

# Machine Learning and Robotic Process Automation Take Higher Education One Step Further

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**Abstract.** Machine learning and digitization have been around for several years, but their use has become a necessity with the Covid-19 pandemic. Lockdown forced us to work remotely overnight, to use digital networks to communicate, make payments, learn all sectors of activity were forced to adapt to the digital age in one night. Digitization and involvement of machine learning become a necessity with the Covid-19 pandemic. This paper shows how artificial intelligence can be used to improve the effectiveness of teaching, research, and study plan, by adapting the new communication technologies and students' needs to achieve the course learning outcomes in a virtual environment. The paper proposes three ways of using artificial intelligence in higher education, namely physical robot at the entrance of the campus to guide the visitors, robotic process automation to assist admission and registration process, and robotic process automation to aid professors in student's evaluation process and improve the academic study plan.

**Key-words:** Machine learning; robotic process automation; higher education.

## 1. Introduction

This paper examines the way in which the university processes can be improved using new technologies. The research is a continuation of a study conducted based on the interview of 100 students and professors in the field of finance and business management [1, 2]. The research highlights the challenges encountered during the pandemic and proposes using new technologies to enhance the higher education system performance.

The main activities carried out in higher education institutions aim teaching and research; knowledge transfer through work-based learning or industry-oriented activities applied teaching and the development of digital skills through the increased use of digital technology [3]. In recent years, it has been observed that on-campus registration, teaching and evaluation, through

face-to-face meetings, has been replaced by online interactions or digitization. For online environment, teaching and evaluation techniques needs to be updated. Nowadays, digitization and digital services in higher education promise a universe of applications and digitalized assets that are expected to work together to allow rapid development of new capabilities that will give competitive advantage and equip the new generation of students with employment-ready skills [2].

The current proposed study has a clear and comprehensive structure. The investigation starts with a short introduction, which refers to the previously developed studies, presents the research methodology approach, and continues with a comprehensive business proposal to enhance higher education efficiency by using machine learning and the robotic automation process. The present study dedicates special attention to three main proposals – fix robot at the entrance of the campus to assist within guidance process; Robotic Process Automation to assist the admission and registration process, and Robotic Process Automation to aid professors in students' evaluation process. The paper presents a detailed roadmap and timeline for business proposals' implementation and concludes with the benefits for all higher education stakeholders.

## **2. Research methodology and preliminary results**

The research started from one main objective – how artificial intelligence can help to improve the higher education system and to achieve student active engagement and student-centered learning. To answer this research question, the present study adopted the interpretative qualitative research method [4]. Contemporaneous researchers underlined that interpretivism recognizes that social phenomena must be understood in the social contexts in which they are constructed and guided by the way people interpret and understand situations [5, 6]. In our study, it was considered that qualitative research is most appropriate as it crosscuts disciplines, and subject matters [7]. The present research represents also a continuation for a recent publication about teaching and learning techniques for the online environment [1, 2].

## **3. Discussions and proposals duction**

Artificial intelligence can help to improve the efficiency of the any business process, including higher education. In the last decade many researchers tried to enhance the importance of artificial intelligence – created by higher education institutes in the dedicated field – to adapt and personalize the education for 21<sup>st</sup> century [8, 9]. Higher education institution can use artificial intelligence to increase the efficiency of the academic process. For example, Machine Learning can help by automatically taking students' attendance at the course, online or on campus. This can be formulated as a machine learning problem in the area of supervised learning. Attendance and active class participation of students in the classroom – face-to-face and/or online – can be done by facial recognition of each student, active participation by recognizing the voice and frequency of speech in the classroom or by recognizing the fingerprint at the entrance to the classroom. This can be a way of sensing, detection. In this case there is enough data to feed into machine algorithms and differentiate between teachers, students, and administrative staff – facial images, fingerprints and voice recognition of all students, professors, and administrative staff. Adding clear criteria, such which students belongs to which class, timing, so on so far, the machine will clearly recognize whether a student belongs to that class, or to that university. The system has enough regularity, hourly, daily, or weekly, depending on the respective academic activity. If it is

a class attendance and participation, the regularity is given by the class weekly schedule. And it is updated semesterly based. So, it is not chaotic, but it is predictable. The data is certain, the system has a defined regularity, and it can work. Increasing the students' class attendance and active participation means increasing the students' learning understandings, weekly feedback professor – student and vice versa, also lead to increase the level of knowledge gained.

At it is presented, the institution chosen for implementing artificial intelligence has as field of activity the higher education, a university. The current paper focus on three artificial intelligence proposals. These proposals target improving the university environment, faster development of the orientation process on the university campus, speed the admission and registration process, and create more time for professor-student interaction by using artificial intelligence for assigning grades automatically.

Universities provide dedicated services. It is about educational services such as (but not limited to) university degree programs, academic advising, executive educational programs, digital library, writing and tutorial center, career centers, laboratories, and research. There can be many ways of introduction new technologies as part of the teamwork between human and artificial intelligence. This research paper plans to implement artificial intelligence technology by targeting three main areas: (1) improving the university environment through placing a fix robot at the entrance of the campus to assist the receptionist within the guidance process and help the students and potential visitors to reach the desired location; (2) Robotic Process Automation to assist the admission and registration process; and (3) Robotic Process Automation to aid professors in students' evaluation process.

In case of placing a physical fix robot at the entrance of the university campus, the strategy is to reduce the time for students and visitors' campus orientation. In case of introducing the machine learning to assist the admission process, the strategy is to speed the admission and registration process. Chatbots can help automate general queries from students and website visitors like admission process, contact person, program/course information. By using machine learning to aid professors in students' evaluation it will make the process more transparent, will be able to provide a high quality and effectiveness of teaching and learning. Here we can talk about assigning grades automatically to certain assessments, where there are clear answers and clear grading criteria by avoiding long process manually.

For all these proposals, the chosen strategy to integrate the artificial intelligence is one of the Porter's three strategy highlighted in [10], i.e. differentiation. It is true that now the higher education system offers more or less the same undergraduate and graduate type of degrees. A university can succeed by being different from our competitors, in terms of quality of services provided and adapting the service delivery taking into consideration the new technologies developments, the students' needs and way they are learning and doing their research.

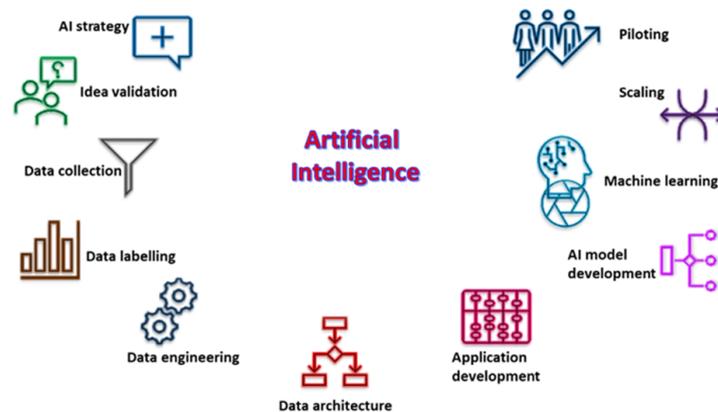
To implement innovative technologies, first of all, there is a need to analyze 1) the feasibility and the benefits of their implementation for all stakeholders, taking into account all the costs involved – here we are talking not only about the costs of acquiring new technologies, but also the costs of implementation; 2) the adaptations of the organizational culture and the proper training of all the actors involved – here we are talking about teachers, administrative staff and students. At the end, all shareholders need to acknowledge that, implementation of artificial intelligence, (Chat)robots and Robotic Process Automation (RPA) require a change in the way of accessing university services.

The implementation of the new technologies starts with an analysis of the implementation benefits, the analysis carried out with the participation of a representative number of stakeholders

- administrative staff, professors, and students, together with a pertinent analysis. The analysis considers the benefits, risks, costs, amendments to the current organizational structure, implementation time, after which it proceeds to the elaboration of an action plan that contains in detail the activities and the time allocated for each party involved, specifying the financial support provided in each execution phase of the project.

Currently, as a result of COVID-19 pandemic, majorities of universities' strategy are structure based on cost leadership. In our study, the strategy chosen is differentiation because it is very difficult to create a complete new and innovative program. But a university can be unique in terms of program content, teaching delivery and assessment mode, and the university services and facilities by using new technologies and make the students' journey more friendly and attractive.

In all there three proposals mentioned above, technologies will be applied between the middle and the final service provision. Fig. 1 gives a general roadmap for introducing RPA and artificial intelligence within a university, while Table 1 presents the roadmap description.



**Fig. 1.** Artificial intelligence implementation roadmap.

As it was specified before, we choose differentiation strategy. By developing and implementing these three proposals, the university environment will change, adopting a more friendly approach, cutting the time in solving all student queries, and provide more time for professor-student interaction, research, and other scholarly activities. More than this, this can be first step in developing a digital campus [11].

For a successful implementation of these three proposals, there is a need of changing the organizational culture and structure. To roll out the proposed initiatives there is a need of understanding the benefits for the entire university's stakeholders, an open approach for using new technologies, allocate dedicated human and financial resources to acquire all necessary equipment (*e.g.*, adequate computers, ensure very good internet infrastructure, dedicated staff, proper training). At the leadership management level, a dedicated unit is encouraged to be developed, to manage the institution's digitalization. Representative staff from all dedicated departments should work together for developing, simulating, implementing, monitoring and control. Quality Assurance Department it is also required to amend the institutional policies according to the new flow of work inside the university and ensure that IT policy is amended accordingly.

As it was specified above, there can be some organizational processes that could benefit from the uses of robotics or Robotic process automation, such as: 1) Physical robot (fixed) located at

**Table 1.** Roadmap stage description

AIroadmap/ Proposals	Physical robot at the entrance of campus to guide the visitors	RPA to assist the admission and registration process	RPA to aid professors in students' evaluation process
Idea Validation	Strategy Development Committee/ Academic Council	Strategy Development Committee/ Academic Council	Strategy Development Committee/ Academic Council
Departments involved	IT; Admission Department; Registration; Finance; Administrative; Student Affairs; Library; Research Centre; College Dean offices; Faculty members; Students	IT, Admission, Recruitment, Registration, Student Affairs, Finance and Academic Affairs	IT,Registrar, Academic Affairs, students and professors
Data architecture	Dataflows through university systems: Proposal1: Each department -> IT Department; Proposal2: Admission, Recruitment and Registrar -> IT Department; Proposal3: Professorsgive assignment -> via portal -> students -> via portal -> professorand Registrar -> IT. In parallel Professors give the key answers grading systemof assignment -> via portal -> Registrar -> IT.		
Data engineering	Data collection process: physical inventory, stored on the server		
Data collection	Physical inventory of all servers; departments location, schedule and contact person; class schedule; faculties schedule, office hours and email address; exact description of what is installed on each server – the operating system, middleware and the application or database that the server supports.	Admission criteria; admission form; prior learning recognition documents and criteria;	Coursegrading system; Assignment key answer with grading system per subject. Formachine learning – questions with multiple choices, or calculations; for Artificial Intelligence, essays within clear parameters.
Specific tasks and processes in the organization that will benefit from using AI	Robots and machine learning will take over the routine repetitive tasks  It can help to automate the general quires from students. The students will receive a prompt and quick answer to their questions, and properly appointment – time reduction. Main beneficiaries: students. Second line beneficiaries: administrative and academic staff – help in better schedule their time.	With automation, check students' eligibility criteria, validate information,shortlist candidates to avoid long processes manually. Main beneficiaries:students. Second line beneficiaries: administrative andacademic staff – help in checking the eligibility criteria and cutting theresponse time for admission.	Manage the assignments and grading system automatically. Main beneficiaries: students and professors. Second line beneficiaries: educational programs – help to conduct a properly course/program achievements and run the review.
Application/ Model development	1. Identification of the business areas which we want to improve the system. 2. Developing a computer program to perform the different tasks. After data architecture, collection and engineering stages are completed, all input is analyzed and structured in alignment the project objectives and expectations. A first step will be planning the database management system. This will allow the IT person in charge – project manager – to form data and function models. The second step – simulation. The third step will be implementation of the needed database system and software to perform the desired functions. Thefourth step is training for all personnel implicated in the process. The fifth is monitoring and correct the errors.		

the entrance of the campus; 2) RAP to assist admission process – on the website. 3) RAP and AI to aid professors in students' evaluation process.

By implementing a robot assistance at the entrance of the university campus, we aim to smooth the guidance process and to help students and potential visitors reach the desired location; we aim to offer a better service to our students, administrative staff, and visitors. Robots can direct the students to find the classroom for their course or can help students or visitors to schedule an appointment for an administrative department, or to guide them to the university reception center.

By implementing a Robotic process automation to assist the admission process we look over to use machine learning to speed the admission process. The interaction between the student the university starts with the university website and the admission process. Using new technologies, we will try to make the admission process more friendly, faster ensuring the quality of the service at the same time.

By using machine learning to aid professors in students' evaluation it will make the process more transparent, will be able to provide a high quality and effectiveness of teaching and learning. Here we can talk about assigning grades automatically to certain assessments, where there are clear answers and clear grading criteria. Based on the students' results at these assessments, it can be predicted whether the learning outcomes of that course have been achieved or not, under which percentage. This can help the professor to review the topic or teaching method to improve and increase the level of learning achievements. In terms of regularity, here we may say that the result of machine learning is not chaotic, but the interpretation is unpredictable.

To employ all these three proposals it must be a timeline for implementing technical changes. However, project development requires scheduling, organizing, budgeting, and review/reporting, as well as goal and strategy setting and risk management. The timeline can be organized as specified in Table 2.

Implementing AI within the university will have a positive impact and will not lead to job reduction. Will lead to tasks reallocation and use the staff for more proper activities than repetitive monotonous tasks. Any university has a quality assurance system, clear rules, policies, and procedures related to what and how tasks should be completed. Once these projects will be developed and implemented, for sure the policies and procedures for each department in concern, for faculty and students as well, will be amended.

**Table 2.** Timeline of Implementation

First month	Plan development	Coordination of the working plan
		Diagnosis of the contents, competencies, and skills
		Analysis and processes of diagnosis result
		Elaboration of activity plan
Second month	Model design	Data architecture
		Data engineering
		Data collection
	Resources	Identify and involve specialized personnel
		Training for all stakeholders involved in developing and implementing the project
		Allocate necessary financial support to acquire all technical resources need it
	Changing the organizational culture and structure	Design training materials for professor, student, and all administrative staff
		Amend the organizational policies, procedures
Design and implement a new communication plan		
Third-Forth month	Simulation	Testing the program Apply correction if it needs it.
Fifth month	Training	All stakeholders are trained in using new technologies
Sixth month	Implementation	Projects are implemented
		Continuous technical assistance and monitoring

## 4. Conclusions

Intelligent learning and research are happening everywhere, nevertheless, conventional teaching and learning in universities, based on face-to-face or in-person approach is still the basic environment. Actual movements in socio-economic life around the world impose e-learning and e-presence. However, moving digital is more than online teaching, which is changing the environment. This study offered an in-depth exploration how to use artificial intelligence to improve the effectiveness of teaching and learning process.

This paper presented three possible partnerships between the artificial intelligence and human intelligence within a higher education institution: (1) Physical Robot to assist the university' receptionist within the guidance process and help the students and potential visitors to reach the desired location; (2) Robotic Process Automation to assist the admission and registration process; and (3) Robotic Process Automation to aid professors in students' evaluation process. Therefore, artificial intelligence though machine learning can help, starting from guidance, admission and registration, continuing with course learning evaluation and ending with program course review process. The completion of course learning outcomes analyze run by machine learning (students' artifacts) can help the professor to understand the level of competences and knowledge acquired at the end of the course, the needs of students and what dedicated topics of the course needs to be amended.

Nevertheless, even the artificial intelligence will not replace the humans, its implementation may lead to certain ethical concern – can the system be corrupted by someone from outside the university? And take control over the machine, especially in grading system? The research couldn't find a clear-cut answer; however, a certain rules and procedures needs to be defined. As future consideration, the present research takes into consideration developing also ethical impli-

cations as well as other projects employ artificial intelligence, as it offers many opportunities to develop the higher education system.

**Limitations.** The most challenging in implementing ML and RPA is to identify highly repetitive tasks that are prone to the most error and consider piloting there. At the time this research was conducted there were some difficulties in collecting the data. Data is the most essential element that leads to the successful implementation of these proposals. Machine learning algorithms need data. Future research will focus on rigorous data collection, data management and data processing and, ideally, an all-encompassing global data strategy.

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