EDUCATION IN THE 5G AND THE AI CONTEXT

Marius OPINCARIU
Philology Department, Lucian Blaga University of Sibiu, 550024, Romania
opincariugroup@gmail.com

Abstract: *Recent research has advanced the knowledge on the impact of motivation and engagement on student performance and retention. In this spectrum, the most relevant factors are the personal and demographic data, general perception about motivation, perception about the university, student behavior, perception about program and perception about classes as well as about teachers. Joining 5G and AI will open new possibilities for eLearning platforms, and will offer unprecedented access and depth to all of the variables in the spectrum. While 5G networks are known for improved device capacity, faster network speed and lower latency the AI networks are capable of offering real time analysis of the dynamic data streams. Data mining algorithms can uncover unseen patterns, unexpected associations, and inadvertencies in the collected data. The speed of the first and the precision of the second, can critically enhance the decision-making processes for more accurate predictions and recommendations in the area of student performance. The unique combination will offer students the option of personalized curriculums, will favor higher engagement rates and further enhance academic success as an economic model*

Keywords: *ai education; 5g education; elearning curriculum design; course recommender; fuzzy association rules; k-means clustering, educational business model;*

1. The status of education

The factual reality is that all of the educational settings function as organizational structures. The present investigation will address the higher education tier, best known as the university educational system. Therefore some of the questions related to technological advancement should also be applied to universities as organizations. Last years' call for papers at the Academy of Management for Organizational Behavior Division, highlighted a few pressing questions related to the digital persona. The technologically induced paradigms seem to posit serious but also formidable opportunities for exploration and insight. The questions that are to be addressed in the 2019-2020 timeframe, are intriguing and exude a high level of relevance:

a. In what industries is digitalization more likely to increase the use of a platform model?

b. Does digitalization facilitate innovation in such industries, or does platformization constrain the scope of potential innovation?

c. Is digitalization more likely to transform organizations in some industries more than others?

d. Are there particular types of organizations better positioned to benefit from digitalization?

e. What is the effect of the use of digital technologies on friendships and informal communication in organizations?

f. How does digital transformation shape reciprocity, empathy and emotional capabilities within the organization?

g. Do digital tools extend or limit individual cognition? Do we observe any effect on cognition and framing at the organizational level?

h. What are the effects of artificial intelligence and digital technologies on creativity, imagination, and intuition?

i. How should organizations overcome resistance in using digital technologies and AI?

j. Which parts of the strategic decision-making process are likely to be outsourced to intelligent machines and what are the likely effects on organizational performance?

k. How will the role of managers change if decision-making is outsourced to machines? [1]

All of these questions are essentially asking an underlying question: How do we align processes with technological advancement and changing market demand? As mass market sectors are increasingly assisted by automated management systems, in order to stay relevant, universities will have to align their vision to the emerging technoculture and produce eligible workforce that will natively integrate with intelligent systems.

The research on the alignment becomes more relevant when connected to the impact of AI infrastructure in contemporary educational designs [2]. On Romanian soil, the alliance between intelligent design and the existing educational infrastructure receives a growing academic interest and support. By focusing on the alignment between curriculum design and market trends, academics signal the systemic benefits of such marriage:

Personalization is the key to offering quality services, and this is what disruptive technologies are offering. Universities have to focus on technologies that are appropriate for their strategy but at the same time to align with key market trends. Students are being more informed and empowered by personal devices that help and assist them in fulfilling their tasks and goals. Anticipating and meeting their needs and expectations suppose automating process and increasing digitization offering in universities. [3]

Probably one of the most entitled institutions to investigate the social impact of the next generation technology is Vodafone. Privately funded research by the telecom cements even more the alignment necessity by finding that:

[...] the future learning model will be an international, immediate, virtual, and interactive environment which enables learners to learn and interact in much different ways that we do today. The new model will be learner-centric, skill-centric, on-demand and personalised. It will improve student development in the areas of critical-thinking and collaborative learning. In order to reach this model embracing mobile technology seems indispensable. Applications such as Virtual Reality (VR) and Augmented Reality (AR) will play a big role in quality education and understanding-based learning. By combining Tactile Internet with VR and AR the learning experience will go far beyond today's one, bringing new definition to Tele-teaching, Tele-mentoring, virtual university, virtual classroom, virtual team-working, etc. New mobile technology and connected devices will give students the opportunity to learn with minimal intervention from teachers and mostly through exploration, discovery and peer coaching [4].[5]

Living in the age of personalized settings, from smartphones and applications, to television and mobility, the 'personal setting' is the new normal, and educational designs need to adapt and incorporate productively the unfolding techno-reality. While the guardians of the traditional educational model still sift through the difference between inevitable and probable, the argument grows stronger for a technologically shaped future. Or, does technology permit for neutrality?

[5]Smart Education as a service has also been recently introduced by Telekom Romania https://www.telekom.ro/business/smart-education/

In many areas, but most especially in online distance learning milieus, educational institutions should, metaphorically, begin to offer an a la carte menu instead of table d'hote menus. In order to take advantage of this wind of change, the authorities should adjust their practices to keep up with today's societies that also exist in virtual spaces. Especially unorthodox learners who do not have the same learning patterns of prevailing teaching methods need to be taken into account [5].

The convenience of personalized settings is gradually inducing a shift in agents' perception. The digital perspective discretely reshapes the universal paradigm of personal preferences into a set user values, mirroring the shift from subjective perception to that of the entitled user rights. The socioeconomic benefits of harnessing the potential of the digital persona significantly favor the early adopters in terms of institutional competitive advantage.

2. Intelligent instruments and devices

a. Artificial intelligence

Over decades of challenges and transformations, some of the earliest computational systems have evolved in state of the art tools for data processing. During the forties, the primary stages were pioneered by Alan Turing, who came to be known as the father of theoretical computer science and artificial intelligence. The second stage was formulated by the stage of machine learning during the early eighties, progress which paved the ground for today's virtual personal assistants such as Siri, Amazon Alexa and Google Assistant. Beginning with two thousand and ten, deep learning emerged as a breakthrough technique for implementing Machine Learning via neural networks. [6] The applications running these architectures are today's recommendation engines, textual sentiment analysis (etc.) with major exponents such as IBM Watson and Google's DeepMind.

While artificial intelligence features great capabilities in terms off task automation, it is still greatly dependent on human input and functions as an adviser for redundant processes:

Housman (2018), "AI is capable of two things: (1) automating repetitive tasks by predicting outcomes on data that has been labeled by human beings, and (2) enhancing human decision-making by feeding problems to algorithms developed by humans" [...] The definition of the concept is multifaceted, however, the essential feature of AI is that it emulates on the natural processes of human biology: Intelligence is the process of thinking, reasoning, perceiving objective facts, comprehension, judgment and conclusion (Uğur and Kınacı, 2006). Artificial intelligence is the intelligence in non-organic systems that can mimic these features. Basically, it works as multi-probability decision-making structures [7].

b. 5G Wireless Networks

As a communication technology development that has recently been launched, competing arguments surface from the private and the public sector, highlighting both the benefits and the risks featured by the revolutionary design. While the risks associated with the new information transmission architecture are still to be fully comprehended, important industrial sectors such as Defense [8], IoV [9] and IoE as part of

IoT, manifest strong interest in adopting and integrating the 5G protocol:

Currently, network communication mainly uses electromagnetic waves to carry information. Different frequencies of electromagnetic waves lead to various transmission speeds of information, of which the main characteristic is: the higher the frequency, the higher the signal transmission bandwidth is, thus the higher the information transmission rate is [...] the transmission rate of 5G network is 100 times faster than that of 4G, and the response delay of 1ms is 30-50 times shorter than that of 4G. In view of electromagnetic wave frequency band, 5G utilizes high frequency band to solve the problem of resource shortage in low-frequency stage. Moreover, according to the analysis of electromagnetic

wave transmission mode, 5G networks communicates directly among devices, reducing the cost of building base stations. In addition to [...] the 5G network also features high reliability and low power consumption. [10]

3. The emergence of ioe designs

Attempts to integrate 5G networks with eLearning designs begin to emerge, and they find fertile grounds under the larger umbrella of the IoT. Smart architectures begin to evolve in a global race of competing designs. As the smart architectures require expert workforce in the process of implementation, exploitation and maintenance, it is very likely they will acquire high adoption rates unless they evolve as a profitable business models. Current independent efforts to develop competitive theoretical designs of nextgen education include both the 5G Smart Campus and the AI powered recommender engine designs. Strengths and weaknesses are identifiable on each side, and it is only when the higher sum of the anticipated or real benefits that overcomes the sum of perceived or real risks. In the following flipped class scenario, the RFID and the IP CAM in the Perception Layer can function both as redundant and complementary physical class login protocols. While the IP CAM may raise deeper personal data privacy issues than the RFID tag tracking.

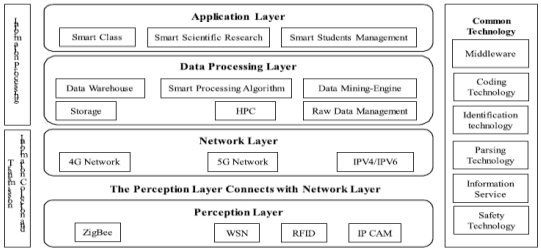

FIGURE 2. **Framework model of smart campus IoT.** [11]

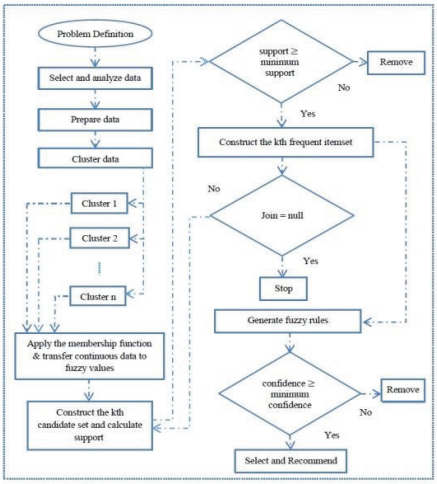

Figure 1. Fuzzy association rule mining model.

As the RFID works on the 4G architecture, the IP CAM when optimized with face detection algorithms works natively with 5G data flows. The complexity of the information collected in the Perception Layer is fed into the Data Mining - Engine and has a conditional impact on the quality of the recommendation. Therefore, the precision performance of both the Smart Student Management and the Smart Scientific Research modules, is directly dependent on the richness of the information fed into the Data Processing Layer. If taken a

step further, the smart architecture can incorporate Face Emotion Recognition technology and can collect the individual and the collective emotional profile of the class and categorize it in different classes of sentiment analysis. While FER requires a 5G, architecture, the 4G version of the procedure can be imported from the social media's model of emotional expression found in text and emoji. It becomes interesting therefore exploring the relevance of the social media model in the forum elearning forum communication design.

4. Discussion and conclusion

The first four questions asked about the impact of platformization (a-d), place education in the fields of those better positioned to benefit from digitalization. The next four questions (e-h) go deeper at the personal level and raise de question regarding the verifiable benefit at the human development level. The question about resistance to AI technologies (i) will be answered by the success or failure of implementing the such designs in viable business models. Regarding the decision making process being outsourced to machines(j-k), at the present the majority of the models function as supervised due diligence designs and do not pose an imminent threat. However, educational programs should not invest in preparing workforce for tasks that are gradually performed better by intelligent designs. Chances are, that all of these questions will be answered by the ultimate economy of scale argument: efficiency.

As smart technologies progressively impact the market verticals and horizontals, the likelihood of a complete alignment in the near future seems inevitable. Education will eventually forego its digital transformation moment under the continuous pressure of market demand and costs. Entrepreneurial universities will adopt performant business models and will offer relevant and competitive products in the educational marketplace. Profitable ventures show favorable associations with Ai and smart designs. Modules such as ToT [12], CSAIL [13], Westlaw Edge [14], ensure fantastic competitive edges in the fields of HR, Radiology and Law. Since highly competitive industries will require equally competitive workforce, it will become the task of the educational field to design and deliver relevant curriculums. The upcoming years will most likely see a redesign of the learning space and will force an entrepreneurial mindset in education. By combining different sets of variables, emerging recommender systems open new and fascinating avenues for personalized educational models:

[...] design a course recommender model that takes the students' characteristics into account to recommend appropriate courses. The model uses clustering to identify the students with similar interests and skills [...] Recommender systems can guide users on a specific path. They may be used to choose suitable alternatives in a large space of options, thus reducing information overload [5]. A course recommender system is a type of recommender system able to suggest the best combination of courses to students and help them plan their educational schedules. Moreover, the system supports students in choosing appropriate courses and provides them with a basic knowledge of past student experiences [6] [...] Recommender systems work with three types of data: (1) social, (2) individual, and (3) content [8]. In order to take advantage of the available information, recommenders employ a number of filtering methods including collaborative, demographic, content-based, and hybrid [9] [...] In demographic filtering, a number of demographic variables such as age, gender, and other individual features are employed [10]. Content-based filtering takes advantage of the previously collected information regarding the user behavior and preferences in the system [11]. Finally, in collaborative filtering, the information and opinions provided by other users are used to make recommendations to the new users [12]. Simultaneous application of these filtering methods is known as hybrid filtering [13] [...] Currently, collaborative filtering, content-based filtering, and data mining techniques are considered as popular and

fundamental methods for constructing recommender systems. Typically, predictive methods in recommender systems utilize classification, whereas descriptive methods rely on the clustering and association rules more than the other methods [7]. [15]

The new architectures are capable of collecting and aggregating ecosystemic data in a way that extracts meaning and provides value at competitive edge levels. Therefore, the bespoke educational curriculums will stay relevant to motivation and engagement and will positively alter the levels of student performance and retention. AI's classification and clustering algorithms enhanced by the high speed processing of 5G networks, will facilitate the rapid and precise value extraction and feedback from the social, content and demographic data. Personalized learning models catering to personal innate abilities and native predispositions, will positively alter the general perception about motivation, perception about the program, perception about classes and teachers and most importantly the perception about the university. Personalized curriculums will stimulate student behavior in ways that are relevant to both his or hers real and digital personas and will fuel higher engagement rates. 5G will also favor innovative learning designs that will engage attention and curiosity at unprecedented level. While AR devices are going to impact educational designs in the long run, the VR instruments are successfully marketed for class formats [16]. The large scale adoption of such paradigms will eventually create demand of qualified instructional designers and will reinforce the economic design behind the workflow of personalized education. In turn, the competitive edge offered by personalized education programs will lead to higher engagement rates financing the development of intelligent course designs. The redefinition of the learning space will also alter the configuration of the educational continuum. Therefore, the entrance and potential adoption of the new models will rewrite the existing status quo.

Face to Face Classes	Flipped Classes: 2G, 3G, 4G	Flipped / Exclusive eLearning Classes: AI and 5G
Old School System	Traditional School System	Recommender / Personalized Learning System

The inception of competing educational recommender systems mark the beginning of personalized learning models, and carry the potential of promoting academic success as an economic model. Although characterized by elementary transhumanist features, the upcoming events will be new opportunities in the saga of continuously transcending our limits through smart learning.

References

Altinay Fahriye, Karaatmaca Ceren; Altinay Zehra, Dagli Gökmen, Developing at a Great Pace: Studies on Artificial Intelligence in Higher Education, The 15th International Scientific Conference eLearning and Software for Education, "Carol I" National Defence University, Bucharest April 11-12, 2019, Vol. 2, p. 330-337.

Basham Randy, Artificial Intelligence in Health, Human Service Delivery and Education: A Brief Conceptual Overview, Journal of Health Science 7 (2019) pp. 73-78.

Ella Miron-Spektor, Academy of Management Discoveries (AMD), Special Issue – Call for Papers, "Digital Transformation: What is new if anything?" https://ob.aom.org/viewdocument/amd-special-issue-digital-transfo?CommunityKey=7640e69d-4151-425e-9dd5-9f043c772c5e&tab=librarydocuments

Harvey J. F. et al.: Exploiting High mm-wave Bands for Military Communications, Applications, and Design, Special Section on Millimeter-Wave and Terahertz Propagation, Channel Modeling and Applications, IEEE Access, Vol. 7, April 2019, pp. 52350 - 52359.

Kafle V. P. , Fukushima Y., Martinez-Julia P. , Miyazawa T., Consideration on automation of 5G network slicing with machine learning," in 2018 ITU Kaleidoscope: Machine Learning for a 5G Future (ITU K), Nov 2018, pp. 1–8.

Li R., Zhao Z., Zhou X., Ding G., Chen Y., Chen Z., Zhang H., "Intelligent 5G: When cellular networks meet artificial intelligence," IEEE Wireless Communications, Vol. 24, No. 5, pp. 175–183, October 2017.

Lin F. et al.: Content Recommendation Algorithm for Intelligent Navigator in Fog Computing-Based IoT Environment, Special Section on Collaboration for Internet of Things, IEEE Access, Vol. 7, May 2019, pp. 53677 - 53686.

Leung Victor C. M., Zhang Haijun , Hu Xiping, Liu Qiang, Liu Zhi (EDS), International Conference on 5G for Future Wireless Networks, Second EAI International Conference, 5GWN 2019, Changsha, China, February 23-24, 2019, Proceedings, pp. 1-195.

Mirzamany Esmat, Neal Adrian , Dohler Mischa , Rosas Maria Lema (eds), 5G and Education, Jisc, 2019, pp. 1-6.

Sisman-Ugur Serap, Kurubacak Gulsun (EDS), Handbook of Research on Learning in the Age of Transhumanism, Anadolu University Press, Turkey, May 2019, pp. 1-448.

Turlacu Luiza-Maria, Orzan Gheorghe, Chivu Raluca-Giorgiana, Herrezeel Tania, Strategic Technologies: Innovation in Higher Education in Romania, The 15th International Scientific Conference eLearning and Software for Education, "Carol I" National Defence University, Bucharest April 11-12, 2019, Vol. 1, pp. 400-406.

Wang Michael, Jiasi Chen, Ehsan Aryafar, and Mung Chiang, A survey of client-controlled hetnets for 5G, IEEE Access 5 (2017), pp. 2842-2854.

Wang Xiaohong, Reflections on the Application of AI in Auditing Practice in the Context of Big Data, In: Xu Z., Choo KK., Dehghantanha A., Parizi R., Hammoudeh M. (eds) Cyber Security Intelligence and Analytics. CSIA 2019. Advances in Intelligent Systems and Computing (The International Conference on Cyber Security Intelligence and Analytics, April 2019, AISC, Vol. 928 pp. 1262-1267).

Xu X. et al.: Research on Key Technologies of Smart Campus Teaching Platform Based on 5G Network, Special Section on Roadmap to 5G: Rising to the Challenge, IEEE Access, Vol. 7, February, 2019, pp. 20664 - 20675.