MOOC 5.0

Subjects: Education & Educational Research
Contributor: Ishteyaaq Ahmad , Sonal Sharma , Rajesh Singh , Anita Gehlot , Neeraj Priyadarshi , Bhekisipho Twala

Massive Open Online Course 5.0 (MOOC 5.0), was introduced and discussed in a Research paper titled "MOOC 5.0: A Roadmap to the Future of Learning" published in 2022. Its features include better universal access, better learner engagement, adaptive learning, greater collaboration, security, and curiosity, which is being developed using Industry 4.0 technologies of the Internet of Things, Cloud Computing, Big Data, Artificial Intelligence/Machine Learning, Blockchain, Gamification Technologies, and the Metaverse and would incorporate the zones of ethics and humanism, while at the same time providing learners with a richer and more individualized experience.

MOOC education technology IoT big data artificial intelligence

1. Overview of Industry 5.0 and Education 5.0

The effect of technology in today's fast-changing world is not confined to modes of transportation and communication; the "Fourth Industrial Revolution" has brought us a new wave of change in all fields. The digital revolution is significantly changing how people live and work [1]. The "Fifth Industrial Revolution", branded as Industry 5.0, promises to alter the way we develop products, increasing productivity and competitive advantage. While Industry 4.0 aspired to develop future "Smart Factories" by combining physical, digital, and virtual environments using cyber-physical systems, in Industry 5.0, intelligent machines will act as collaborators rather than opponents since they will be integrated with human brains [2]. Industry 5.0 offers a vision of the business that goes beyond the narrow focus on production and efficiency and strengthens the function and value of the industry in society [3]. **Figure 1** illustrates all five industrial revolutions.

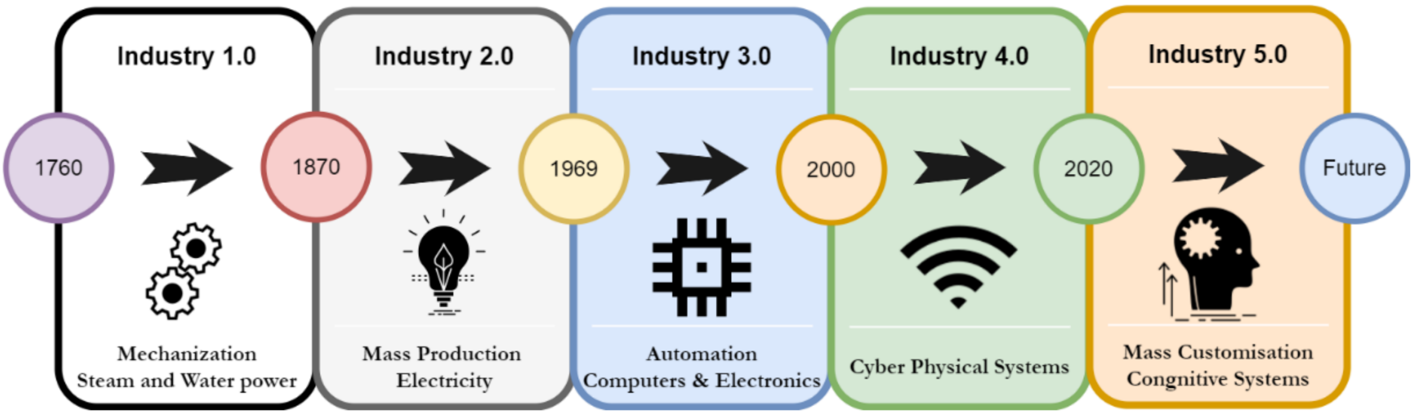

Figure 1. Industrial Revolutions.

“Industry 4.0” developments are having a wide range of organizational repercussions, not simply technological ones [4]. The first and foremost challenge of “Industry 4.0” is that there is a greater need for highly skilled employees [5][6]. Over the next five years, technology-driven job creation is likely to outnumber job loss. There is a growing sense of urgency to assist people in transitioning to more long-term employment prospects [7]. Industry 4.0 is said to be driven by technology, whereas Industry 5.0 is driven by values [8]; as a result, the current state of industry inevitably raises concerns in this period of exponential technological advancement, such as the appropriateness of the current educational system in light of Industry 5.0′s requirements, design of the new educational paradigm, components in Education 5.0, etc.

Education has progressed from ‘going to university’ of Education 1.0 to Internet-based learning of Education 2.0, proceeding towards knowledge-based education of Education 3.0, and finally to innovation-based education in Education 4.0 [9]. Technology infiltrations into education, such as the use of smartphones, online testing, Artificial Intelligence, and Big Data, are all part of Education 4.0 [10]. Education 5.0 moves beyond the creation and use of technology and into the spheres of humanism and ethics [11]. The term “Education 4.0” and “Education 5.0” has gained popularity among educators all across the world, and emphasizes adapting to the changes, and for institutions of higher learning, this involves knowing what is expected of their incoming graduates. **Figure 2** illustrates the progression of education.

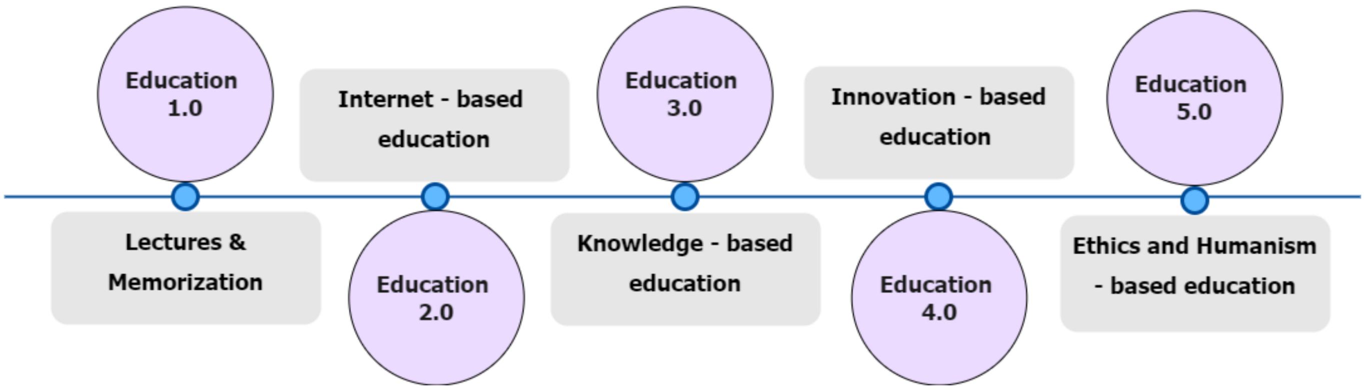

Figure 2. Progression of Education.

The technologies of Industry 4.0 are already influencing our daily lives. Universities and colleges should prepare for the significant shift of incorporating technology-driven designs into the curriculum with the support of educationists and other visionaries. It is heartening to learn that the education system is integrating the usage of Cyber System technologies in learning under the mantra Education 4.0 [12][13]. At this juncture, it is vital to explore teaching methodologies in the context of the technical advancements of Industry 4.0 as the future years will test our ability to redesign learning for the learners of today’s digital generation [14][15]. MOOCs also require improvements on the parts of both learners and instructors to adapt to the new paradigms of learning. The features are depicted in **Figure 3**.

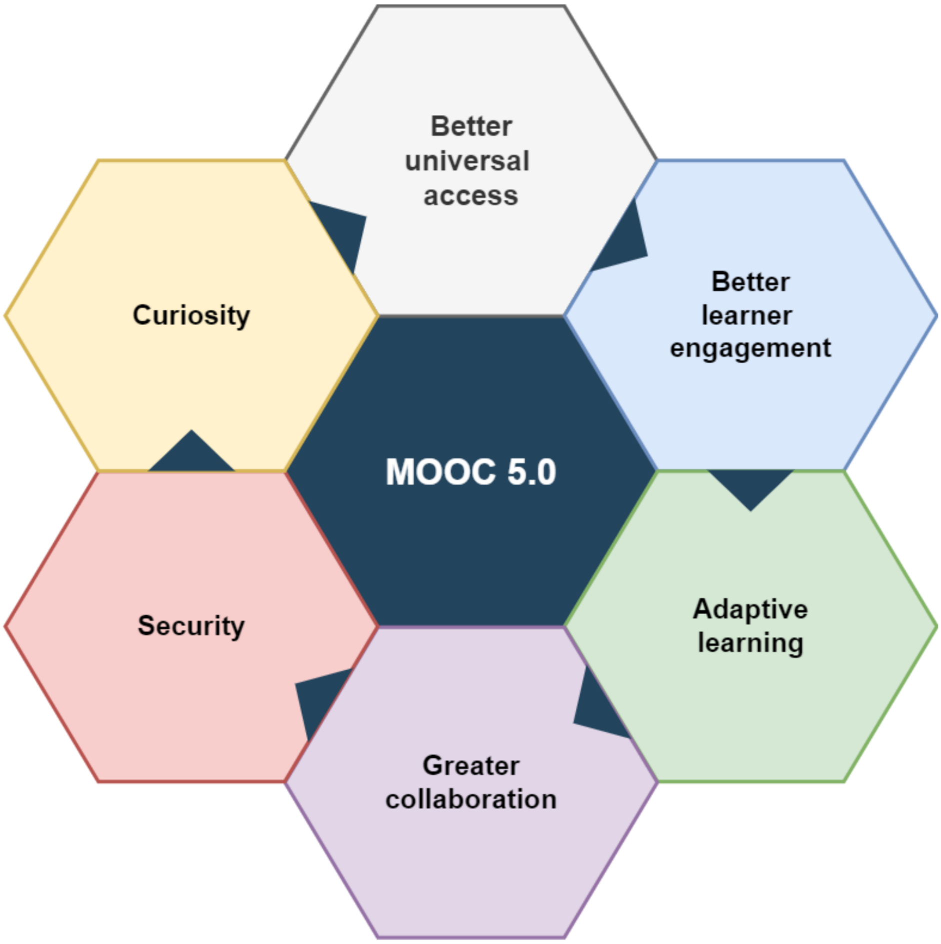

Figure 3. Features of MOOCs 5.0.

2. Technology Intervention in MOOCs

The social revolution has been sparked by Industry 5.0. technologies such as the Internet of Things (IoT), Cloud Computing, Big Data, Artificial Intelligence/Machine Learning, Block Chain, Robotics, Digital Twin, Gamification Technologies, Virtual reality (VR)/Augmented reality (AR), and the Metaverse. It is anticipated that technology will have advanced to the point of total autonomy by 2050 [6]. Future MOOCs will undergo a significant change in terms of education due to these technological improvements.

2.1. IoT in MOOCs

Kevin Ashton, a British technologist, coined the phrase “Internet of Things” (IoT) [16] to describe a way for people and items to be connected across a network. These are now widely utilized and well liked in a variety of industries, including smart homes, smart cities, wearable technology, and industrial equipment. IoT envisions a bright future for such an Internet where machine–machine communication will predominate over the present models of human–human or human–device connection [17]. Future intelligent virtual products will be created from real-world objects with the expansion of the Internet of Things [18]. IoT can be embedded in online higher education with the help of a cutting-edge AI-assisted system that considers environmental data and embedded biosensor data to estimate learners' progress, wellness, and health [19]; this will not only improve e-learning platforms but will improve learning outcomes for professions and will increase completion but also reduce expenses [20]. A literature review suggests that researchers concentrated on several topics, a few of these included IoT in mobile learning [21], blending lab projects with IoT-based learning frameworks for Science, Technology, Engineering, and Mathematics (STEM) learners [22], personalized instruction for students through IoT data collection [23], etc. All students will profit from the inclusion of IoT in MOOCs since there will be improved communication and individualized learning, not to mention the unique advantages for those with impairments.

2.2. Cloud Computing in MOOCs

In recent years, the shift to Cloud Computing has picked up pace [24]. Business owners are turning over control of their assets, including critical systems, to platforms that cloud service providers offer and operate [25]. Cloud Computing is quickly replacing traditional computer paradigms in all facets of life including education; some of the successful examples of this paradigm in the education field are Learning management systems (LMS), MOOCs, and Podcasts [26]. They all use the Internet to make education perpetually accessible to a limitless number of learners. In this paradigm, two main cloud service models are employed, which are infrastructure as a service (IaaS) and software as a service (SaaS). All the major MOOC providers employ cloud services and resources to promote quality teaching and learning internationally [27]. As the Cloud Computing trends make it abundantly evident that it will be crucial to IT in the upcoming years [28], MOOCs will witness better and more affordable services in the near future.

2.3. Big Data in MOOCs

MOOCs produce a significant amount of heterogeneous educational data [29] and provide several chances to study a variety of issues connected to teaching design and learner outcomes [30]. Finding a way to extract knowledge from the extraordinarily rich datasets being produced and turn it into information that can be used by students, instructors, and the general public is the key problem in Big-Data-intensive research and learning analytics [31]. According to a literature study, researchers investigated a variety of MOOC categories using Big Data, among which included diverse Big Data of MOOC [32], identification of MOOC dropout learners [33][34], forecasting MOOC learners' potential grades [35], MOOC data analytics [36], learning analytics [37], demand for MOOC [38], Educational Privacy in the Online Classroom [39], Automated text detection [40], Privacy in MOOC [41], MOOC video watching behavior [42], Topic-oriented learning assistance [43], etc.

2.4. Artificial Intelligence/Machine Learning in MOOCs

Artificial Intelligence (AI) and Machine Learning (ML) have made considerable strides in recent years, and they now represent an emergent technology that will transform how people live. The use of AI/ML in education is expanding quickly to enhance the caliber of teaching and learning. According to the Horizon Report's Higher Education Edition from 2017, Artificial Intelligence will be applied in higher education by 2022 [44]. MOOCs have a strong probability of using AI/ML by an analysis of the extensive MOOC dataset [45]. AI/ML may employ data analytics to enhance teaching and learning methods. Large datasets of MOOCs may be used to train Machine

Learning algorithms so they can learn from them and provide predictions or suggestions on how to learn something new or improve teaching. The MOOC dropout prediction studies using AI/ML have been discussed by several authors [46][47][48][49]. While notable researchers focused on many different subjects, some of these included learner clickstream analyses [50][51], satisfaction among the learners [52][53], time-based metrics of learner interactions and evaluations [54], the usage of MOOC datasets for the K-means method [55], using Machine Learning techniques to sort and categorize MOOC learners [56], learners' emotional tendencies [57], MOOC learning behaviors [58], an intelligent investigation [59], Convolutional neural networks (CNN) for measuring the levels of learner engagement through webcam [60], etc.

2.5. Blockchain Technology in MOOC

Blockchain technology has demonstrated remarkable application opportunities since its beginnings and has been used in numerous sectors; because of its strengthening security feature, it may be used to construct many Blockchain systems [61][62]. Blockchain technology may be implemented at higher education institutions to enhance teaching strategies, provide better learning platforms, improve recordkeeping, and enhance student involvement and motivation [63]. The literature suggests that the rapid advancement of Blockchain technology will have a positive impact on the creation of MOOC communication platforms resulting in the advancement of higher education [64]. MOOCs' completion records are kept in Electronic Learning Records (ELRs), which are often maintained in a cloud data center, which are crucial for learners since they provide solid proof of the learning process. However, the security and Privacy of ELRs cannot be ensured with third-party storage. As a result, a Blockchain-based solution for the safe storing and distribution of ELRs in MOOC learning systems can be implemented [65]. A Blockchain system that keeps track of every detail of every transaction will allow the academic institution that awards credentials to confirm that learning actually happened and that knowledge, competencies, and skills were accurately assessed [66]. Melanie Swan suggested using Blockchain to encode open badges for MOOCs [67].

2.6. Digital Twin in MOOCs

Though highly creative and needing a broad framework of several technologies, the Digital Twin notion is still not at the cutting edge [68]. The qualities of a Digital Twin include a virtual and actual symbiosis, high levels of simulation, real-time contact, and deep understanding, among others. The trend of its use is moving from the industrial to the educational sectors [69]. Interesting scientific material has begun to stream on topics such as smart factory Digital Twin technology in education [70], Digital Twin Campus [71], Ontology [72], etc. For many IT applications in Industry 5.0, the concept of the "digital twin for everything" seems to be a relevant one [73]. However, the use of Digital Twin (DT) in education is still in its infancy when compared to that of DT in the industrial sector.

2.7. Gamification Technologies in MOOCs

Gamification is the application of components often prevalent in games, such as plot, feedback, rewards systems, conflict, collaboration, competition, defined objectives and rules, levels, trial-and-error, enjoyment, engagement, and interactivity [74], and it is often used to fix problems and enhance learning [75]. The primary goal of Gamification, for non-gaming objectives in real-world environments, is to increase human motivation and performance concerning a particular task [76]. In the beginning, Gamification techniques were used in marketing campaigns and web applications to encourage, involve, and retain customers [77].

With the shifting paradigm in education, Gamification has also found use in the teaching–learning process. Concept acquisition and awareness were considerably enhanced when using information and communication technologies (ICT) along with Gamification [78]. It applies the foundational principle of learning by doing, which encourages students to acquire knowledge and make discoveries about many topics via independent experimentation. There is limited acceptance of serious games in higher education; for example, higher education institutions in Portugal use only around 20% of the Gamification techniques [79]. Massive Online Open Courses (MOOCs) are a growing trend, but their extremely low completion rates provide difficulty. Finding innovative strategies to inspire learners and persuade them to finish the course is vital because a significant number of learners drop out of the MOOC [80]. Gamification-based methodology for motivating MOOC learners to complete the course can be a better strategy [81][82][83][84]. Gamification design for MOOCs should incorporate both social and individual components, based on the implementation goal, social presence, social impact, and flow theory [85]. Studies have revealed that MOOC Gamification has been implemented in a few cases and even if the outcomes on motivation and learning are positive, there are still prospects for scholarly publishing [86].

2.8. Metaverse in MOOCs

The Metaverse is a perpetual multi-user habitat that unifies the actual world with digital virtual elements [87]. Virtual reality (VR), Augmented reality (AR), as well as mixed reality (MR), are some of the most important elements of the Metaverse since they successfully give users a 3D immersive virtual experience [88], although Virtual reality (VR)/Augmented reality (AR) is now employed extensively across many industries. As MOOCs need personalization and communication for traditionalist means of material introduction (fixed visual, sound, and contents) to provide the learners with a more engaging learning experience [89], the Metaverse and its components provide excellent chances to raise educational standards by developing fresh approaches and strategies. Few Metaverse MOOCs have been implemented where learners confirmed their applicability and functioning both within and outside of the classroom [90] and some have been proposed [91]; however, it will take time, and studies presently show that there is a research gap in the educational Metaverse [92].

3. MOOC 5.0

For a substantial portion of the world's population, MOOCs provide not only learning opportunities but access to world-class educators and researchers from top-tier educational institutions [93]. Some literature categorizes MOOCs in various ways; however, there does not appear to be agreement on the best way to do so. It has been classified as MOOC 2.0. on the concepts of collaboration among other online learners [94][95], credit credentials [96], and personal learning goals [97], as MOOC 3.0 is based on MOOC incorporation into traditional academic programs and credit recognition [98]. Otto Scharmer [99] suggests that MOOCs have evolved from instructor-centric one-to-many to learner-centric many-to-one personalized education. **Figure 4** explains all four levels of evolution of

MOOCs. The theory was based on a pilot MOOC, where for evolution from MOOC 1.0 to MOOC 4.0, there has effectively been a change in the conversational level at which the learning takes place, which evolves from downloading MOOC 1.0 to a two-way interaction in MOOC 2.0, to a multi-lateral dialogue in MOOC 3.0 before finally being anchored in level 4 as collective creativity in MOOC 4.0 because conversation is experienced as a co-creative.

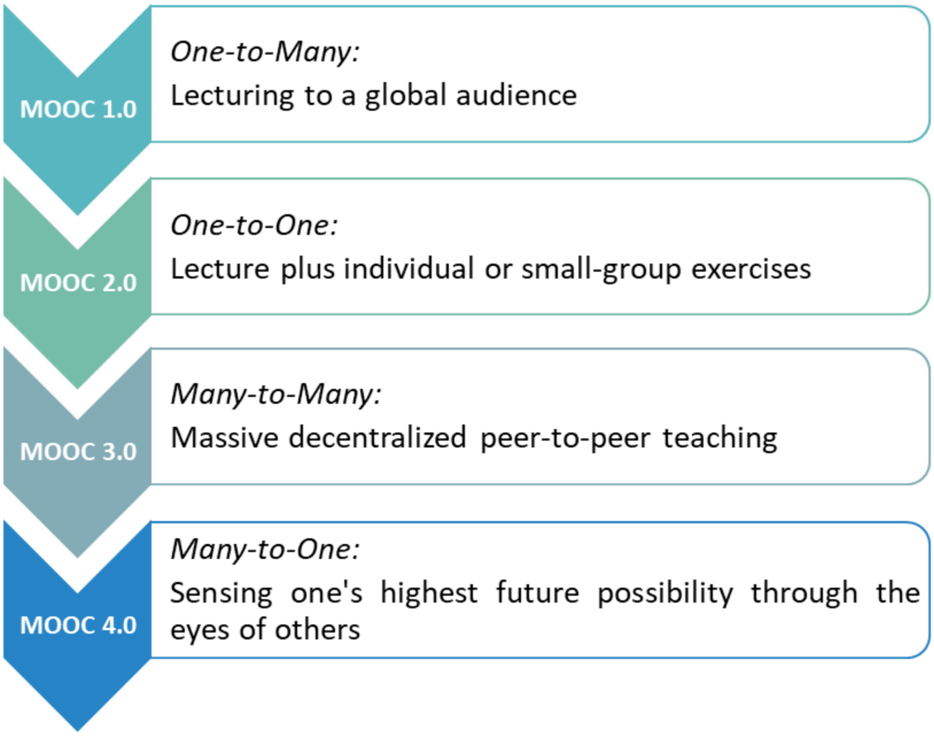

Figure 4. Evolution of MOOCs based on Otto Scharmer's classification [99].

As learners will have access to more technology in the future, humanized online courses that cater to each learner's unique requirements will be more and more essential [100]. This is where MOOC, which is being developed using Industry 5.0 technology and also examines the areas of ethics and humanism, may be extendedly classified, giving it the name MOOC 5.0. The focus of MOOC 5.0 teaching may be on each learner's interpretation and way of thinking, as well as providing them with personalized learning recommendations that have humanism and ethics. The concept is shown in **Figure 5**.

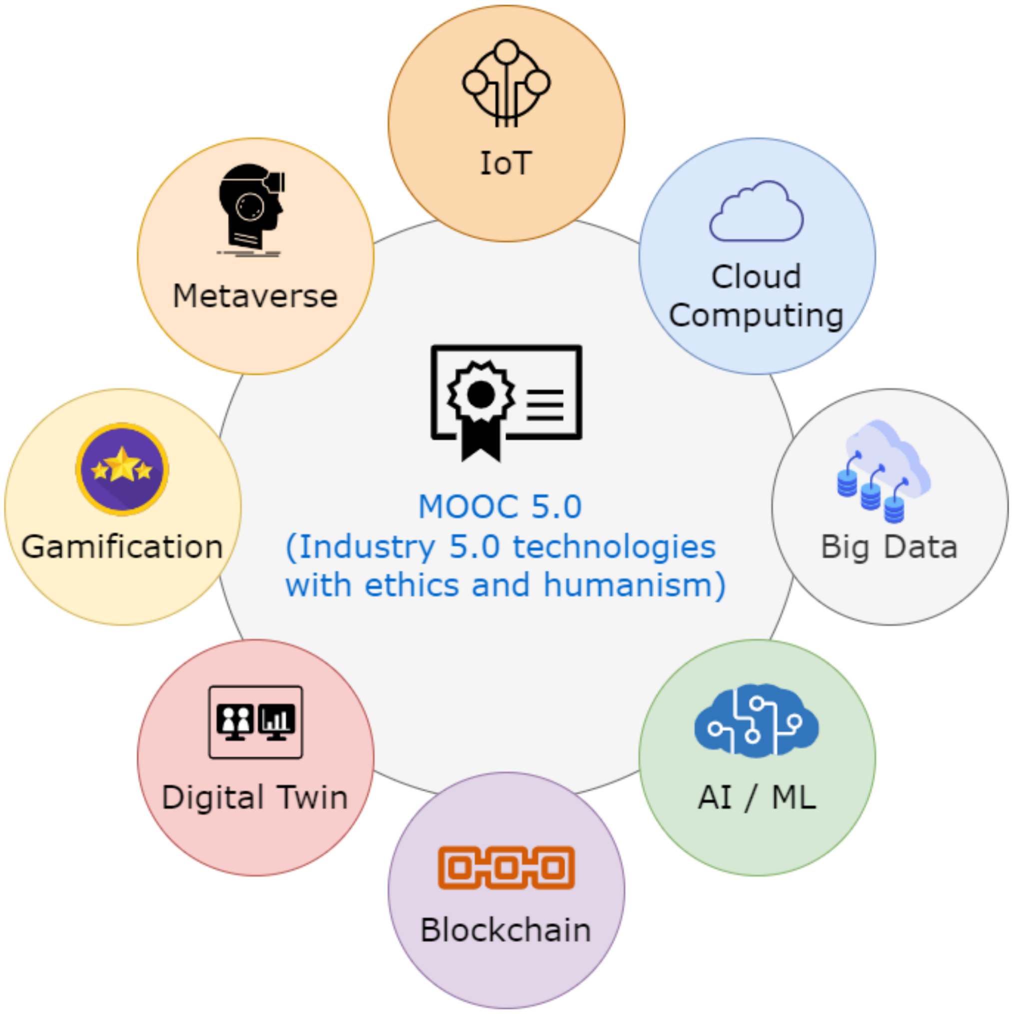

Figure 5. MOOCs 5.0.

References

1. Ghobakhloo, M. Industry 4.0, digitization, and opportunities for sustainability. J. Clean. Prod. 2020, 252, 119869.

2. Nahavandi, S. Industry 5.0—A Human-Centric Solution. Sustainability 2019, 11, 4371.

3. European Economic and Social Committee. Industry 5.0. 2021. Available online: https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/industry-50_en (accessed on 6 August 2022).

4. Lasi, H.; Fettke, P.; Kemper, H.-G.; Feld, T.; Hoffmann, M. Industry 4.0. Bus. Inf. Syst. Eng. 2014, 6, 239–242.

5. Schwab, K. The Fourth Industrial Revolution: What it Means and How to Respond World Economic Forum; World Economic Forum: Geneva, Switzerland, 2016; Available online:

https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond (accessed on 29 April 2022).

6. Uggal, A.S.; Malik, P.K.; Gehlot, A.; Singh, R.; Gaba, G.S.; Masud, M.; Al, J.F.-A. A sequential roadmap to Industry 6.0: Exploring future manufacturing trends. IET Commun. 2022, 16, 521–531.
7. The Future of Jobs Report; World Economic Forum: Geneva, Switzerland, 2020; Available online: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf (accessed on 2 May 2022).
8. Xu, X.; Lu, Y.; Vogel-Heuser, B.; Wang, L. Industry 4.0 and Industry 5.0—Inception, conception and perception. J. Manuf. Syst. 2021, 61, 530–535.
9. Salmon, G. May the Fourth Be with You: Creating Education 4.0. In J. Learn. Dev.; 2019; 6, pp. 95–115. Available online: https://eric.ed.gov/?id=EJ1222907 (accessed on 2 August 2022).
10. Uğur, S.; Kurubacak, G. Artificial Intelligence to Super Artificial Intelligence, Cyber Culture to Transhumanist Culture. In Handbook of Research on Learning in the Age of Transhumanism; IGI Global: Hershey, PA, USA, 2019; pp. 1–16.
11. Lantada, A.D. Engineering education 5.0: Continuously evolving engineering education. Int. J. Eng. Educ. 2020, 36, 1814–1832.
12. Hussin, A.A. Education 4.0 Made Simple: Ideas for Teaching. Int. J. Educ. Lit. Stud. 2018, 6, 92.
13. Mustika, N.; Saripudin, A. Analysis of Student Interests in the Electrical Engineering Education Study Program FPTK UPI in the Vocational Teacher Profession in the 4.0 Education Era. In Proceedings of the 4th International Conference on Innovation in Engineering and Vocational Education (ICIEVE 2021), Jawa Barat, Indonesia, 13 November 2021; Volume 651, pp. 185–192.
14. Skvirsky, S. In Proceedings of the IFTF: Signaling Work and Learning Readiness in 2030: The Future of Assessment, Palo Alto, CA, USA, 19–20 February 2019. Available online: https://www.iftf.org/future-now/article-detail/signaling-work-readiness-in-2030-the-future-of-assessment/ (accessed on 29 April 2022).
15. Kamal, N.N.M.; Adnan, A.H.M.; Yusof, A.A.; Ahmad, M.K.; Adnan, M.M.K. Immersive interactive educational experiences–adopting Education 5.0, Industry 4.0 learning technologies for Malaysian Universities. In Proceedings of the International Invention, Innovative & Creative (InIIC) Conference, Series, Senawang, Malaysia, 22 January 2019; pp. 190–196.
16. Ashton, K. That ‘internet of things’ thing. RFID J. 2009, 22, 97–114.
17. Farooq, M.U.; Waseem, M.; Mazhar, S.; Khairi, A.; Kamal, T. A review on internet of things (IoT). Int. J. Comput. Appl. 2015, 113, 1–7.
18. Madakam, S.; Ramaswamy, R.; Tripathi, S. Internet of Things (IoT): A Literature Review. J. Comput. Commun. 2015, 3, 164–173.

19. Ciolacu, M.I.; Binder, L.; Popp, H. Enabling IoT in Education 4.0 with BioSensors from Wearables and Artificial Intelligence. In Proceedings of the 2019 IEEE 25th International Symposium for Design and Technology in Electronic Packaging (SIITME), Cluj-Napoca, Romania, 23–26 October 2019; pp. 17–24.
20. Woodside, J.M.; Amiri, S.; Sause, W. The internet of things in e-learning. In Proceedings of the E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education, San Diego, CA, USA, 19 October 2015; pp. 1207–1210. Available online: https://www.learntechlib.org/primary/p/152149/ (accessed on 2 August 2022).
21. Pruet, P.; Ang, C.S.; Farzin, D.; Chaiwut, N. Exploring the Internet of Educational Things (IoET) in rural underprivileged areas. In Proceedings of the 2015 12th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), Hua Hin, Thailand, 24–27 June 2015; pp. 1–5.
22. He, J.; Lo, D.C.; Xie, Y.; Lartigue, J. Integrating Internet of Things (IoT) into STEM undergraduate education: Case study of a modern technology infused courseware for embedded system course. In Proceedings of the 2016 IEEE Frontiers in Education Conference (FIE), Erie, PA, USA, 12–15 October 2016; pp. 1–9.
23. Moreira, F.; Ferreira, M.J.; Cardoso, A. Higher Education Disruption Through IoT and Big Data: A Conceptual Approach. In Learning and Collaboration Technologies. Novel Learning Ecosystems LCT 2017; Lecture Notes in Computer Science; Zaphiris, P., Ioannou, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2017; pp. 389–405.
24. Qian, L.; Luo, Z.; Du, Y.; Guo, L. Cloud Computing: An Overview. In Cloud Computing. CloudCom 2009. Lecture Notes in Computer Science; Jaatun, M.G., Zhao, G., Rong, C., Eds.; Springer: Berlin/Heidelberg, Germany, 2009; pp. 626–631.
25. Haber, M.J.; Chappell, B.; Hills, C. Cloud Computing. In Cloud Attack Vectors; Apress: Berkeley, CA, USA, 2022; pp. 9–25.
26. Hapl, L.; Habiballa, H. Applications of cloud computing in education. AIP Conf. Proc. 2022, 2425, 060007.
27. Mustapha, A.; Muhammad, S.H.; Salahudeen, S.A. Massive Open Online Courses: A Success of Cloud Computing in Education. OcRI 2016, 16, 141–151.
28. Velimirovic, A. 6 Cloud Computing Trends for 2022 (and Beyond). 2022. Available online: https://phoenixnap.com/blog/cloud-computing-trends (accessed on 3 August 2022).
29. Zheng, Y.; Yin, B. Big Data Analytics in MOOCs. In Proceedings of the 2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing, Liverpool, UK, 26–28 October 2015; pp. 681–686.

30. Diver, P.; Martinez, I. MOOCs as a massive research laboratory: Opportunities and challenges. Distance Educ. 2015, 36, 5–25.

31. Dede, C.J.; Ho, A.D.; Mitros, P. Big Data Analysis in Higher Education: Promises and Pitfalls. Educ. Rev. 2016. Available online: https://dash.harvard.edu/handle/1/34785368 (accessed on 6 August 2022).

32. Kizilcec, R.F.; Brooks, C. Diverse Big Data and Randomized Field Experiments in MOOCs. In Handbook of Learning Analytics; Society for Learning Analytics Research (SoLAR): New York, NY, USA, 2017; pp. 211–222.

33. Tang, J.K.T.; Xie, H.; Wong, T.-L. A Big Data Framework for Early Identification of Dropout Students in MOOC. In Technology in Education. Technology-Mediated Proactive Learning; Lam, J., Ng, K., Cheung, S., Wong, T., Li, K., Wang, F., Eds.; Communications in Computer and Information Science; Springer: Berlin/Heidelberg, Germany, 2015; Volume 559, pp. 127–132.

34. Liang, J.; Yang, J.; Wu, Y.; Li, C.; Zheng, L. Big Data Application in Education: Dropout Prediction in Edx MOOCs. In Proceedings of the 2016 IEEE Second International Conference on Multimedia Big Data (BigMM), Taipei, Taiwan, 20–22 April 2016; pp. 440–443.

35. Qian, Y.; Li, C.; Zou, X.; Feng, X.; Xiao, M.; Ding, Y. Research on predicting learning achievement in a flipped classroom based on MOOCs by big data analysis. Comput. Appl. Eng. Educ. 2021, 30, 222–234.

36. O'Reilly, U.-M.; Veeramachaneni, K. Technology for Mining the Big Data of MOOCs. In Res. Pract. Assess.; 2014; 9, pp. 29–37. Available online: https://eric.ed.gov/?id=EJ1062785 (accessed on 7 August 2022).

37. Merceron, A.; Blikstein, P.; Siemens, G. Learning Analytics: From Big Data to Meaningful Data. J. Learn. Anal. 2016, 2, 4–8.

38. Tong, T.; Li, H. Demand for MOOC—An Application of Big Data. China Econ. Rev. 2018, 51, 194–207.

39. Young, E. Educational Privacy in the Online Classroom: FERPA, MOOCs, and the Big Data Conundrum. Harv. J. Law Technol. 2014, 28. Available online: https://heinonline.org/HOL/Page?handle=hein.journals/hjlt28&id=561&div=&collection= (accessed on 7 August 2022).

40. Devi, M.M.; Seetha, M.; Raju, S.V. Automated text detection from big data scene videos in higher education: A practical approach for MOOCs case study. J. Comput. High. Educ. 2021, 33, 581–613.

41. Daries, J.P.; Reich, J.; Waldo, J.; Young, E.M.; Whittinghill, J.; Ho, A.D.; Seaton, D.T.; Chuang, I. Privacy, anonymity, and big data in the social sciences. Commun. ACM 2014, 57, 56–63.

42. Hu, H.; Zhang, G.; Gao, W.; Wang, M. Big data analytics for MOOC video watching behavior based on Spark. Neural Comput. Appl. 2020, 32, 6481–6489.
43. Song, J.; Zhang, Y.; Duan, K.; Hossain, M.S.; Rahman, S.M.M. TOLA: Topic-oriented learning assistance based on cyber-physical system and big data. Futur. Gener. Comput. Syst. 2017, 75, 200–205.
44. Becker, S.A.; Cummins, M.; Davis, A.; Freeman, A.; Hall, C.G.; Ananthanarayanan, V. NMC Horizon Report: 2017 Higher Education Edition. New Media Consort. 2017. Available online: https://www.learntechlib.org/p/174879/ (accessed on 2 August 2022).
45. Ahmad, I.; Sharma, S.; Kurubacak, G.; Kumar, A.; Kumar, R.; Ahmad, S. Artificial Intelligence in MOOCs: A Bibliometric Perspective. In Proceedings of the Intelligent Systems—Proceedings of ICIS-2022, Dehradun, India; 2022; pp. 38–47.
46. Fei, M.; Yeung, D.Y. Temporal Models for Predicting Student Dropout in Massive Open Online Courses. In Proceedings of the 2015 IEEE International Conference on Data Mining Workshop (ICDMW), Atlantic City, NJ, USA, 14–17 November 2015; pp. 256–263.
47. Liang, J.; Li, C.; Zheng, L. Machine learning application in MOOCs: Dropout prediction. In Proceedings of the 2016 11th International Conference on Computer Science & Education (ICCSE), Nagoya, Japan, 23–25 August 2016; pp. 52–57.
48. Sun, D.; Mao, Y.; Du, J.; Xu, P.; Zheng, Q.; Sun, H. Deep learning for dropout prediction in MOOCs. In Proceedings of the 2019 Eighth International Conference on Educational Innovation through Technology (EITT), Biloxi, MS, USA, 27–31 October 2019; pp. 87–90.
49. Dalipi, F.; Imran, A.S.; Kastrati, Z. MOOC dropout prediction using machine learning techniques: Review and research challenges. In Proceedings of the 2018 IEEE Global Engineering Education Conference (EDUCON), Santa Cruz de Tenerife, Spain, 17–20 April 2018; pp. 1007–1014.
50. Alamri, A.; Sun, Z.; Cristea, A.I.; Senthilnathan, G.; Shi, L.; Stewart, C. Is MOOC Learning Different for Dropouts? A Visually-Driven, Multi-granularity Explanatory ML Approach. In Intelligent Tutoring Systems. ITS 2020; Kumar, V., Troussas, C., Eds.; Lecture Notes in Computer Science; Springer: Berlin/Heidelberg, Germany, 2020; pp. 353–363.
51. Al-Rifaie, M.M.; Yee-King, M.; D’Inverno, M. Boolean prediction of final grades based on weekly and cumulative activities. In Proceedings of the 2017 Intelligent Systems Conference (IntelliSys), London, UK, 7–8 September 2017; Volume 2018, pp. 462–469.
52. Hmedna, B.; el Mezouary, A.; Baz, O.; Mammass, D. A machine learning approach to identify and track learning styles in MOOCs. In Proceedings of the 2016 5th International Conference on Multimedia Computing and Systems (ICMCS), Marrakech, Morocco, 29 September–1 October 2016; pp. 212–216.

53. Hew, K.F.; Hu, X.; Qiao, C.; Tang, Y. What predicts student satisfaction with MOOCs: A gradient boosting trees supervised machine learning and sentiment analysis approach. Comput. Educ. 2020, 145, 103724.
54. Jha, N.I.; Ghergulescu, I.; Moldovan, A.-N. OULAD MOOC Dropout and Result Prediction using Ensemble, Deep Learning and Regression Techniques. In Proceedings of the 11th International Conference on Computer Supported Education, Heraklion, Greece, 2–4 May 2019; Volume 2, pp. 154–164.
55. Shrestha, S.; Pokharel, M. Machine Learning algorithm in educational data. In Proceedings of the 2019 Artificial Intelligence for Transforming Business and Society (AITB), Kathmandu, Nepal, 5 November 2019.
56. Mourdi, Y.; Sadgal, M.; Fathi, W.B.; el Kabtane, H. A machine learning based approach to enhance MOOC users' classification. Tur. Online J. Distance Educ. 2020, 21, 54–68.
57. Wang, L.; Hu, G.; Zhou, T. Semantic analysis of learners' emotional tendencies on online MOOC education. Sustainability 2018, 10, 1921.
58. Feng, W.; Tang, J.; Liu, T.X. Understanding Dropouts in MOOCs. In Proceedings of the the AAAI Conference on Artificial Intelligence, Honolulu, HI, USA, 17 July 2019; Volume 33, pp. 517–524.
59. Li, C.; Zhou, H. Enhancing the efficiency of massive online learning by integrating intelligent analysis into MOOCs with an Application to Education of Sustainability. Sustainability 2018, 10, 468.
60. Dubbaka, A.; Gopalan, A. Detecting Learner Engagement in MOOCs using Automatic Facial Expression Recognition. In Proceedings of the 2020 IEEE Global Engineering Education Conference (EDUCON), Porto, Portugal, 27–30 April 2020; pp. 447–456.
61. Li, X.; Jiang, P.; Chen, T.; Luo, X.; Wen, Q. A survey on the security of blockchain systems. Futur. Gener. Comput. Syst. 2020, 107, 841–853.
62. Wang, H.; Zheng, Z.; Xie, S.; Dai, H.N.; Chen, X. Blockchain challenges and opportunities: A survey. Int. J. Web Grid Serv. 2018, 14, 352.
63. Bucea-Manea-Țoniş, R.; Martins, O.M.D.; Bucea-Manea-Țoniş, R.; Gheorghiță, C.; Kuleto, V.; Ilić, M.P.; Simion, V.-E. Blockchain Technology Enhances Sustainable Higher Education. Sustainability 2021, 13, 12347.
64. Zhang, J.; Haleem, S. Application of Blockchain Technology in the Construction of MOOC Digital Communication Platform. In Proceedings of the 2021 International Conference on Smart Technologies and Systems for Internet of Things, Springer, Singapore, 3 July 2022; Volume 122, pp. 564–573.

65. Li, D.; Han, D.; Zheng, Z.; Weng, T.-H.; Li, H.; Liu, H.; Castiglione, A.; Li, K.-C. MOOCsChain: A blockchain-based secure storage and sharing scheme for MOOCs learning. Comput. Stand. Interfaces 2022, 81, 103597.
66. Contact North, Uber-U Is Already Here. 2015. Available online: https://teachonline.ca/tools-trends/exploring-future-education/uber-u-already-here (accessed on 4 August 2022).
67. Swan, M. Blockchain: Blueprint for a New Economy; O'Reilly Media, Inc.: Sebastopol, CA, USA, 2015.
68. Bartsch, K.; Pettke, A.; Höbert, A.; Lakämper, J.; Lange, F. On the digital twin application and the role of artificial intelligence in additive manufacturing: A systematic review. J. Phys. Mater. 2021, 4, 032005.
69. Shuguang, L.; Lin, B. Holographic Classroom Based on Digital Twin and Its Application Prospect. In Proceedings of the 2020 IEEE 3rd International Conference on Electronics and Communication Engineering (ICECE), Xi'an, China, 14–16 December 2020; pp. 122–126.
70. Bai, Y.; Wang, Y.; Wang, Y. Application of smart factory digital twin technology in the teaching system of cultivating undergraduates's ability to solve complex engineering problems. In Proceedings of the 2021 4th International Conference on Information Systems and Computer Aided Education, Dalian, China, 24–26 September 2021; pp. 164–168.
71. Tong, W.; Wang, Y.; Su, Q.; Hu, Z. Digital twin campus with a novel double-layer collaborative filtering recommendation algorithm framework. Educ. Inf. Technol. 2022.
72. Tsoutsa, P.; Fitsilis, P.; Iatrellis, O. Towards an Ontology for Smart City Competences. In Proceedings of the 25th Pan-Hellenic Conference on Informatics, Volos, Greece, 26–28 November 2021; pp. 254–259.
73. Ju, D. Digital Twin for Everything: Some Pilot Studies. 2019. Available online: https://www.semanticscholar.org/paper/Digital-Twin-for-Everything%3A-Some-Pilot-Studies-Ju/a0b220aa6ef0430eb64706aed03865bb27056c0c (accessed on 2 August 2022).
74. Khaleel, F.L.; Sahari Ashaari, N.; Wook, T.S.M.T.; Ismail, A. Gamification Elements for Learning Applications. Int. J. Adv. Sci. Eng. Inf. Technol. 2016, 6, 868.
75. Alsawaier, R.S. The effect of gamification on motivation and engagement. Int. J. Inf. Learn. Technol. 2018, 35, 56–79.
76. Sailer, M.; Hense, J.U.; Mayr, S.K.; Mandl, H. How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. Comput. Human Behav. 2017, 69, 371–380.
77. Zichermann, G.; Cunningham, C. Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps; O'Reilly Media, Inc.: Sebastopol, CA, USA, 2011.

78. Kayımbaşıoğlu, D.; Oktekin, B.; Hacı, H. Integration of Gamification Technology in Education. Procedia Comput. Sci. 2016, 102, 668–676.

79. Almeida, F.; Simoes, J. The Role of Serious Games, Gamification and Industry 4.0 Tools in the Education 4.0 Paradigm. Contemp. Educ. Technol. 2019, 10, 120–136.

80. de Freitas, M.J.; da Silva, M.M. Systematic literature review about gamification in MOOCs. Open Learn. J. Open Distance e-Learn. 2020, 1–23.

81. Gené, O.B.; Núñez, M.M.; Blanco, Á.F. Gamification in MOOC. In Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality—TEEM'14, New York, NY, USA, 1–3 October 2014; pp. 215–220.

82. Romero-Rodriguez, L.M.; Ramirez-Montoya, M.S.; Gonzalez, J.R.V. Gamification in MOOCs: Engagement Application Test in Energy Sustainability Courses. IEEE Access 2019, 7, 32093–32101.

83. Rincón-Flores, E.G.; Mena, J.; Montoya, M.S.R. Gamification: A new key for enhancing engagement in MOOCs on energy? Int. J. Interact. Des. Manuf. 2020, 14, 1379–1393.

84. Martínez-Núñez, M.; Fidalgo-Blanco, Á.; Borrás-Gené, O. New challenges for the motivation and learning in engineering education using gamification in MOOC. Int. J. Eng. Educ. 2016, 32, 501–512. Available online: https://repositorio.grial.eu/bitstream/grial/560/1/19_ijee3155ns.pdf (accessed on 2 August 2022).

85. Antonaci, A.; Klemke, R.; Kreijns, K.; Specht, M. Get Gamification of MOOC right! Int. J. Serious Games 2018, 5, 61–78.

86. Rincón-Flores, E.G.; Montoya, M.S.R.; Mena, J. Engaging MOOC through gamification. In Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality, New York, NY, USA, 16–18 October 2019; pp. 600–606.

87. Mystakidis, S. Metaverse. Encyclopedia 2022, 2, 486–497.

88. Centieiro, H. The roles of VR, AR and MR on the Metaverse. In Proceedings of the 2019 Artificial Intelligence for Transforming Business and Society (AITB), Kathmandu, Nepal, 5 November 2019; Available online: https://medium.datadriveninvestor.com/the-roles-of-vr-ar-and-mr-on-the-metaverse-593569cfb686 (accessed on 2 August 2022).

89. Nuraliev, F.M.; Giyosov, U.E.; Okada, Y. Enhancing Teaching Approach with 3D Primitives in Virtual and Augmented Reality. In World Conference Intelligent System for Industrial Automation; Springer: Berlin/Heidelberg, Germany, 2021; pp. 155–163.

90. Díaz, J.; Díaz, J.; Saldaña, C.; Ávila, C. Virtual World as a Resource for Hybrid Education. Int. J. Emerg. Technol. Learn. 2020, 15, 94–109.

91. Wei, D. Gemiverse: The blockchain-based professional certification and tourism platform with its own ecosystem in the metaverse. Int. J. Geoheritage Park. 2022, 10, 322–336.
92. Tlili, A.; Huang, R.; Shehata, B.; Liu, D.; Zhao, J.; Metwally, A.H.S.; Wang, H.; Denden, M.; Bozkurt, A.; Lee, L.-H.; et al. Is Metaverse in education a blessing or a curse: A combined content and bibliometric analysis. Smart Learn. Environ. 2022, 9, 24.
93. Zhang, K.; Bonk, C.J.; Reeves, T.C.; Reynolds, T.H. MOOCs and Open Education in the Global South: Successes and Challenges; Routledge, Taylor & Francis Group: New York, NY, USA, 2019; pp. 1–14. Available online: https://www.taylorfrancis.com/chapters/edit/10.4324/9780429398919-1/moocs-open-education-global-south-ke-zhang-curtis-bonk-thomas-reeves-thomas-reynolds (accessed on 2 August 2022).
94. SOYLEV, A. MOOCs 2.0: The social era of education. Tur. Online J. Distance Educ. 2017, 18, 56.
95. Sharma, Y. Global: Move Over Moocs—Collaborative Mooc 2.0 is Coming. In Understanding Global Higher Education; Sense Publishers: Rotterdam, The Netherlands, 2017; pp. 167–169.
96. Legon, R. MOOCs and the Quality Question; Insid, H., Ed.; Inside Higher Ed: Washington, DC, USA, 2013; Volume 4, pp. 25–28. Available online: www.insidehighered.com/views/2013/04/25/moocs-do-not-represent-best-online-learning-essay (accessed on 5 August 2022).
97. Hoffman, E.S.; Hoffman, E.S.; Menchaca, M.P. Personal Learning Goals versus Attrition in MOOCs: A Learner Framework for. E-Learn World Conf. E-Learn. Corp. Gov. Heal. 2015, 2015, 187–193.
98. Sandeen, C. Integrating MOOCS into Traditional Higher Education: The Emerging 'MOOC 3.0′ Era. Chang. Mag. High. Learn. 2013, 45, 34–39.
99. Scharmer, O. MOOC 4.0: The Next Revolution in Learning & Leadership. 2015. Available online: https://www.huffpost.com/entry/mooc-40-the-next-revoluti_b_7209606 (accessed on 3 August 2022).
100. Pacansky-Brock, M.; Smedshammer, M.; Vincent-Layton, K. Humanizing Online Teaching to Equitize Higher Education. 2019. Available online: https://doi.org/10.13140/RG.2.2.33218.94402 (accessed on 2 August 2022).