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GENERATIVE AI: CHALLENGES TO ACADEMIC QUALITY

Abstract. This study explores the intricate relationship between Generative Artificial Intelligence and Academic Quality, two domains that have robust technical and historical underpinnings. Originating from divergent research fields, an understanding of the impact of one on the other necessitates a foundational familiarity with both. We offer a comprehensive review that serves as a bedrock for future scholarly dialogue. We articulate key insights into how emerging generative technologies are anticipated to influence academic quality. Concurrently, we note that these technological advancements are emerging at a time of significant transformation and diversification within higher education. While it is premature to proffer definitive predictions, we argue that the impact of these technologies will be institution-specific, contingent upon the unique mission and vision of each educational entity. Our analysis and reflection suggests that institutions emphasizing critical thinking and innovation stand to gain more from the integration of Generative Artificial Intelligence technologies than those primarily focused on career preparation for students.

Key words: AI, Generative AI, academic quality, Higher education, ChatGPT

Introduction

Generative Artificial Intelligence (GAI) has rapidly expanded its presence within edu- cational institutions, finding acceptance among students, faculty, and staff alike. This technology exhibits the capability to engage in sustained interactive dialogues and pro- duce reasonably meaningful written content. Unsurprisingly, it is now a routine tool for faculty to generate questions and assignments, for students to submit assignments and facilitate self-directed learning, and for administration to craft manuals, memoranda, and policy documents. With its potential to drive significant social innovation, teetering on the brink of becoming a disruptive force, it appears highly improbable that it will fade into obscurity without becoming deeply integrated into nearly all facets of academic and pedagogical activities. While it is premature to precisely determine the role of this technology in education, we offer insights to assist in deliberations and provide a con- cise overview of the opportunities and challenges it presents. Our primary focus is on examining the impact of GAI on academic quality.

The concept of academic quality is inherently multifaceted, with various interpretations and ambiguities. Furthermore, definitions of academic quality are formulated differently by different institutions, each shaped by their distinct philosophies regarding higher education. These institutional philosophies can span a wide spectrum, ranging from traditions rooted in Humboldtian ideals to those of vocational schools, from an emphasis on job-oriented STEM disciplines to nurturing the social and emotional development of students.

Main provisions: AI Technology in Brief

Among all others, Artificial Neural Networks (ANN) serve as the foundational framework for contemporary commercially widespread use of AI. They originated in the mid-20th century with the aim of emulating the intricate structure of the human brain. The human brain comprises numerous interconnected neurons linked by synapses, facilitating the transmission of electrical signals. This observation gave rise to the notion that a similar network could generate electrical activity capable of manifesting various aspects of intelligence, including perception, cognitive processes, consciousness, self-awareness, and intellect.

In their nascent stages, these circuits featured as a building block a single neuron with multiple inputs and a single output. This was easily build upon the existing technology of analog computers in which input and output

voltages at each terminal represented the value of a system variable. All input signals underwent modification through their input function, often as simple as a multiplicative weight, before reaching a *summer* (Yeralan, 2023). The summer then aggregated the weighted voltages to yield a solitary output that passes through an activation function. Here, the neuron fires or not based on the strength of the output. Note that while some inputs strengthen the output, some may act as inhibitors, weakening the output. A single neuron constructed as such was referred to as a *perceptron*. While individual neuron units were developed as building blocks, they could be interconnected to create more intricate networks, encompassing a multitude of inputs and outputs. Typically, neurons are grouped into layers, representing stages. Then, a successive series of layers form a network. In this topology, while the inputs of the initial layer and the outputs of the final layer are available to communicate with the outside world, multiple hidden layers improves performance and accuracy. Such inside layers are referred to as "hidden layers" and networks employing potentially may hidden layers are called *deep neural networks*. From a mathematical viewpoint, each signal weight and each threshold function adds to the degrees of freedom of the system. The number of such parameters grows with the number of neurons. It is conjectured that the perceived intelligence of the entire network increases superlinearly with the total degrees of freedom, or the total number of independent parameters.

To employ the neural network, one must represent the input for the application as a vector containing specific values that encode its features. Consider, for instance, a facial recognition application that distinguishes cats and dogs. Initially, a set of features are extracted from a provided image, through image processing techniques. These features may include measurements like the normalized distance between the eyes, between the eyes and nose, and so forth. These feature values are then fed into the neural network, each as an input to a neuron. Each output of the network represents a different type of animal (dog, cat, other). The network's task is to identify the closest match and present its selection as the output.

The proper functioning of a neural network hinges on two key factors: the determination of input weights and the activation function. This determination process bears a resem- blance to curve fitting through the application of the least-squares method (Holland, 1992). It involves estimating parameter values to establish the most effective relation- ship between the network's output and input. Typically, the activation function form is set *a priori* while its parameters are free to change. With a large number of neurons, the number of parameters grows quite rapidly. It is not uncommon to have the size of the parameter space to exceed hundreds of millions of parameters. It is reported that (Open AI, 2023) ChatGPT versions 2, 3, and 4 had 1.5 billion, 175 billion, and 1.7 trillion parameters respectively.Determining the best values of system parameters poses a formidable challenge. How- ever, this task can be accomplished through an iterative procedure involving the pre- sentation of inputs and observing the corresponding outputs within the neural network. Internal to the network, a mathematical search process is employed to identify the system parameters that best establish a relationship between the provided inputs and outputs. This essential procedure is known as "training the neural network," and at its core, it resembles a curve-fitting endeavor whose mathematics are hidden within.

The logic underpinning ANNs is inherently straightforward. Individual neurons are not imbued with intelligence. Rather, intelligence is conceived as an emergent property arising from the interactions of a multitude of neurons. This perspective recognizes that each perceptron does not embody intelligence but contributes to the emergence of it. Notable thought experiments, such as the 1960s Game (Dneprov, 1961) and the 1980s Chinese Room (Searle, 1980), illustrate this concept brilliantly.

We conclude this brief overview reiterating the key point: AI in its most commonly imple- mented form relies on emergent behavior acquired through a vast parameter space. The practicality of its mathematical parametrization is done indirectly through input-output pairs (training), thereby removing the burden of directly solving for model parameters. The vast number of parameters provide extensive flexibility, allowing the network to be trained in any application. Notwithstanding the theoretical and philosophical implica- tions of the mathematical structure, we simply accept the technology to *almost* pass the Turing test (Turing, 1950).

GAI relies heavily on Natural Language Processing (NLP). It involves the deployment of a relatively extensive neural network featuring an extensive array of hidden layers. Until a short while ago, there was uncertainty regarding whether such a network could successfully emulate human language skills or facilitate authentic interactions through natural language inputs and outputs (Solaiman et al., 2019). The training process for contemporary NLP networks, particularly the Large Language Models (LLM) that have become commonplace, demands substantial computational resources, a considerable neural network size, and a multitude of hidden layers. Nevertheless, the fundamental logic behind this endeavor remains quite straightforward.

OpenAI's ChatGPT (Open AI, 2023), as detailed on their website, represents an ambi- tious endeavor involving the development of an LLM through extensive human trainer collaboration. GPT, an acronym for Generative Pre-trained Transformer, characterizes a neural network that evaluates words to select the most suitable continuation for an incomplete sentence. This description, though simplified, highlights the complexity in- herent in this process. Notably, it must navigate diverse potential conclusions for an initial sub-sentence, necessitating a decision on how to complete the sentence. Further- more, the system scrutinizes each word within a sentence for overall coherence with the entire statement. Despite this intricacy, the system chooses words and phrases to generate textual output. In a manner akin to conventional grammar and spell check- ers, this neural network is equipped with rules and the capacity to ensure grammatical correctness and proper punctuation of its output.

Another noteworthy and advantageous feature that sets ChatGPT apart from conven- tional search engines is its utilization of the "*Open Session*" concept, which incorporates previous interactions into its generation of new text. Consequently, ChatGPT is not limited to a mere query-and-response process, as is typical with search engines. Instead, it can be employed iteratively, involving a cycle of requesting information, submitting queries, reviewing responses, and refining queries. For instance, one might initially re- quest ChatGPT to provide a recipe for a dish and subsequently refine the request byasking for a more spicy version. This interactive episodic search experience creates the impression of communicating with a human being, heightening the perception of Chat- GPT as a collaborator or co-pilot.

Materials and Methods

Academic Quality

The study of the effects of GAI on academic quality holds as a prerequisite a clarification of the notion of academic quality itself.

The Merriam-Webster Dictionary defines the adjective "quality" to refer to "high qual- ity", i.e., having a large degree of "quality". As a noun, the dictionary provides several entries. Of those, we list the ones that are most relevant to academic quality (Table 1).

Table 1 – Academic quality

1	Nature, Property	peculiar and essential character, e.g., "a disturbing quality of on-line education"
2	Characteristic, Timber, Vividness	distinguishing attribute, e.g., "the tonal quality con- tributed to the overall success of the band"
3	Grade, Rank	degree of excellence, superiority in kind, e.g., "the quality of the cafeteria food was a determining factor"

A common source of confusion and miscommunication in academia is due to the various different definitions of "quality". At the simplest level, do we speak of "characteristics" or of "rank"? That is, are we focused more on "what attributes are appropriate for education" or "the level of our excellence"? Moreover, if the latter, to what do we compare our level? Is it our past performance, or that of other institutions? Given that there are different determinants of "excellence" and that no single institution is a non-dominated superior in all such factors, which factors do we prioritize, and why? Presumably, the "why" must be related back to the national and regional needs of the community the institution is serving, which in itself is a demanding task.

The confusion is highlighted in an OECD study (H´enard & Leprince-Ringuet, 2008) regarding teaching quality.

But quality teaching lacks a clear definition, because quality can be regarded as an outcome or a property, or even a process, and because conceptions of teaching quality happen to be stakeholder relative.

At the onset, we must also note that there are interrelated concepts, often associated and sometimes confused with quality, such as *faculty performance* or *student achievement*.

As we contemplate "academic quality", we are mindful of existing literature. Typically, the literature classifies academic quality issues under a few domains.

- Course design, development, and deployment
- Course resources (laboratories, library, etc.)
- Faculty competency and well-being
- Student support

- Institutional and administrative support
- Evaluation and assessment

This is by no means an exhaustive set, but rather what one encounters the most in the literature. Nonetheless, these aspects are useful in developing an operational definition of the concept.

Moreover, the flurry of activity during the past few decades has led to the notion of the "quality culture". As it applies to higher education, much have been debated as to how and why such a culture must be established, and what factors have positive or negative effects on such an institutional culture of quality. A good summary is from Bendermacher et al. (Bendermacher et al., 2017). A radicalization of the notion of "quality culture" is also present in the literature. For instance, DeMarco and Lister use the term the "cult of quality" (DeMarco & Lister, 1999).

Bendermacher et al. (Bendermacher et al., 2017) submit that the quality culture, while may have the intention and potential to promote clear policies, people-oriented shared values, a climate of trust and shared understanding, and the clarification of responsibili- ties, it also may result in a hierarchical divided structure, top-down management, a rigid control-oriented culture, act as communication gatekeepers, and discourage sharing best practices among competing divisions. An immediate derivative of this view is that the benefits of the quality culture are more easily achieved in a liberal and inclusive envi- ronment compared to a more rigid-control oriented one predisposed to more autocratic practices.

A Definition of "Academic Quality"

There may be a myriad of definitions of academic quality. Of the few definitions enter- tained, perhaps the best is represented by that from the University of Glasgow. The University of Glasgow ("Academic Quality Framework", 2021) defines academic quality as

Academic quality is a way of describing how well the learning opportunities available to students help them to achieve their award. It is about making sure that appropriate and effective teaching, support, assessment and learning opportunities are provided for them.

This definition proposes that the academic environment is responsible for the establish- ment of favorable conditions for learning. The onus of learning is on the students. If some students succeed in learning then the academic environment should be declared as being of sufficient quality. An immediate corollary of this definition is that any measure- ment of quality is not contingent on the success of all students. It is entirely possible that the institution is of sufficient quality (i.e., is providing a fertile environment for learning) but the students chose not learn. After all, the student has the legal right to take a class and fail if she so desires[1].

This notion is often openly declared, for instance, as illustrated by the Atlanta Metropoli- tan State College (AMSC, 2023) website, which gives students advise on academic success.

Remember that you alone are responsible for your academic achievement. Your instructor is your guide and your classmates may help you to under- stand your assignments; however, you are responsible for your own success.

Some posit that quality improvement starts with the students. This notion has even prompted discussion on how to empower students as agents of change (Kay et al., 2010).

It is clear from even a cursory review of the literature that the concept of academic quality lacks a sufficiently universal definition that would allow a rigorous evaluation of any potential effects of GAI on quality. Such a quest may proceed by selecting a set of definitions and developing an understanding based on that contingency. However, it may be best to view such lack of a common understanding as an indication and invitation to further scrutinize pertinent components of the phenomena with hopes to develop alternative contemporary conceptualizations of education and academic quality as a larger system.

Indicators of "Academic Quality"

Academic quality is almost always measured by a set of performance measures or in- dicators. These are typically quantitative measures, whose values are easily treated as statistics. One could perform many arithmetic operations, such as computing averages, standard deviations, ranges, modes, medians, etc. The numerics also allow for the values to be compared to past performances, to extract trends, and to set flags when thresholds are breached.

On a more general survey (Strang et al., 2016) regarding the factors that influence academic excellence, a pre-pandemic study lists about two dozen indicators grouped under three categories: student experience,

teacher performance, and institution. Most indicators seem to be weak in their predictive power. Only a few seem to have a moderate value in determining and assessing teaching quality. This is quite troublesome, as quality is often quantified and measured so that its improvement could be tracked and reported. While all indicators fare rather poorly, the somewhat marginally relevant indicators fall under the category "institution". This may be a revealing result, as it seems to point to the notion that the primary function of a university is the physical infrastructure that allows students and teachers to interact. This may seem as a departure from the notion that students as interested agents and teachers as mentors constitute the primary component of education. Any such a departure may also be evaluated by entertaining the notion that education in general has been experiencing a shift in focus, modalities, purpose, and outcome.

The Changing Landscape of Higher Education

One must also be mindful of the changes in higher education. These are affected by technological developments as well as social, political and economic processes.

The universities and professors are no longer seen as the only reservoir of information. One can learn from many sources. A response to this fact has manifested itself in the concept of the *flipped classroom*. However, it could be argued that the ample availability of knowledge outside the university would have to be addressed by more substantial modalities than a simple flipping.If students do not come to the university for knowledge, then what exactly is the attrac- tor? Below is an incomplete list.

- Social skills
- Future professional networking
- Facilities, e.g., laboratories
- Team work, interdisciplinary work
- Belonging to an exclusive society
- A diploma
- Access to industry/professional institutions

If indeed the function of the university is in flux, then so must the approach to academic quality. In fact, one could argue that the determination of the specific function or functions of the university is a prerequisite for the way academic quality matters are to be structured.

A strong case is made in the literature regarding the effects of neo-liberal pressures on higher education (Brown, 2015; Marginson, 2016; Slaughter & Rhoades, 2004). While there is much criticism regarding the perceived overreach of neo-liberalism into education (Readings, 1996), others see the influence as a component of the change to knowledge- based economies (Olssen & Peters, 2005).

The end of the Cold War served as a pivotal moment, not just in geopolitics, but also in the conceptual framing of higher education's role and structure (Harvey, 2007). Neo- conservatives interpreted the collapse of the Soviet Union and the end of the ideological battle between capitalism and communism as a definitive victory for free-market capital- ism. This interpretation led to the belief that the principles underlying competitive, open markets were universally applicable and should be adopted by all institutions, including higher education (H. Giroux, 2002).

This ideological shift further accelerated the corporatization of higher education. The logic of the market was increasingly imposed on academic institutions, reinforcing the view that they should operate like corporate businesses to be efficient, profitable, and ostensibly, more effective. The neoliberal and neo-conservative ideologies converged in their influence, intensifying the focus on vocational training, commercialization, brand- ing, and market orientation. This exacerbated the existing trends of privatization and fundamentally altered the ethos of higher educational institutions, diverting them further from their original missions of broad-based, liberal education and critical inquiry.

The triumphalist interpretation of capitalism's "victory" over communism or even all other forms of social structures (Fukuyama, 2006; Barber, 1996) not only impacted eco- nomic and political spheres but also had a profound and lasting influence on the many industries including the academic world. The evolving corporate philosophies and oper- ational strategies during the late 20th century in Western economies can be interpreted as a strategic response to the emergence of new economic powers, primarily in Asia, during the 1970s. Existing management frameworks such as Total Quality Management (TQM) (Deming, 2018), ISO 9000 standards (Hoyle, 2009), Lean Manufacturing (Wom- ack et al., 2007), and Six Sigma (Singh & Rathi, 2019) appear to have facilitated a seamless transition for Western corporations into the neoliberal economic model, which

gained prominence during this period (Harvey, 2007). With this background, neolib- eral views justified and intensified the application of market principles to educational institutions, cementing the shift towards a more commercialized, market-driven model of higher education (Slaughter & Rhoades, 2004; Marginson, 2011).

Typical claims include students seeing themselves as a customer and their diploma as a commodity (H. A. Giroux, 2014; Bok, 2009). This fits well with the view that university education is for the purpose of acquiring the skills and knowledge for the workforce. As a departure from the Humboldtian principles of enlightenment, this view emphasizes the "vocational school" aspect of education. These developments have been received by much dismay among much of the established academic community (Readings, 1996; Nussbaum, 2016).

Results and Discussion

Uses of AI in Higher Education

The utilization of AI in the realm of higher education is not a recent occurrence (Amershi et al., 2014; Belda-Medina & Calvo-Ferrer, 2022; Kuhail et al., 2023). It has given rise to certain apprehensions, primarily centered on the concern that students may exploit AI-driven tools to complete their academic assignments with minimal genuine effort. Additionally, educators might employ such tools to generate multiple-choice quizzes or presentations for their courses. Such a scenario may spiral down to the instructors' AI communicating with the students' AI, nullifying the exercise from any trace of learning or intellectual growth.

While AI-powered tools can prove valuable in the initial stages of brainstorming and drafting, there exists a valid worry regarding the potential for academic dishonesty. Plagiarism detection systems have grown increasingly sophisticated in identifying content generated by AI systems. Nevertheless, it remains conceivable to submit AI-generated output as original work. As is customary, the progression of technology for creation and detection evolves in tandem, with each feeding off and influencing the development of the other.

On one hand, the potential for the misuse of GAI exist, potentially short-circuiting the pedagogical process by allowing students to produce output without intellectual growth. On the other side of the debate lies the fact that GAI can serve as a valuable asset in streamlining many of the cognitive processes, the least of which is writing. One can request GAI to produce alternative responses and multiple iterations of an initial draft, thereby enhancing and simplifying the initial brainstorming phase and enriching the thinking process. Therefore, the proposition that universities summarily should ban the use of GAI must be carefully reviewed not to result in an erroneous reflex response.

AI in Future Higher Education

With the complex historical tapestry of pertinent technological, social, political, and economic constructs, it is clear that any future use of AI in higher education will be a heterogeneous, case-dependent proposition. Accordingly, any ethical or normative considerations will be varied. In short, the implementation of AI as well as the wide range of educational modes and structures will inevitably lead to a very wide range of dissimilar uses, implementations, regulations, and views.

A case in point, an educational institution that has centered itself as a resource to prepare students for their careers and jobs may discourage the use of GAI by its students. The justification is clear: these schools focus on skills that must be learned and exercised by graduates. Using AI tools to pass check-points that verify that such skills are acquired clearly undermines the mission of the school. Here, one may expect a shift towards the use of oral examinations or presentations in front of a panel of instructors to pass such check-points.

On the other hand, schools that have taken upon themselves the mission to provide the fertile grounds for students to reach further enlightenment through their individual path choices, schools that prioritize creative and innovative thinking beyond job-skill acquisition, are likely to find GAI a useful too that promotes brainstorming while reduces some of the tedium in the process by undertaking the routine aspects of the work.

The discourse surrounding the impact of AI on employment is complex and multi-faceted, often framed by polarized narratives. One assertion posits that AI will not directly displace workers but will empower a single individual to accomplish tasks traditionally requiring multiple persons. Implicit within this is the concern that this singularly enabled individual becomes the agent of job displacement for others.

This viewpoint aligns with the concept of "skill-biased technological change," which sug- gests that technological advancements often disproportionately benefit skilled workers while making unskilled workers redundant (Autor et al., 2003). By amplifying the capa- bilities of a skilled individual, AI serves as a force multiplier that enables that individual to execute functions previously requiring a team, thereby rendering others in the team expendable.

The notion that one person, amplified by AI, will be the agent of job displacement also resonates with theories related to economic inequality. For instance, the "winner-takes- all" market phenomenon (Frank & Cook, 2013) can be seen as extended into the realm of employment by AI, where the 'winner' is the individual most adept at leveraging AI technologies to their advantage.

However, it is crucial to also consider counterarguments. The "complementary" nature of human-machine interaction suggests that while certain tasks may be automated, new roles that require human creativity, emotional intelligence, or domain-specific expertise may emerge (Agrawal et al., 2018). After all, this pattern has been repeated over the last millennium as new disruptive technologies emerged, from steam to electricity, to information, etc.

GAI is unlikely to act as a monolithic force that invokes a uniform response from academia. We do submit, thought, that those universities whose mission better aligns with skill transfer will tend to suppress the use of AI and GAI, while those institu- tions that align more with innovation and enlightenment will tend to find a useful place in their work, potentially leveraging the new technology to develop new modalities of instruction.

Conclusion

The effects of AI on higher education on academic quality is subject to still evolving phenomena whose diagnosis requires the preponderance of many technological, social, political, and economic factors. Defining and improving "quality", whatever that may entail for the specific institution, is a good place to start the soul-searching effort towards institutional identity, character, culture, purpose, and effectiveness. In this respect, the institution may benefit from intensive and continuous discussions on the subject matter.While this brief report leaves much to be desired, at the least, institutions may recognize that the field is yet to be fully developed and established to provide grounds to seek a robust long-term worldview. The recognition that the phenomena is multi-faceted and far from a monolithic proposition will be of benefit in any quest.

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ГЕНЕРАТИВТІ ЖИ: АКАДЕМИЯЛЫҚ САПА МӘСЕЛЕЛЕРІ

Аңдатпа. Бұл зерттеу генеративті жасанды интеллект пен академиялық сапа қиылысына тоқталады. Бұл екі сала да техникалық және тарихи әдебиеттерде кеңінен ұсынылған. Зерттеу салалары әртүрлі болғандықтан, бірінің екіншісіне әсер етуіне мағыналы жауап беру үшін кез келген ізденіс кем дегенде әрқайсысына әсер етуді қамтуы керек. Біз қосымша талқылауларды жеңілдету және жаңа технологияның академиялық сапаға әсері туралы тиісті ойларды ұсыну үшін осы салаларға қысқаша шолуды ұсынамыз. Сондай-ақ мақалада генеративті ЖИ-дің жоғары білімге оң ықпалы талқыланады және болашақ коммуникацияда, ұжымдық жұмыста ЖИ-ді қолданудың болашақ бағыттары көрсетіледі.

Тірек сөздер: ЖИ, генеративті ЖИ, академиялық сапа, жоғары білім, ChatGPT.

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ГЕНЕРАТИВНЫЙ ИИ: ПРОБЛЕМЫ АКАДЕМИЧЕСКОГО КАЧЕСТВА

Аннотация. Данное исследование посвящено пересечению генеративного искусственного интеллекта и академического качества. Обе эти области широко представлены в технической и исторической литературе. Поскольку области исследований разнородны, любой поиск значимого ответа на влияние одной на другую должен включать как минимум воздействие каждой из них. Мы даем краткий обзор этих областей, чтобы облегчить дальнейшее обсуждение и представить соответствующие мысли об ожидаемом влиянии новой технологии на академическое качество. В документе также обсуждается положительное влияние генеративного ИИ на высшее образование и демонстрируются будущие направления использования ИИ в будущем общении и коллективной работе.

Ключевые слова: ИИ, генеративный ИИ, академическое качество, высшее образование, ChatGPT.