Short Plaidoyer for Introduction of EcoArtificial Education in Diverse Curricular Systems of the Planet Earth

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Abstract. In this short plaidoyer, we focus the attention of the reader on the fact that as of 2023, plethora of diverse platforms, apps and models exists which allow one to use AI-assisted systems in education of eco- and bio- logical sciences. Nonetheless, these sciences are often left unnoticed by the AIED community and no curriculum seems to exist which would use such AI assistants in a systematic and organized way. After labeling such potential learning-with-AI curriculum as "ecoartificial education" (EAE), we subsequently introduce typology of artificial systems which may provide useful EAE assistance for both teacher and learner alike: namely, "classifiers" , "optimizers", "simulators", "generators" and "communicators". After giving some concrete example for each type (e.g. plant recognition, diet problem solvers, or bird song generator/communicators) we conclude the article with a statement of hope that EAE shall allow humans of future generations to better understand and protect the organic beauty which surrounds us.

Keywords: ecoartificial education · species identification · classifiers · generative models · inter-species communication · artificial life · SDG 2,3,6,11-15

1 Introduction

1.1 Human condition

Human H - an always unique, individual instance of a species *Homo sapiens sapiens* - is a mammal. As such, questions of food, energy and water sources, shelter, health and interaction with other species - be it parasites or symbionts - are vital for H's survival.

Since times immemorial, teaching and learning of vast majority of humankind - as well as many of our evolutionary predecessors [3]- had been centered around a fairly limited amount of topics: what fruits and plants and nuts and mushrooms are edible and under what conditions; who is the predator and who is the prey; where to go for water and where rather not; how - and from what organic material - to build a house, a hammock, a boat, a weapon and by what means can one crack a nut.

1.2 Current situation

Some indigenous communities and reform-pedagogic schools aside, things changed irreversibly with ideals of Enlightement and advent of industrial era and automatization. Suddenly, the *G*oal of education became full unfoldment of human potential and somehow, W. Humboldt's ideal of studying Latin and Greek and abstract algebra in a sterile indoor environment has been gradually evaluated as more worthy a path to the noble *G*oal than teaching children on a manure-odored field what is a difference between a bull and an ox or why does composting hold a key to proliferation or Life on our planet.

Less than two hundred years later and the very same students who can easily enumerate a list of their twenty most favorite TikTok influencers are not able to name even a most common plant of their surrounding (e.g. a Dandelion) or recognize a difference between a goose and a duck. Such is the current situation.

Billions of children all around the planet invest their time and cognitive resources into "learning" that due historical reason X their nation state is more worth of existence than that of their neighbors while, in the same time, nobody tells them that chewing the plant groving on the school yard may well relieve of pain >90% of mammals suffering of stomach ache. Such is the current situation.

Should the current trends continue, the generation of current pupils may well become the last generation who could have actually acquired - from their human predecessors - useful information about their local, regional biotopes . For learners of today are teachers of tomorrow and what is the probability that a young student shall sometimes in the future transfer her knowledge about nuances and peculiarities of more than 200 different species of meso-american frogs if no teacher during twelve years of her primary and secondary education ever explained her a difference between a frog and a toad ?

How could at least few out of 17 Sustainable Development Goals [15] be brought to life by students if their own teachers are not aware what SDGs are or that something like SDGs exist ?

Such questions are not rhetoric and the answer may surprise: in spite of the fact that current teachers are - due to historical reason Y and Z - often ignorant of importance of eco-aware, sustainable behaviour for survival of their own pupils, a cohort of powerful allies emerges on the horizon, able to fill the epistemological gap: allies known as AIs [18].

Current situation in AIED field An AI can be considered as an ally only if research community considers her an notices her as such. Table 1 tries to address the question whether it is - as of 2023 - already the case. Table summarizes number of found results after searching for 8 life-related keywords (LRKs) in archives of two most prominent peer-reviewed journals dealing with Artificial Intelligence and Education (AIED) [3]

[3] Reader may confirm our observations by querying `https://dl.acm.org/action/doSearch?SeriesKey=jaie` for JAIE 1989-1998 archive, `https://link.springer.com/journal/40593/volumes-and-issues` for JAIE 2013-2022 archive

Table 1. Occurences of diverse eco- and bio- keywords in two archives of "Journal of Artificial Intelligence in Education" and "Computers and Education: Artificial Intelligence".

Keyword	JAIE	CEAI	**Keyword**	JAIE	CEAI
biology	1 + 45	9	**ecology**	0 + 13	3
plant	0 + 19	3	**mushroom**	0 + 2	1
animal	0 + 23	10	**food**	0 + 31	7
forest	0 + 28	15	**biodiversity**	0 + 1	0

As may be observed, the first article containing a LRK which was considered worth of publication by JAIE peer reviewers was an article dealing with programming and problem solving in biology education [13]. Otherwise, biology and ecology education did not seem to be a topic in the early decade of AIED community.

In more recent articles, however, one may observe a certain increase in occurences of cetain LRKs. Still, it cannot be excluded that this impression often turns out to be illusionary: for example, out of 28 occurences of the word "forest" in last decade of JAIE publications, 26 have actually nothing to do with those CO_2 sequestrating nests of biodiversity but with "random forest" algorithm [2]. Thus, the only two articles dealing with the topic of $forest$ as originally known is that of [19] - a classical STEM - AIED paper on assessment of student explanations of the deforestation phenomenon - and a publication "Teaching and Learning in the Pleistocene: Biocultural Account of Human Pedagogy and Its Implications for AIED" [10] whose communicative intention is very close to intention behind this ecoartificial education (EAE) plaidoyer.

Similarly, the AIED publications using the term "mushroom" do not deal with educational deployment of AIs for mushroom identification but rather speak about "mushrooming of EdTech startups" [1] or articulate strongly generalizing statements that exercise problems concerning gathering mushrooms in the woods are "certainly .. not appropriate for American audiences" [7].

In sum, it may be stated that if ever an LRK occurs in an AIED paper, it tends to be submerged in a broader context of STEM education; or tends to play a colateral role of an exercise item ("covering basic vocabularies related to food, animals and plant"); or uses the LRK in a metaphoric way (e.g. "random forests" and "mushrooming EdTech"). While some exceptions like [10] exist, pupil's relation to other members of the biosphere is not - as of 2023 - addressed by the academic AIED community.

Thus, in spite of the fact that there exists at least a dozen of fairly accurate apps for plant identification which are used by milions of people, the number of occurences of the expression "plant identification" at both CEAI and JAIE is zero.

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and for CEAI 2021-2023 archive `https://www.sciencedirect.com/search?pub=Computers%20and%20Education%3A%20Artificial%20Intelligence`.

1.3 Ecoartificial education

Departing from the concept of "home community" - *οικοσ* - from which the prefix eco- is derived, interpreting the *οικοσ* as our auto-poietic, self-organising biosphere [6], we define ecoartificial education as follows:

"**Ecoartificial education (EAE) integrates those forms of pedagogical and didactic practice where artificially intelligent systems are being deployed for the purpose of increase of H's knowledge and respect of the surrounding biosphere.** [4]"

In order to avoid potential misunderstanding, we underline that in terms introduced by AIED fellows, EAE primarily provides a framework for "learning-with-AI" [4, p.19-23] and not "learning-about-AI (AI-literacy)" [4, p.26-32] curricula. Should it be the latter, topics of quantification of AI-related carbon emissions [8] would be in the center of EAE's interest.

We repeat: while rigorous thematization of ecological impacts of AI within an AI literacy curriculum is indeed of utmost importance for establishment of future nature-human-machine Nash equilibrium [11], the focus of EAE as hereby defined - and notably on the level of primary and secondary school education - is "learning-with" sub-discipline of AIED. That is, that sub-discipline where learner-assisting and teacher-assisting artificial systems play the central role.

2 Typology of EAE assistants

2.1 Classifiers and domain-specific oracles

We label as "classifiers" such hardware or software solutions which allow the human learner or teacher to classify or identify certain object or group of objects. In context of EAE, such "objects" are mostly visual (e.g. photos) or acoustic (e.g. audio recording) representations or productions of a certain living organism.

Table 2. Three cases of high-quality EAE classifier & identification apps issued from academic / citizen science research.

Name	Use	Reference
Merlin Bird ID	Bird identification based on visual (Photo ID) and acoustic (Sound ID) inputs	[16]
Svampeatlas	Mushroom identification (>80% accuracy for more than 1400 European species)	[12]
Pl@ntNet	Plant identification of more than 36000 species	[5]

[4] Given that it is indeed *the biosphere* which is the main focal point of EAE, it is also appropriate to speak about "bioartificial education". However, given that the term "bioartificial" is already used in medicine to denote the meaning of "being composed of both living and manufactured components" we opt for the EAE term devoid of a potential terminological collision.

A classifier with 100% recognition accuracy for any potential input relevant for domain D is called a D-oracle. While such oracles are still only hypothetical and advice of a human experts is still necessary in certain rare-species cases, the current progress in domain of transformer architectures [12] coupled with emergence of vivid ML-communities [5] and inflow of data from citizen science initiatives is slowly but steadily getting teachers and their students into situation where proper usage of certain classifiers reduces a security risk - i.e. probability of getting poisoned - limitely close to zero.

And once problem of species identification could be considered as solved, *EAE* can gradually start focusing on identification and classification of other species' mental states and communicative intentions [14].

2.2 Optimizers and simulators

We label as "**optimizers**" such hardware or software solutions which assists the human learner or teacher in finding an optimal (i.e. "best") or quasi-optimal (i.e. "for all practical purposes better than any other solution") solution(s) to a problem P there, where finding such solution by non-algorithmic means would be difficult or out of reach. Obviously, in context of EAE, P-solving is somehow related to eco-, bio-, or enviro- aspects [13].

Two Ps can be considered as "canonic" in this regards. First is a linear-programming "diet problem" where student's are given the task to find a most nutritively valuable combination of input foods which satisfy certain constraints. Another problem with which we confront our students during our proto-EAE seminars is "the Tangle" whereby the objective is to find such a combination of plants which mutually maximize their nutritive yield on a 1 / 4 / 9 / 16 square meter large raised beds.

Often, their is not a clear demarcation line between an EAE-optimizer and a system hereby labeled as an EAE **simulator**. While some of these simulators sometimes may have form of proprietary expensive CAD systems or MatLab modules, many new or old computer games can rightfully be called an EAE-simulator providing the pupil or a student a graspable and engagin entry into EAE world. Abandonware games like "Ecco the Dolphin" or games issued from the Sim- family (SimAnt, SimIsle: Mission in the RainForest) are just few among many worthy to be mentioned.

2.3 Generators and communicators

We label as EAE "generator" such hardware or software solutions which allow the human learner or teacher to generate signal which is relevant to non-human coinhabitants of the Gaian biosphere. As far as current research goes, it is highly probable that generative transformer-based models - potentially endowed with

[5] The most renowned machine-learning competition where future EAE-classifiers are evaluated is LifeCLEF (with sub-tracks like PlantCLEF, FungiCLEF, BirdCLEF, SnakeCLEF etc.).

Fig. 1. An ecoartificial generator (left) and communicator (right), as "generated" by the Midjourney text-to-image generative model. C.f. footnotes for specific prompts. CC-BY-NC-SA licence

attention layers [17] - are to constitute the core ML-related components of such generator EAE assistants.

Ultimately, mix of "classifiers", "reinforcement learning" and "generators" converges in deployment of first "**communicators**" allowing more advanced teachers and students to establish first robust communication channels with other species. Figure 1. illustrates how such EAE assistants may look like according to a text-to-image Midjourney model queried with prompts [6] resp. [7].

It goes without saying that acoustic (e.g. artificially generated bird utterances) and visual (e.g. e-ink and holographic plant simulacra) are just few among many modalities by means of which communication channels with other species can and will be established with further progress of science and technology (e.g. protein prediction or pheromone synthesis).

3 The Goal of EAE

In the last book of his 103-year old life, a former NASA-engineer, scientist and inventor par excellence, the man whose "Gaia Hypothesis" proposed to consider the biosphere of our planet as a living system - James Ephraim Lovelock CH CBE FRS - coined yet another term: "Novacene" [9].

Strikingly similar to outcome of Asimov's Foundation and Robot series, the Novacene world is a world where humanity provides an indispensable service in keeping the Gaian biosphere and the realm of machines in a state of delicate

[6] Ecoartificial Education classifier, an identification system based on both sound and image. Symbiotic, biometric, synth, product concept, speculative, in style of solarpunk –v 4 –q 0.25 –ar 3:2 –s 100

[7] An Ecoartificial Education simulator with a bird. Symbiotic, biometric, synth, eco friendly, sustenable, product concept, industrial design, product photographic, concept art, speculative, detailed, realistic, solarpunk style, concept art –v 4 –q 1 –ar 3:2 –s 100 –no frame

equilibrium. Such a goal is distant but one thing is certain: *should we* - humans, AIs, and other species issued out of organic or technological evolution - *make Novacene real*, we shall get there by means of assisting each other in the teaching & learning process.

That is, by means of education.

And should we not get there, this "short plaidoyer" still fulfilled its role for anyone who, for a short while, considered as theoretically possible that "ecoartificial education" - or a similar concept - will allow humans of future generations to better understand and protect the organic beauty which - as of 2023 - still surrounds us.

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