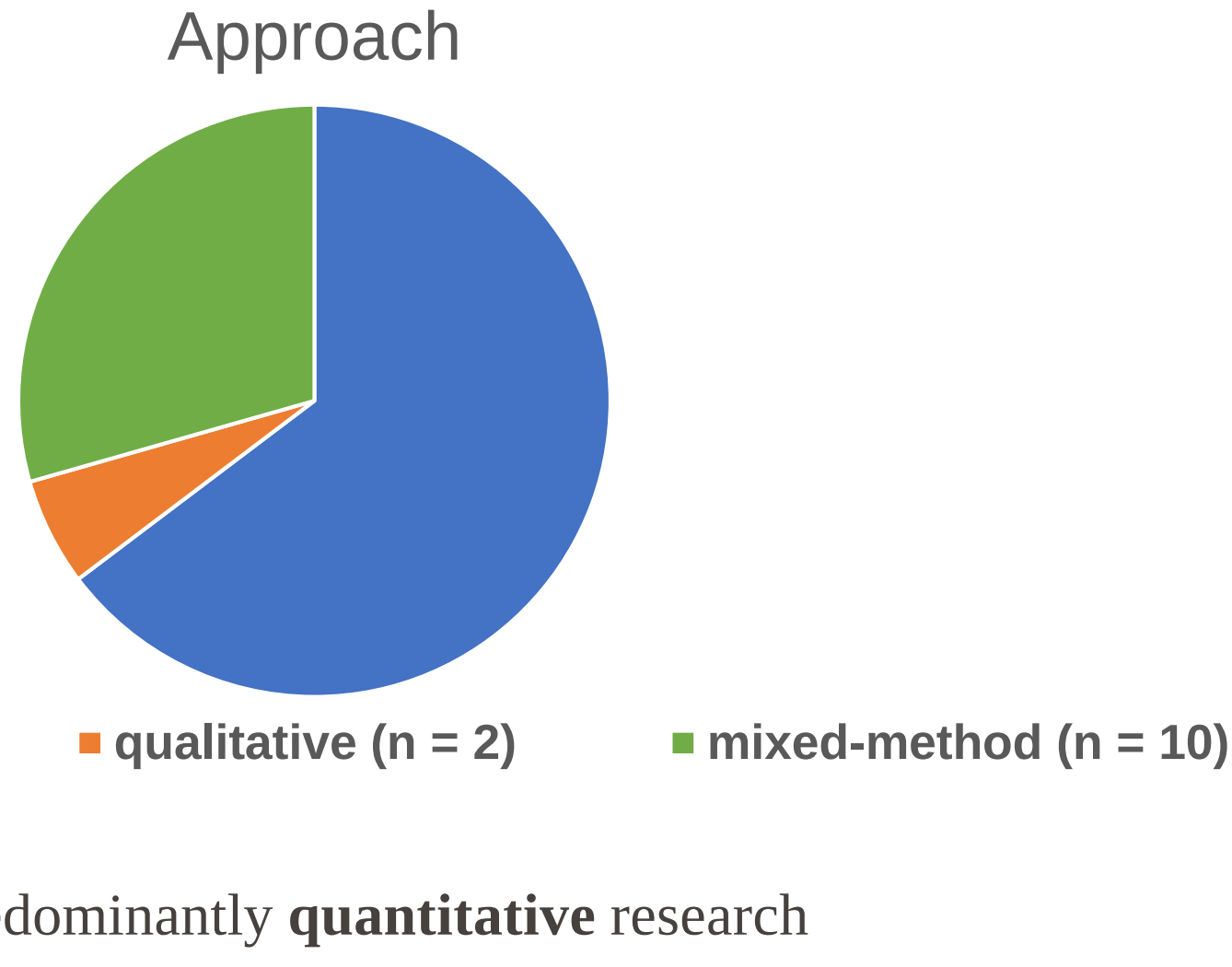
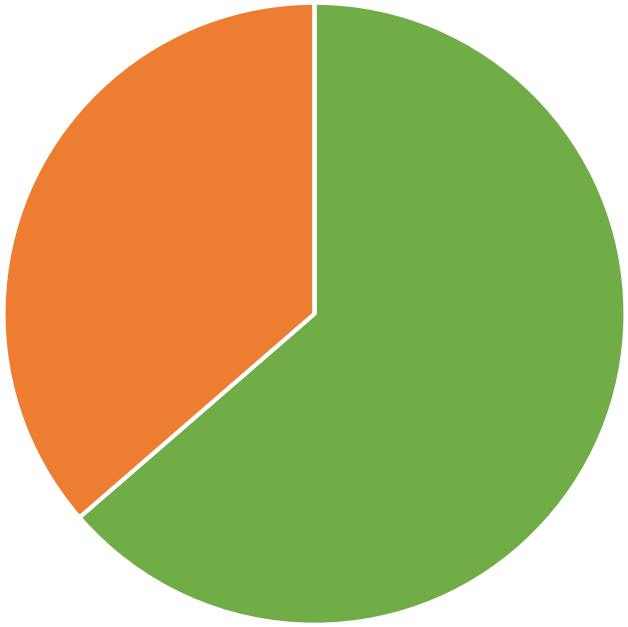
RESULTS



predominantly **quantitative** research

RESULTS

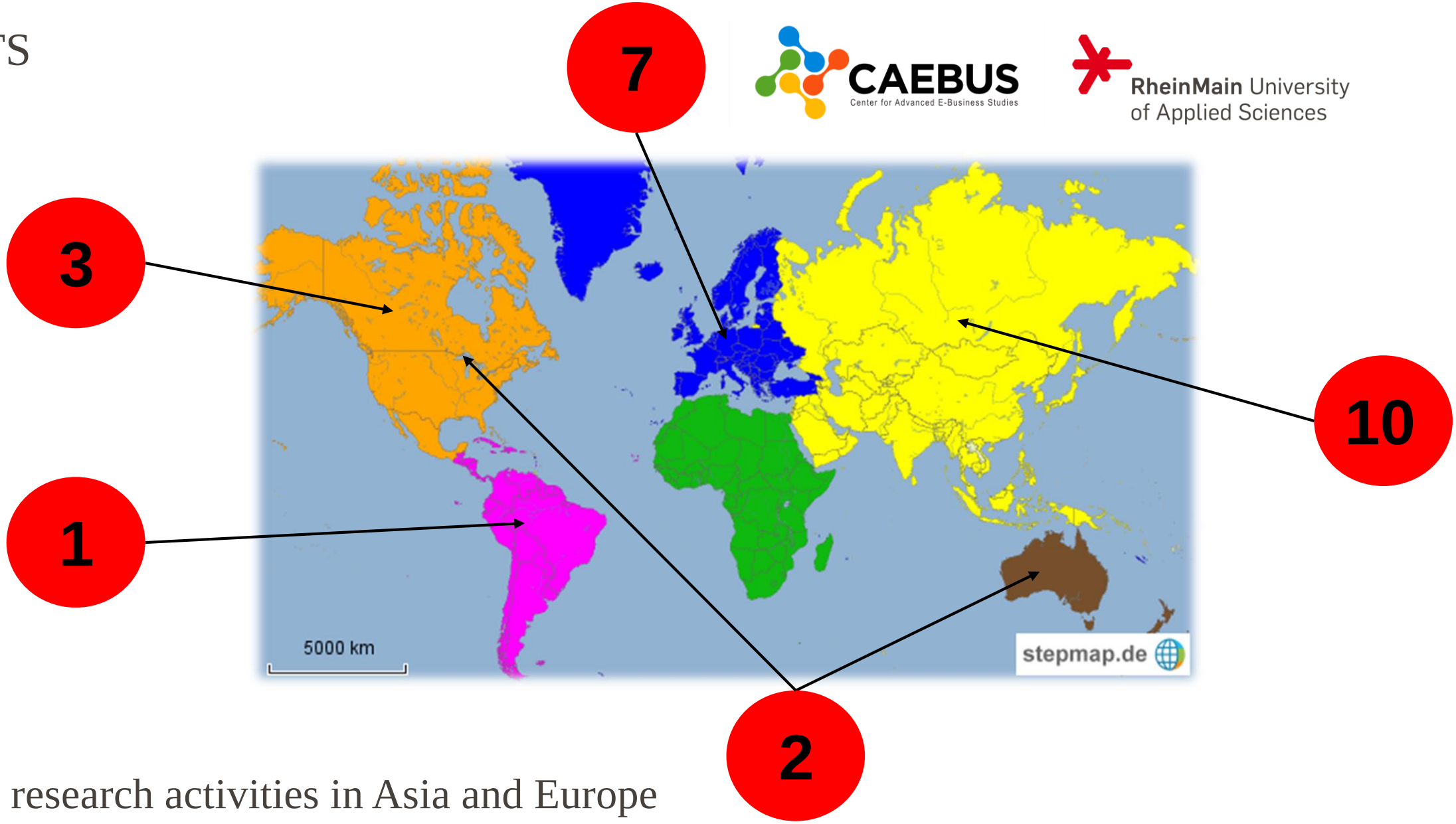
Augmented Reality Application Device



no Specification (n = 14) Mobile Device (n = 8) AR glass (n = 0)

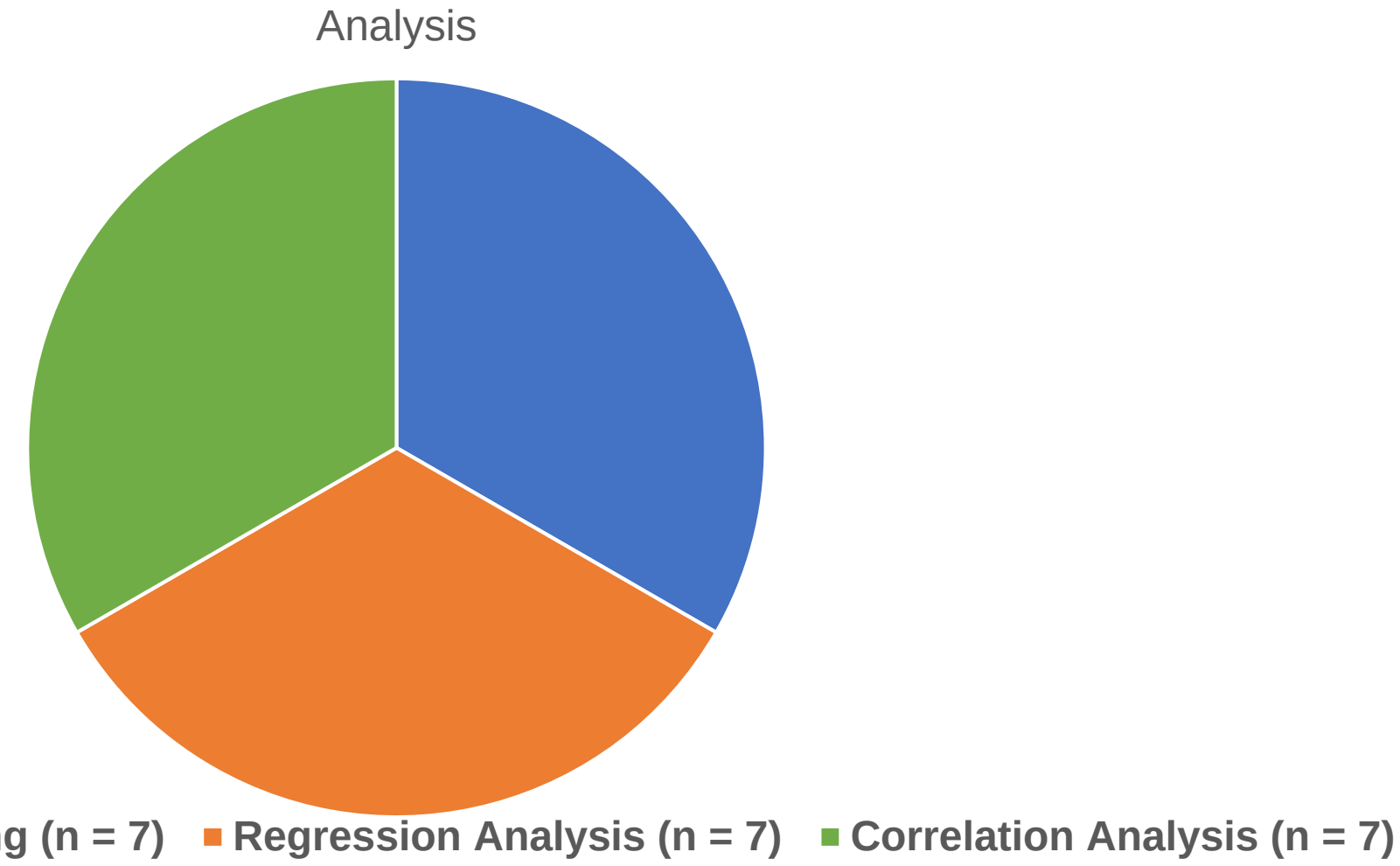
➜ no specification of devices

RESULTS



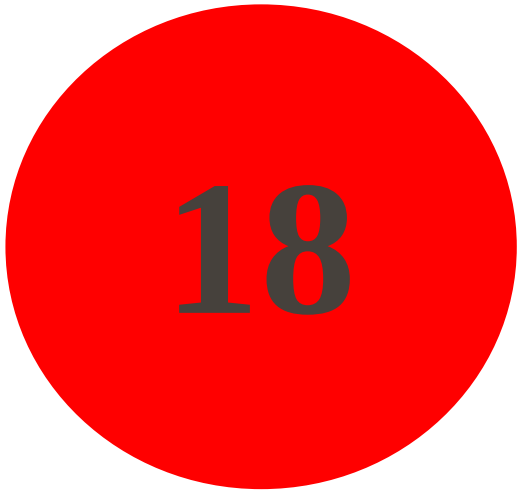
most research activities in Asia and Europe

RESULTS


Analysis
Structure Equation Modelling (n = 7)
Regression Analysis (n = 7)
Correlation Analysis (n = 7)

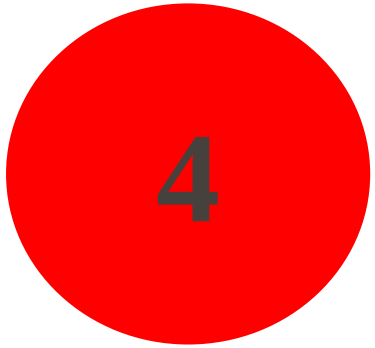
RESULTS

Technology Acceptance Model (TAM)

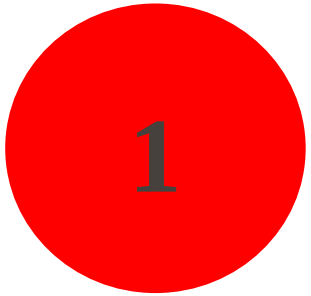


Unified Theory of Acceptance and Use of Technology (UTAUT)

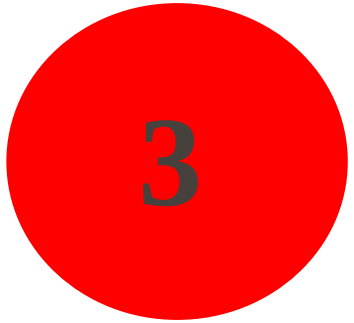
RESULTS



No model extension

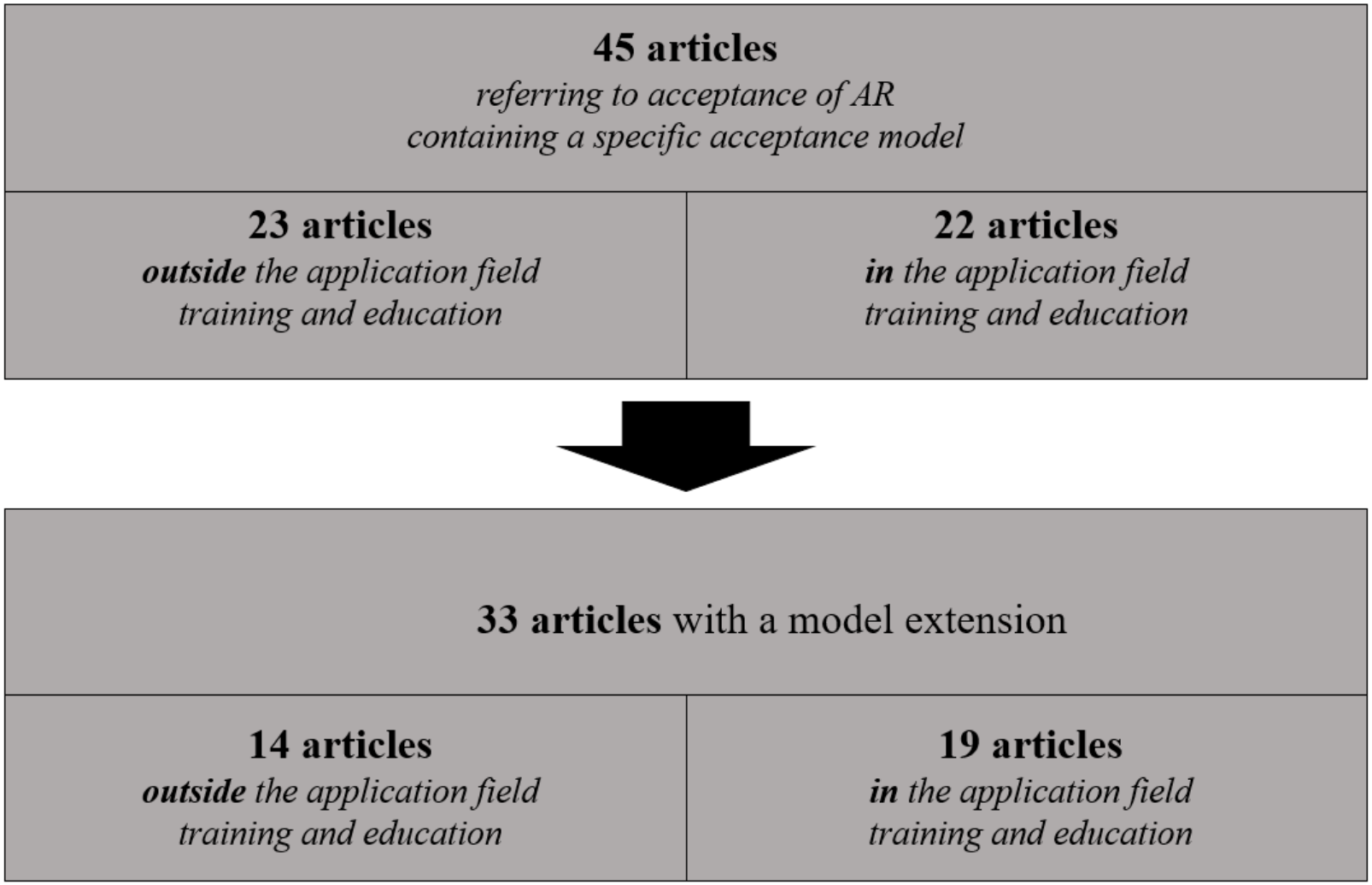


TAM 2



Original TAM

LITERATURE REVIEW



AR Variables in other Application Fields

Perceived Benefits/ Relative Benefit (2)	Positive aspects resulting from the use of AR
Personal Innovativeness (2)	Users' willingness to try out new services and products
Costs of Use (2)	Costs include efforts costs, loss of privacy costs and usage costs
Self Presentation (1)	Self-presentation is defined as presenting personal thoughts by using a creative manner of expression
Information Sharing (1)	Information sharing refers to the level of willingness to share information with others
Visual appeal (1)	Visual appeal relates to the exhibition of fonts and other visual elements such as graphics; it acts to enhance the overall presentation of information systems
Technology Readiness (1)	An overall state of mind that the user is ready to use a technology
Personal Innovation (1)	Users' willingness to adopt or reject a new technological innovation
Dimensions of cultural differences (1)	Different cultural dimensions which affect the technology acceptance. Uncertainty, Power distance, Masculinity-Feminity, Individualism/collectivism, and time orientation are summarized to the variable Dimensions of cultural differences
Personality Traits (1)	Big Five' Personality Factors conscienceless, Openness, Agreeableness, Neuroticism, and Extraversion

RESULTS

AR Variables in the Application Field of Training and Education

Perceived Situation Awareness (2)	Assistance for Understanding the environment around someone
Interface Style (2)	Visualization of the AR content
Technology Optimism (2)	a positive view of technology, including control, flexibility, convenience, and efficiency
Technology Innovativeness (2)	a person's inclination to try new information technologie
Visual Quality (1)	the degree to which a user considers that the app is aesthetically attractive to the eye
Ergonomics of AR-platform (1)	features related to hardware and accessories that can help students develop favourable (or unfavourable) perceptions regarding the motivational factors
Resistance to Change (1)	attitudinal response of a person not accepting an innovation
Mobile Self-Efficacy (1)	an individual's perceptions of his or her ability to use mobile devices in order to accomplish particular tasks
Motivational Support (1)	External support based on the culture, leadership and environment
Teachers' acceptance and integration of technology (1)	a theoretical framework which includes pedagogical knowledge, content knowledge, and pedagogical content knowledge for teaching. Furthermore, technology knowledge refers to these aspects

RESULTS

Variables in other Application Fields

- Perceived Interactivity
- Media Novelty
- Previous Media Experience
- Users' Innovativeness
- Recommendation
- Risk
- Playfulness Expectancy
- Content Relevance Expectancy

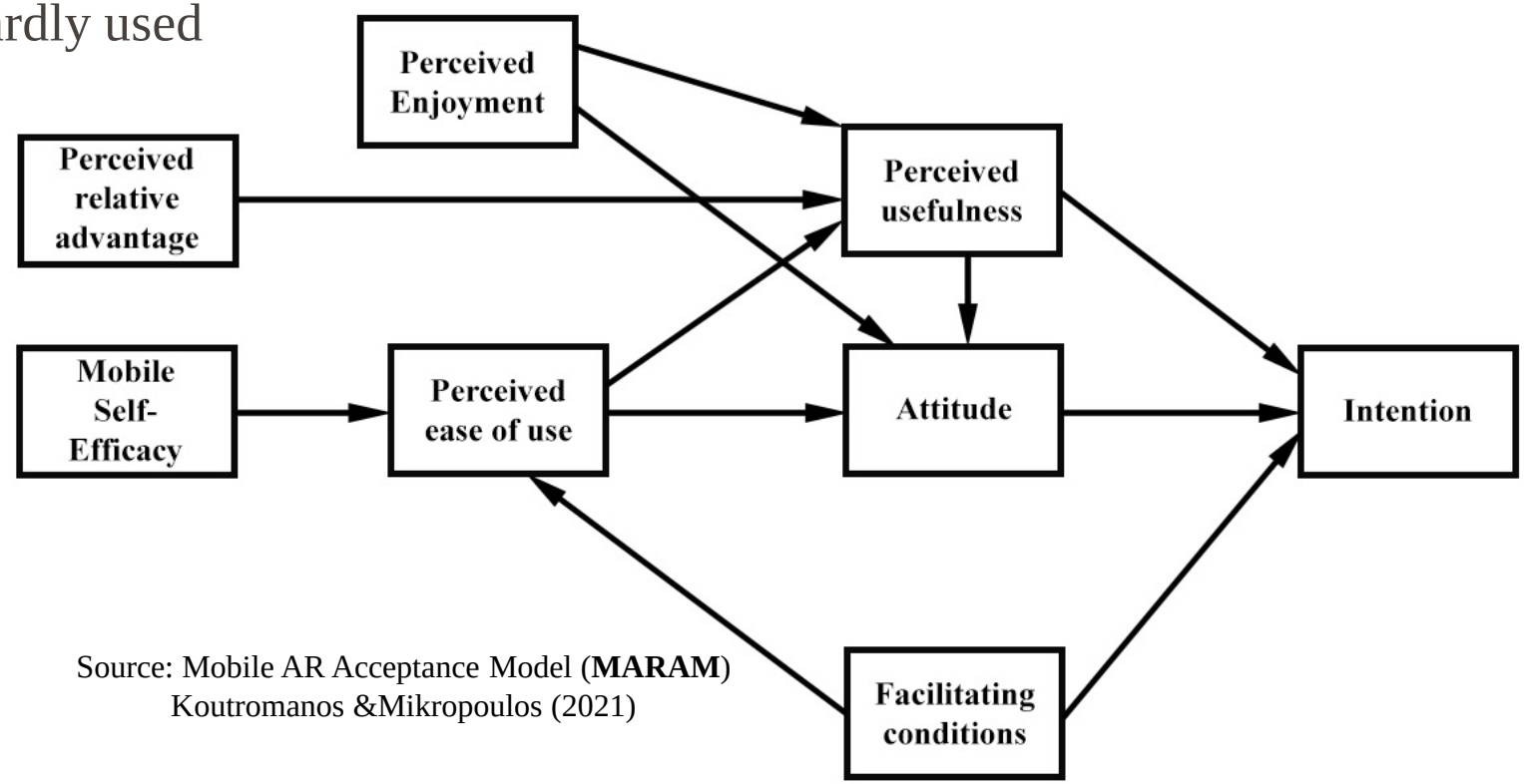
Variables in the Field of Training and Education

- Teaching Experience
- Technology Experiences
- Characteristics of the system
- Information Experience
- Information Literacy
- Moderating factors (Duration of Use, Perceived Exertion, Emotion, Attachment, Harm, Perceived Change, Movement, and Anxiety)

RESULTS

- Technology Acceptance Research is mostly based on the TAM
  - ➜ extended versions of the TAM with new variables
  - ➜ different variables which are hardly used

- Only a few approaches regarding a modular version for Augmented Reality Technology Acceptance
- Hardly any variables referring to the field Training & Education
- Only a few specific variables for AR
- None of the new variables weres used more than two times



Source: Mobile AR Acceptance Model (**MARAM**)
Koutromanos &Mikropoulos (2021)

RESULTS

- Most contributions in the field of training and education
- **only one paper** refers to an industrial context
- the research articels deal with the topic of academic education

➜ differentiation of the field training and education into the subfields **academic teaching** and **corporate training**

➜ research about using AR in companies or industrial environments is unrepresented

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CONCLUSION

- Technology Acceptance Research of Mobile AR still a **young research field**
  - ➜ relatively few research papers

- most papers (n = 22) refer to the field **Training and Education**
  - ➜ primarily focus on academic teaching
  - ➜ lack of research: **Corporate Training** in industrial environments

- Mostly Quantitative research

CONCLUSION

- **Technology Acceptance Model** (TAM) and its core variables are most frequently used
  - ➜ no modular Augmented Reality Technology Acceptance Model
- ¾ **of all investigations** have made a model extension integrating own variables
- **34 new variables** were found
  - ➜ **only a few variables** relate to AR or Training & Education

OUTLOOK

- **Empirical significance of the new variables** as influencing factors need to be adressed in further research

- Problem: researchers try to **produce new** models **instead of validating** the existing ones

  → many new variables were applied only by the individual research

  → only extended versions of common models

→ Further research for the validation of varibales and models

→ Further research for developing new models refering Augmented Reality in Corporate Training

THANK YOU FOR YOUR ATTENTION!

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