www.ijprems.com
editor@ijprems.com

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 04, Issue 11, November 2024, pp : 2004-2010

e-ISSN : 2583-1062
Impact Factor : 7.001

ROLE OF ARTIFICIAL INTELLIGENCE IN EDUCATION ADVANCEMENT

Tanushka M. Lokegaonkar[1], Prof. G. Anburaj[2]

[1]School of Computer Science and Engineering Vellore Institute of Technology, Vellore-632 014, Tamil Nadu, S. India.
tanushka.lokegaonkar2023@vitstudent.ac.in

[2]Assistant Professor of English Vellore Institute of Technology, Vellore-632 014, Tamil Nadu, S. India.
anburaj.g@vit.ac.in

DOI: https://www.doi.org/10.58257/IJPREMS37195

ABSTRACT

The working principles of AI-driven tools are based on progressive learning algorithms that allow data to program itself. These tools find patterns in data to develop skills. They can use real-time or existing data to analyse and adapt to changes quickly. For instance, personalized learning apps observe user habits and adjust teaching methods accordingly. This makes learning more user-friendly, compared to traditional classroom settings where individual attention is limited.

Students benefit from the use of AI in education. AI, however, now makes these tasks easier and can be achieved in a snap of time with the help of apps like Duolingo for language learning or scheduling reminders using Google Assistant. With AI in learning, it stretches itself to interactively train students and offer them real-time feedback, and lessons are built uniquely per student response, making the process of supporting a child more effectively rendered.

AI has played a part in the changing role of teachers. AI to completely replace teachers someday is a lone probability; however, it will mostly work as an aid enabling human instructors to do their jobs more easily. AI tools allow teachers to do anything from attendance and grading through policed chatbots, simulations, or gamification-style learning experiences.

However, it is important to strike a balance with technology use, especially for the younger generation, to ensure that creativity is not stifled. Overreliance on technology can have negative effects on health, so it is crucial to maintain a balance between technology use and personal well-being.

Keywords: 1: Working Principles of AI, 2: Impact of AI on students' life, 3: Impact of AI implementation on Teachers, 4: Impact of AI on creative thinking among students, 5: Exploring ways to minimize Over reliance on AI, 6: Things that are to be improved

1. INTRODUCTION

AI is a part of our everyday lives and often do not realize how it has the power to transform the way we perceive, think, or interact. Since the beginning, when it arrived, AI has grown and blossomed. It affected the things around us—like light switches, which have now turned into voice-controlled systems. Similarly, AI has transformed our education system so much that it is just the surface of what we are going to see in the future concerning AI. In this write-up, we singled out a few of these popular research areas and built the article around them.

Artificial intelligence has proved to be a revolutionizing agent in every sector, whether it's personalized online education systems, medicine, automobiles, manufacturing (robotics), finance (automated/algorithmic trading), media, communication, agriculture, and energy distribution. Since every individual is different in the sense that they have distinctive learning styles, abilities, and needs, teaching all students through traditional means of education can be challenging. In any case, the personalized learning systems of AI have already largely solved this issue.

Step 1: Start with how AI works. In effect, AI is a form of personalized CCTV — so all depends on how it is taken up and used. If you should use any personalized learning AI tool (i.e. Duolingo, Cognition, Squirrel), it will analyse your response and make changes that are more user-friendly for the experience of users. In short, AI runs on the database either given to it or data gathered through analysing user responses.

This paper navigates the changes that emerged in education due to AI. We will also deep dive into the specific applications of AI in various subdomains within education to enhance them at present. It will, moreover, discuss the way AI changes students' lives and what remains to be discovered/developed by students themselves (opinion).

AIMS

The study is trying to examine how AI has redefined the entire educational system by looking at how students are engaged, considering the various teaching methods used and learning processes. The benefits of AI in the education system show that traditional models are being replaced by more personalized learning experiences.

www.ijprems.com
editor@ijprems.com
INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 04, Issue 11, November 2024, pp : 2004-2010
e-ISSN : 2583-1062
Impact Factor : 7.001

PROBLEM STATEMENT

The increasing pace of technological development and the growing complexity of global issues have led universities to realize they need to rethink their academic approaches. AI plays a major role in this. Since its introduction, AI has made significant improvements, such as increasing learning outcomes like active and critical thinking through real-world problem-solving abilities among students. It has also automated grading, reducing the operational workload of teachers. However, there's still a long way to go before AI can be universally applied in education. There are both opportunities and challenges with AI in education. Every technology has its pros and cons, and AI is no exception. While AI offers many personalized tools to ease the workload of both teachers and students, there are concerns about data privacy, transparency in decision-making, and whether institutions have enough resources to fully implement AI. This research study provides insights into AI implementation and its potential future improvements in the educational sector by addressing these challenges.

RESEARCH GAP

The main gap identified in this study is the need to understand how AI systems are affecting learner-instructor interaction in online learning, along with risks and concerns about responsibility. Despite AI's growing prominence, there is limited research on how well it works across different institutions. Additionally, data privacy issues and the reliability of results—especially from students' perspectives—are yet to be resolved. Moreover, there is little research on how well students are being prepared for the changing demands of the workforce through AI-driven education.

2. LITERATURE REVIEW

The evolution of academic approaches in universities has been largely influenced by technological advancements to address global challenges. Traditionally, professors were the main sources of knowledge, and learning was lecture-based. However, as technology has advanced, universities have integrated more digital tools, leading to dynamic and interactive learning environments. AI has played a key role in this transformation, with online courses, virtual classrooms, and interactive software redefining traditional teaching methods and promoting active learning and critical thinking.

3. RESULT ANALYSIS

1. Basic working principles of AI driven tools

AI-driven tools function based on their primary operations. The first step is learning by examples. Progressive learning happens without human supervision, where data drives the programming. AI identifies patterns and regularities in data, allowing algorithms to make predictions. In other words, data (real-time or pre-existing) is the key to how AI works. For example, in personalized learning apps, AI collects real-time data and observes users' habits or mistakes, adjusting its teaching patterns accordingly to make the experience more user-friendly. Compared to a teacher managing a class of 50-60 students, where personal attention is hard to provide, these apps have become essential for students. Regarding pre-collected data, AI tools like chatbots use this data to provide direct answers to questions. Previously, students had to consult numerous books and articles, often encountering irrelevant sources. In such cases, AI is very useful, providing precise information.

2. Positive Impact of AI on students' life

The use of AI-driven learning methods has been a pivotal shift in modern education. This evolution is not just a trend but a response to the growing demand for more dynamic, flexible, and globally accessible learning environments. It decreases the workload on students, a lot of things that would take time to do manually can be done easily using AI. Using AI effectively makes the everyday chores of a student more feasible. From making a daily timetable and a reminder to follow it to preparing PowerPoint presentations more representative, learning a new language, or increasing proficiency in a particular topic/language through personalized learning apps (Duolingo, Udemy, etc) AI is found to be very applicable. It takes learning experience to another level through interactive learning methods. Although there are no physical consultations in this technology, but the way it keeps its users focused is impressive.

In all, if a student knows how to make use of AI effectively, he/she will succeed. According to the observations made, the students who know how to make use of AI-driven tools effectively are doing well in both academic as well as in extracurricular activities. From students' perspective, the ethical use of AI in academics not only helps to improve grades but also helps to improve personal skills. As the use of AI tools saves a lot of time, one can spend his/her remaining time sharpening their skills or focusing on their field of interest. This may help in fostering new skills apart from academics which will indeed be beneficial for them in the future. The benefits of technology-driven learning extend beyond engagement. Real-time feedback and personalized learning paths enable students to receive the support they need more quickly and efficiently.

3. **Impact of AI implementation on Teachers**

Although it seems that AI might replace teachers in the future, some things can never be replaced. According to the observations made, some students still prefer learning through the teacher. According to them, teachers are their priority, and they use AI only when it is most needed. This perspective is also right as the feelings of a person can be understood by another person. No AI tool has yet been developed that can understand human emotions and can give solutions or guide anyone accordingly. This can only be done by someone who has gone through it and has had experience with it.

Indeed, AI will best be applied as a supplement tool to make teachers' jobs easier. A lot of AI-driven tools are being developed that would help teachers in different ways. AI tools like QuillBot can generate the code on its own based on the topics provided by the teacher. The usage of Artificial Intelligence not only reduces the workload on students but also teacher's workload as nowadays starting from taking attendance to grade calculations everything can be atomized. Face recognition for attendance, Quillbot, Yippity, Quizlet, etc for generating quizzes, Gradescope for auto-generating grades, or a few of the commonly used AI tools among teachers. AI can also help teachers to create more engaging and interactive lessons, using tools such as chatbots, simulation, and gamification. Moreover, AI can enable teachers to collaborate with students and experts across the world, sharing best practices and resources.

4. **The Impact of AI on creative thinking among students**

Every coin has two sides; similarly, AI also has its boons and curses. Relying too much on technology can hurt our health, so it's important to have a proper balance between using technology and taking care of ourselves. Overreliance on technology is not good for young generation as he/she is in their developing stage. In this stage, the creativity of youth is at its peak, and a lot of new ideas pop up in the mind of youth which can further lead to the discovery of new things. Overreliance on AI tools to generate new ideas for projects or any other thing can hinder this process of creative thinking and developing oneself.

As mentioned earlier only ethical use of AI can be very helpful for both one's development as well as the development of society. Although AI helps in increasing critical thinking at the same time it has a huge impact on the creative thinking of students. Relying on self-instinct is always a better solution when it comes to creating something new, as the creative suggestions generated by AI are often based on patterns, existing data, and known designs. This could limit students' capacity to develop truly innovative ideas, as they might be nudged towards solutions that are more formulaic or common, rather than groundbreaking.

With AI tools handling much of the "grunt work," students may miss out on learning the craft of art, writing, or design, which often involves deep, hands-on engagement. This loss of skill-building might hinder long-term creativity and the ability to think critically and solve problems manually. AI-generated works raise questions of ownership and authorship, which can affect how students approach creative tasks. The uncertainty around the intellectual property of AI-assisted work may diminish the value placed on originality and innovation.

5. **Exploring ways to minimize Over reliance on AI**

As mentioned above reliance not only on AI tools as well as any other technology is not good both physically and mentally. Minimizing over-reliance on AI, especially in creative and educational settings, is crucial for ensuring that students continue to develop their independent thinking, problem-solving, and creative skills. So, to reduce over-reliance on AI we are going to see a few ways to overcome this issue. According to observations made, students tend to prefer a "Personalised Learning Plan". As no one knows you better than you, you can create a personalized learning plan that suits you the best.

It starts with a detailed assessment of the student's strengths, weaknesses, interests, and learning preferences. At this point, self-realization is one thing that will help students. AI can help identify areas where students excel and where they need improvement, but the focus should be on understanding the student's unique capabilities. Clearly define goals that involve both manual work and AI-assisted work. For example, a goal could be to draft an essay or design a piece of artwork without AI first, and then refine it using AI for enhancements. This approach reinforces foundational skills before AI enters the creative process.

Another effective approach would be Project-based learning. It is an educational approach where students actively explore real-world problems and challenges over an extended period, leading to deeper learning, engagement, and skill development. Engaging in real-world problem solving that requires hands-on research, experimentation, and creativity can be an effective as well as an interesting way to learn new things rather than use AI to do so. After completing a project, students can analyse what they learned, how they solved problems, and how much of their

work was influenced by AI. This reflection helps them recognize their strengths and areas where they can improve without technology.

6. **Things that are to be improved**

As we all know AI is still in its developing stage hence there are a lot of things that still need to be improved. Let's investigate some of the scenarios that need improvement. From the perspective of students, Privacy protection is one of the main concerns. As discussed, earlier AI works on either originally existing data or data collected through real-time observations made. This can cause serious privacy issues. Using AI-driven tools frequently is like you are being watched through a surveillance camera. AI tools are designed in such a way that they keep track of your every search and that's how videos or news that we are interested in pop up every time we open Google or YouTube. This provision is made to keep the user updated according to their field of interest.

Another point of concern from the perspective of students is that AI is not that accurate precise or reliable. One of the reasons behind this can be the data on which the AI tool is trained may not be updated from time to time. AI models like ChatGPT are trained on vast datasets collected from the internet, books, and other sources, but these datasets may contain inaccuracies, outdated information, or even biased content. Since AI is only as reliable as the data it is trained on, if the training data includes misinformation, the AI can inadvertently propagate false or misleading information.

4. DISCUSSION ON RESULTS

AI-driven learning has brought about both significant benefits and notable challenges. Digital tools such as virtual labs, online quizzes, and multimedia resources have promoted active learning and enhanced engagement. These tools accommodate various learning styles, making education more accessible and flexible, allowing students to learn at their own pace and from any location. The increased accessibility to global resources and collaboration opportunities has also prepared students for an interconnected workforce, enabling them to engage with diverse perspectives and global issues.

The advantages of technology-driven learning go beyond just keeping students engaged. Real-time feedback and personalized learning paths help students get the support they need quickly and efficiently. This personalized approach allows students to concentrate on areas where they need to improve. Additionally, gamification techniques help motivate students and encourage them to take an active role in their education. The use of simulations and interactive tools has been particularly effective in fields such as medicine and engineering, enabling students to bridge the gap between theory and practice and gain a deeper, more practical understanding of complex subjects. However, the results also highlight several challenges. Overreliance on AI can have a negative impact on health. It's important to balance technology use with self-care, especially for the young generation. Overusing AI tools can hinder creativity and independent thinking in students. Minimizing over-reliance on AI in educational settings is crucial for fostering critical thinking and problem-solving skills. Personalized learning plans and project-based learning are effective ways to reduce dependence on AI and promote hands-on engagement. The results also underscore the areas in AI that need improvement. For students, privacy protection is a major concern. AI tools track user activities, which can feel like constant surveillance. Additionally, AI may not always be accurate or reliable due to outdated or biased training data.

UNEXPECTED FINDING

One surprising outcome from the research is that students are more concerned about the accuracy of results than they should be about privacy when using AI tools. Students may view the potential privacy risks as distant or abstract, whereas prioritize the benefits of accurate AI-assisted results which offer immediate academic advantages. When faced with the choice between getting quick, correct answers and worrying about the hypothetical misuse of data, many students may choose to prioritize the short-term benefit of high-quality academic results.

5. SCOPE OF FURTHER RESEARCH

Through this paper, the students and faculties can gain a foundational understanding of how AI works and its effect on the educational field. However, further research is necessary to explore several critical areas. According to observations made, students are more interested in a technology known as Artificial Superintelligence. This is a new field that is still under development and has the potential to address all the above issues. Artificial Superintelligence refers to the hypothetical future development of AI that surpasses human intelligence in all aspects—cognitive, emotional, social, and practical. It is a concept that goes beyond current AI capabilities and represents a potential point where machines could outperform humans in virtually every task, including creativity, problem-solving, decision-making, and emotional intelligence. As it holds such a great power, its application is not possible yet. It poses existential risks that require careful thought, regulation, and preparation. As AI continues to evolve, the debate surrounding the development of ASI will intensify, balancing the promise of transformative progress with the potential for unforeseen dangers.

6. CONCLUSION

From the above research, it can be concluded that AI-driven tools have significantly impacted both students and teachers in the education sector. AI tools have revolutionized learning methods, making them more dynamic, flexible, and globally accessible. Students are benefiting from personalized learning experiences, real-time feedback, and decreased workload, which in turn is positively impacting their academic performance and personal skill development.

Teachers are also experiencing reduced workloads and enhanced teaching capabilities through the implementation of AI tools. Additionally, the research highlights the importance of maintaining a balance between using technology and nurturing creativity, as overreliance on technology may have negative effects, especially on the creative thinking of young individuals. Finally, to conclude both the future of education and the development of AI go hand in hand.

7. REFERANCE

[1] H. Zhao, G. Li, W. Feng Research on application of artificial intelligence in medical education 2018 international conference on engineering simulation and intelligent control (ESAIC), IEEE (2018), pp. 340-342

[2] L. Zhao, Y. Zhou, H. Lu, H. Fujita Parallel computing method of deep belief networks and its application to traffic flow prediction Knowledge-Based Systems, 163 (2019), pp. 972-987

[3] Q. Zhong, B.-H. Li, Q.-Q. Zhu, Z.-M. Zhang, Z.-H. Zou, Y.-H. Jin The top 100 highly cited original articles on immunotherapy for childhood leukemia Frontiers in Pharmacology, 10 (2019), p. 1100

[4] A. Zouaq, R. Nkambou Building domain ontologies from text for educational purposes IEEE Transactions on learning technologies, 1 (1) (2008), pp. 49-62 V. Zovko, M. Gudlin

[5] Artificial intelligence as a disruptive technology in education

[6] W. Ma, O.O. Adesope, J.C. Nesbit, Q. Liu Intelligent tutoring systems and learning outcomes: A meta-analysi Journal of Educational Psychology, 106 (4) (2014), pp. 901-918

[7] L.P. Macfadyen, S. Dawson, A. Pardo, D. Gaševic Embracing big data in complex educational systems: The learning analytics imperative and the policy challenge Research & Practice in Assessment, 9 (2014), pp. 17-28

[8] D. Mussack, R. Flemming, P. Schrater, P. Cardoso-Leite Towards discovering problem similarity through deep learning: Combining problem features and user behavior Proceedings of the 12th international conference on educational data mining (EDM 2019) (2019), pp. 615-618

[9] T. O'Shea, J. Self Learning and teaching with computers: The artificial intelligence revolution Prentice Hall Professional Technical Reference (1986) H.G. Okuno, K. Nakadai, H. Kitano June). Social interaction of humanoid robot based on audio-visual tracking

[10] International conference on industrial, engineering and other applications of applied intelligent systems, Springer, Berlin, Heidelberg (2002), pp. 725-735

[11] C. Lang, G. Siemens, A. Wise, D. Gašević Handbook of learning analytics Society for Learning Analytics and Research (2017)

[12] J.H. Larkin, R.W. Chabay Computer-assisted Instruction and intelligent tutoring systems: Shared Goals and complementary approaches. Technology in education series Lawrence Erlbaum Associates, Hillsdale, New Jersey (1992)

[13] S. Lathuilière, B. Massé, P. Mesejo, R. Horaud Neural network-based reinforcement learning for audio-visual gaze control in human-robot interaction Pattern Recognition Letters, 118 (2019), pp. 61-71

[14] Q. Li, R.W. Lau, B.W. Wah, H. Ashman, E.W. Leung, F. Li, et al. Guest editors' introduction: Emerging internet technologies for e-learning IEEE Internet Computing, 13 (4) (2009), pp. 11-17

[15] J. Li, P. Li, W. Niu Artificial intelligence applications in upper gastrointestinal cancers The Lancet Oncology, 21 (1) (2020), p. e4

[16] Anderson et al., 1995 J.R. Anderson, A.T. Corbett, K.R. Koedinger, R. Pelletier Cognitive tutors: Lessons learned

[17] Arkin, 2008 R.C. Arkin Governing lethal behavior: Embedding ethics in a hybrid deliberative/reactive robot architecture

[18] Proceedings of the 3rd ACM/IEEE international conference on human robot interaction (2008), pp. 121-128

[19] Azevedo and Gašević, 2019 R. Azevedo, D. Gašević Analyzing multimodal multichannel data about self-regulated learning with advanced learning technologies: Issues and challenges Computers in Human Behavior, 96 (2019), pp. 207-210

[20] T. Bayne, D. Brainard, R.W. Byrne, L. Chittka, N. Clayton, C. Heyes, et al What is cognition? Current Biology, 29 (13) (2019), pp. R608-R615

[21] S.J. Buckingham Shum, R. Luckin Learning analytics and AI: Politics, pedagogy and practices British Journal of Educational Technology, 50 (6) (2019), pp. 2785-2793

[22] Q. Wang, Z. Mao, B. Wang, L. Guo Knowledge graph embedding: A survey of approaches and applications IEEE Transactions on Knowledge and Data Engineering, 29 (12) (2017), pp. 2724-2743
[23] M.J. Wolf, K.W. Miller, F.S. Grodzinsky Why we should have seen that coming: Comments on microsoft's Tay "experiment" and wider implications The ORBIT Journal, 1 (2) (2017), pp. 1-12
[24] H. Xie, H.C. Chu, G.J. Hwang, C.C. Wang Trends and development in technology-enhanced adaptive/personalized learning: A systematic review of journal publications from 2007 to 2017 Computers & Education, 140 (2019), p. 103599
[25] H. Xie, D. Zou, F.L. Wang, T.L. Wong, Y. Rao, S.H. Wang Discover a learning path for group users: A profile-based approach Neurocomputing, 254 (2017), pp. 59-70
[26] H. Zhu Big data and artificial intelligence modeling for drug discovery Annual Review of Pharmacology and Toxicology, 60 (2020), pp. 573-589
[27] J.C. Burguillo Using game theory and competition-based learning to stimulate student motivation and performance Computers & Education, 55 (2) (2010), pp. 566-575
[28] P. Chen, Y. Lu, V.W. Zheng, X. Chen, B. Yang KnowEdu: A system to construct a knowledge graph for education
[29] IEEE Access, 6 (2018), pp. 31553-31563
[30] Y. Chi, Y. Qin, R. Song, H. Xu Knowledge graph in smart education: A case study of entrepreneurship scientific publication management Sustainability, 10 (4) (2018), p. 995
[31] Y. Duan, J.S. Edwards, Y.K. Dwivedi Artificial intelligence for decision making in the era of Big Data–evolution, challenges, and research agenda International Journal of Information Management, 48 (2019), pp. 63-71
[32] A. Essa A possible future for next generation adaptive learning systems Smart Learning Environments, 3 (1) (2016) Article 16
[33] N.T. Heffernan, C.L. Heffernan The ASSISTments ecosystem: Building a platform that brings scientists and teachers together for minimally invasive research on human learning and teaching International Journal of Artificial Intelligence in Education, 24 (4) (2014), pp. 470-497
[34] G.J. Hwang Definition, framework, and research issues of smart learning environments-a context-aware ubiquitous learning perspective Smart Learning Environments, 1 (1) (2014), p. 4
[35] G.J. Hwang, P.H. Wu, H.R. Ke An interactive concept map approach to supporting mobile learning activities for natural science courses Computers & Education, 57 (4) (2011), pp. 2272-2280
[36] X. Jin, B.W. Wah, X. Cheng, Y. Wang Significance and challenges of big data research Big Data Research, 2 (2) (2015), pp. 59-64
[37] J. Kay AI and education: Grand challenges IEEE Intelligent Systems, 27 (5) (2012), pp. 66-69
[38] S. Steenbergen-Hu, H. Cooper A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning Journal of Educational Psychology, 106 (2) (2014), pp. 331-347
[39] E.J. Topol High-performance medicine: The convergence of human and artificial intelligence Nature Medicine, 25 (1) (2019), pp. 44-56
[40] Y.S. Tsai, O. Poquet, D. Gašević, S. Dawson, A. Pardo Complexity leadership in learning analytics: Drivers, challenges and opportunities British Journal of Educational Technology, 50 (6) (2019), pp. 2839-2854
[41] J.R. Van Seters, M.A. Ossevoort, J. Tramper, M.J. Goedhart The influence of student characteristics on the use of adaptive e-learning material Computers & Education, 58 (2012), pp. 942-952
[42] K. VanLehn The relative effectiveness of human tutoring, Intelligent Tutoring Systems, and other tutoring systems Educational Psychologist, 46 (4) (2011), pp. 197-221
[43] D. Gašević, S. Dawson, G. Siemens Let's not forget: Learning analytics are about learning TechTrends, 59 (1) (2015), pp. 64-71
[44] D. Gašević, V. Kovanović, S. Joksimović Piecing the learning analytics puzzle: A consolidated model of a field of research and practice Learning: Research and Practice, 3 (2) (2017), pp. 63-78
[45] U. Gasser, V.A. Almeida A layered model for AI governance IEEE Internet Computing, 21 (6) (2017), pp. 58-62
[46] A.C. Graesser, S. Lu, G.T. Jackson, H. Mitchell, M. Ventura, A. Olney, et al. AutoTutor: A tutor with dialogue in natural language Behavior Research Methods, Instruments, & Computers, 36 (2) (2004), pp. 180-192
[47] S.A. Hart Precision education initiative: Moving toward personalized education
[48] Y. Pu, W. Wu, T. Jiang ATC framework: A fully automatic cognitive tracing model for student and educational contents
[49] Proceedings of 12th international conference on educational data mining (2019), pp. 635-638

[50] I. Rahwan, M. Cebrian, N. Obradovich, J. Bongard, J.-F. Bonnefon, C. Breazeal, et al. Machine behaviour Nature, 568 (7753) (2019), pp. 477-486

[51] E.F. Risko, S.J. Gilbert Cognitive offloading Trends in Cognitive Sciences, 20 (9) (2016), pp. 676-688

[52] N. Selwyn Should robots replace teachers? AI and the future of education John Wiley & Sons, Indianapolis (2019)

[53] G. Siemens, S. Dawson, G. Lynch Improving the quality and productivity of the higher education sector. Policy and Strategy for Systems-Level Deployment of Learning Analytics Society for Learning Analytics Research for the Australian Office for Learning and Teaching, Canberra, Australia (2013)