

Introduction to Digital Primer Project : Part 0 : Ethical Imperatives

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Abstract. The aim of the “Digital Primer”, AI-driven project is to facilitate pupil’s entry into the world of letters, numbers and codes. In this article, we present two imperatives which help us to design the Primer in an ethically valid and sustainable manner. The first imperative states that one should not develop nor deploy AIED systems which one would be unwilling to use in learning process of one’s own children. The second imperative states that the machine should be adapted to the child and not the child to the machine. In both cases, we provide some more concrete insights how these imperatives are implemented within the Digital Primer project.

Keywords: digital primer · AI-assisted literacy acquisition · automatic speech recognition · categorical imperative · sustainable ethics · AIED counter-colonialism

1 Introduction

1.1 EdTech and AIED colonialism

According to the recent report [3], the size of educational technologies (EdTech) industry was valued at USD 254.80 billion in 2021 and is expected to reach USD 605.40 billion by 2027. Technology of augmented reality aside, it is especially artificial intelligence in education technology (AIED) which is “expected to drive the digital education market” [3].

According to [11], venture capital investments in AI start-ups reached a total of 75 billion USD in coronavirus year 2020 alone, out of which “around USD 2 billion was invested in AIED companies, mostly in the US ”[11, p.45]. Still, in spite of such amount investments, Holmes et al. state that “there is actually surprisingly little to justify wide use of AIED in well-resourced classrooms, other than the marketing materials and mostly unsubstantiated hopes expressed by many policy makers” [14].

Thus, education for EdTech industry is essentially *yet another business-as-usual* where evidence-based reasoning recedes into background to put money-making into prime light. Commonly, such business is dominated by a handful of corporations originating from global north which do not hesitate to launch planet-wide marketing campaigns promoting “their one and only solution” for

all problems a modal teacher or a school director may encounter, independently of a cultural or geographic context.

In [11], such tentatives are be labeled as “AIED colonialism”. That such “AIED colonialism” indeed exists is an undisputable fact to anyone who ever attended an EdTech industrial fair. As a consequence, AIED is dominated by believers of “one model, one algorithm, one device, one language, one platform and one set of values” paradigm whereby the “one model / one algorithm / one device/ one platform ” are the ones which were just trained / developed / designed by Silicon Valley / Shenzhen priests working for corporation C ; “one language” is the English / Chinese one and “one set of values” is the one which maximizes the profit of C in the long run.

It is intriguing that all this happens in spite of huge diversity of educational systems which still survive on our planet to this date - with their different traditions, methodologies and objectives. Truly, one can ask whether the colonialist belief that there can indeed exist a “magical learning platform” satisfying needs of everyone between Lapland and Patagonia is a symptom of lack of knowledge about unreducibility of diverse cultural contexts to a common denominator, or a symptom of industrial $\upsilon\beta\rho\iota\varsigma$, or both.

1.2 Accountability Problem

It is only fairly recently that the problem of accountability in EdTech / AIED industry starts to receive the focus it rightfully deserves [12]. Who is to held ultimately accountable in a case when things go wrong - as they often do ? Is it the vendor, the distributor, the teacher / school director / politician who introduced a harming system in the classroom, or is it the executive board, stock holders, programmers, network modelers, training data providers or *the AI model itself* ?

It is our conviction that in an industrial setup, such *accountability problem* is essentially unsolvable and no amount of ethical committees or external auditors may ever be able to provide absolute guarantees. This conviction is based on our technical knowledge on how IT and AI systems operate: if ever the character of the person who trains the ML system or holds the private keys / database access credentials / superuser “root” rights on the machine where ML system is trained is corrupt, incompetent or simply unaware of what is at stake; and unless the profit-oriented “business model” of the EdTEch provider satisfies highest ethical criteria, there is very little which an ethical committee could do during its monthly coffee & cookie meeting to avoid potential infractions, leaks, biases or adversarial attacks [10].

In classical, pre-digital schools the moral integrity of a human T is taken as a priori given and there are many mechanisms - e.g. face-to-face meetings between teacher and parents or teacher’s membership in collegium of other teachers just to name a few - which reduce to minimum the probability of any kind of incident and make clear who is to held accountable should any problem occur. For example, as our recent experience confirms, it is more and more common in countries of “the global south” that in case of human teacher’s absence, the classroom of

pupils is left without a supervision in front of a screen playing some YouTube videos. Believing that this is the way how “education of 21st century” looks like, is it the school director or is it someone else who should be held accountable in case the algorithm at some point exposes the children to inappropriate content, as it often does ? [8]

2 Digital Primer

Digital Primer (DP) project is our counter-colonial answer to industry’s “accountability problem”. Inspired by Stephenson’s visionary Bildungsroman “Diamond Age: Or, Young Lady’s Illustrated Primer (YLIP)” [18] and realized consistently with spirit and philosophy of open-source, open-hardware, do-it-Yourself and make-Your-own-device movements, the aim of the project is essentially twofold:

1. learning-with-AI objective: develop a hardware and software AIED book-like artefact assisting younger pupils in their entry into the world of basic literacy
2. learning-about-AI objective: increase AI literacy of older pupils so that they are able to repair, create and ameliorate new Primers

It is not aim of this article to describe DP’s “23 properties” [5,6], its RaspberryPi-driven hardware [7], Linux-based software or to elaborate further on the ontology and web-interface to DP’s PostgreSQL-encoded knowledge graph: these have been and will be presented in other publications. Within this article, we solely thematize the ethical guidelines and imperatives which motivate our actions and design choices as we - a small community of parents, artists and AIEDTech researchers - aspire to make Stephenson’s YLIP something more than just a dream.

3 Ethical Imperatives behind the Digital Primer Project

Imperatives presented in this article have a syntactical form of imperative statements addressing the second person singular, i.e. “You”. The “You” thus addressed is to be interpreted as “I” of a person developing an AIED system: an engineer, a computer scientist, a learning theorist, a teacher, a parent or, ideally, all these roles at once ³.

Primer imperatives are statements which describe mandatory resp. prohibited actions of any aieducator deploying Primer-like systems. Among these, awareness of a meta-principle known as “categorical imperative” holds a special place.

³ Should a need arise to refer to such a person in a 3rd person, we will use the neologism “aieducator” to do so.

3.1 Categorical imperative

Categorical imperative (CI) ⁴ has been first described by Immanuel Kant as follows:

“Act only according to that maxim by which you can at the same time will that it should become a universal law.” [13]

Being one of the - if not *the* - highest achievement(s) of Western moral philosophy, CI is a formal statement and meta-principle whose correct interpretation and application may allow any reasoning system to converge to answer “Is X moral ?” whereby X is an arbitrary principle of action - a maxim.

According to Kant, logical consistency and morality go hand in hand: an X can be considered as moral if and only if promotion of X to status of universal law does not result in a logically impossible world. On the contrary, X is not moral if its universal quantification results in the world with inherent logical contradiction. As an example, maxim X =“You can give false promises” is not moral because if ever such X would obtain a status an universal law and each promise could be a false one, the very *notion* of promise would be devoid of sense, thus leading to a contradiction.

3.2 First Primer imperative

“Do not design, develop or deploy AIED systems which You would not allow Your own human children to use.”

The first imperative (I_1) is strongly reminiscent of a so-called “Golden Rule for Computers in Education” (GRCE) stated as **“Teach others as you would like to be taught.”** [2,1]. Both GRCE and M_1 seem to be generalizable into universal law and thus can be considered ethical according to CI. There is, however, a slight difference between our and Aiken’s proposal: given that target audience of the DP project are primarily children, the intention behind M_1 is clearly pedagogical. On the contrary, the GRCE seems to be more of andragogical nature: teaching other as one would like to be taught does not necessarily lead to success if “the other” is a child and “the one” is an adult.

It is also easy to see what could constitute the anti-thesis to I_1 : namely, position held by Steve Jobs who, on one hand, unleashed the “iphone sprawl” ⁵ on children of all nations of planet Earth while, in his private life, dissuaded his children to use those very same devices. [4] It is obvious that promotion of such an anti-maxime “Deploy systems which Your own children should rather

⁴ C.f. [9, p.64-69] for introduction to categorical imperative in context of computer ethics.

⁵ “*Computer sprawl is worldwide and culturally transforming. Computer sprawl is not necessarily rational or harmless, but it is an undeniable force in the world that will affect not only the lives of all of us in technological societies but quite possibly everyone on the planet and their descendants for centuries to come. The ethics gap that is generated because we massively computerize without taking time to consider the ethical ramifications is therefore quite wide and deep.*” [15]

not use.” into the status of universal law would lead to contradiction and thus would be considered as immoral from Kant’s perspective.

In context of DP development, M_1 is implemented as follows: before making a new “knot” public ⁶ and deploying it “in production”, the children of Primer’s principal aieducator are exposed to the knot. Only when no objections arise from neither the aieducator herself nor her 10-year and 5-year old child does the newly emergent knot pass the ethical clearance and becomes a publicly available component of DP’s knowledge graph. C.f. the Figure 1 for two examples of an AI-generated illustration knots which have been accepted (left) resp- rejected (right) by the principal aieducator.



Fig. 1. Some illustrations generated by the artificial text-to-image generator (Midjourney) will be used in the public-directed version of the Primer project, others will not.

In certain sense, the inspiration from M_1 comes from the domain of “developmental psychology” and “developmental linguistics” where observations of cognitive development of one’s own children - as performed by Piaget, Braine or Tomasello [19], just to name some most famous researchers - provide deep insights into ontogeny of psyche, resp. language. Being aware of epistemological downsides of such approach - i.e. that when one is working with one own children, *one is biased by definition* - the joy and depth of insights which one obtains during work with one’s own children clearly overweight danger of any “parental fallacy” trap into which one may potentially fall.

3.3 Second Primer Imperative

Adapt a machine to a human child and not a human child to a machine.

Less than 35 years after creation of a first web-site, 30 years after first smart-phone and 25 years after norming of the WLAN protocol, adaptation of human behaviours to exigences of machine’s interfaces, algorithms and protocols is an

⁶ Knots - or knowledge units - are basic units of Primer’s knowledge graph. Practically anything in the Primer world - an illustration, a model, a word, an exercise, a template, a sentence or even a syllable - is considered a “knot”.

ubiquitous, worldwide, irreversible phenomenon. Given that we discuss the problem of machine-induced habits in our other DP-related articles [5], we limit our discussion of I_2 implementation in DP project to domain of automatic speech recognition (ASR).

The primary objective of the DP project is to teach children how to read. And since reading is *in essentiam* nothing else than translation of graphemic codes into phonetic codes, a well-functioning ASR system is a fundamental pillar of DP's usefulness.

In one among earliest observations of man-to-machine adaptation the members of AIED community reported, more than twenty years ago, that “people were accommodating to new kind of computer interface by speaking in a monotone voice, thus straining their vocal chords” [2, p. 165] .

In the meanwhile, the ASR systems made a progress so immense that “vocal chord damage” caused by adaptation of a human user to an ASR system is hardly considered a topic anymore. What remains a topic, however, is gradual disappearance of language diversity as humans adapt their linguistic behaviour to diverse assistants like Siri or Alexa.

In this context, accurate processing of child speech is a particularly difficult nut to crack [17,16]. Children are simply too different from each other and their means of verbal interaction with too vivid and wild to be accurately transcribed into text by “one model to process them all”.

Thus, it seems that the only viable solution is to fine-tune the ASR system to voice of a particular child and that is, indeed, how the ASR core of the Primer operates.⁷

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