IX WORKSHOP ON TEACHING MECHANICAL ENGINEERING

Informatics Education in permanent change:
Example Artificial Intelligence (AI)

Enseñanza de la informática en un cambio permanente:
Ejemplo Inteligencia Artificial (IA)

Manuela Kanneberg[1], Elke Glistau[2]

1- Manuela Kanneberg, Otto von Guericke University, Germany,
manuela kanneberg@ovgu.de

2- Elke Glistau, Otto von Guericke University, Germany,
elke.glistau@ovgu.de

Abstract:

- **Problem to deal with:** Computer science education must be constantly adapted to the latest developments and trends. Current trends concern e.g. AI and machine learning, big data mining, automation and robotics, AR and VR, low-code developments for users, blockchain technology, edge computing, IoT, cloud solutions, green coding as a contribution to sustainability, safety and security especially cyber security and agile software development. Artificial intelligence in particular opens up many new possibilities (e.g. individual learning support, individual tutorial support, language support, relief from routine activities and elaborate documentation) but requires an adaptation of academic teaching and examination methods.

- **Aims:** Research questions are:

  (1) What are the demands of Information and Communication Technology (ICT) trends on computer science education?

  (2) How does ChatGPT change knowledge acquisition?

  (3) What forms of academic training and what types and forms of examinations are appropriate in the age of ChatGPT and AI?

1

4th International Scientific Convention UCLV 2023
Central University "Marta Abreu" of Las Villas
"Informatics Education in permanent change: Example Artificial Intelligence (AI)"

- **Methodology:** Literature analysis on trends in computer science, Literature analysis on the status and possible applications of AI and machine learning, Expert survey

- **Results and Discussion:** The discussion of students and university teaching staff should help to prevent conflicts and to use the new technologies adequately.

- **Conclusions:** Fields of action and measures for the adaptation and reorientation of teaching and examination forms are derived.

Keywords: Computer science; Artificial Intelligence; Questionnaire; Forms of examination; Robotics

Palabras Claves: Informática; Inteligencia Artificial; Cuestionario; Formas de examen; Robótica

1. Introduction

We are currently in the age of digitalization and networking. Many new ICT solutions are emerging and pushing into application. Artificial intelligence (AI) in particular will disruptively change teaching and learning. For academic training, the question also arises as to which skills are necessary for professional activity and should be acquired in a stimulated and, if necessary, accompanied manner. AI in particular opens up many new possibilities (e.g. individual learning support, individual tutorial support, language support, relief from routine activities and elaborate documentation) but requires an adaptation of academic teaching and examination methods.

Research questions are:

(1) What are the demands of ICT trends on computer science education?

(2) How does ChatGPT change knowledge acquisition?

(3) What forms of academic training and what types and forms of examinations are appropriate in the age of ChatGPT and AI?

The authors provide a snapshot in this highly dynamic process at the time of September 2023, which, however, must be permanently updated.

2

4th International Scientific Convention UCLV 2023
Central University "Marta Abreu" of Las Villas
"Informatics Education in permanent change: Example Artificial Intelligence (AI)"

2. Methodology

The methodology used includes the literature analysis on trends in computer science, literature analysis on the status and possible applications of AI and machine learning, and expert survey by professionals from different scientific disciplines. For the analysis of relevant aspects, ChatGPT 3.5 (OpenAI, 2023) was also used for the first time and identified as a source of knowledge.

3. Results and Discussion

3.1. Result 1: Connection between ICT trends and academic education

Table 1 collects the results to answer the question, what are the demands of ICT trends on computer science education?

Table 1. ICT Trends (Berlit & Scherf, 2018), (DHL, 2020), (Kruse, Borgelt, Braune, Mostaghim. & Steinbrecher, 2016), (Wehberg, 2019), (Glistau & Coello Machado, 2019), (Glistau, Coello Machado, & Trojahn 2022), (OpenAI, 2023) & (own elaboration, 2023)

Trend in the IT world (Name & course characteristics)	Impact on academic education and training	
	Form, Tools & Methods	Content
AI and Machine Learning Highly developing field with topics such as genetic algorithms, machine learning, computer vision, speech recognition & processing, expert systems, reinforcement learning, fuzzy logic, cognitive systems and many more.	Acceptance and integration of AI solutions (e.g. ChatGPT, Dall E2) - Practical projects - Case studies - Students should learn to create models and solve real-world problems	AI methods AI Examples
Cybersecurity Threats through espionage, manipulation, extortion etc.	Practical exercises	Overview of methods of prevention and defense Ethical hacking and network security
Big Data Mining Increasing data volume requires efficient methods of processing. It is necessary to evaluate situations and do forecasts.	Practical data analysis Projects	Pattern recognition Applications Benefit
Automation and robotics Current developments in robotics include: AI and Machine Learning, Autonomous Driving, Social Robots, Robots in Medicine, Cobots, Nanorobotics etc.	Robot Workshops Robot Hackathons Robot Clubs Robot Project	Basic knowledge of mechanics, electronics, programming, control systems and AI Applications

Continuation of Table 1. ICT trends (Berlit et al., 2018), (DHL, 2020), (Kruse et al., 2016), (Wehberg, 2019), (Glistau et al., 2019), (Glistau, et al., 2022), (OpenAI, 2023), (own elaboration, 2023)

Trend in the IT world (Name & course characteristics)	Impact on academic education and training	
	Form, Tools & Methods	Content
Augmented & Virtual Reality Extension of the real world by digital elements (AR) up to completely digital worlds (VR).	Project for creating AR and VR applications	Terms Stage of development Applications and tools (software and hardware)
Low code development for users Simplify software development	Solve programming tasks as easily as possible	Methods (ChatBots, visual development environment, low code platforms)
Blockchain technology The accounting of activities can be realized automatically by using Blockchain technology (e. g. smart contracts).	Creating smart contracts and experimenting with multiple blockchain platforms	Principle of action Use cases (e.g. Finance, Healthcare, Logistics)
Edge Computing Data processing is brought close to where it is needed. Important for IoT.	Case studies, practical exercises Guest lectures & experts	How does edge computing work and how can it be linked? Examples of meaningful use cases Comparison with Cloud Computing
Quantum Informatics Quantum computing describes the behavior of particles at the subatomic level. Promises new opportunities for solving complex problems.	Information about this trend, If necessary, quantum mechanical experiments	**Specialty, only in development!** Mathematical and quantum mechanical foundations
Networking, Internet of Things (IoT) IoT connects physical and virtual devices by using information and communication technologies. The task is now to develop the Internet of services (IoS).	Developing IoT projects and working with sensors and actuators in practice	Overview of IoT technology Example solutions Procedure for implementation
Cloud-platforms and cloud software Integral part of many IT infrastructures; New offered services are infrastructure (IaaS), platforms (PaaS) and software (SaaS). Memory capacity, processing power and applications are provided by internet and do not installed local.	Practical exercises are carried out on cloud platforms such as AWS, Azure or Google Cloud	Cloud Technologies Problems of the cloud

Continuation of Table1. ICT trends (Berlit et al., 2018), (DHL, 2020), (Kruse et al., 2016), (Wehberg, 2019), (Glistau et al., 2019), (Glistau, et al., 2022), (OpenAI, 2023), (own elaboration, 2023)

Trend in the IT world (Name & course characteristics)	Impact on academic education and training	
	Form, Tools & Methods	Content
Green coding as a contribution to sustainability Aims to program in a sustainable and environmentally friendly way	Group discussion and awareness-raising	Teaching methods, e.g. Efficient algorithms and data structures, avoiding unnecessary calculations, switching to energy-saving mode, resource efficiency (efficient use, virtualization & containerization, creating awareness)
Agility • Agile approaches to software development • Agile Organizations • Agile project management	Team project on a small problem to learn about the organization, approach, methods and evaluate the results	Comparison of classic and agile software development Methods and rules of agile software development Use of ChatGPT as a programming aid
Home office and remote working places Strong proliferation of home-based work and work that can be done from anywhere.	Integration of home office into teaching and examination operations	Tools to support distributed work while ensuring security standards
Demand for digital know-how Require professional qualification and lifelong learning.	Adapt the shape to the requirements and possibilities	Permanent definition and updating of what digital know-how means, lifelong learning vision
Digital Twins The virtual representation of a physical object or system is used to understand it, optimize it, predict it, control it, or repair it etc.	Establishment of an own digital twin as a test platform	Setting up and structuring digital twins
Increased data protection, safety and security Requires critical protection of sensitive data from corruption, compromise, or loss.	Own thematic exercises to defend against threats	Threats Possible courses of action Regulate
3D Printing Changes the supply chains fundamentally. The product is first created at or near the customer.	Laboratory equipment with 3D technology, Hands-on training	State of 3D development Necessary further develop-ments in the IT sector
Benign AI-powered bots Integration of bots into existing programs for e.g. evaluation of data, learning in decision-making situations and visualization of options for action and effects.	Bot Lab (Design & Goals, Training Data, ML & NLP, Ethics, Monitoring & Improvement, User Experience, Security)	Programming and integration of bots Examples are e.g. social media bots, chatbots, health bots

These ICT trends denote topics and new solutions that must be included in academic training and subsequently transferred to application with proof of their positive effects and durability. As an academic form of training in this context, digital guest lectures by experts (developers, users, critics) who provide specialist input and discuss the topic broadly and intensively are initially suitable. A positive example of this form of training is the digital guest lecture series Logistics. (Compare (GVR, 2023)) Subsequently, proven topics should be perpetuated and suitably integrated into the training. A mix of knowledge input and practical usage experience should always be accomplished.

3.2. Result 2: Disruptive change of education and examination by ChatGPT

The digital world of learning prior to ChatGPT was presented, for example, in Teaching Forms of E-Learning. (Teaching, 2020). ChatGPT comes new in 2022 and is an AI-based chatbot that has been making a splash for a year now. Many students and teachers are already exploring the benefits of ChatGPT in everyday life and at university. There is a body of literature from 2022 and 2023 that addresses the opportunities, changes, and needs for action related to ChatGPT. Recommended are e.g. (Firat, M., 2023), which derives guidance for universities from literature review and interviews with 21 people.

(Willems, J. et al., 2023) proves the current limitations and flaws of ChatGPT and concludes "... it is the teacher's (privileged) responsibility to instruct students tools correctly and wisely ...". In (Nickel, J. & Ganguin, S., 2023) the view of student teachers on so-called de-bounded learning and teaching is presented and put under the heading: <Practical and overwhelming at the same time> - learning and teaching in the culture of digitality. They relate the de-limitations to the means of learning, the learning time, the place of learning, the learning space, the social form, the learning content up to the de-limitation of teaching.

Figure 1 shows important applications of the chatbot the opinion & the empirical knowledge of the authors and interviewed experts at the Otto von Guericke University Magdeburg.
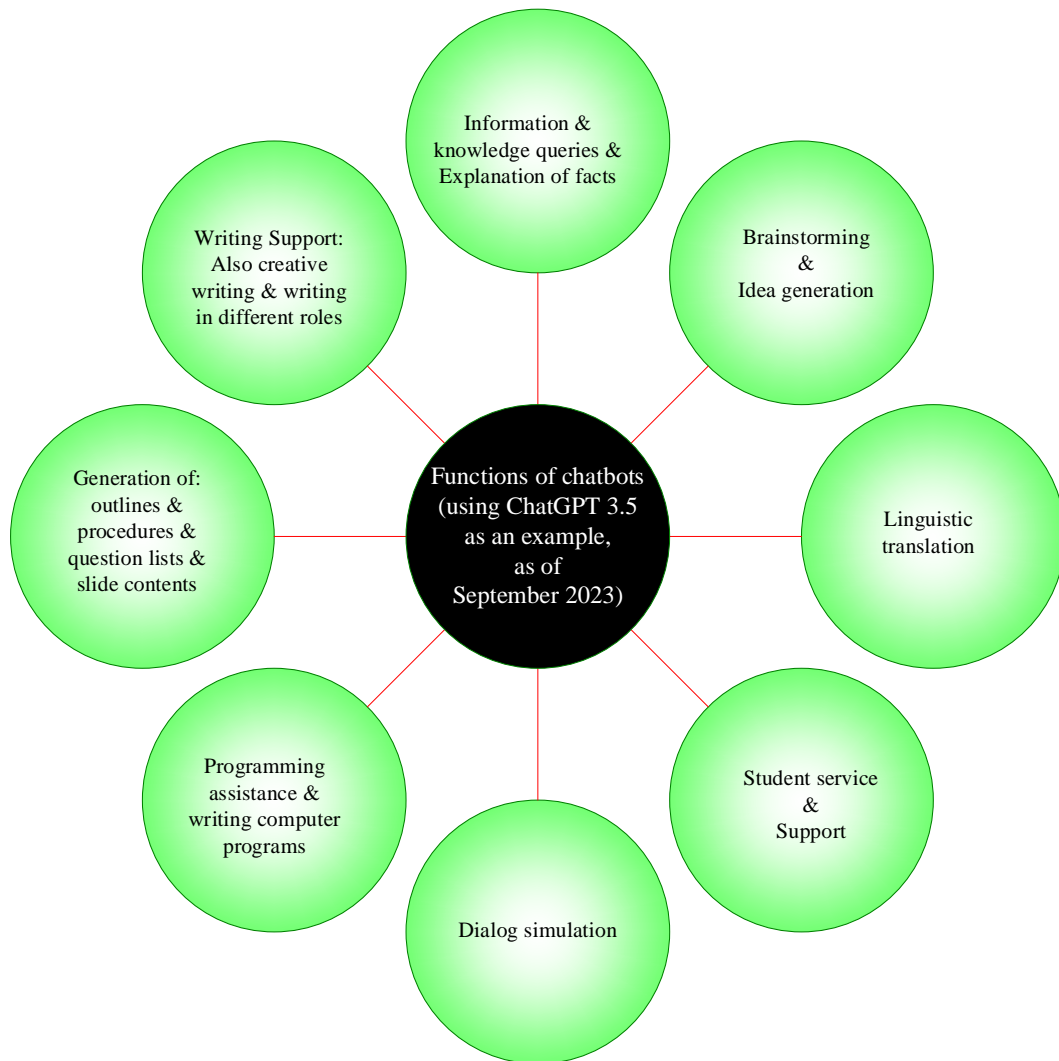
Figure 1. Possible applications of ChatGPT in an academic context (Facebook, 2023) & (own elaboration, 2023)

Problems of chatbots, as of 2023, are:

- Stage of development of chatbots (incorrect answers, old answers, incomplete answers, answers with bias, i.e. with prejudices and distortions),
- Motivation to use it generate and maintain permanently,
- Digital user behavior (fast, varied, work with rewards).

Table 2 collects the results to answer the question, how does ChatGPT change knowledge acquisition.

Table 2: Comparison of the world before and with ChatGPT to illustrate the differences and possibilities
(own elaboration, 2023)

Old (before ChatGPT)	Possibilities from ChatGPT	New (with ChatGPT)	
		Learner	Academic teacher, tutor, coach
• Transmission of knowledge by teachers • Reading of texts • Own research of knowledge (internet, library)	**Information & knowledge queries**	• Self-study • Exam repetition • Use as an encyclopedia • Digital fellow student	• Own continuing education • Digital "colleague"
		• Learning to ask accurate questions, develop questioning strategies. • Learning to distinguish contexts • Learning to question presented knowledge (control questions) • Learning to work with knowledge and add to it creatively • Learning to check and compare sources • Generating overview knowledge quickly	
• Homework • Vouchers • Project reports • Bachelor theses • Master theses	**Writing support** (resume, email, letters, texts and reports of any kind)	• Use when writing any type of text. • Adaptation to concrete circumstances may still be necessary	
		• Significantly reduce the effort required to write (see left) • No to little own, understanding part • No own practice in formulating • No prolonged examination of the content	• e.g. to create assignments, teaching materials, research proposals, research reports, publications of any kind (book, paper, presentation)
• Own creativity, • Creativity techniques in small teams	**Brainstorming & Idea generation**	• Ideas available to all • Ideas can be produced at will without effort	
• Learning a foreign language • Translate yourself • Use deepl & Google	**Language translation**	• Language skills continue to lose importance	
• Teaching syntax, • Programming yourself	**Programming assistance**	• Manual programming becomes less important; artificial intelligence takes over the actual programming. • If necessary, program control & evaluation • Complex, networked programs are currently still generated traditionally	
• Conversation and chat with real people	**Chatting** (Communication)	• "Conversation" and chat with artificial beings	

8

4th International Scientific Convention UCLV 2023
Central University "Marta Abreu" of Las Villas
"Informatics Education in permanent change: Example Artificial Intelligence (AI)"

Continuation Table 2. Comparison of the world in front of and with ChatGPT to illustrate the differences and possibilities (own elaboration, 2023)

Old (before ChatGPT)	Possibilities from ChatGPT	New (with ChatGPT)	
		Learner	Academic teacher, tutor, coach
• Independent structuring of work & drafting of procedures and outline	**Outlines & Procedures**	• Automatically structure work (papers, reports, final papers, etc.) • Create procedures	• Structure courses & research • Create procedures
• Loosening up of lessons by teaching staff	**Telling Jokes**	• Integrate jokes and funny stories on demand	
• staff with office hours to answer customer inquiries • (lecturers, study advisors, examination office)	**Customer Service & Support** (Taking orders and answering questions)	• Change of counseling at the university • 24/7 - counseling possible	
• Required initiative and independence to repeat the learning material with or without the use of IT	**Learning support and education** (reviewing learning material)	• Repetition and consolidation of the learning material can be done AI-supported, independently. • Explaining facts, (complex, difficult)	• Sort the teaching/learning material by: Must be taught, can be worked out on your/their own
• Writing assignments to learn how to write technical documentation • Own creativity	**Creative Writing** (poems, stories)	• Work on the same tasks with different writing styles, also role reference possible, such as, "Formulate like a lawyer"	• Possibility of easy generation of case studies and examples
• Personal discussion with other students, friends and family	**Dialogue simulation** (train real conversation situations, test for exams)	• "Conversation" with the AI • Targeted use for exam preparation in conversation	• Digital "colleague"
• Questions had to be thought up or researched by oneself • typical task of teachers for repetition and for exams (exam questions)	**Create questions and question lists**	• Work more with questions	• Create tested question catalogs
		• Generate questions for research and questions e.g. for scientific papers. • Questions and question lists can be generated easily (checking, sorting and completion may be useful) • Generate questions for interviews and questionnaires	

Continuation Table 2. Comparison of the world in front of and with ChatGPT to illustrate the differences and possibilities (own elaboration, 2023)

Old (before ChatGPT)	Possibilities from ChatGPT	New (with ChatGPT)	
		Learner	Academic teacher, tutor, coach
• Own creativity and expression in writing interesting texts	**Content marketing** (newsletters, advertising texts)	• One's own creativity and expression lose importance	
• PowerPoint presentations had to be generated by the user	**Create Presentations**	• Slide content can be easily generated	

These changes highlight the need for careful planning, collaboration, and ongoing evaluation to exploit the potential of AI in higher education while addressing the associated challenges.

3.3. Result 3: Forms and content of academic training

The forms of academic training (lecture, exercise, seminar, etc.) date back to another century. The underlying vision was determined by an academic education for a "classical" profession and its lifelong practice. However, the requirements for academic training and technical possibilities have changed fundamentally in recent years and require a reengineering of academic education and training. In the future, the new academic education and training should and will accompany the academic throughout his or her life. In this sense, it is no longer about classic professions, but essentially about skills and experiences. Many published solutions of digitalization and networking in the context under consideration are currently like small pieces of the puzzle and have initially mostly brought about small improvements to the existing actual solution, as in Kaizen. Some of the main advantages of digitalization are individualization, flexibilization, preparatory training for lifelong learning, digital interlocutors and colleagues; improved inclusion (e.g. for disabilities, lack of language skills, girls in technical professions & boys in girls' professions). In addition, there is an increase in

variety among students through the use of diverse media and an increase in interactivity. Important possibilities of interactivity as a small overview are described in Tables 3 and 4.

Table 3. Morphology for the characterization of digital forms of interaction (OpenAI, 2023) & (own elaboration, 2023)

Criterion	Forms							
Why:	**Learn**	**Conti-nuing edu-cation**	**In-form**	**Admi-nistrate**	**Collaborate**	**Playing, Enter-tainment**	**Establi-shing contacts**	**Test Examine**
Context:	**Social** (interpersonal, e.g. between students)		**Cultural** dependent, e.g. on university standards		**Business** University administra-tion, e.g. registration for the exam		**Without context**	
What: Type of digital Medium	**Read texts** Online resour-ces, E-books, online articles, blogs	**Texts back and forth** Email, Chatbot Discus-sion forums	**View picture** Graphic, Photos, Memes	**Picture back and forth** Email SMS, Whats-app Chat-bots	**Listen to Audio** Podcast Audiobooks Voice Message, Music Stream	**Audio back and forth** Tele-phony	**Watch Video** Online Videos On platform or strea-ming	**Video back and forth** Video call Video conferen-cing
		Social Networking Platforms Facebook, Twitter, Instagram	**Interactive Media** Digital simulation games, games, VR, AR		**E-learning media** Online Courses Webinars		**File** Deploy	**Edit file**
Who: Target group	**Private**		**Professional-internal**		**Professional–external**		**Public**	
With how many: Interaction	**Just me** Use of the Internet		**With one person** classic chat		**With several people** Social media, chat group		**With all** Posting opinions	
Own activity:	**Low** streaming & watching Videos				**High** Benefits of social media			
When:	**Real time** Video call, chat, voting				**Not in real time** Emails, Forums			
Wherewith: Technolo-gies	**Web Application** • **Interactive Media** (Digital simula-tion games, games, VR, AR) • **E-learning media** (Online Courses, Webinars)				**App**		**Social Media Platform** Facebook, Twitter, Instagram	
Wherewith: Hardware	**Computer**		**Smartphone**		**Tablet**		**Smart TV**	
Where:	**Internal** Accessible only in the university network				**External** Access from the outside possible			
Data Protection & Security:	**Different levels of data security** Raise awareness, read privacy policies, backup, secure Wi-Fi, beware of phishing, updates, be careful when sharing information, password or 2-factor authorization.							

Table 4. Overview of important digital forms of interaction
(Forms according to (OpenAI, 2023), (own elaboration, 2023) for characterization)

Digital Interaction potentialities	Examples of tools	Brief Characteristics	Text, Images	Video	Audio	Virtual Meetings	Webinar	Cooperation	Forums, blogs
Social media	**Facebook**, Twitter, Instagram	Interaction and communication between users via texts, images and videos	■	■					
Email	**Gmail,** gmx, Outlook & Yahoo	Exchange of messages and documents via the Internet	■						
Instant Messaging	**WhatsApp**, Telegram & Slack	Real-time communication via text, audio and video	■	■	■				
Video-Conferencing tools	**Zoom**, Microsoft Teams & Google Meet	Video conferences & virtual meetings	■			■			
Webinar tools:	**GoToWebinar** & WebEx	Implementation of webinars and training courses via the Internet					■		
Professional Networks	**LinkedIn** & Xing	Establish and maintain professional contacts	■						
Online Forums & Community Platforms Blogs & Blogging Platforms	**Reddit & Stack Overflow** Blogs	Forums where users can ask questions, have discussions, and share information							■
Collaborative work platforms:	**Microsoft 365**, Google Workspace & Slack	Collaborate on documents, projects and tasks in real time						■	
Social VR Platforms	**Oculus** & AltspaceVR	interact & share social experiences in a digital environment	■	■					
Gamification Platforms	**Duolingo** (Language Learning), Fitbit (Health & Fitness Goals)	Game-like elements to encourage user interaction and engagement	■	■	■			■	
User inter-Action software	**Live Chat Software** & Chatbots	to communicate with users in real time and provide support	■					■	

Table 5 collects the results to answer the question, what forms of academic training and what types and forms of examinations are appropriate in the age of ChatGPT and AI.

Table 5. Changing traditional forms of teaching, learning, training and evaluation
at universities and colleges (OpenAI, 2023), (own elaboration, 2023)

Traditional forms of teaching, learning, training and evaluation	Alternatives using digitalization
Traditional face-to-face lecture over 90 minutes Traditional classroom exercise over 90 minutes Traditional face-to-face seminar over 90 minutes	**A. Teacher-controlled:** • **Presence with integration of various online tools, interactive elements such as simulations, quizzes**, polls, discussion forums and peer assessments to promote learner engagement. • **Hybrid** event • **Online** event, **webinars**, and virtual seminars: Webinars are live presentations or training sessions that are broadcast online. They enable real-time interactions between the presenter and attendees, including Q&A sessions and discussions. **B. Self-directed learning:** • **E-learning platforms** (e.g. Moodle, Canvas, Blackboard) and directly on the Internet = provision of course content, such as: texts, tables, images, data, slides, audios, videos, questions, tasks, tests, etc. motivating elements such as gamification: (The integration of playful elements such as points, badges and competitions can increase student motivation and engagement.) • **Podcasts and video podcasts**: Teachers can record audio or video content and deliver it as podcasts • **Video tutorials and screencasts:** Teachers can create short videos in which they explain concepts or demonstrate software. Share via YouTube or Vimeo. • **Use of AR and VR** (Students can immerse themselves in virtual environments and explore concepts digitally, realistically.) • **Learning apps and mobile platforms:** on smartphones and tablets. Examples from other disciplines include Duolingo (languages) and Khan Academy (mathematics and science) • **Adaptive learning systems:** These systems tailor the learning process to learners' individual needs and progress, providing personalized learning paths. **C. Online discussion forums and social media:** Encourage students to discuss and ask questions
Homework, document / project work (individual project), internship report, draft	• Combination of written elaboration and oral exam / interview

13

Continued Table 5. Changes in traditional forms of teaching, learning, training and evaluation at universities and colleges (OpenAI, 2023), (own elaboration, 2023)

Traditional forms of teaching, learning, training and evaluation	Alternatives using digitalization
Document / project work / scientific project (team project)	• Use of digital tools • Use of tools for group work and communication
Strategy game	• Digital simulation game
Laboratory internship in presence Experimental work	• Internship with accompanying reflection seminar (AI module) • Massive Open Online Courses (MOOCs) are free online courses available for anyone to enroll. MOOCs provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale.
Guest lectures in presence	• Guest lectures online via Zoom • Questions in the chat
Internship	• VR internship
Excursions to companies and trade fairs	• Videos and online discussions
Written exam under supervision with personal presence in the lecture hall (written exam)	• Still possible without digital tools • E-exam room, deliver a text in a specific time frame
Oral exam with 2 examiners with personal presence	• Still possible without digital tools
Written work (project report, Bachelor's thesis, Master's thesis)	• Preparation with the support of digital media with indication of digital sources • Producing digital results (videos)
Colloquia for the presentation and scientific discussion of the results in the personal presence of all participants, presentations	• Still possible without digital tools • Enrichment with digital media

Digitalization will make many forms of study possible in the future: Attendance as direct study (full-time study), part-time study (practice-integrating, part-time, job-integrating), simultaneous study at several locations, distance learning, international study, in addition, simple online access to lifelong continuing education must and will

14

be created. The proportion of teacher-centered forms will decline in favor of student-centered forms.

A good example of studying at different locations is offered by the new bachelor's degree program AI Engineering. In the winter semester 2023/24, the OVGU Magdeburg will start the new bachelor's degree program AI Engineering - Artificial Intelligence in Engineering Sciences (B.Sc.) in cooperation with three other universities in the state of Saxony-Anhalt.

For the future, the bachelor's degree program in AI Engineering opens up a world of opportunities for graduates in different industries. "As an AI expert, you are driving the digital transformation in a company, implementing your own start-up projects with new technological approaches or working in research and development in an academic or industrial context: in any case, thanks to your skills and experience in the field of artificial intelligence, you will be well trained to develop innovative solutions to the technical problems of our time and master the challenges of tomorrow." (AI engineering, 2023) & (Module handbook AI, 2023). Figure 2 visualizes the new learning with AI.
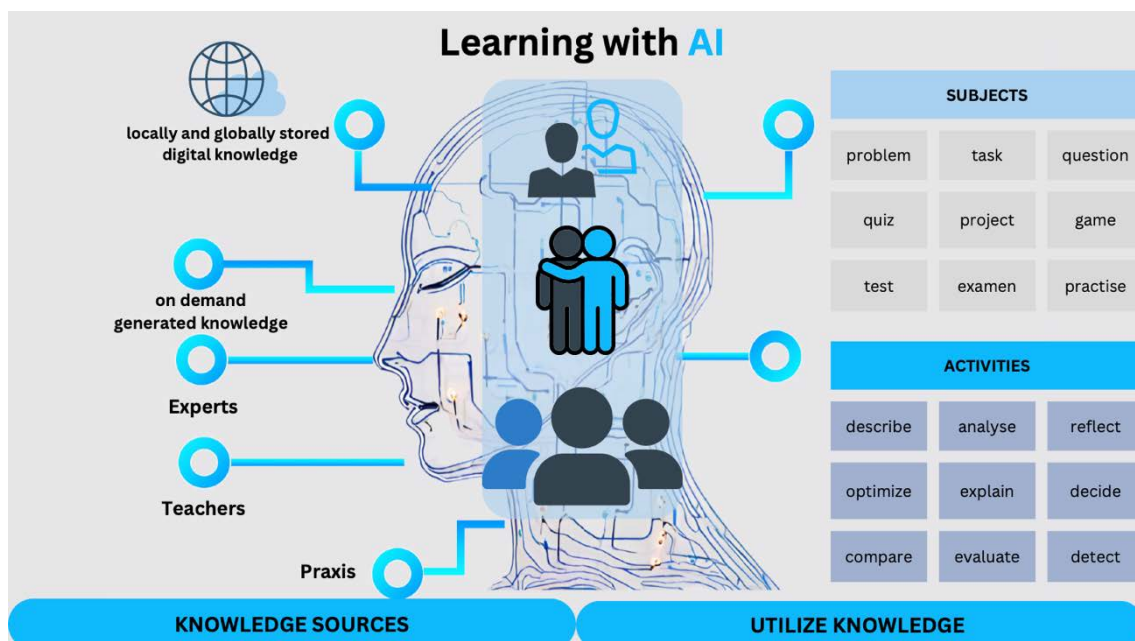

Figure 2: Change of learning with AI in an academic context (own elaboration, 2023)

4. Conclusions

Digitalization and networking have now reached a level of development that fundamentally changes traditional academic forms of teaching and learning and will change them even more radically. A reengineering of academic education becomes necessary.

Instead of completing academic courses face-to-face at universities and then attending further education courses if necessary, the philosophy is moving towards lifelong learning and the permanent acquisition of necessary skills. Since the world of work is very heterogeneous and individual, the necessary skills in demand will (have to) also be individual. Many issues and problems of the present are complex and can only be solved in a multidisciplinary way. Traditional thinking in terms of courses of study and modules with fixed CP seems too inflexible and does not exhaust the available possibilities.

The authors represent the vision that the face-to-face university of the last centuries will be radically transformed. In her new role, she will become a research centre and companion of lifelong academic learning. The classic lecture in the lecture hall is an obsolete model, because basic knowledge can be provided digitally via a wide variety of media and current knowledge can be generated and used on a daily basis. With regard to academic teaching, the tasks of the scientist are shifting to creating digital teaching and learning media together with "digital colleagues". It makes sense to vote on common platforms, for example, in order to avoid pointless duplication of work. Academic teaching becomes a lifelong companion and requires research, tutorial support, coaching, and advising.

The present research results answer three questions:

(1) What are the demands of ICT trends on computer science education?

(2) How does ChatGPT change knowledge acquisition?

(3) What forms of academic training and what types and forms of examinations are appropriate in the age of ChatGPT and AI? The current status of 2023 was recorded through a literature analysis and expert discussions and an attempt was made to roughly characterize the consequences of the current situation and the development of technology and technology in the ICT sector.

16

These developments are changing the vision, structure, form and content of academic education. With regard to ICT trends, this was exemplified in the paper without claiming to be complete. We are looking forward to a lively scientific discussion!

5. Bibliographic references

AI engineering (2023). Anhalt University of Applied Sciences. https://www.hs-anhalt.de/nc/studieren/orientierung/studienangebot/detail/ai-engineering-bachelor-of-science.html

Berlit, M., & Scherf, J. (2018). Intralogistik 4.0. Die Top 4 Digitalisierungstrends in der Intralogistik für 2018. MM Logistik. Vogel, 10, 18.

DHL (2020). The Logistics Trend Radar. 5th Edition. DHL, https://www.dhl.com/global-en/home/insights-and-innovation/insights/logistics-trend-radar.html

Facebook (2023). Evaluation of a chat history of a Facebook group ChatGPT & OpenAI - German-speaking group (DACH). Public group. 6 friends. 104,482 Members

Firat, M. (2023). What ChatGPT means for universities: Perceptions of scholars and students. Journal of Applied Learning and Teaching, 6(1).

Glistau, E., & Coello Machado, N. I. (2019). Logistics 4.0 - solutions and trends. In COMEC 2019, 13 pp. Presented at COMEC2019, June 23rd-30th, 2019, Cayos de Villa Clara, Cuba.

Glistau, E., Coello Machado, N. I., & Trojahn, S. (2022). Logistics 4.0: Goals, trends and solutions. Advanced Logistic Systems - Theory and Practice, 16(1), 5–18. https://doi.org/10.32971/als.2022.001

GVR – Gastvortragsreihe Logistik (2023). Otto von Guericke University. https://www.gvrlog.ovgu.de/

Kruse, R., Borgelt, C., Braune, C., Mostaghim, S. & Steinbrecher, M. (2016). Computational Intelligence. A Methodological Introduction. London. Knight.

Nickel, J. & Ganguin, S. (2023). ‹ Praktisch und überfordernd zugleich›− Lernen und Lehren in der Kultur der Digitalität: Zur Sicht von Lehramtsstudierenden auf entgrenztes Lernen und Lehren. MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung, 53, 76-95.

Module Handbook AI Engineering. (2023). Anhalt University of Applied Sciences. https://www.hs-anhalt.de/fileadmin/Dateien/Bilderpool_HSA/Courses/module_manuals/20230428_MHB_Ba_AiEng.pdf

17

OpenAI. (2023). ChatGPT-3.5: A large-scale generative language model.
https://platform.openai.com/docs/guides/chat/citation

Teaching Forms E-Learning (2020). MMB Institut. https://www.mmb-institut.de/wp-content/uploads/mmb_Vielfalt_Lernformen_neue_Darstellung_2020.jpg

Wehberg, G. G. (2019). Logistik 4.0–die sechs Säulen der Logistik in der Zukunft. In: Göpfert I. (eds.) Logistik der Zukunft - Logistics for the Future. Wiesbaden, Springer Gabler. pp.367-395.

Wikipedia contributors. (2023, August 2). Live coding. In Wikipedia, The Free Encyclopedia. Retrieved 09:16, September 11, 2023, from https://en.wikipedia.org/w/index.php?title=Live_coding&oldid=1168454487

Willems, J. (2023). ChatGPT at universities–the least of our concerns. Available at SSRN 4334162.