

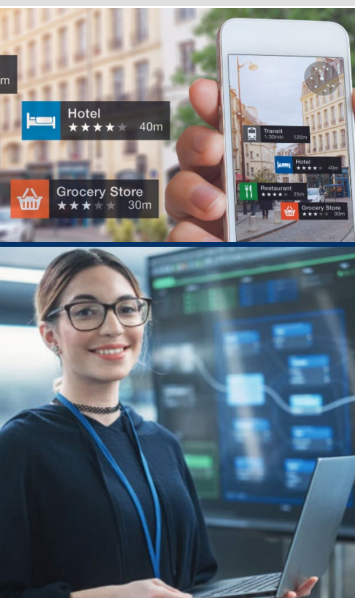
UNESCO UNEVOC Centre Magdeburg

“Expert Meeting on AI and Technical Vocational Education and Training (TVET)”

TOPIC: “AI in TVET: Bridging Gaps or Building Walls in Education?”

Elbfabrik of the Fraunhofer IFF, Magdeburg, Germany
February 18-19, 2025

Prof. Dr. Dr. h.c. Georg Spöttl, University of Bremen



Agenda

1. Introduction (TVET activities, AI in Europe)
2. Ethical fundamentals (scenarios, Golden Rule)
3. TVET – Development – Digitalization – AI (Competences)
4. Status of AI – What can we expect?
5. Use of digital media and AI for learning – Clarification
6. AI literacy frameworks
7. Consequences for TVET – future development!
8. End

Venue: Factory of the Future
Elbfabrik, Magdeburg, Germany

UNESCO UNEVOC Centre Magdeburg

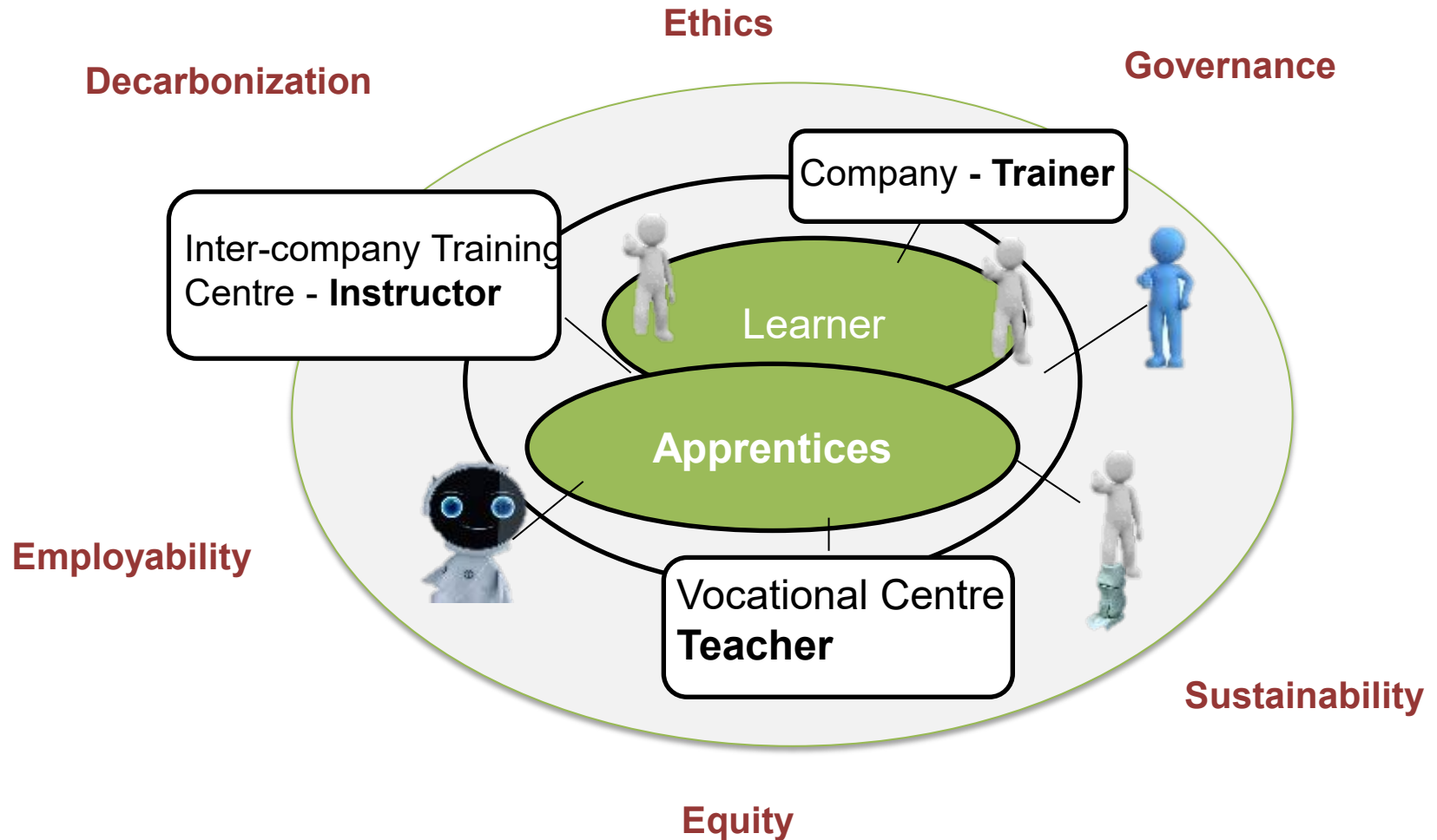
Expert Meeting on AI and TVET

Be at the forefront of AI-driven education and training



Introduction

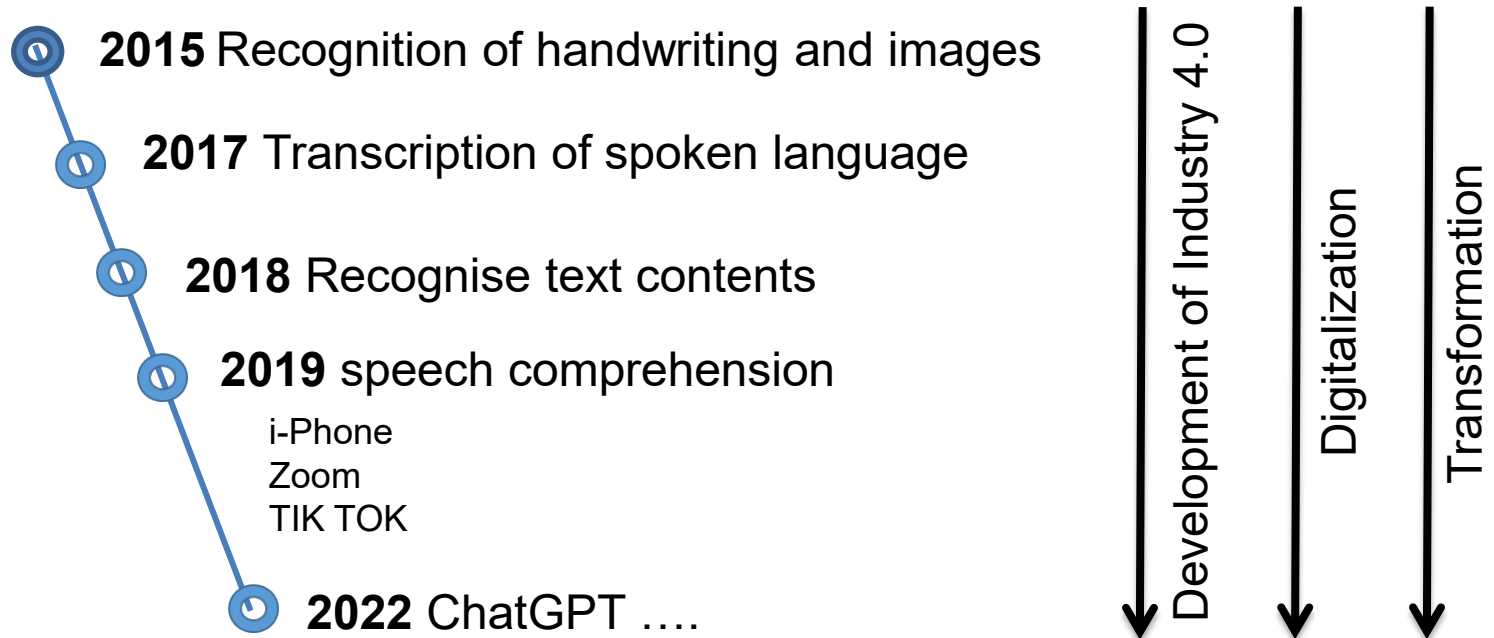
TVET „Ecosystem“



Artificial Intelligence (AI) in Society and Education

- AI shapes our ways of living, giving us meaning and directions,
- AI supports a strong relation between humans and technology,
- AI will persevere and will continue to develop unaided!
- All of us should accept the use of AI,
- We should qualify to make efficient use of AI,
- We should document the use of AI in a transparent way,
- We should prevent AI models from developing their own successors, practically automating research,
- We should carefully check all the contents generated by AI.

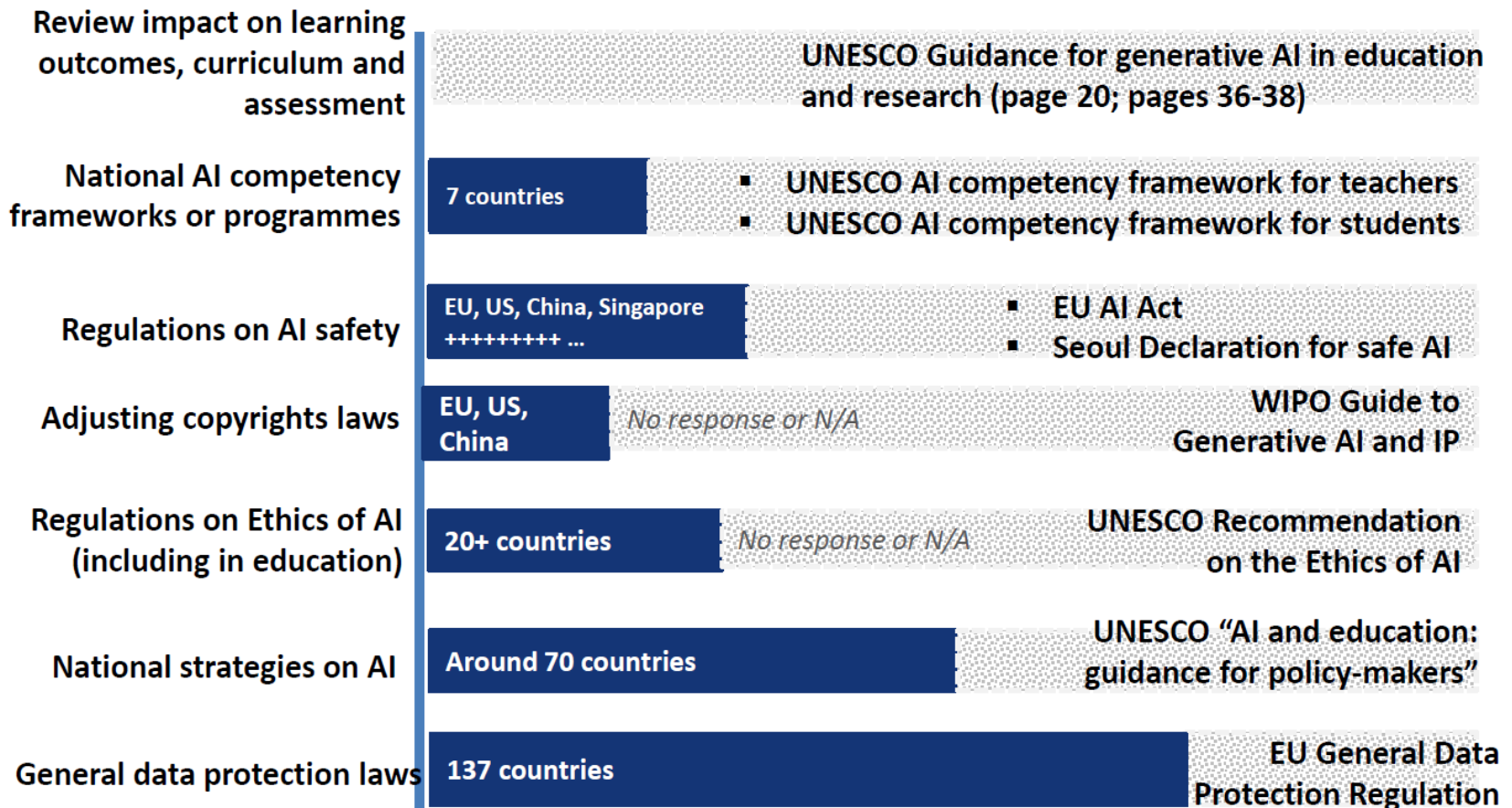
Development of AI in Language Modeling



Dramatic increases in AI language modeling capabilities

In schools: Apart from devices, more knowledge must be accumulated to underpin successful learning.

A Basic Roadmap to Safe and Trustworthy AI for education



Source: Fengchun Miao, UNESCO

Impact of AI in Europe

...The **EU AI Act** is part of a wider policy package supporting the development of AI...

...As the AI revolution gains momentum, technology is reshaping economies, labour markets and society, occupations and skill needs...

...demand for AI skills has increased in the past decade – both within the information and communication technology sector and beyond...

...Europe for the Digital Decade targets take-up of cloud, big data and AI technologies by at least 75% of European companies and 20 million more ICT specialists by 2030..

...The share of workers who deploy advanced AI methods still accounts for less than **0.5-1% of total employment** in advanced economies...

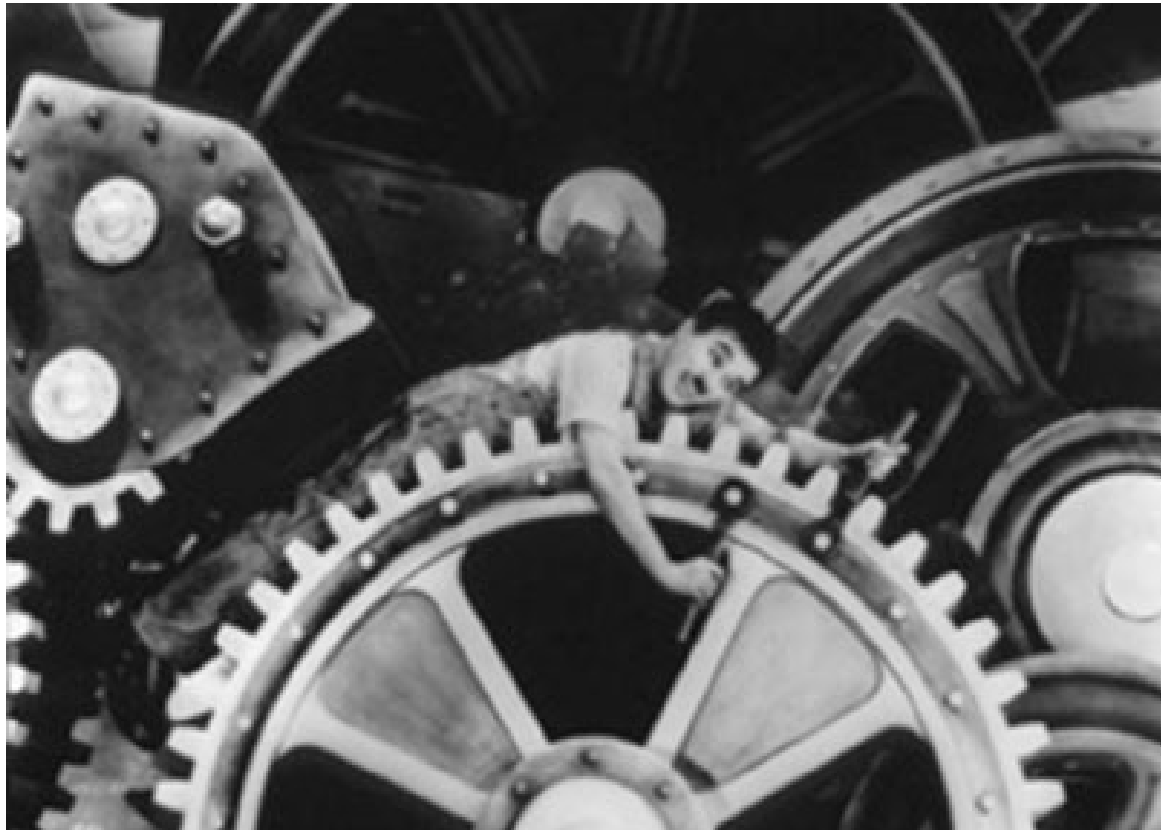
“The AI revolution will not result in the massive job destruction predicted about a decade ago. ..., **for most jobs in European labour markets AI means the transformation of tasks and skills**” (Pouliakas, 2018).

CEDEFOP 2025

AI: “Ability of a machine to use algorithms to analyse, learn from data and use what has been of autonomy – to achieve specific goals.” (Cedefop, [‘Glossary’](#)).

Ethical Fundaments

Complex Technology – The Only Objective?



Attack of the Machines!!

Source: http://www.eiszeitkino.de/web/index.php?option=com_content&view=article&id=883:moderne-zeiten&catid=5&Itemid=25

AI is not a new phenomenon

In 1950, Alan Turing presented a computational model for intelligent reasoning.

He had asked the question: **“Can Machines Think?”**

More important questions have emerged – e. g.: shaping of interfaces!

What could be supported by AI?

- scientific literacy, computational literacy, technological literacy (conflicting definition behind)

Consensus definition for “technological literacy”:

“it is the ability to use, manage, assess, and understand technology”

(ITEA – International Technological Education Association)

But TVET? Technology is not enough!

Recommendation:

Vocational Competence – ability to shape **work and technology** and to use, manage, assess, and understand work requirements.

Hybrid Constellations

Today's intelligent information systems, computers and AI are capable of making decisions independently. This leads to a new quality in the division of labor between humans and machines. This leads to two questions:

How much technology is adequate?

How many humans may (still) remain?

New concepts for the interaction of people, "smart" technology and AI are needed to ensure that the society of the future is still in control and remains humane.

Three Possible Scenarios

Limitation of the autonomy of skilled workers in plants and machines

Technology scenario

The technology is applied in order to automate processes
Sustainability is limited!

The development of competences of qualified skilled workers

Human scenario

Human beings should maintain their capability of
shaping work-processes and carrying responsibility!
Sustainability must play an important role!

Hybrid scenario

Combination of automation and expert **scenario**

Ethics: Immanuel Kant's Golden Rule

Kant established three formulae for defining moral needs and actions as universal, impartial and rational.

Kant's improvement on the Golden Rule, the **Categorical Imperative:**

„Act as you would wish all other rational people to follow, as it were an universal law.“
(www.qcc.cuny.edu)

TVET – Development – Digitalization - AI



The Future of TVET – „Activity Areas“!

Continuous Requirements

- AI & digitalization
- Validation + Guidance
- Efficiency and financing
- International dimension
- Flexibility and responsiveness

Excellence

- Supporting innovation
- Regional development
- Regional economic strategies
- Initial and continuing VET –LLL

Medium Term Requirements

Changing world of work
Digitalization, Industry 4.0, AI

Teacher Training
New methods for teaching and learning

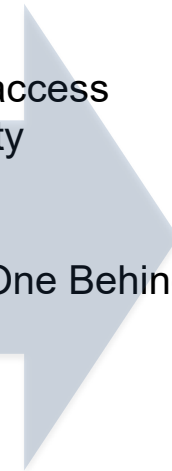
Sustainability and green development

- UN Decades
- Environment
- Natural resources
- Categorical imperative
- AI

Long Term Requirements

Inclusion

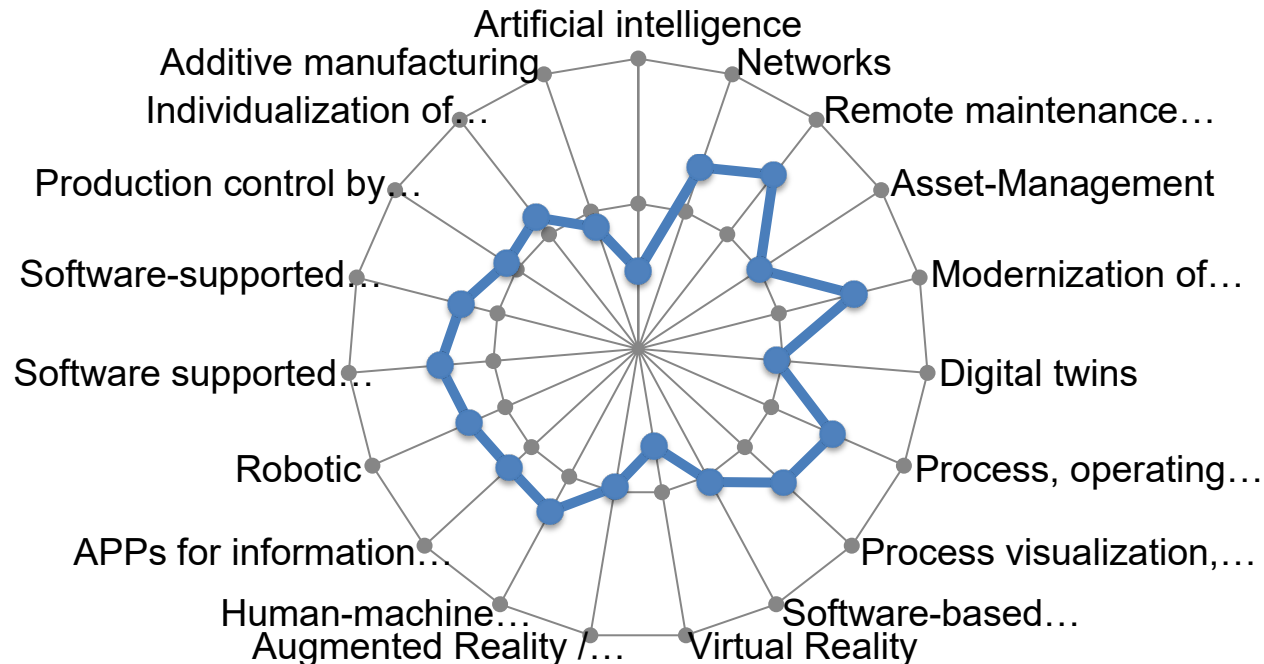
- AI
- Broadening access
- Social mobility
- Guidance
- Validation
- Leaving No One Behind



Digitalization: Challenge Through Technology

Significance for skilled workers

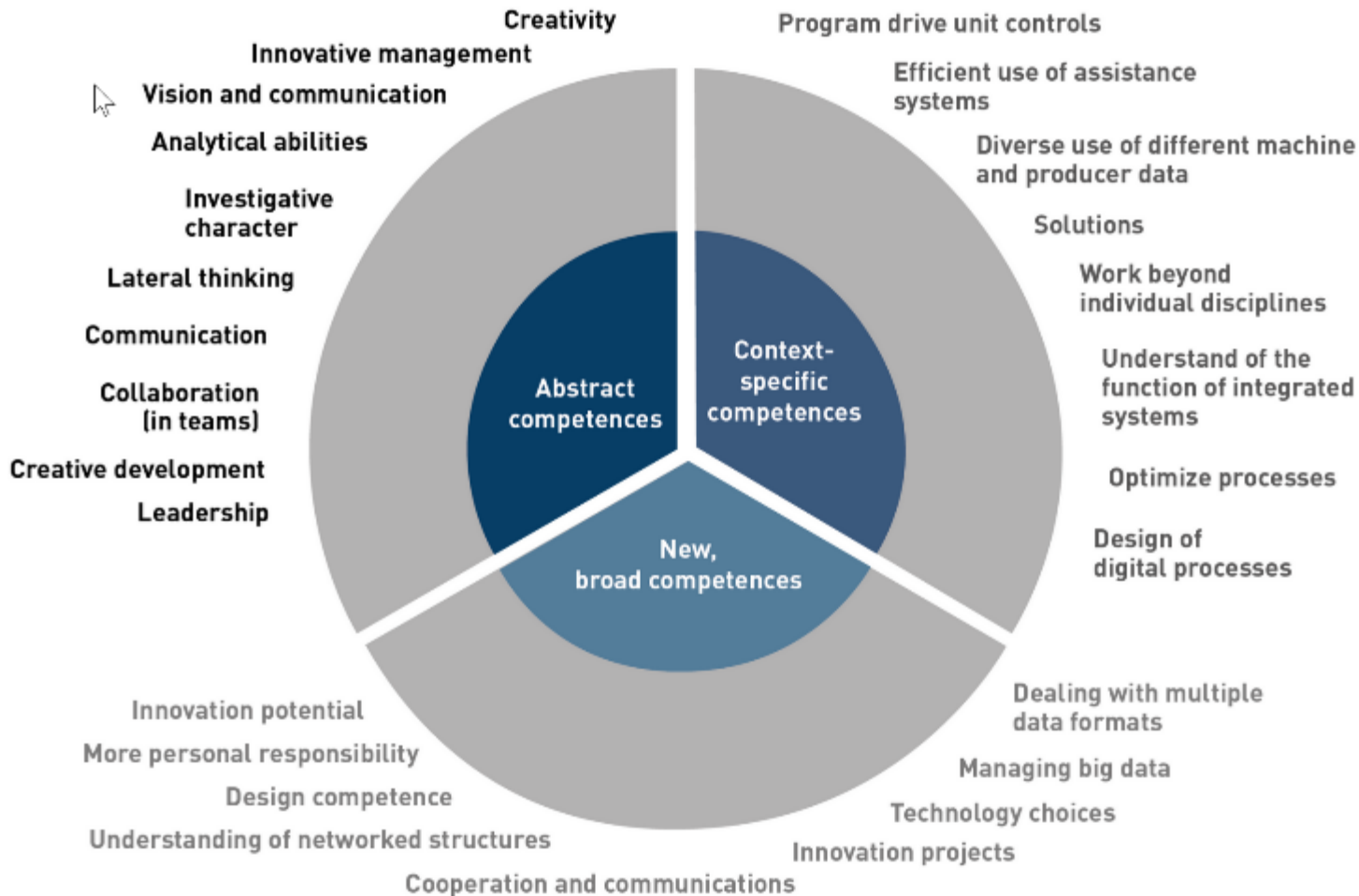
All skilled workers in industry are now handling digitized tools and media



- MES and ERP permeate the shop floor - but rather Industry 3.0 instead of 4.0

Degree of challenges for skilled workers
(outside: strongly challenged | center: not at all challenged)

Industry 4.0 & AI „Skills“ Radar



Overall Requirement on TVET Today

TVET is undergoing a profound evolution driven by

- complex work-processes and the rapid advancement of technologies, AI-driven generative technologies, digitalization and sustainability .

Consequently: Growing demand for a higher level of competence and a skilled workforce capable of addressing the challenges.

Status of AI: What can we Expect?



Future of AI - by Thousands of AI Authors

Undisrupted AI development:

“The chance of unaided machines outperforming humans in every possible task was estimated at

- 10 per cent by 2027
- 50 per cent by 2047“

(2778 AI researchers were asked)

Are all human occupations becoming fully automatable?

Source: Expert Survey, Grace et al. 2024

“**Skill-Skipping**” (Nuxoll, 2025)

Conflict in Education – “Outcome Orientation!”

Students deliver an end product created with the help of AI, but have not gone through a learning process!

Problem: Only the end product (outcome) counts, not the way to get there!



Need of learning-process orientation!

AI – Basic of Learning or a Barrier?

Digital media and AI can be used anywhere: Learning outside the “regulatory system” becomes normal!

Critical

- school and the classroom as a place of learning environments are becoming less important,
- the design of learning by teachers / instructors is losing its dominance,
- learning in the work-process (core of the “Dual System”) is being replaced by digital media & AI.

Consequence

- The “Dual System” of learning in school and at work is losing its “identity”

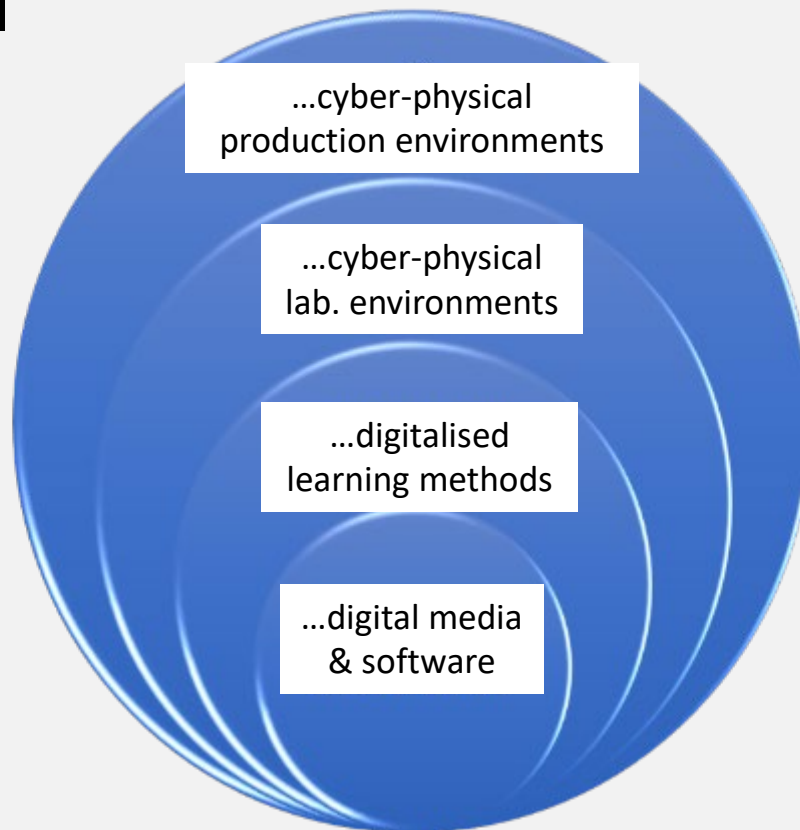
What to do?

- Organize training in cyber-physical production environments,
- Provide work-integrated training in school and companies (real and per simulation)!
- Train directly on digital instruments / machines of production.

Use of Digital and AI Media for Learning: What Must be Clarified?

Trends in the Use of Learning with Media / AI

AI



Quelle: Kuka Group

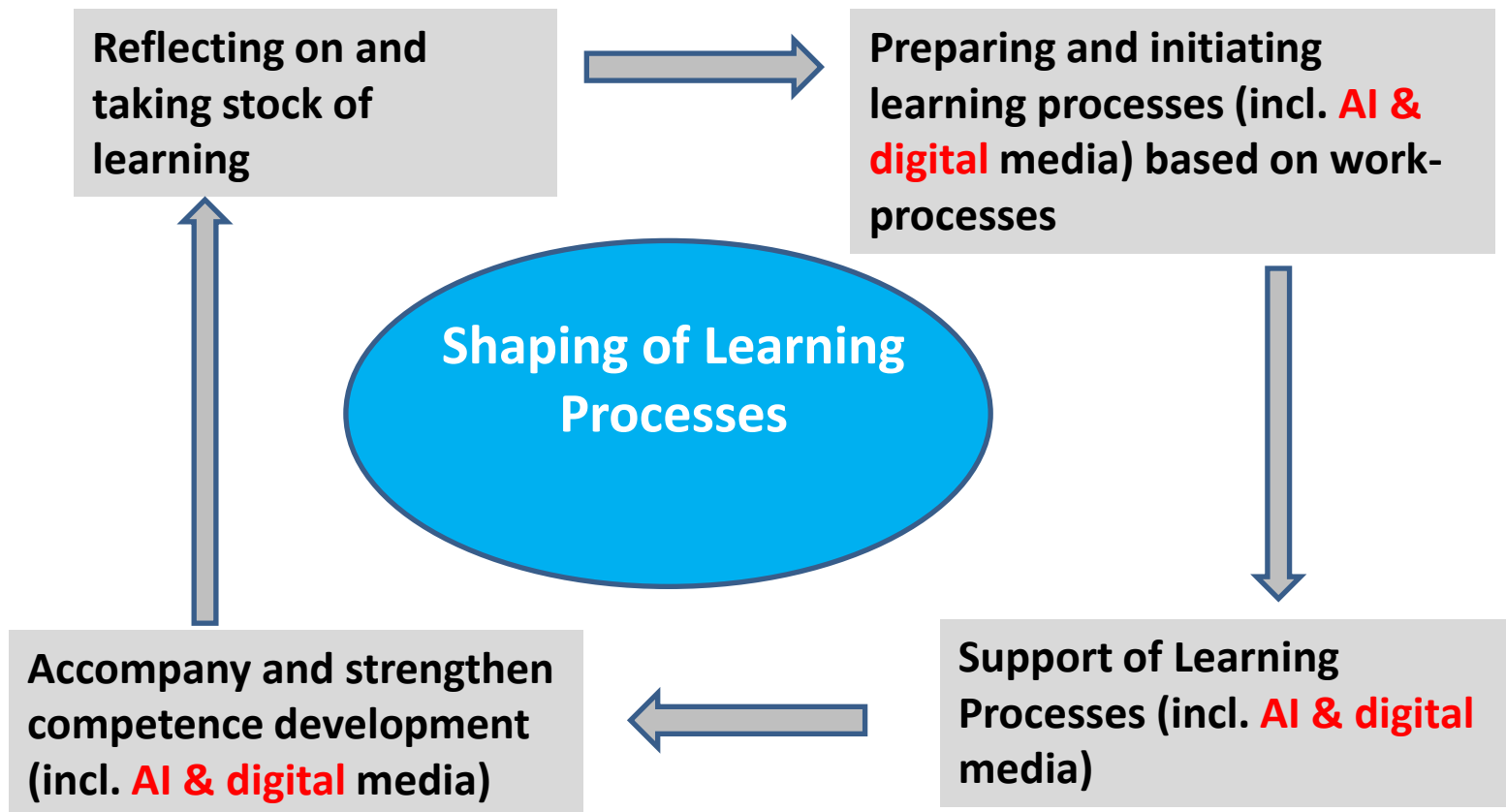


Quelle: Festo



AI

Shaping of Learning and Teaching – Mobilisation of AI in TVET –



AI Literacy Frameworks

A Framework of AI Literacy for Technology Education

(Based on policy documents and literature analysis)

A framework of AI literacy for technology education. Stolpe / Halström 2024

Target: Unified framework!
Adjusted to context of
education & technology.

Characteristics

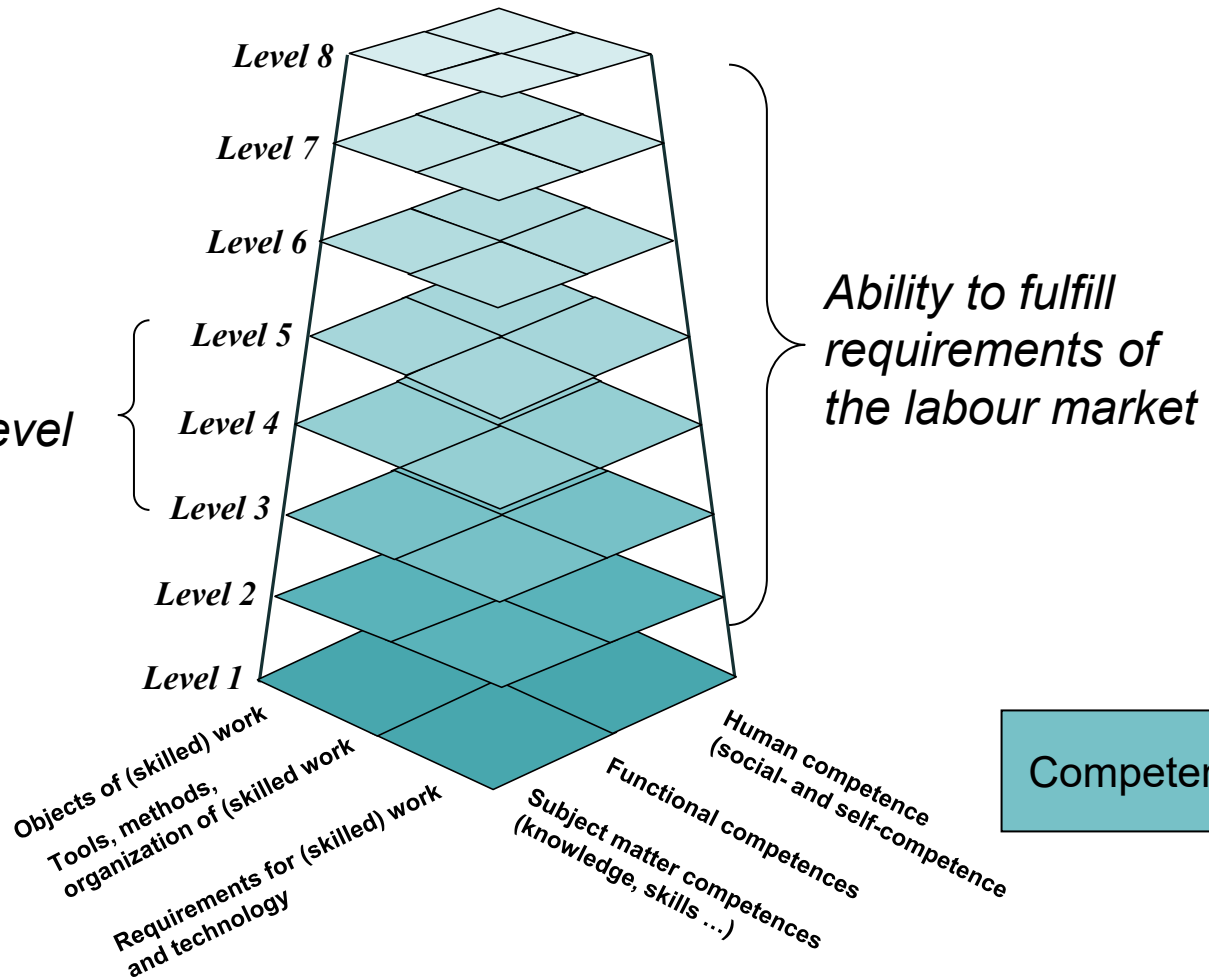
- Three-part heuristic framework for technology
- Connection to conceptual, procedural and technological knowledge
- Question: “What”? identifies technological scientific knowledge related to the content?

	Technological scientific knowledge	Technical skills	Socio-ethical technical understanding
Epistemological stance	Conceptual knowledge	Procedural knowledge	Contextual knowledge
Description of the category	Conceptual aspects Definitions Understanding why things work or not	Skill or ability to make things work Problem-solving Coding	Critical thinking, relating technology to society/the human world, and the environment
Source of knowledge	Technology, engineering, science, and computer science	Experience, trial and error, practical work, practice, rules of thumb in computing and technology	Humanities and social sciences, philosophy
Analytical question	What?	How?	Why? Consequences?
Examples from AI literacy	Defining AI Recognising AI Understanding AI Role of data in AI Computational thinking Design thinking Systems thinking	Programming Data literacy, e.g., data use Product development	Human role in AI AI ethics AI's impact on society and the environment Privacy, integrity, and cyber security Bias

Dimensions of a Work-Process Related Framework of AI Literacy for TVET

Framework as a tool for more clearly defining AI literacy for a specific field in TVET!

Frame of specific AI level



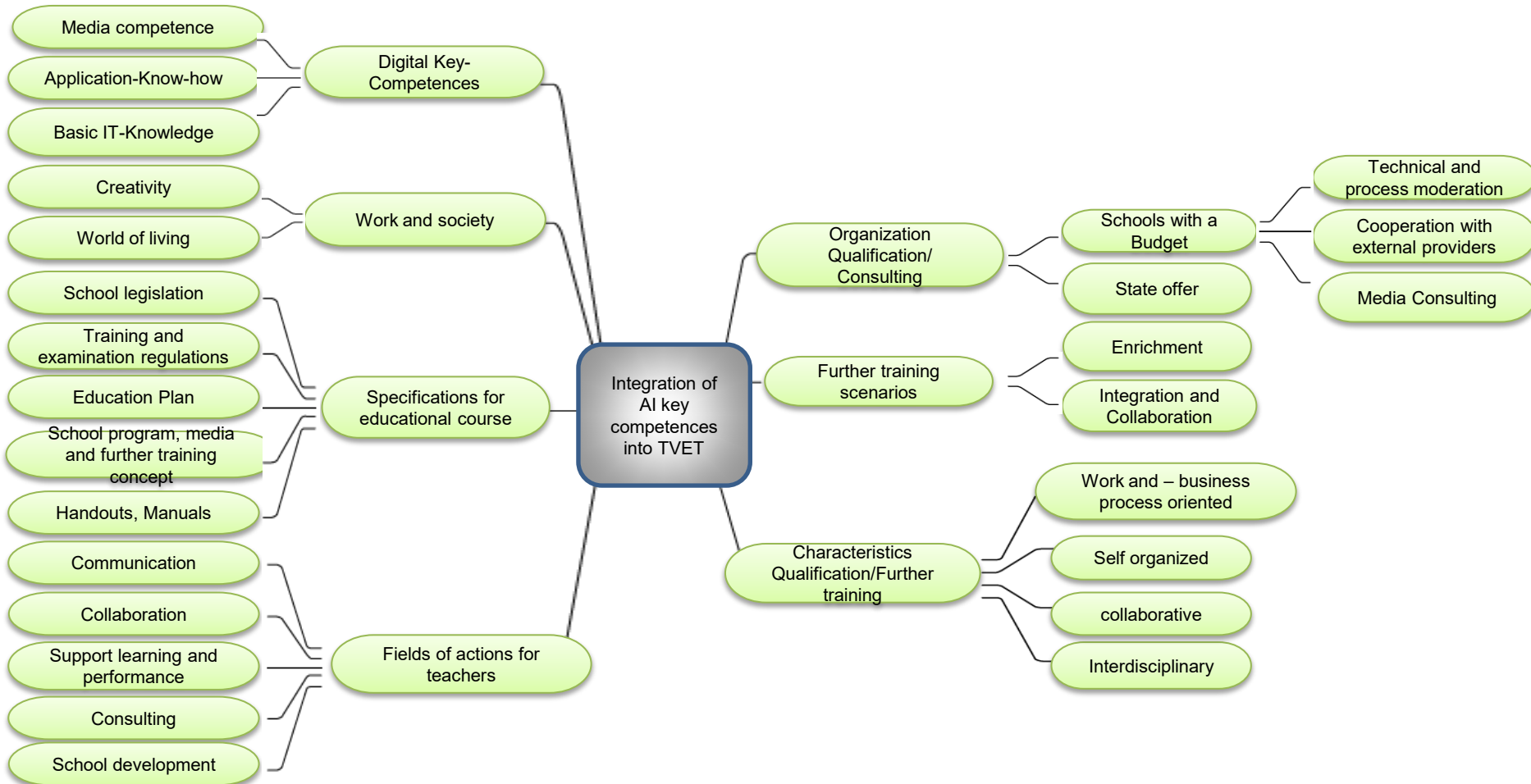
Work related categories

Competences

Consequences for TVET: Future Development!

A. Integration of AI Key-Competences Into TVET!

Analysing AI literacy frameworks for use in curriculum work and teaching – creation of a “**shadow curriculum**”!



B. Design of a Work-Process Related AI Framework

B 1. AI & Autonomy Levels on Workplaces of Skilled Workers

AI changes levels of autonomy in the design of human-machine interfaces

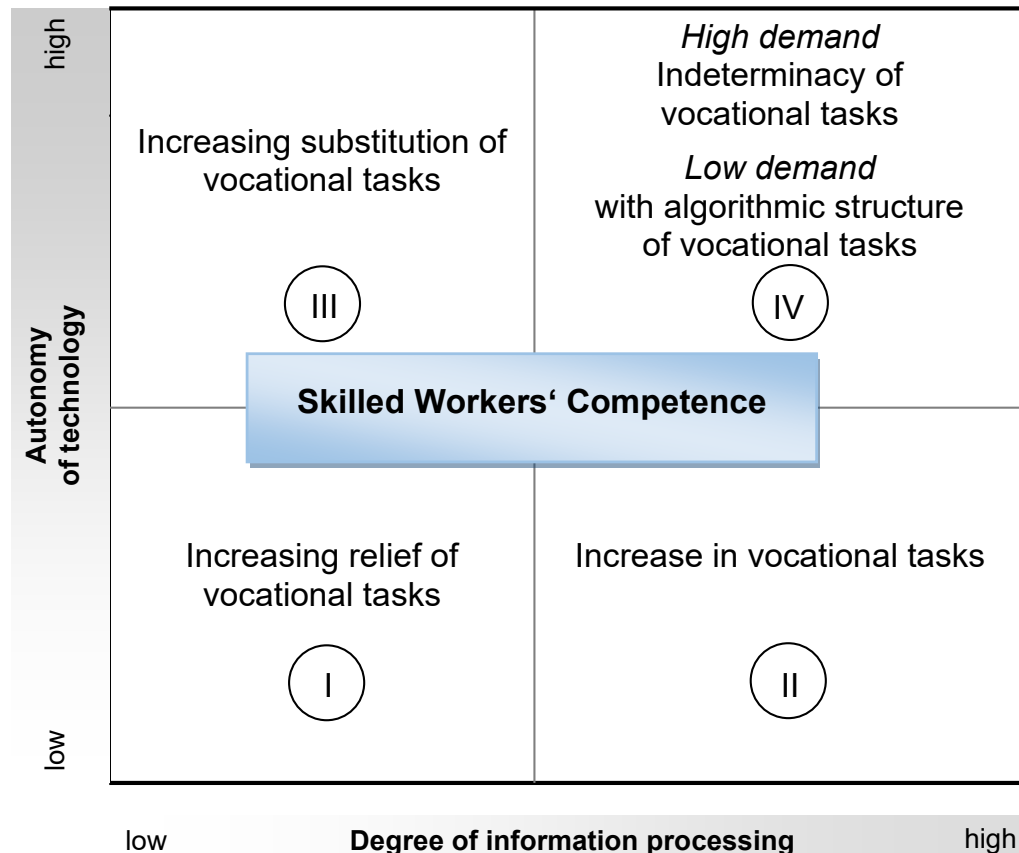
Level 0	No autonomy, human has full control without assistance.
Level 1	Assistance with selected functions, human is always responsible and makes all decisions
Level 2	Temporary autonomy in clearly defined areas, human is always responsible and sets (partial) goals
Level 3	Delimited autonomy in larger subareas, system warns in case of problems, human confirms proposals for solution of the system or acts as fallback level
Level 4	The system works autonomously and adaptively within certain system limits, human can monitor or act in emergency situations
Level 5	Autonomous operation in all areas , including cooperation and changing system boundaries, human can be absent.

Source: Becker/Spöttl/Windelband 2022

Autonomy level 4-5: System assumes responsibility, destruction of jobs!

B. Design of a Work-Process Related AI Framework

B 2. Impact of AI on skilled work and occupations



Changes of tasks and specialist skills due to AI influence

Based on B 1 & B 2: Design of TVET-Framework and Curricula

Establishing Intelligent (UNEVOC) Alliances for Promoting AI in Education, Training & Learning

The Target

Worldwide and across all segments of society we need to initiate projects for

Establishing Intelligent AI Alliances in Education, Training & Learning.

These Alliances should have the intention to make sure that all interdependences in our lives are geared towards a human centered orientation.

The final goal must be the implementation of *human centered curricula* for directing AI & digitalization & sustainability.

Thank you very much for your attention!

University Bremen, Germany
Prof. Dr. Dr. h. c. Georg Spöttl M.A.
spoettl@uni-bremen.de

Venue: Factory of the Future
Elbfabrik, Magdeburg, Germany

UNESCO UNEVOC Centre Magdeburg

Expert Meeting on AI and TVET

Be at the forefront of AI-driven education and training

