Turning Tides in Higher Education? Exploring AI's Roles in Qualification, Self-Education and Socialization

Sandra Hummel[1], Mana-Teresa Donner[1], Rudolf Egger[2]

[1]ScaDS.AI Dresden, TUD Dresden University of Technology, Germany
[2]Department of Educational Sciences, University of Graz, Austria

Abstract: This study examines the transformative potential of AI learning assistants in higher education, emphasizing how these systems reconfigure key educational processes, including qualification, self-education, and socialization. Using a mixed-methods design, combining quantitative survey data from $n = 113$ participants and qualitative focus group discussions ($n = 32$), this research investigates how AI systems such as the VISION AI Mentor affect students' educational experiences. The findings demonstrate that AI systems initiate significant shifts in the dynamics of academic interaction and peer collaboration, giving rise to new modes of engagement and communication. The integration of AI tools introduces a transformative interplay between personalized learning pathways and established academic practices, simultaneously reconfiguring the structures of academic collaboration. These shifts create new opportunities for reimagining how students engage with learning, promoting a more adaptive and responsive educational environment. This transformation enables the coexistence of efficiency and deeper intellectual engagement, encouraging students to navigate learning processes through newly formed patterns of self-regulation and inquiry. The study advocates for a strategic integration of AI that capitalizes on these emerging shifts, ensuring that AI tools serve as enhancers of human-centered educational processes. By aligning AI's capabilities in task automation with the broader objectives of fostering critical thinking and intellectual autonomy, AI can support the redefinition of traditional academic structures.

Keywords: AI in Higher Education, Qualification, Self-Education, Socialization

ahead is to balance the allure of technological advancement with the enduring mission of education, preserving the richness of academic inquiry while embracing the new opportunities AI can offer.

References

Aleks. (2024). About Aleks. https://www.aleks.com/about_aleks

Alzubi, S., Mughaid, A., Quiam, F., & Hendawi, S. (2022). Exploring the Capabilities and Limitations of ChatGPT and Alternative Big Language Models. *Artificial Intelligence and Applications.*

Aron, J. (2011). How innovative is Apple's new voice assistant. Siri. *NewScientist, 212*(2836), 24.

Bartok, L., Donner, M.-T., Ebner, M., Gosch, N., Handle-Pfeiffer, D., Hummel, S., Kriegler-Kastelic, G., Leitner, P., Tang, T., Veljanova, H., Winter, C., & Zwiauer, C. (2023). Learning Analytics – Studierende im Fokus. *Zeitschrift für Hochschulentwicklung: ZFHE; Beiträge zu Studium, Wissenschaft und Beruf, 18* (Sonderheft Hochschullehre), 223-250. https://doi.org/10.3217/zfhe-SH-HL/12

Benotti, L., Martnez, M. C., & Schapachnik, F. (2018). A tool for introducing computer science with automatic formative assessment. *IEEE Transactions on Learning Technologies, 11*(2), 179-192. https://doi.org/10.1109/TLT.2017.2682084

Bohlinger, S., & Hummel, S. (2024). Digital Capacity Building in Teacher Education: An Environmental Case Study from Cambodia. In S. Hummel (Ed.), *Empowering Education in Cambodia and Sri Lanka: Advancing Quality in 21st Century Teaching and Learning* (pp. 31-50). Springer. https://doi.org/10.1007/978-3-658-43306-2_3

Biesta, G. (2020). Risking ourselves in education: Qualification, socialization, and subjectification revisited. *Educational Theory, 70*(1), 89-104.

Birks, M., & Mills, J. (2015). *Grounded Theory: A Practical Guide* (2nd ed.). Springer.

Carnegie Learning. (2024). MATHia – The 1-to-1 math coach that makes your life easier. https://www.carnegielearning.com/solutions/math/mathia/

Chen, L, Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access, 8*, 75264-75278. https://doi.org/10.1109/ACCESS.2020.2988510

Colby, K. M. (1972). PARRYing. *Behavioral and Brain Sciences, 4*(4), 550–560.

Cooper, G. (2023). Examining science education in chatgpt: An exploratory study of generative artificial intelligence. *Journal of Science Education and Technology, 32*(3), 444-452.

Coursera Blog. (2017, October 17). New on Coursera: Start-to-finish learning paths for starting a new career. *Coursera*. https://blog.coursera.org/new-on-coursera-start-to-finish-learning-paths-for-starting-a-new-career/

Crawford, J., Cowling, M., & Allen, K.-A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching and Learning Practice, 20*(3), 02.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and Conducting Mixed Methods Research* (3rd ed.). SAGE Publications.

Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education, 20*(1), 1-22.

Cunningham-Nelson, S., Boles, W., Trouton, L., & Margerison, E. (2019). A review of chatbots in education: practical steps forward. In *30th annual conference for the Australian Association for engineering education* (AAEE 2019): educators becoming agents of change: innovate, integrate, motivate (pp. 299–306).

Currie, E., Harvey, P. H., Daryanani, P., Augusto, J. C., Arif, R., & Ali, A. (2016). An Investigation into the Efficacy of Avatar-Based Systems for Student Advice. *EAI Endorsed Transactions on e-Learning*, 3(11).

de Sales, A. B., & Antunes, J. G. (2021). Evaluation of educational games usage satisfaction. *16th Iberian Conference on Information Systems and Technologies* (CISTI), 1-6.

de Witt, C., Rampelt, F., & Pinkwart, N. (2020). *Künstliche Intelligenz in der Hochschulbildung*. KI Campus. https://ki-campus.org/sites/default/files/2020-10/Whitepaper_KI_in_der_Hochschulbildung.pdf

Diederich, S., Brendel, A., Morana, S., & Kolbe, L. (2022). On the Design of and Interaction with Conversational Agents: An Organizing and Assessing Review of Human-Computer Interaction Research. *Journal of the Association for Information Systems, 23*(1), 96-138.

Dilger, B., Gommers, L., & Rapp, C. (2019). The Learning Problems Behind the Seams in Seamless Learning. In C.-K. Looi, L.-H. Wong, C. Glahn & S. Cai (Hrsg.), *Seamless Learning: Perspectives, Challenges and Opportunities* (pp. 29-51). https://doi.org/10.1007/978-981-13-3071-1_2

Döring, N. (2023). Wissenschaftstheoretische Grundlagen der empirischen Sozialforschung. In N. Döring (Ed.), *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften* (pp. 31-78). Springer. https://doi.org/10.1007/978-3-662-64762-2_2

Egger, R. (2016). *Qualität in Studium und Lehre. Kompetenz- und Wissensmanagement im steirischen Hochschulraum.* Springer. https://doi.org/10.1007/978-3-658-13738-0

Egger, R., & Hummel, S. (2016). *Lernweg Schulweg. Sozialräumliche Annäherungen an ein Alltagsphänomen*. Springer. https://doi.org/10.1007/978-3-658-10518-1

Egger, R., & Hummel, S. (2020). *Stolperstein oder Kompetenzstufe. Die Studieneingangsphase und ihre Bedeutung für die Wissenschaftssozialisation von Studierenden.* Springer VS. https://doi.org/10.1007/978-3-658-23283-2

Egger, R. (2022). Herausforderung durch Anerkennung. Wissenschaftssozialisation zwischen Zufall, Neugier, Curriculum und Prüfung. In G. Reinmann & R. Rhein (Eds.), *Wissenschaftsdidaktik 1. Einführung* (pp. 199-220). Transcript. https://doi.org/10.1515/9783839460979-010

Egger, R., & Hummel, S. (2020). *Stolperstein oder Kompetenzstufe? Die Studieneingangsphase und ihre Bedeutung für die Wissenschaftssozialisation von Studierenden*. Springer. https://doi.org/10.1007/978-3-658-23283-2

Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., & Baah, P. K. (2022). The influence of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *International Journal of Educational Technology in Higher Education, 19*(1), 1-19.

Fariani, R. I., Junus, K., & Santoso, H. B. (2023). A systematic literature review on personalised learning in the higher education context. *Technology, Knowledge and Learning, 28*(2), 449-476.

Fauzi, F., Tuhuteru, L., Sampe, F., Ausat, A. M. A., & Hatta, H. R. (2023). Analysing the role of ChatGPT in improving student productivity in higher education. *Journal on Education, 5*(4), 14886-14891.

Filho, A. H., Viecelli, K., do Prado, H. A., Ferneda, E., Thalheimer, J., & da Rocha Fernandes, A. M. (2021). An Adaptive and Proactive Interface Agent for Interactivity and Decision-Making Improvement in a Collaborative Virtual Learning Environment. In *Enterprise Information Systems. ICEIS 2020. Lecture Notes in Business Information Processing*, *22nd International Conference on Enterprise Information Systems, ICEIS 2020*, Springer Science and Business Media Deutschland GmbH, 612-634.

Gnewuch, U., Morana, S., & Maedche, A. (2017). Towards designing cooperative and social conversational agents for customer service. *Proceedings of the 38th international conference on information systems (ICIS).*

Gradescope. (2024). Deliver and Grade Your Assessments Anywhere. https://www.gradescope.com

Grosz, B. J., & Stone, P. (2018). A Century Long Commitment to Assessing Artificial Intelligence and Its Influence on Society. *Communications of the ACM, 61*(12), 68-73. http://dx.doi.org/10.1145/3198470

Gubareva, R., & Lopes, R. P. (2020). Virtual Assistants for Learning: A Systematic Literature Review. *CSEDU 2020 – Proceedings of the 12th International Conference on Computer Supported Education*, 97-103.

Gulz, A., Haake, M., Silvervarg, A., Sjödén, B., & Veletsianos, G. (2011). Building a social conversational pedagogical agent: Design challenges and methodological approaches. In *Conversational agents and natural language interaction: Techniques and effective practices* (pp. 128–155). IGI Global.

Gupta, S., K. Jagannath, N. Aggarwal, R. Sridar, S. Wilde, & Y. Chen. (2019). Artificially Intelligently (AI) Tutors in the Classroom: A Need Assessment Study of Designing Chatbots to Support Student Learning. In D. Xu, J. Jiang J. & H.-W. Kim (Eds.), *Proceedings of the 23th Pacific Asia Conference on Information System*, Association for Information Systems.

Handke, J. (2020). Humanoide Roboter. Showcase, Partner und Werkzeug. Tectum.

Harvard Business School Digital Initiative. (2021, April 21). Knewton personalizes learning with the power of AI. Digital Innovation and Transformation. https://d3.harvard.edu/platform-digit/submission/knewton-personalizes-learning-with-the-power-of-ai/

Haw, J. Y., & King, R. B. (2023). Understanding Filipino students' achievement in PISA: The roles of personal characteristics, proximal processes, and social contexts. *Social Psychology of Educ*ation, *26*, 1089-1126. https://doi.org/10.1007/s11218-023-09773-3

Herrera, A., Yaguachi, L., & Piedra, N. (2019). Building Conversational Interface for Customer Support Applied to Open Campus an Open Online Course Provider. In M. Chang, D. G. Sampson, R. Huang, A. S. Gomes, N.-S. Chen, I. I. Bittencourt, K. Kinshuk, D. Dermeval & I. M. Bittencourt (Eds.), *Proc. - IEEE Int. Conf. Adv. Learn. Technol., ICALT, Institute of Electrical and Electronics Engineers Inc.*, pp. 11-13.

Hobert, S., & von Wolff, M. R. (2019). Say hello to your new automated tutor – a structured literature review on pedagogical conversational agents. *14th International Conference on Wirtschaftsinformatik, Siegen, Germany.*

Huber, L. A. (2009). Warum Forschendes Lernen nötig und möglich ist. In L. Huber, J. Hellmer & F. Schneider (Eds.), *Forschendes Lernen im Studium* (pp. 9-35). Universitäts-Verlag Webler. 10.5771/9783845236605-59

Hummel, S. (2020). *Grundlagen der Hochschullehre*. Springer. https://doi.org/10.1007/978-3-658-28181-6

Hummel, S. (2021). Chatbots in Forschungsgeleiteter Lehre. *FNMA Magazin, 01*, 19-20.

Hummel, S., Aldrian, S., & Sheehan, B. (2024). Culture, Education and Digital Transformation in Sri Lanka. In S. Hummel (Ed.), *Empowering Education in Cambodia and Sri Lanka: Advancing Quality in 21st Century Teaching and Learning* (pp. 9-29). Springer. https://doi.org/10.1007/978-3-658-43306-2_2

Hummel, S., Bohlinger, S., & Sheehan, B. (2024). Modern Pedagogies in the Digital Era: Elevating Educational Standards in Teacher Education. In S. Hummel (Ed.), Empowering Education in Cambodia and Sri Lanka: Advancing Quality in 21st Century Teaching and Learning (pp. 65-76). Springer. https://doi.org/10.1007/978-3-658-43306-2_5

Hummel, S., Brodacz-Geier, M., & Sheehan, B. (2024). Pedagogical Professionalization in Digital Contexts. In S. Hummel (Ed.), *Empowering Education in Cambodia and Sri*

Lanka: Advancing Quality in 21st Century Teaching and Learning (pp. 203-219). Springer. https://doi.org/10.1007/978-3-658-43306-2_13

Hummel, S., Köhler, T., Brouwer-Zupanicic, N., Egger, R., & Rieger, M. (2023). Empowering Students with AI-based Chatbot Assistants: A New Era of Higher Education? In T. Köhler, E. Schopp, N. Kahnwald & R. Sonntag (Eds.). *Gemeinschaft in Neuen Medien. Digitalität und Diversität. Mit digitaler Transformation Barrieren überwinden!?* Proceedings of 26thConference *in Neuen Medien (pp. 38-43)*. TUDpress. https://doi.org/10.25368/2024.7

Hummel, S. (2024; in press). Learning with AI – a Surface Phenomenon? *Heliyon*.

Hummel, S., & Donner, M.-T. (2023). KI-Anwendungen in der Hochschulbildung aus Studierendenperspektive. *FNMA Magazin, 3*, 38-41. https://doi.org/10.13140/RG.2.2.13967.97446

Hummel, S., Donner, M.-T., & Egger, R. (2023). *Lehren mit Learning Analytics. Qualifizierungsprogramm für die Hochschullehre*. Universität Graz. https://oer-portal.uni-graz.at/edu-sharing/components/collections?viewType=1&id=df2fc7c7-b832-421b-acec-764181c6c2f0

Hummel, S., Egger, R., & Donner, M.-T. (2023). Lehren mit KI: Learning Analytics für mehr Studierendenorientierung in der Hochschullehre? In T. Köhler, E. Schopp, N. Kahnwald & R. Sonntag (Eds.), *Gemeinschaft in Neuen Medien. Digitalität und Diversität. Mit digitaler Transformation Barrieren überwinden!? 26. Workshop GeNeMe'23 Gemeinschaften in Neuen Medien* (pp. 7-16). TUDpress. https://doi.org/10.25368/2024.7

Hummel., S., & Donner, M.-T. (2024). *The Dual Influence of AI in Academia: From Deskilling Risks to Upskilling Opportunities.* ARQUS Online Workshop.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher, 33*(7), 14-26. https://doi.org/10.3102/0013189X033007014

Kabiljo, M., Vidas-Bubanja, M., Matic, R., & Zivkovic, M. (2020). Education system in the republic of Serbia under COVID-19 conditions: Chatbot-academic digital assistant of the Belgrade business and Arts Academy of applied studies. *Knowledge-International Journal, 43*(1), 25-30.

Kaharuddin, A. (2021). Assessing the effect of using artificial intelligence on the writing skill of Indonesian learners of English. *Linguistics and Culture Review, 5*(1), 288.

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., Stadler, M., Weller, J., Kuhn, J., & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, 102274. https://doi.org/10.1016/j.lindif.2023.102274

Khan, M. A., Asadi, H., Zhang, L., Chalak Qazani, M. R., Oladazimi, S., Kiong Loo, C., Peng Lim, C., & Nahavandi, S. (2024). Application of artificial intelligence in cognitive load analysis using functional near-infrared spectroscopy: A systematic review. *Expert Systems with Applications, 249*, 123717. https://doi.org/10.1016/j.eswa.2024.123717

Kiesler, N. (2024). Approaching the Concept of Competency. In N. Kiesler (Ed.), *Modeling Programming Competency* (pp. 17-36). Springer. https://doi.org/10.1007/978-3-031-47148-3_2

Konecki, M., Konecki, M., & Biškupić, I. (2023). Using artificial intelligence in higher education. In *Proceedings of the 15th International Conference on Computer Supported Education*.

Konrad, K. (2014). Selbstgesteuertes Lernen: Begriffsbestimmung und Entwicklung. In K. Konrad (Ed.), Lernen lernen – allein und mit anderen. Springer VS. https://doi.org/10.1007/978-3-658-04986-7_4

Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: systematic literature review. *International Journal of Education and Technology in Higher Education, 20*, 56. https://doi.org/10.1186/s41239-023-00426-1

Lang, S. (2023). Einleitung und Kontext der Studie: Hochschuldidaktik und Forschendes Lernen in der Lehrkräftebildung. In S. Lang (Ed.), *Unterrichtenlernen und Forschenlernen* (pp. 1-12). Springer VS. https://doi.org/10.1007/978-3-658-42581-4_1

Langemeyer, I. (2018). Enkulturation in die Wissenschaft durch forschungsorientiertes Lehren und Lernen. In M. Kaufmann, A. Satilmis & H. Mieg (Eds.), *Forschendes Lernen in den Geisteswissenschaften* (pp. 59-77). Springer VS. https://doi.org/10.1007/978-3-658-21738-9_4

Lee, S. (2021). Erforschung der Hochschulbildung als akademische Selbstbildung von Studierenden. *CGHE Arbeitspapier 76. Oxford: ESRC/RE Centre for Global Higher Education.* https://www.researchcghe.org/publications/working-paper/researching-higher-education-as-students-academic-self-formation/

Mabunda, K. (2020). An intelligent chatbot for guiding visitors and locating venues. *6th Intl. Conference on Soft Computing & Machine Intelligence.*

Marginson, S. (2023). Hochschulbildung als studentische Selbstbildung. In S. Marginson, B. Cantwell, D. Platonova & A. Smolentseva (Eds.), *Assessing the Contributions of Higher Education* (pp. 61-87). Edward Elgar.

Masters, K. (2023). Ethical use of artificial intelligence in health professions education: AMEE Guide No. 158. *Medical Teacher, 45*(6), 574-584.

McTear, M., Callejas, Z., & Griol, D. (2016). *The conversational interface* (Vol. 10, pp. 978). Springer.

Miao, H., & Ahn, H. (2023). Influence of ChatGPT on interdisciplinary nursing education and research. *Asian/pacific Island Nursing Journal, 7*(1), e48136.

Müller-Werder, C., & Erlemann J. (Hrsg.) (2020), *Seamless Learning – lebenslanges, durchgängiges Lernen ermöglichen*. Waxmann. https://doi.org/10.31244/9783830992448

Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence, 2,* 100033.

Pérez, J. Q., Daradoumis, T., & Puig, J. M. M. (2020). Rediscovering the Use of Chatbots in Education: A Systematic Literature Review. *Computer Applications in Engineering Education, 28*(6), 1549-1565.

Plass, J. L., & Pawar, S. (2020). Toward a taxonomy of adaptivity for learning. *Journal of Research on Technology in Education*, *52*(3), 275-300. https://doi.org/10.1080/15391523.2020.1719943

Rahaman, M. S., Ahsan, M. M., Anjum, N., Rahman, M. M., & Rahman, M. N. (2023). The AI race is on! Google's Bard and OpenAI's ChatGPT head to head: An opinion article. *SSRN.* http://dx.doi.org/10.2139/ssrn.4351785

Renz, A. (2021). KI in der Bildung: Educational Technology und KI. In I. Knappertsbusch & K. Gondlach (Eds.), *Arbeitswelt und KI 2030* (pp. 381-388). Springer. https://doi.org/10.1007/978-3-658-35779-5_39

Riedel, A., & Mörth, M. (2023). Mit künstlicher Intelligenz die Hochschullehre neu gestalten. *Online-Ressource des BZHL.* https://www.tu.berlin/bzhl/ressourcen-fuer-ihre-lehre/ressourcen-nach-themenbereichen/ki-in-der-hochschullehre

Rudolph, J., Tan, S., & Tan, S. (2023). War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its influence on higher education. *Journal of Applied Learning and Teaching, 6*(1).

Schiff, D. (2021). Out of the laboratory and into the classroom: the future of artificial intelligence in education. *AI & Society, 36*(1), 331-348.

Schmohl, T., Watanabe, A., & Schelling, Kathrin (2023). Künstliche Intelligenz in der Hochschulbildung: Chancen und Grenzen des KI-gestützten Lernens und Lehrens. Eine Einführung in die Beiträge des Bandes. In T. Schmohl, A. Watanabe & K. Schelling (Hrsg.),

Künstliche Intelligenz in der Hochschulbildung (pp. 7-26). Transkript. https://doi.org/10.14361/9783839457696-001

Schönmann, M., & Uhl, M. (2023). Eine ethische Perspektive auf KI in der Bildung. In C. de Witt, C. Gloerfeld & S. E. Wrede (Eds.), *Künstliche Intelligenz in der Bildung* (pp. 433-453). Springer VS. https://doi.org/10.1007/978-3-658-40079-8_21

Sharef, N. M., Azmi Murad, M. A., Mansor, E. I., Nasharuddin, N. A., Omar, M. K., Samian, N., Arshad, N. I., Ismail, W., & Shahbodin, F. (2020). Learning-Analytics Based Intelligent Simulator for Personalised Learning. In *International Conference on Advancement in Data Science, E-learning and Information Systems (ICADEIS2020)*, Institute of Electrical and Electronics Engineers Inc.

Shoufan, A. (2023). Exploring Students' Perceptions of CHATGPT: Thematic Analysis and Follow-Up Survey. *IEEE Access.*

Smart Sparrow. (2024). Design. Create. Deliver. https://www.smartsparrow.com

Stephen, J. S. (2024). Academic and Social Integration. In: Academic Success in Online Programs. In J. S. Stephen (Ed.), *Springer Texts in Education* (pp. 77-92). Springer. https://doi.org/10.1007/978-3-031-54439-2_6

Strauss, A., & Corbin, J. (1994). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 273-285). Sage Publications.

Tahiru, F. (2021). AI in education: A systematic literature review. *Journal of Cases on Information Technology (JCIT), 23*(1), 1-20.

Timotheou, S., Miliou, O., Dimitriadis, Y. et al. (2022). Influences of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technologies, 28*, 6695-6726. https://doi.org/10.1007/s10639-022-11431-8

Von Thiessen, R., & Volz, S. (2023) *Künstliche Intelligenz in der Bildung. Rechtliche Best Practices.* Kanton Zürich. https://www.zh.ch/content/dam/zhweb/bilder-dokumente/themen/wirtschaft-arbeit/wirtschaftsstandort/dokumente/best_practices_ki_bildung_de_v2.pdf

Weitz, K. (2023). Erklärbare Künstliche Intelligenz im Kontext von Bildung und Lernen. In C. de Witt, C. Gloerfeld & S. E. Wrede (Eds.), *Künstliche Intelligenz in der Bildung* (pp. 413-432). Springer VS. https://doi.org/10.1007/978-3-658-40079-8_20

Weizenbaum, J. (1966). ELIZA – A computer program for the study of natural language communication between man and machine. *Communications of the ACM, 9*(1), 36-45.

Winkler, R., & Söllner, M. (2018). Unleashing the potential of chatbots in education: A state-of-the-art analysis. *Academy of management annual meeting (AOM).*

Winkler, R., M. Söllner, M. L. Neuweiler, F. Conti Rossini, & J. M. Leimeister. (2019). Alexa, Can You Help Us Solve This Problem? How Conversations With Smart Personal Assistant Tutors Increase Task Group Outcomes. *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, New York: Association for Computing Machinery, 1-6.

Wollny, S., Schneider, J., Di Mitri, D., Weidlich, J., Rittberger, M., & Drachsler, H. (2021). Are we there yet? – A systematic literature review on chatbots in education. *Frontiers in Artificial Intelligence, 4,* 654924.

Wong, L.-H., & Looi, C.-K. (2011). What seams do we remove in mobile assisted seamless learning? A critical review of literature. *Computers & Education, 57*(4), 2364-2381.

Zajda, J. (2023). The Influence of Motivation on Students' Engagement and Performance. In J. Zajda (Ed.), *Globalisation and Dominant Models of Motivation Theories in Education. Globalisation, Comparative Education and Policy Research*, Vol. 39 (pp. 127-138). Springer. https://doi.org/10.1007/978-3-031-42895-1_9

Zawacki-Richter, O., Marín, V.I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Education Technology in Higher Education, 16*, 39.

Zhang, Q. (2023). Investigating the effects of gamification and ludicization on learning achievement and motivation: An empirical study employing Kahoot! and Habitica. *International Journal of Technology-Enhanced Education (IJTEE), 2*(1), 1-19.