



From Didachography to AI: Metaphors Teaching is Automated by

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ARTICLE

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ABSTRACT

Although automation is not a novelty, high hopes are currently pinned on more and more ingenious devices built with Artificial Intelligence (AI). AI has become a key discussion point in the agendas of governments and multinational agencies, with particular interest in educational applications. This article explores parallels between ideas surrounding AI in education and conceptions proposed in the 17th century by Jan Amos Comenius, known as the father of modern education. Drawing upon illustrations from ongoing research that takes metaphor as its core analytical category, the piece assumes that metaphors are not mere stylistic elements, but strategic persuasive devices. Comenius' *didachography*, a portmanteau coined in his 1657 *Didactica Magna* to describe an inclusive educational system, relies heavily on metaphors that suggest remarkable similarities with contemporary EdTech rhetoric, especially on AI-related developments. Whilst exemplifying that ideas and premises entailed in current discourses on EdTech may hark back to centuries-old ideas, the paper argues that, despite taking on varying, contextually situated linguistic expressions, underlying metaphors appear to have endured from Comenius' time to support the advent of an educational system poised to automate teaching and, thus, dispense with a key part of his scheme: the teacher. In closing, the piece suggests that we may need to acknowledge the *contingent* nature of teaching and learning, perhaps accepting that key aspects of what makes us human may always resist engineering.

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Scenarios of an automated human existence are not a novelty: from ancient texts to contemporary literature and cinema, myth and fiction have explored different prospects for the thorny relationship between human and machine. Despite dystopian concerns, the history of technology offers many examples of devices designed and built to carry out tasks with minimal (or no) human intervention (Pickover 2019), from mechanical automata created for entertainment (Reilly 2011) to current data-driven devices. Whilst digital technologies have opened new horizons for automation in terms of sophistication, reach and potential functionalities, it seems that, since the mid-20th century, boundaries between fiction and reality have been forcefully challenged, in part due to the popularisation of ideas originating in Computer Science and promoted by enthusiastic futurologists defending a view of progress as a fundamentally technoscientific enterprise. With a combination of anticipation and fear, the 'technological singularity' is awaited, and its projected issues discussed (Bostrom 2014).

Currently, high hopes are pinned on Artificial Intelligence (AI) as the path towards more and more ingenious forms of automation. AI has become a key point in the agendas of governments and multilateral agencies (e.g., UNESCO 2019, 2021; OECD 2019, 2020), raising issues that require urgent attention given the speed at which these techniques are being embedded in everyday life, invariably with blessings in the form of prioritised financial support for research and development. Interestingly, Crawford (2021: 115) notes that AI research is usually conducted without prior ethical review, a sort of privilege inherited from its historical connections with fields deemed not directly concerned with people (e.g., Cybernetics). This appears to be the case with research on AI in education, specifically, which, according to Zawacki-Richter et al. (2019), predominantly originates in Computer Science and Engineering departments, with little or no attention paid to pedagogical questions that arise in respect to actual uses of such systems in real educational settings. Other surveys of research output on the topic (e.g., Chassignol et al. 2018; Hooshyar, Yousefi & Lim 2019; Guan, Mou & Jiang 2020; Aljarrah et al. 2021; Zhai et al. 2021; Flores et al. 2022)¹ offer consistent claims, shedding further light on the ways in which ideas such as affective computing, natural language processing and facial recognition are being recontextualised to support the development of AI for assumedly educational purposes.

Most of the areas addressed by AI development for education, as presented in the reviews mentioned above, pertain broadly to one of two categories: administration (from higher levels of management to routine actions of teachers such as attendance registration) and pedagogy (albeit with little consideration of practices and their intertwining with work considered administrative; Selwyn 2022a). These categories are mirrored by OECD (2019: 3) in what is described as the challenge of 'reaping the benefits of AI (...) to improve educational processes in the classroom and at the system level'. Technological solutionism (Morozov 2013) is an overarching perspective. Ultimately, great expectations appear to be placed on the industry's promises to *personalise* learning, thus improving individual achievement, raising academic standards and, ultimately, widening participation in quality educational experiences.

This article explores parallels between current ideas surrounding automation in education and conceptions proposed in the 17th century by the Czech educator Jan Amos Comenius, known as the father of modern education. Comenius figures amongst a handful of pioneers who contributed theoretical developments in pedagogy based upon principles of the Renaissance (Nordkvelle 2004). His name has also been invoked in bids to lend theoretical support to EdTech initiatives (Glava & Baci 2015; Černá 2019; Mozelius, Jaldemark & Hellerstedt 2020) and connected to utopian discourses on cyberculture via his projections of an education to prepare people to build a better, more equitable and fairer future (Dahlin 2009). This piece suggests that Comenius' *Didactica Magna*, a visionary work published in Latin in 1657, advanced a role for technical mediation that bears remarkable similarities to contemporary forms of thinking about technology in education.

Comenius' *Didactica* relies heavily on metaphors and analogies to describe the author's vision for an educational system open to all. This article draws upon ongoing research that takes metaphor as its core analytical category, assuming that metaphors establish displacements of meanings and operate as powerful persuasive devices. The research involves a critical metaphor

¹ These reviews cover the last ten to twenty years, but AI in Education has been coalescing as a research field since the 1960s, with a more marked development from the 1980s onwards (Williamson & Eynon 2020).

analysis (Charteris-Black 2004) of a corpus that includes samples of academic texts, documents published by multilateral agencies and media material produced by companies. With focus on a selection of metaphors identified in the analysis, particularly in texts published by the OECD and UNESCO, the paper argues that key Comenian concerns appear represented in EdTech rhetoric, specifically regarding AI in education. In this sense, the discussion exemplifies that conceptions and premises entailed in current discourses on EdTech may hark back to centuries-old ideas, even if they tend to circulate as pressing ‘innovations’ without recognition of their historicity, which is an issue yet to be more widely addressed in critical research on EdTech (Selwyn 2022b).

In contrast with what appears to be a generalised advocacy of AI in much of what is said about its potential as ‘solution’ to educational problems, research adopting critical perspectives (e.g., Gallagher & Breines 2021; Hrastinski et al. 2019; Andrejevic & Selwyn 2020; Selwyn et al. 2022) treats automation more cautiously and consistently with O’Neil’s (2016) stark warnings about the reproduction of inequality and injustice through data-based decision-making. As argued below, prospects of de-skilling or, in the extreme, teacher replacement with machines, which reflect much older concerns with the effects of automation on work and the professions (Noble 2010), are directly associated with ways of conceiving teaching, learning, education itself and, crucially, the nature and role of technology in these processes. These conceptions often take the shape of ontological metaphors, i.e., ‘ways of viewing events, activities, emotions, ideas, etc., as entities and substances’ (Lakoff & Johnson 1980: 25). As discussed in the next section, metaphors frame educational thought and guide pedagogical action whilst being deeply embedded in everyday language surrounding educational technologies (Hlynka & Nelson 1991; Stevenson 2007; Blau, Greenberg & Shamir-Inbal 2018; Farrelly, Costello & Donlon 2020).

METAPHORS OF EDUCATIONAL TECHNOLOGY

A key idea shared by the literature reviews mentioned above and many other writings on AI (e.g., Tuomi 2018; UNESCO 2019) is the aim of measuring or predicting its *impact* in education. This represents a view of objects as though they operate in clear cause-effect chains, a form of determinism that has its ‘essence’, according to Nye (2006), encapsulated in the first scene of Kubrick’s *2001: A Space Odyssey*, which portrays the (fortuitous) discovery of tools as the basis for humanity’s development into a space-faring species. Winner’s (1986: 10) metaphor of technology as a *bulldozer* is also descriptive of this form of determinism in that it explicates the work of assessing impact as an ‘impotent mission’, conducted ‘after the bulldozer has rolled over us, [when] we can pick ourselves up and carefully measure the treadmarks.’ In this vein, like meteors that crash on Earth causing varying levels of destruction, technologies are construed as *external objects*. ‘Impact assessment’, in this light, would amount to either futurology or *firefighting*, as impacts are only felt after the *invading* object has effectively landed.

Like other metaphors, these are not mere stylistic features to be brushed aside as poetic glee. Metaphors establish displacements of meanings, defining relationships between distinct domains of thought in their form of ‘condensed analogies’ (Perelman & Olbrechts-Tyteca, 2008: 671). In this sense, they constitute key persuasive strategies that encapsulate conceptions and values, suggesting aspects of their ideological basis not only from what they highlight but also from what they obscure. When one metaphor is chosen instead of another, certain ways of describing things are brought into play that represent specific forms of identifying, classifying and assessing these things. Conceptual metaphors, in particular, constitute mental constructs that define ways of perceiving, thinking and relating with the world (Lakoff & Johnson 1980) and hence may be understood as ‘self-fulfilling prophecies’ (Lakoff & Johnson 1980: 156). In this sense, metaphors play a central role in framing, disseminating and reproducing specific viewpoints, with an efficacy that relies on their being easily naturalised (Charteris-Black 2004). The idea that technology will have *impact*, perhaps the most common way of framing thought about its effects, implies its inevitability and, crucially, neutrality, a particularly problematic assumption for education (c.f. Selwyn 2014).

Taken as a visual metaphor, Figure 1 can shed light on ways in which discourses on EdTech employ metaphors that circumscribe ways of conceiving not only objects, their potential uses and advantages over existing alternatives, but also further aspects entailed in education, including subjects. The image also hints at the possibility that such conceptions may represent older ideas, even if they are redressed and presented as novelties.

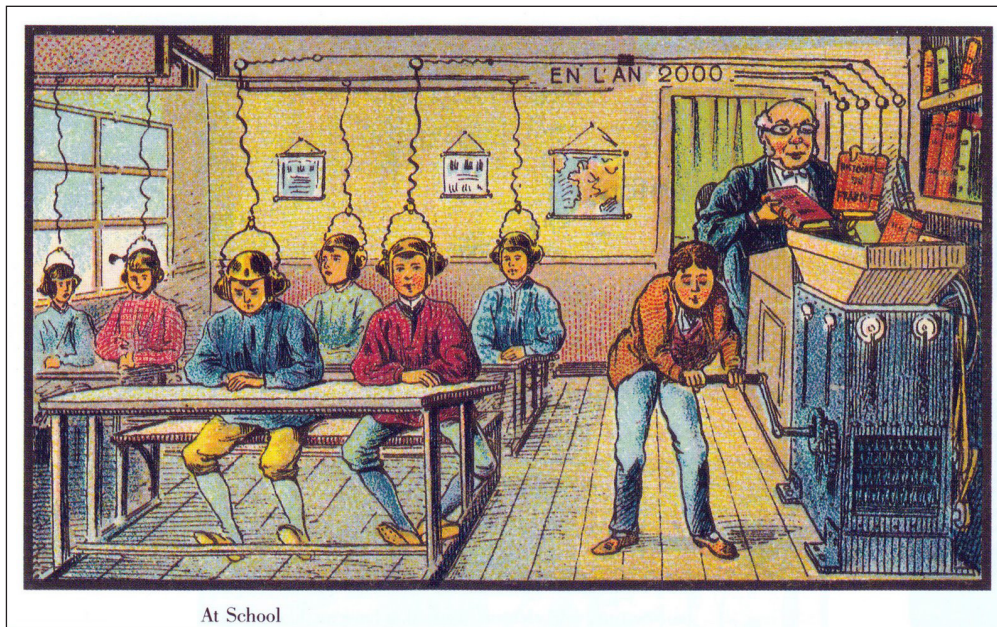


Figure 1 *En l'an 2000*.
Attributed to Jean-Marc
Côté, circa 1900 (Wikimedia
Foundation 2022).

Prior to the advent of data-driven automation devices, EdTech was heavily constrained in its attempts to ‘innovate’ pedagogy, so technology would seem to have remained predominantly a transmission medium (Ferster 2014) – precisely as shown in the future of the past represented in the image. The figure can be read as showing a schoolmaster-cum-curator selecting *content* to be *fed* or *poured into* learners through a *transmission* line *powered* by an apparently less advantaged youth than those sitting at their desks. The image also suggests an objectified view of knowledge and curriculum, as though both were simply *contained* in books and somehow *transferable* to learners, assumedly by some sort of didactic transposition engendered by technological means. The placement of technology here already suggests a form of de-skilling of the teacher’s work associated with the objectification implied by these ontological metaphors. Also, like Skinner’s teaching machines and much contemporary educational technology, still founded predominantly on behaviourist principles (Watters 2021), there is no direct interaction between teacher and learners.

This arrangement is strongly reminiscent (if a chronological inversion can be pardoned) of the scenario painted in The Wachowskis’ *The Matrix* (1999). Playing with the metaphor of the *subject as a brain* (Ortega & Vidal 2007; Vidal 2009), the film epitomises the metaphor of the *brain as a computer* by portraying learning as receiving the upload of new programs – an effortless, relatively painless, and practically instantaneous process in which the only part of the body that matters is contained in the skull. As Friesen (2010: 84) points out, the latter metaphor is foundational in the history of theory development in the cognitive sciences, but it implies a ‘circular, self-reinforcing tautology’ when technology-inspired psychological theories are applied to the development of educational technologies and interface design. This tautology is implied in the search for ‘thinking machines’ based on assuming the mind as a machine in the first place.

In *The Matrix*, learning appears to require no teacher, only a computer terminal operator. In the classroom shown in the image, we can assume that there is a teacher, but he has no direct dealings with the learners, who remain appropriately disciplined even as they face the world, rather than the instructor, in a classroom open to external inspection. A key conceptual metaphor is at play here, one that construes teaching as *filling a container* constituted by the learner’s mind. This metaphor neatly encapsulates complementary conceptions of teaching and learning (filling/being filled), assigns roles to teacher and learner (to transmit/to receive), and, thus, configures specific subject positions, outlining their possible forms of relationship. The metaphorical expression ‘learning as *acquisition*’ (Sfard 1998; Elmholtz 2003), albeit implying a more active role for the learner, is consistent with the *filling* metaphor, which was approached from a political perspective by Freire (2005) in his widely known critique of the idea of education as *banking*. In exploring the idea that teachers ‘deposit’ knowledge in students’ minds, Freire points to an asymmetry in the relationship between these actors that begs unpacking questions of power.

The remainder of this paper focuses on metaphors to explore parallels between ideas proposed by Comenius in his *Didactica Magna* and those surrounding automation in education. Comenius' classroom differs, in significant ways, from the one shown in the image above, but his *Didactica* presents a variety of metaphors and analogies related to the *filling* metaphor represented in the image and, importantly, in everyday contemporary expressions such as 'curriculum content'.

WIDENING PARTICIPATION: STANDARDISATION, EFFICIENCY AND ECONOMIES OF SCALE

Comenius was born at the end of the 16th century, heir to the protestant faith disseminated in Bohemia after the execution of Jan Hus, rector of the University of Prague. Before Luther's Reformation, the Bohemian Unity of the Brethren had already begun to disseminate their faith through schools and books, especially the Bible translated into the national language. In this context, combining religion and education, Comenius started his life's mission of formulating and implementing educational reforms amidst periods of exile due to persecution by the Catholic Habsburgs.

Drawing upon his experience as a teacher and head of educational institutions, Comenius drafted his *Didactica Magna* in Czech 30 years before its eventual publication in Latin as part of the *Opera Didactica Omnia*. The volume's subtitle – *The Whole Art of Teaching all Things to all Men* – is revealing of its author's universalist perspective in terms of both its inclusiveness (of the poor, women, and those with 'the dullest intelligences' – Comenius 1907: 158) and its focus on standards, as discussed below. Before Comenius, education had been a privilege. Criticisms and suggestions put forward in Rabelais' *The Life of Gargantua and Pantagruel* (ca. 1532–1564) and Montaigne's *Essays* (1580) were aimed at the preceptorship of the aristocracy's children. Rousseau's classic *Emile* (1762), albeit published a century after Comenius' *Didactica*, remains focused on an individual tuition model. Even models more closely resembling schools as we think of them today had a quaint, improvised character. Teaching was conducted at the teacher's home, with learners of different ages cared for individually whilst others would remain idle, resulting in frequent physical punishment. Comenius understood that this could not yield a blueprint for the expansion of schooling.

Comenius proposed a comprehensive structure to support teaching large numbers of students, complete with details of the material conditions of schools, the organisation of school times and the use of pre-determined curricula and books for each level of instruction. His proposal envisaged schooling for ages up to 24, drawing inspiration from technical developments of his time, one of transition between mediaeval craftwork and the industrial revolution yet to take place. Comenius accommodated in his vision the ideas of 'multiplicity' and 'perfection' which he associated with batch production in manufacturing, taking bakers and brick-makers as models for the teacher who would, henceforth, have to deal with large numbers of students and propose activities for all to carry out simultaneously:

(...) as a baker makes a large quantity of bread by a single kneading of the dough and a single heating of the oven, as a brick-maker burns many bricks at one time, as a printer prints hundreds of thousands of books from the same set of types, so should a teacher be able to teach a very large number of pupils at once. (Comenius 1907: 165)

In this excerpt, two major Comenian concerns are represented: *efficiency* and *standardisation*. Comenius claimed that his scheme would enable teachers to eschew the chaos of one-to-one teaching through a rationality of simultaneous teaching integrated into a support structure. Along the *Didactica*, he moved on from the *teacher-gardener* to the *teacher-batcher* and, towards the end of the book, to the *perfect* teacher embodied in the *teacher-typesetter*. The analogy of the typography belongs to a family of images that involve making numerous standardised products. Describing his method with the portmanteau *didachography*, he expressed his trust in emerging technologies as models to a then new type of education – an education for the masses – which entailed issues equated with what we would currently frame as *economies of scale*. He thus explains the idea:

In didachography (to retain this term) the same elements [of the typography] are present. Instead of paper, we have pupils whose minds have to be impressed with the symbols of knowledge. Instead of types, we have the class-books and the rest of the apparatus devised to facilitate the operation of teaching. The ink is replaced by the *voice of the master, since this it is that conveys information from the books to the minds of the listener* [emphasis added]; while the press is school-discipline, which keeps the pupils up to their work and compels them to learn. (Comenius 1907: 289)

Comenius' baroque writing style may appear overdrawn to modern readers, but his analogy of teaching as printing involves, explicitly, a linguistic expression of the conceptual metaphor of teaching as *filling*, as highlighted in the excerpt. As blank sheets, learners were to receive knowledge. In contrast with the French image discussed above, however, Comenius does not automate the *transmission of content*: instead, he places the teacher right at the centre of the process, a key idea we shall discuss further below. Here, we point out that, elaborating his analogy in excruciating detail, the author constantly reminds the reader of his concern with pedagogical practice using specially prepared resources:

The types are not left in confusion, but are neatly arranged in boxes that they may be ready to hand when needed. Similarly, our class-books do not present their subject-matter to the pupil in a confused mass, but split it up into sections, allotting so much to a year, a month, a day, and an hour. (...) Finally, type-setters use a straight edge which helps them to arrange the words in lines, and the lines in columns, and prevents any part from getting out of place. In the same way the instructors of the young should have some standard or model to aid them in their work; that is to say, guide-books should be written for their use, and these should tell them what to do on each occasion, and should preclude the possibility of error. (Comenius 1907: 290)

In other words, Comenius' is a scheme that uses standardised resources to be applied in pre-specified ways within a particular structure. In this light, contemporary Instructional Design can be viewed as a legitimate heir to Comenius' vision. Indeed, Mumford (1970: 101) recognised Comenius 'as the precursor if not the inventor of mechanically programmed education: nothing separates him from those who now have at their command the necessary electronic and mechanical apparatus for carrying his method out.' This appears to be the case with thinking that surrounds the design and uses of educational technologies, which, according to Watters (2021: 246), still involve 'breaking lessons down into the smallest possible pieces of content, for example, giving students immediate feedback on their errors, and allowing them to move at their own pace until they've mastered a concept.' Echoes of the centrality ascribed by Comenius' to books may be heard in the rhetoric surrounding Learning Objects (LOs) and Open Educational Resources (OERs), conceived variously with the metaphors of *Lego bricks*, *puzzle pieces* and *tools* (Ferreira & Lemgruber 2019), with the latter constituting (arguably) the most common metaphor used to describe educational technologies. These metaphors are consistent with a perspective of teaching and learning as a matter of combining appropriate *parts* or *building blocks* in a technical arrangement.

In Comenius' idealised version of the typography, all sheets would be printed without errors or imperfections, provided they were well prepared. The author's faith in the wide applicability of his method, which reverberates in the book's subtitle, also embraced teacher training:

Even masters who have no natural aptitude for teaching will be able to use it with advantage; since they will not have to select their own subject-matter and work out their own method, but will only have to take knowledge that has already been suitably arranged and for the teaching of which suitable appliances have been provided, and to *pour it into* [emphasis added] their pupils. (Comenius 1907: 288)

In this excerpt, the metaphor of teaching as *filling* is explicit. Crucially, despite the importance attributed to resources, a key element of Comenius' argument lies precisely in how he located teachers within his didachography, where resources alone are not enough:

As we have already remarked, it is the voice of the teacher that corresponds to the ink used in printing. If it be attempted to use types when they are dry, nothing but a faint and evanescent mark is made on the paper, in contrast to the firm and almost

indelible impression that results when they have been inked. Similarly, *the instruction that boys receive from books, those dumb teachers, is obscure and imperfect* [emphasis added], but when it is supplemented by the voice of the teacher (who *explains everything in a manner suitable to his hearers* [emphasis added]), it becomes vivid and makes a deep impression on their minds, so that they really understand what they learn and are conscious that they understand it. Again, printing-ink differs from writing ink, since it is made, not with water, but with oil (indeed, those who want a very superior ink, use the finest oil and the best charcoal); and, similarly, *the voice of a teacher who can teach persuasively and clearly should sink like oil into the pupils' minds and carry information with it* [emphasis added]. (Comenius 1907: 290–291)

The excerpt above also indicates that Comenius did not propose teachers as mere *readers* of books: explanations and persuasive techniques are required to promote effective learning. However, whilst portraying teaching as an *art* throughout the *Didactica*, the author reveals the limits of his understanding of what might be involved in teachers bringing book-based knowledge to life:

An organist can read any piece of music from his notes, though he might not be able to compose it or to sing or play it from memory; and a school-master, in the same way, should be able to teach anything, if he have before his eyes the subject-matter and the method by which it should be taught. (Comenius 1907: 288)

This last excerpt also reiterates his belief in standardisation as a foundational element of an inclusive education, but the analogy between teaching and performing a written piece of music is fraught with difficulties. However, despite his simplistic view, Comenius' didachography allows for a distance between text and its presentation that constitutes a space of creative appropriation and adaptation. This space remains an attribute of teachers' work in Comenius' scheme which, unfortunately, does not seem guaranteed by current trends, as discussed below.

OLD, NEW AND ENDURING METAPHORS

Comenius saw the world as a chain of certainties. As the Creator is perfect, so are His works: there is *Order* in the Heavens and on Earth. After nearly 100 pages of considerations of this nature, the *Didactica* explicitly presents teaching as a *technical* issue, associating its workings with those of a *clock* in terms of regularity:

The art of teaching, therefore, demands nothing more than the skilful arrangement of time, of the subjects taught, and of the method [emphasis added]. (...) Let us therefore endeavour, in the name of the Almighty, to organise schools in such a way that in these points they may bear the greatest resemblance to a *clock* [emphasis added] which is put together with the greatest skill, and is cunningly chased with the most delicate *tools* [emphasis added]. (Comenius 1907: 96–97)

Regularity lies at the basis of what Mumford (1967: 11) describes as *megamachine*, an 'archetypal machine composed of human parts' with origins in ancient civilisations that left monumental works such as pyramids as testimonials of the ways in which different manners of a 'cosmic order' were used to support specific forms of social hierarchies. As Mumford (1970: 103) suggests, 'Comenius' work makes plain the interweaving of inventions, mechanical experiences, regimented institutions, and, underlying them all, exorbitant magical expectations, which produced the new industrial and political fabric.' Comenius' optimism with the printing press finds a parallel in the contemporary enthusiasm for AI as the way forward to 'democratising access and creating equality of opportunity' in education (OECD 2019: 338). He derived not only confidence but also justification from a worldview strongly rooted in his religious heritage. However, stripped of such overtones, the *mechanical* view he applied to education appears to be precisely what supports AI-related claims.

AI tends to be presented in terms of its potential to *do* a variety of things that have traditionally been part of what teachers do; for example: '*identify* [emphasis added] pedagogical materials and approaches adapted to the level of individual students'; '*make predictions, recommendations and decisions* [emphasis added] about the next steps of the learning process based on data from

individual students'; '*respond* [emphasis added] to a learning situation and *adapt* [emphasis added] to the students' needs and skills' (OECD 2020: 5–8). All the highlighted metaphorical expressions support the idea that *harnessing* or *leveraging* AI would be a key 'advantage' of automated systems in terms of their ability to improve efficiencies: 'the promise of AI for teachers lies in its ability to increase the effectiveness of their teaching and to assist them in providing the ideal conditions in which their students can learn and grow' (UNESCO 2020: 17).

Assigning to machines actions normally reserved to teachers furthers the fragmentation of teaching and learning already entailed in Distance Education (DE), particularly in more recent ramifications such as e-Learning supported on MOOCs. Mostly originated in DE quarters, LOs, OERs and ideas such as *unbundling* and *uberisation* (Weller 2021) are associated with metaphors that support a view of education as a 'problem' to be solved with assemblages of standardised building *blocks*. The fragmentation is epitomised in Intelligent Tutoring Systems, Adaptive Learning Platforms, robot-teachers and other labels (Selwyn 2015) that designate systems intended to support learning with minimal or no direct teacher mediation (Selwyn 2019). Claiming that AI aims 'to *provide* [emphasis added] every learner, wherever they are in the world, with access to high-quality, personalized, and ubiquitous lifelong *learning* [emphasis added]' (UNESCO 2021: 15) implies AI would be able to deal with difference across numbers in ways that human teachers assumedly cannot. Nevertheless, real-world issues related to teachers' working conditions other than growing student numbers – underpayment and excessive bureaucracy, for example – are not, however, a necessary part of the scenario as addressed by AI advocacy.

In this context, a key paradox remains unexamined: whilst discourses on personalisation stress difference, standardisation takes the form, for instance, of focus on assessment as a key area for AI support, albeit usually without mention of issues involved in standardised curricula and learning outcomes (González-Calatayud, Prendes-Espinosa & Roig-Vila 2021). This paradox reverberates unchallenged in EdTech talk, to the extent that Bloom's Two-Sigma problem (Bloom 1984), the much-cited question of teaching large numbers of learners (presumably) as effectively as is possible in individual tuition, is claimed to have been (or to be on the brink of being) resolved with AI (Olcer 2018). Standardisation and personalisation would appear to be at odds in these discourses, which also disseminate claims that AI has already had a major impact in education, mostly accompanied with positive valuations (e.g., Chen, Chen & Lin 2020) but without much to the effect of empirical support.

Crucially, Comenius' mechanical metaphors appear to echo in the *engineering* metaphor of education discussed by Hlynka and Nelson (1991) as the dislocation, to education, of a perspective originated in engineering (and management). This can be understood as the rationale that frames the teacher-learner relationship in discourses on AI. In this light, efficient problem-solving is promoted by breaking complex problems into smaller *chunks* that can be modelled and analysed with a view to creating partial solutions to be later *tailored* as required. As Hlynka and Nelson (1991: 114) advanced, the *engineering* metaphor is 'appealing in as much as educators are concerned about the vast expenditures in education'. With economies of scale as an implicit concern, Comenius supported a measure of specialisation in a didachography that splits planning from teaching, a piecemeal approach amplified in discourses on AI, which depict the teachers' work as a process that can be usefully broken down. This fragmentation allows for specific tasks to be identified, labelled and programmed into machines that will hypothetically operate as aids to teachers, whilst it also supports assessment of the *impact* of AI on the profession.²

In an education conceived as a megamachine, subjects are *objectified*, becoming fallible components even as the *tools* metaphor figures repeatedly to suggest that *users* will still be required. On the other hand, AI appears, as is the case with big data (Ferreira et al. 2020), to be construed as a *subject*: 'The use of Artificial Intelligence to *interrogate* [emphasis added] vast amounts of data and to *identify a specific individual in need of help* [emphasis added] is increasingly viewed by counselling services as a valuable, if not an essential *tool* [emphasis added] in their efforts to prevent (...) tragic losses.' (UNESCO 2020: 24). In this extract, AI appears not only as mediator between humans but also as a powerful precog who is able to predict (possibly fabricated?) crises.

² See Tuomi's (2018: 20) discussion of this rationale applied to school teaching, which concludes with the claim that teachers will remain relevant in an AI-based education.

As suggested above, claims surrounding AI epitomise earlier EdTech ‘solutions’ to widening access to education, which Mumford (1970: 286), referring to developments of the 1960s, understood as something that ‘solidifies the system introduced by the archaic-modern megamachine.’ Mumford’s critique may serve as a warning that AI-driven systems may *trap* students in solitary cages, cut off from all real interaction with others, and fed according to patterns drawn in opaque ways from masses of data collected from other equally imprisoned subjects. This process would be positioned not within a Comenian-like divine order, but in a world ruled by an *invisible hand*, a metaphor that obfuscates transactions involved in the actual operation of *markets*.

In this context, education may be reduced to producing subjects that will both support and maintain existing structures, as illustrated by a marked concern with professional training in ‘AI skills’ (UNESCO 2019; OECD 2021). As the internal workings of AI systems are not easily audited, teachers may be, at best, relegated to a role comparable to the high priesthood of earlier megamachines. With a blind faith in the wisdom of AI, all that might remain for them to do might be to endorse the perfection of a new AI-dictated ‘(cosmic) order’, a possibility that is consistent with Noble’s (1999) portrayal of technology development as a form of religious enterprise.

From this perspective, the de-socialisation (Selwyn et al. 2021) entailed in automation can be understood as associated with the paradox standardisation/personalisation that lies concealed in AI discourses. Here, Comenius’ batch-production metaphors involving baking might be more appropriate than the analogy of the typography, as the language around personalisation with AI tends to avoid portrayals of learners as somehow *empty*, possibly as an attempt to avoid the types of criticism levelled at behaviourist approaches. Claims surrounding AI support the expansion and sophistication of a mechanical approach to education, even if ‘what is actually required is mechanical simplification and human amplification’ (Mumford 1970: 286). Discourses on automation leave no space to imagine other alternatives to a democratised education or to reframe the problem: to rethink education not in terms of how to cater with AI for larger numbers of learners, but in terms of how to tackle issues surrounding insufficient numbers of teachers.

As suggested above, Comenius’ system is also akin to a Mumfordian megamachine in its focus on standards and efficiency as the foundation of scaling. Although his classroom differs from the French image discussed earlier, it would seem that his didachography allocated a role for technology that bears remarkable similarities to contemporary ways of thinking. Comenius’ text was couched in language specific to his time and, especially, his core commitment to democratising education for both social and religious purposes. In contrast, contemporary perspectives are underpinned by a different set of values that expropriate wider societal interests to legitimise a view of education reduced to equipping people with skills and knowledge required by the job market in an *AI-impacted* future.

Despite various parallels with contemporary approaches, Comenius’ scheme retains, in his assigning a leading role to ‘the voice of the teacher’, possibilities for human interaction which current trends of automation explicitly curtail in proposals that stress, at best, machine-mediated communication. Indeed, what appears to be at stake with bids to the personalisation of learning via AI is the reconstruction of the teacher-learner relationship assigning AI as the substitute for Comenius’ teaching voice. Whilst metaphorical language is situated and, therefore, varying, underlying ontological metaphors of a technical basis – building *blocks*, *tools*, *empty vessels* to be filled in as efficiently as possible – appear to have endured to support the advent of an educational system poised to automate teaching and, thus, dispense with a key element of Comenius’ didachography: the teacher.

CONCLUDING REMARKS: TO SUM UP, TO OPEN UP

This paper explored parallels between Comenius’ ideas and current discourses surrounding AI in education, with a focus on metaphors. Various metaphors were discussed that appear (paradoxically) to support both the place of teachers in Comenius’ didachography and current trends towards replacing them partially or entirely with machines, albeit in different linguistic realisations and, in contemporary discourses, despite claims that teachers will *not* be substituted

with AI. The discussion highlighted that, whilst Comenius' arguments were underpinned by the religious values of his time and place, the contemporary version of Mumford's educational megamachine is guided by a perspective of education as a means to producing subjects for the job market. In this light, beyond locating historical antecedents of contemporary educational technology in the mid-twentieth century, as suggested by Watters (2021), the discussion points to a much older rationale. From this perspective, Comenius emerges not only as a foundational educational thinker, but also a key precursor to contemporary ideas on the place of automation in education.

As the technology industry bets on new material forms to create progressively more complex simulacra of the human body and its surroundings, it is not far-fetched to imagine that equally impressive anthropomorphic embodiments of AI teachers, supposedly endowed with 'affect', may yet be advanced. We cannot predict the effects of reconstructing the teacher-learner relationship with assumedly intelligent objects-*cum*-subjects, which is precisely what appears to be on the AI agenda under the guise of help and support to increase teachers' efficiency. In this context, metaphors appear to converge in a drive towards a hypothetical personalisation of learning that may dehumanise education. Given the pervasive nature of these metaphors, which support the ways in which technologies are designed, marketed and advocated in policy documents and media outlets globally, much work would need to be done to devise forms of resisting the dominant underlying logic, if that is even possible.

The discussion presented, however, is not meant to suggest specific value judgements, including on the possibility of teaching as an *endangered* profession, although we certainly share questions posed in some critiques of AI. Amongst these, we are concerned with the types of subjects that may be produced in contexts with reduced (or devoid of) human interaction. In this respect, we are reminded of the *hikikomori* in Japan, who, as Tsing (2015: 263) suggests, 'live through electronic media', isolating 'themselves through engagement in a world of images that leaves them free from *embodied* [emphasis added] sociality.' The key role of embodied human interaction in the processes of subjectification entailed in education appears implied by the centrality of the 'teacher's voice' in Comenius' didachography, despite its technical character. In discourses on personalisation with AI, however, the anticipated forms of interaction suggest further reductionism of what appears to us to be the human need for connecting with others.

As Hejnal (2017: G87) remarks, 'metaphors are always a double bind: they at once allow us to see and stop up our abilities to notice'. *Noticing*, however, is a necessary first step towards renewed understandings and change. In this piece, we examined sitting metaphors, metaphors that 'sit on a page and wait for the reader to find them' (Gallagher and Lindgren 2015: 391). Innovative ideas may emerge from creative approaches to metaphor as 'a "mental sandpit" in which to explore issues from different perspectives' (Weller 2022: 170). Alternatives have indeed begun to appear in areas that seek inspiration in cultural and biological diversity (Tsing 2015; Cadena & Blaser 2018; Tsing et al. 2017). Indeed, even *The Matrix* includes a role for the human teacher in Morpheus, a teacher that is not only embodied but also *emotive*. Perhaps a way forward is to engage with metaphor in ways that bring to the fore connections between learning, affect and the body in context, which are precisely the aspects overlooked by Comenius in his comparison between teaching and music performance. In his time, written scores were held merely as broad instructions to support particular renderings, specific to performers, times and places of performance. Acknowledging the contingent nature of teaching and learning, as musicians in Comenius' time did in respect to their craft, we might feel inspired to rethink the megamachine as a model for education. Ultimately, we may need to acknowledge that key aspects of what makes us human may stubbornly resist engineering.

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