Artificial Intelligence in Higher Education – a Blessing or a Bane?

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Abstract

Artificial Intelligence (AI) has been present in our lives for quite some time now, although in many cases we may be unaware of it. Examples of daily, even hourly reliance on AI abound - search engines recommendations; routes selection by applications on our smartphones; buying suggestions in ecommerce sites; credit scoring; hiring decisions; and more. Some of these have become an integral part of our daily lives that we do not notice them, consciously, anymore.

For higher education, AI has two major implications: can it be used to improve higher education's functions, and how should the curricula deal with it. This paper will address primarily the first question, although the second question will be touched upon, in a tangential way.

1. What is Artificial Intelligence and how does it impact Higher Education?

There are several definitions, all very similar. Copeland (2020) defines it as "the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience."

When we discuss AI in the framework of higher education, a good way is to look at these four different tasks and examine what each means in this framework.

- Ability to Reason (AtR): this is logical function. It means looking at facts, assessing them according to the rules of logic and drawing inferences from them, usually in the form of "if A and B (are true) then C (must inevitably be true)". [1]
- Discover Meaning (DM): looking at several data points and finding out what they have in common, or what implications they have for a specific topic or issue, and what insights can be derived from the collection of data points as a whole. This capability also entails sifting through the data to separate the relevant from the non-relevant. Note that this capability requires flexibility since the classification of data points to relevant and non-relevant is both context specific and nonbinary.
- Generalize (G): taking a few instances and formulating a rule that explains all of them, and that can then be applied to other, similar, occurrences.
- Learning from Past Experience (LfPE): when an event occurs, or a process progresses, it is compared to similar phenomena in the past and a decision is made regarding how to handle the event or manage the process. This decision is made by selecting the response that

[1] In this paper, we will not consider the notion of fuzzy logic which, simply put, returns as a result of such inference not an absolute value of 0 (false) or 1 (true) but any real number in [0,1].

resolved the event or managed the process in the best way in the past. Upon conclusion, the chosen response and its outcome are added to the historic collection from which a response will be drawn in the future in similar circumstances.

Before considering the implication, and potential uses, of AI in higher education, it is worthwhile to note that:

- In principle, all these four functions – as they describe the characteristics of human intelligence – can be done by people and are done by people on a routine basis. Without getting into a prolonged, detailed comparison between the strengths and weaknesses of the two competing entities, it is important to understand that the main advantages an AI system has are enormous speed and unlimited memory, whereas people have higher flexibility, imagination, and creativity.[2]
- Because of its nature and its properties, AI is capable of answering questions that humans cannot answer in a reasonable amount of time.

How does all that impact higher education?

The answer to this question, we need to look at Higher Education (HE) from several directions. The first involves the essence of HE: it is about research and teaching – but it relies heavily on massive administrative systems to enable it to perform these tasks. The second involves the way HE performs these tasks. The third involves its human composition.

Research can certainly benefit from AtR, DM, and G. All of them are relevant, at one time or another, to research. Reasoning, meaning, and generalizations are some of the most important tools available to researchers. They are employed throughout all research activities, and it may even be said that they are the fundamental building blocks of research.

Teaching can benefit from DM and G and LfPE. Discovering meanings, particularly ones that are non-obvious and hidden, can help bring a new light into the subject matter being taught. Generalizations, too, may shed

[2] Newer generations of AI systems, employing Machine Learning, may evolve to close the gap in the areas of flexibility and creativity.

light on phenomena under study. Learning from past experience can be extremely beneficial in test design – test items can be assessed continuously, and their effectiveness can be judged.

Another part of teaching that can be improved using AI is curriculum design. This topic can be construed in a narrow sense – how should the individual courses be designed, based on students' response and on their completion rates and grades distributions over the years – and in a wider sense of deciding how the overall curriculum of a given department should be designed, given the insights from all the individual courses that comprise it. Another issue related to curriculum design involves the introduction of AI-related topics into the curriculum. The current tendency is to include AI skills, as opposed to just theory, as one of the required subjects for all students, not just STEM students (Yizhi and Keng, 2019).

Administration can also derive great benefits from AI. Academic administrator can monitor groups of students and ferret out, early, those who exhibit signs of falling behind or even dropping out, and offer various forms of assistance to help them cope better. Administrators in charge of finances, admissions and infrastructure services may benefit from AI much like their "commercial" counterparts do, since logically their tasks are the same in academia as those of administrators in commercial enterprises.

2. AI-based teaching in Higher Education

In this section, the issue of AI-based teaching will be discussed from two vantage points – the micro level (a single course) and the macro level (a complete degree program).

On the micro level, AI-based teaching has been present in academia for a while, although it was usually not called by that name. The more common name used for these courses was "adaptive courses". In an adaptive course, the student is presented with some material and is his understanding and mastery of this material is assessed using a computerized test. Based on his achievement in the assessments, another part of the course is presented to him. Which part is given is determined by the software and it is based on the student's results – compared with the accumulated results of previous students who have been tested on the same material. This is classic example of LfPE, and the database that serves to determine which next chapter the student is assigned is augmented with the results of each student taking the course. The results of adaptive courses seem to be comparable to other methods (Dziuban et al, 2018; Dziuban, Moskal, & Hartman, 2016). The adaptive course presents a number of benefits to the student: setting his own pace - when to study and how long will be the duration of each study period; progressing through the material along a path that best suits him; immediate feedback; the option to repeat a section when needed.

The use of the term "teaching" is somewhat problematic in an adaptive course since there is no teacher in the process once the student takes the course. There are, of course, "blended" adaptive courses where a teacher may take part at given times, or where he can be called upon to provide assistance (in a 'live' format or via email or similar formats, asynchronously) but the idea is to give the student (almost) complete control – and responsibility – over his learning.

On the macro level, a single, stand alone, adaptive course is the given to the student (or a small number of such courses), and most courses are still delivered in the traditional formats, the benefits mentioned above are present, but an even greater benefit may arise when a collection of related adaptive courses – up to and including a whole degree – is available: that of drastically reducing the time span needed for the completion of a degree. Clearly, if students can progress in an adaptive way and they do

not have to wait for prescribed dates (like the beginning of the next semester or the next academic year) for taking the following one, they may finish all degree requirements sooner. Given that Life-Long-Learning is an absolute necessity in today's world, shortening the time spans for courses and allowing the students to control the pace becomes not only a desirable outcome but almost a must.

The consequences of such a system of adaptive courses on higher education will be enormous. Chief among the will be:

- Dramatic role change – from classroom instructors to developers of adaptive courses.
- Reduction of staff. If today's number of teachers in higher education is strongly correlated with the number of students in an institution, this correlation will no longer exist because of the infinite scalability of computerized adaptive courses.
- Over a period of time, campuses may be reduced or retasked.

Another, less revolutionary, change in the teaching in higher education that will come about as a result of introducing AI, in particular educational data analytics, will be the closer supervision, by each teacher, of the progress made by each of his students. Alerts provided by systems that will monitor, continuously, assignments, tests, participation and more of each student, will enable the teachers to intervene in time to assure successful completion of the course by most students, thereby reducing dropouts. Good monitoring systems, capable of checking more than an individual course and correlating performance across courses and even across different study programs, will enhance this individual treatment of the students, guaranteeing higher success rates.

3. AI-based administration in Higher Education

A part of higher education that will be impacted even faster than teaching is its administration. In addition to being able to better control mundane activities like students' payments (by using big data to detect and predict payments issues), AI will be able to give administrators more tools for managing the institutions.

Administrative tools can be divided into three broad categories: management of students, management of faculty, management of supporting infrastructure (including administrative staff, physical plant, finance, etc.).

AI will most likely assist the management of supporting infrastructure (finances, buildings, purchasing, security, maintenance, advertising, etc.) in higher education much it will assist in similar activities in other enterprises, and hence this aspect of the impact of AI on higher education will not be discussed further here. The focus here will be on the impact AI is likely to have on aspects that are specific to higher education, namely the management of students and faculty.

Student Management

Student management begins with the application process. In order to handle a large number of applicants, large enough to exceed the intake capacity of the institution, some forms of AI are already being used. It is here that the first obstacle is encountered – trusting such a major decision, one that may be life-critical for the individual applicant to a de-humanized software - poses questions and creates risks. It is already evident that the algorithms used in many critical AI applications are biased. They reflect the biases that exist in the training data sets, that is the biases that created the group cases that the algorithm is supposed to increase – as long as the new members are 'similar' to the existing ones. As Williamson, Bayne, and Shay, (2020) say "Algorithmic decision-making automates inequalities, and discriminates along racialized and gendered lines. For example, controversy has arisen over automated recruitment systems, where applications for jobs are screened without human oversight, because they are found to disadvantage applicants from already under-represented groups, based on previous training data showing that predominantly white male applicants perform more highly."

(A good, vivid, description of these phenomena is presented in the award-winning film Coded Bias (2020)). Clearly, any software system set up to augment a group based on the assumption that there must be a similarity of properties, traits, behaviors, etc. of the new members with those of existing members will just reproduce the biases, misconceptions, and affinities of the existing set, whether intended or not. Therefore, special attention must be paid to the training set, to the rules of inclusion or exclusions. In addition, human override must be possible, and a clear and well-defined audit mechanism must be established. In Marcinkowski et al, (2020), the consequences AI may cause an institution are quite clearly stated – and they cover many aspects of impact.

After admission, AI can help the institution follow the progress, or lack thereof, of students throughout their time at the institution. Learning analytics, actually used today by many institutions, can assist teachers and administrators monitor this progress in various aspects of the student's life – academics, financial, even social if the student resides in dormitories run by the institution. The next generation of AI tools may be able to combine all these indicators and raise 'red flags' when problems are likely to arise, thus enabling early intervention and better overall results – for the students and for the institution.

Faculty Management

AI may affect faculty management in several ways. One involves promotions and tenure. Sun (2021) proposes a system that will manage faculty: "With such system, university leader board can make a proper strategic plan of faculty management in time to get acceleration on development. Meanwhile, individual faculties can be guided to be promoted following a professional pathway".

Another way would be to find a better fit between faculty members and the courses they teach. By considering all aspects of a course – subject, difficulty level, assessment methods and results, students' feedback (both numerical and verbal), dropout rates, absenteeism and more – faculty members will be assigned to the courses in which they perform well, subject to constraints like availability, schedules, budgets, etc. which will also be incorporated into the system. These assignments are performed today using a combination of manual and computerized systems, with

usually less than optimal results. AI, with its vast databases and immense computing power, will be able to produce better results.

4. Discussion

AI is an evolving technology. It has given us, for the first time, the tools that enable us to process enormous quantities of data, and to perform, automatically. Tasks that were relegated till quite recently, to people and their cognitive skills. Reasoning, discovering meaning, generalizing, and learning from experience have, till now, been the sole kingdom of Man. Because of the built-in features of these systems - they are fast, have a seemingly infinite memory, and work 24/7 at the same speed and efficiency - they are becoming quite appealing in many areas of life. And, indeed, they are quite useful and beneficial in many applications – commerce, quality, medicine and more. As for higher education, it seems that we are yet to reap great benefits from AI, though the risks mount. It may be that the automated system's lack of any emotional or other, nonquantifiable or not digitized input, while being in many cases an advantage, may make it somewhat problematic for uses of managing students and faculty. Great care must be applied to the design and the application of such systems, and a continuous audit system must be in place before we can trust it implicitly. The risks are very serious, as both Bill Gates and Elon Musk, just to name two, have recently warned. (Gates, 2019). Thus, we should proceed – cautiously.

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