

NHNAI Project (*New Humanism in the time of Neurosciences and Artificial Intelligence*)

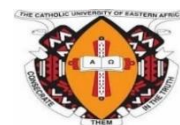
Global synthesis of NHNAI societal discussions
(2023-2025)

Education



In 2023 and 2024, discussions on what it means to be human in the time of neuroscience (NS) and AI have been facilitated by NHNAI partners in 9 different countries. In each country, 3 lines of discussions have been opened to explore this question in the **3 thematic fields of education, health, and democracy**. Each partner then produced 3 **local syntheses** reporting on the content of discussions in these 3 fields in the corresponding countries.¹ On this ground, the coordination team proposed 3 **global thematic syntheses** (one per field explored, education, health and democracy). Finally, ideas of these 3 global thematic syntheses have been grouped to generate one **global-transversal synthesis**, gathering ideas that were more general and have been expressed in different thematic fields.

This document presents the **ideas of the global-education synthesis**. The first part highlights the **nexus of complexity**, where ideas emerging from discussions enter in conflict and tension, manifesting possible complexities and delicate points of questions related to the topic of education. The second part contains ideas which appear less problematic as they don't belong to a nexus of complexity.



¹ For an exact total of 8*3 + 2 local syntheses. In Canada (Québec), Cégep Sainte-Foy organized discussions focused on Democracy and Education, but not on Health.

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Part 1: Global-Education nexuses of complexity

Being human in the time of NS and AI implies carefully exploring nexuses of complexities where valid ideas are nonetheless in tension, manifesting subtleties and challenges one should not overlook. Here are below some examples of **nexuses of complexity** in the field of **Education**, identified based on **local and global syntheses**.

AI and NS in education with respect to human development

I- Inclusion, personalization and human relationships

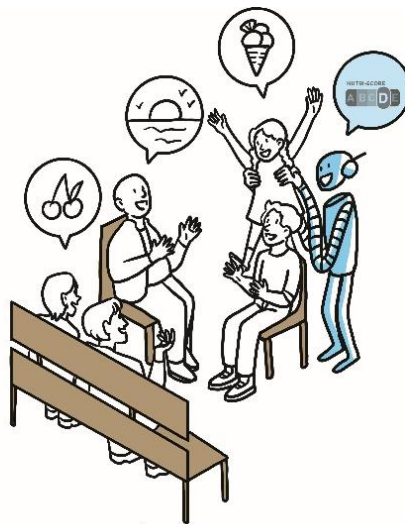


Figure 1: AI can facilitate integration

Participants highlight the benefits that AI can bring to education, starting with digitization and online school platforms, which make online teaching materials accessible to anyone, facilitating instruction outside class hours, enabling pupils and students to extend the subjects seen in class, and making it easier to catch up on lessons when absent. Digital technologies also allow for online discussions and debate forums that could make it easier for people who are very shy or uncomfortable speaking in public to express themselves.

More specifically, participants also recognize that AI can be of great help in education. AI-assisted translation and language learning systems, especially coupled with conversational bots with speech to text – text to speech capacities, are becoming more accessible. They can be of great help, for instance because language learning partly requires oral practice (conversational robots then being possibly more effective than language books). Such tools may even prove indispensable for people with language difficulties or for deaf or hearing-impaired persons (as mentioned in Kenya and France).

For participants, chatbots like ChatGPT, when used wisely, could be a formidable pedagogical tool, a necessary aid to learning complementing to the teacher. This complementary aspect

between AI and the teacher was emphasized several times in the discussions, notably with respect to the personalization of learning. AI makes it possible to personalize learning paths according to each student's pace, level and abilities. As it is physically and cognitively impossible for the teacher to take into account all the specificities of each student, AI enables him or her to have an overall view and to identify students in difficulty who are in greater need of support.

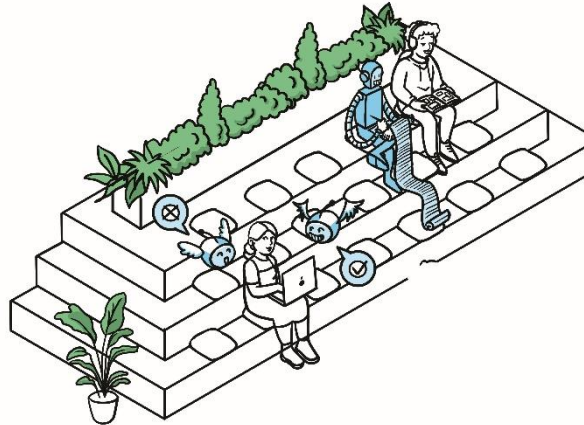


Figure 2: Enhancing learning with AI

But participants also recognize that AI's contribution to education (more inclusion, more access...) very often comes at the expense of face-to-face interaction and human contact, and this concern was almost unanimous in the discussions. The availability of online learning materials can also have the negative effect of encouraging students to invest less time in classroom activities, or even prompting some to drop out and home-school, given that everything is now available online, and within everyone's reach. As evoked in several countries including Portugal, there is also a risk that younger people, having become accustomed to this new format of online relationships, will become content with these virtual contacts and start ignoring their relational, emotional and physical needs, to the point of becoming distant and cold in contact with others.

In general, participants converge on the idea that undermining human relationships in face-to-face interactions globally threatens education. Only in face-to-face interactions can empathy, emotion, mutual and reciprocal understanding - in short, the encounter with the other - genuinely come into play. Face-to-face interactions when it comes to learning how to be, how to know and how to act. The presence of a teacher and the transmission of his or her passion and emotions play an important role in the learner's motivation and attention, and therefore in his or her learning. So school is not just a place for learning, but also a place for sharing, meeting new people, and learning to live together, to help society flourish. Through face-to-face interaction, we confront each other, learn social codes and pass on values. Digital education, or education that takes place too much behind screens, can ultimately contribute to reinforcing individualism and selfishness, which would constitute a major hindrance to community life and a threat to social cohesion.

Moreover, even if they recognize that AI can render didactic material more accessible and enhance learning processes, participants also worry about the risk of exacerbating inequalities. Indeed, AI might be accessible and beneficial only to wealthy socio-economical groups or people, notably as AI programs need expensive resources and infrastructures that some populations currently lack. In addition, AI programs are not deprived of biases, and this could perpetuate discrimination and stigma, especially when some cultures and populations are underrepresented in training databases (rendering AI tools less efficient for them, in addition to direct discrimination issues).

Ideas from local and global synthesis mobilized in this nexus of complexity:

- [\(Education – Global\) Fostering social inclusion thanks to AI technologies](#)
- [\(Education – Global\) Using AI and NS to better teach and learn](#)
- [\(Education – Global\) Preserving human relationships and in-person interactions](#)
- [\(Education – Global\) Not exacerbating social and economic inequalities with AI](#)

Expertise input:

- A. Avoiding the disinvestment in human relationships and the commodification of the human being

Based on insights from Brian P. Green,² Laura Di Rollo,³ and Juan R. Vidal⁴

In her book "Alone together" (2011),⁵ Sherry Turkle is concerned that young people are no longer investing in human relationships, and that more is expected of technologies than of humans. Education-focused relationships are among the most important relationships we have as humans. Most people can remember someone who taught them something, whether it was our parents, a friend, or a teacher in school. These educational relationships are vital to our humanity and AI puts them at risk, particularly in two ways: 1) as a distraction from learning (such as with recommendation algorithms on social networks and other digital platforms, that are optimized for grabbing attention), and 2) as a replacement for learning (for instance with generative AI tools that children and students may use to breeze through their assignments).

Humans need each other, especially for education. With degraded socialization, the human brain suffers stress-like symptoms, entraining not only a reduction in capacities by the nervous system, but more clearly an impoverishment in the quality and diversity of experiences, which abide to a certain loss of overall freedom of thought and action throughout life. In order to become genuine human beings, children should not be raised by screens and algorithms, but by other genuine human beings. In this perspective, one can wonder about the right time and place for introducing advanced technological tools for children, students and teachers. In order to be able to adequately judge the interest and added value of technology in a given activity, teachers should in the first place be capable of giving class without any major technological device. If teachers learn to be so with a high level of dependence of technology from the start, it questions the reliability of their understanding of the cycle of learning through human interaction.

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⁴ Associate professor in cognitive neuroscience (UCLy (Lyon Catholic University), UR CONFLUENCE : Sciences et Humanités (EA 1598), Lyon, France)

⁵ Turkle, S. (2011). *Alone together. Why We Expect More from Technology and Less from Each Other*. Basic Books, New York.

In addition to the issue of disinvestment in human relationships, digital technologies also present the risk of commodifying human beings, i.e. reducing them to mere objects. Indeed, as Sherry Turkle (2011) points out, the risk is that our "self" is transformed into an online "object-self," where we treat each other more and more like objects and in an expeditious manner. The most telling example is certainly email. Emails are a cognitive load in themselves, but sometimes they're messages from friends or colleagues that we say we need to "deal with" or "get rid of so" we can cross them off our to-do list, as if we were talking about emptying our paper basket.

Ultimately, the danger is that we lose the feeling of being alive, the way of being-in-the-world that preserves a certain dignity and authenticity, and that only human relationships and face-to-face contact can provide. AI has the potential to be a weapon of mass destruction upon the world's educational system. It needs to be disarmed and instead harnessed as a source of power to assist humans to become better people rather than harm us by enabling the worst parts of our nature. Thus, it seems necessary to strike a balance so as to benefit from what AI can bring us, while preserving those precious human contacts that largely define our humanity, notably through certain attributes. The human voice is to Sherry Turkle what the face is to Levinas.⁶ For Sherry Turkle, it is in the voice that the range of human emotions and the singularity of beings are transmitted and heard. For Levinas, it is through the face that the other appears to me in his or her fragility, vulnerability and singularity, which calls for an ethical injunction to protect and not to harm. The face is an interface that enables us to enter into a relationship with others, and through them, with humanity. This raises the question of whether the danger threatening humanity, with relationships mostly at a distance and mostly faceless, is not indifference to the other, and with it, the loss of concern for humanity.

B. Escaping the rise of inequality: Solidarity and Relationships

Based on insights from Brian P. Green, Nathanaël Laurent⁷, and Federico Giorgi⁸

AI as a driver of social and economic inequality is an inescapable question because AI will reduce the value of labor and increase the value of capital, thus driving wealth away from workers and towards owners of AI. How to prepare students today for the strange world of tomorrow, where labor might have no value and only those who already own wealth will retain wealth is an unsolved problem of gargantuan proportion.

Students need to know that a strange future is approaching and to be aware of AI and neuro-technology as developing technologies that can affect their futures. Additionally, the uncertainty that will be sparked by these revelations should not be allowed to overpower the growing importance of particularly human pursuits such as seeking ethics, justice, and creating a more caring world. While intellectual labor might be, in some cases, automatable, caring relationships between families and friends can never be automated. Particular human relationships are not fungible and therefore AI can never replace them. The value of family and

⁶ Lévinas, E. (1984). *Ethique et infini*. Le livre de poche

⁷ Associate professor in philosophy of biology (Université de Namur, ESPHIN, Belgium)

⁸ Post-doctoral researcher in philosophy (Université de Namur, ESPHIN, Belgium)

friends should be re-emphasized and the study of what makes good relationships should be a key part of the revision of education.

The overall concern that AI could become a tool of exclusion against the less affluent segments of the population does not appear to be tied specifically to any one type of technology. Rather, it potentially arises whenever a new scientific discovery is made that can improve the living conditions of a significant portion of the population. If, for instance, a highly effective but expensive treatment for a serious illness were to be commercialized in the future, the same risk of exclusion would apply to those who lack the financial means to afford it.

The participants' reflections therefore raise very broad questions, but ones that are no less relevant to the concrete reality experienced daily by millions of people—namely, the relationship between ethics and economics. Can we still maintain today that economic science should enjoy absolute autonomy from any proposals for regulation aimed at limiting the devastating effects of inequality? Or is it necessary to challenge such an economic view, as proposed by thinkers such as Jean Ladrière, Amartya Sen, and Martha Nussbaum (Caltagirone, 2017)?

The contributions of participants in the NHNAI debates once again seem to confirm that economic and technological development cannot be separated from a moral evaluation of the risks of exclusion that digitalization entails for those who lack access to new technologies.

You can also find this complexity on the NHNAI website: <https://nhnai.org/focus-on-nexus-es-of-complexity-education/>

II- Support, automation and cognitive development

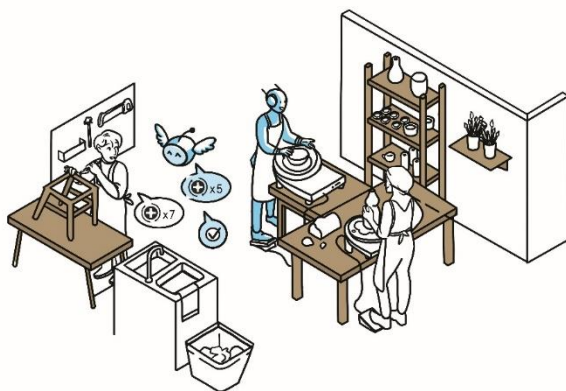


Figure 3: Enriching learning experiences with AI

Participants in societal discussions recognize the advantages of using AI in education. First, AI can help us to be more productive and efficient, because some tasks are easier and faster to complete with AI (such as producing summaries and taking notes for students, proofreading for teachers...). Automation can also be a mean to relieve teachers who are exhausted from tiring tasks (permanently) or to ensure continuity when they have a health problem (temporarily). Moreover, AI and automation allow us to save time that

could be used in other activities to exert our humanity, or to focus on other essential things like relationships (as evoked in France and Portugal). Another point is that AI can release us from repetitive or uninteresting tasks, which allows us to focus on more profound tasks that need high intellectual activity and might be more interesting or stimulating.

However, participants are also worried about the risk of cognitive impoverishment and loss of autonomy with AI. Delegation through automation implies being dispossessed from a certain (know-how) knowledge and to become machine-dependant. We lose autonomy when we are not able to realize a task by ourselves, without a machine. Moreover, by freeing ourselves from a task, we no longer call upon the cognitive capacities that enabled us to carry out this task, we no



Figure 4: The risk of cognitive impoverishment

longer call upon the cerebral areas we need for the realization of the task (as it is the case with the systematic use of GPS that impoverishes the activity of cerebral areas associated to space orientation and memory). On top of that, certain cognitive faculties need practice to be developed (such problem-solving, creativity...), notably by trial-error as we are also learning from our mistakes. Relying too much on AI to get answers may prevent us from practicing enough. Finally, some tasks we judge uninteresting or of "lower level" may prove key for the development of important cognitive faculties or values (such as patience, maturity...).

Ideas from local and global synthesis mobilized in this nexus of complexity:

- [\(Education – Global\) Using AI and NS to better teach and learn](#)
- [\(Education – Global\) Using AI to free time for human flourishing](#)
- [\(Education – Global\) Using AI to improve performance and innovation](#)
- [\(Education – Global\) Preventing the risk of cognitive impoverishment](#)
- [\(Education – Global\) Preserving human autonomy](#)

Expertise input:

Based on insights from Juan R. Vidal, Laura Di Rollo, and Brian P. Green

A. Escaping the law of "the least effort"

Although there could be several beneficial uses of AI in education that can enhance learning (e.g., using ChatGPT for generating questions about the lesson before an exam, or for providing initial ideas for starting a writing project...), it might be very tempting for students to generalize its use to as many as possible of their academic tasks. Technology such as AI makes some tasks easier and appeals to the principle of the "least effort" which, indeed, may be detrimental for cognitive development. This is particularly well illustrated by a study⁹ that suggests that

⁹ Abbas, M., Jam, F. A., & Khan, T. I. (2024). Is it harmful or helpful? Examining the causes and consequences of generative AI usage among university students. *International Journal of Educational Technology in Higher Education*, 21(1), 10.

excessive use of generative AIs like chatGPT among students is likely to increase procrastination, memory loss, and impact academic results.¹⁰

Learning new (intellectual and practical) skills requires practice and, often, repetition in order to increase the efficiency and quality of actions regarding their long-term goal. Practice (with repetition) is not possible without making efforts and often facing frustration when not quite achieving the expected goal. If the use of technological devices and AI shortcuts these important learning steps, the individual will not acquire the new capacities and knowledge, and will thus be impoverished. It is therefore important to evaluate the use of AI through this “effort-for-learning” lens, that should not be viewed as a waste of time, but rather as the time needed to learn-and-keep the knowledge (be it abstract or concrete know-how). Moreover, making efforts also conveys sense-making in learning, which is important for a person’s identity.

It is thus important to think of the use of technology and AI as a means to potentiate the learning of human capacities as such, and not only through the sole lens of the maximization evaluation scores in the education system. We should use AI as a complementary tool that does not prevent making cognitive efforts. For instance, AI could be used to help us remind of things we need to do, rather than only to do it for us, thereby depriving us of experiences that enable us to grow and flourish. AI could be used as a motivator instead of only or mainly as a facilitator of complex tasks (that may be necessary for learning, especially long-term ones). It is teachers’ and trainers’ responsibility to encourage learners to strike a balance between technological assistance and personal effort, in order to preserve learning and cognitive development, and to limit as far as possible the sources of distraction that technology can represent.

Indeed, understanding better how we learn and how we are influenced by our environment and our practices, fosters the view of a human being whose freedom to flourish depends on the capacity to control the interactions with all aspects of his environment, especially with technological devices that capture attention very efficiently, depriving people from freely paying attention to what’s happening around them. Neuroscience allows to better understand the constraints and mechanisms of human behaviour and thought. It gives ground to take action in order to avoid or domesticate interaction with mind-monopolizing artefacts.

B. The importance of the body and of lived experience in learning

Neuroscience reveals that the human brain does not really behave as a computer. Contrarily to ideas coming with a computational view of mind, knowledge is not the resultant of abstract calculations specified by software that the brain would execute. According to a more embodied view, cognition, knowledge, sense-making are by far enabled by the body-brain interaction, by the proactive engagement of the embodied mind through the ongoing interactions between nervous system, body and environment. Reducing these interactions, especially those with the

¹⁰ However, this study not only highlights the causal relationship between excessive chatGPT use and cognitive impoverishment. It also shows the causal relationship between excessive use of chatGPT and time pressures and high workload levels. So, AI or technology alone may not be the sole triggers of cognitive impoverishment. Their inclusion in a socio-economic model that overvalues production and consumption, efficiency and speed also looks causally involved.

social environment, amounts to impoverishing learning experience with a certain loss of overall sense-making and global integrated understanding of all knowledge.

A consequence of such embodied views is that learning “knowledge with meaning,” or “knowledge that has a sense for the individual,” has something to do with bodily know-how. Digital technology and AI (especially conversational AI) mostly deliver knowledge through written (or audio transformed) text. Sensorimotor manipulations or body movements involved do not go beyond using our fingers to tap or scroll on screens (impoverished interaction with the environment). Passing much time doing screen-job, even though it is for “learning” may fail stimulating enough the coupling between the nervous system and the body. It assimilates learning to what machines do: information storage in a pre-allocated space. As a consequence, cognitive and learning processes might be impoverished. Accordingly, it may prove crucial to find, during school educational years, an equilibrium between time-in-front-of-screens and activities that stimulate more directly the body at a sensorimotor level (in the effort of doing, in a more varied and extended range of lived experiences).

In any case, AI should not lead to reinforce the power of attraction and capture of screens and digital tools on children’s attention and activity-time. It AI should not, under the pretext of optimizing learning, lead to a reduction in the richness of lived experiences. Human knowledge is an experiential (bodily) process more than an algorithmic information process. When reducing the richness and variety of experiences, we inevitably reduce knowledge quality. AI tools may offer the opportunity to go faster through assignments and tasks, but at the expense of the richness and variety of lived experience. One may make an analogy with movie trailers. They may constitute good syntheses of the movies’ content, but they will never exhaust the experience of watching the full movies. Who would like to speed up movie watching in order to watch “more movies more efficiently”? In many contexts, machine-like processes of optimization cannot meet the human thirst for rich, varied, and high-quality experiences (the quenching of which imposing to accept the existence of extended unoptimized time lapses).

C. Preventing the loss of skills: critical thinking and creativity

The use of AI brings along with it the risk of deskilling. There are some sorts of skills that seem to be acceptable to lose, for example skills related to outdated technologies, etc., but there are other skills that seem intrinsic to our humanity, skills like those necessary for survival, for living in society, or rational skills for relating to truth. How exactly can we determine what skills we should continue teaching and what skills we are all right with losing is a somewhat open question, but there do seem to be skills that we should not lose.

In any case, the important role of the experience of making some efforts should always be kept in mind. Learning is not a passive process, which is why effort is part of the natural process of learning, especially when what is learned has a certain degree of complexity. Complex knowledge is not a matter of “load” but rather of “relations” between ideas. Establishing these links requires intrinsically more effort than merely retaining the information. Sense-making also goes this path. Effort, though less efficient, is a guarantee for the knowledge and skills acquisition processes. Therefore, an important question is: when does the use of AI as a tool become a substitute for the human thought-action process of knowledge and skills acquisition? When, how and why do students operate the substitution? Answering this

question might guide towards developing strategies and contextual adaptations in educational systems to avoid this substitution to happen.

In this respect, we may need to reinvent assignments and activities that cannot be easily solved by AI tools but instead require students to call upon their creativity and critical thinking. Moreover, valuing such activities could motivate students to engage more deeply in the learning process and be more willing to complete tasks on their own.¹¹

However, many of the commenters around the world expressed concern that AI might harm our creativity, our critical thinking, our mental development, our social development and so on. These threats should be taken seriously, avoided if possible, and if they start coming true then halted quickly.

Nevertheless, education is also not purely about practical useful skills – it is also about enjoying the more abstract or theoretical aspects of life, pondering the deep mysteries and meanings of the universe. If AI can take away some of the drudgery of life and make us more able to enjoy higher pursuits, as well as other enjoyable human pursuits, then this could be a good outcome.

You can also find this complexity on the NHNAI website: <https://nhnai.org/focus-on-nexuses-of-complexity-education-2/>

Improving our understanding of the human being while not giving in to ontological reductionism



Figure 5: Better understanding ourselves without reducing us to mere data

In France and in Portugal, participants highlight that advances in neuroscience and AI enable us to better understand the brain development as well as the biological and neurological mechanisms behind learning. Thus, NS and AI are expected to allow identifying students with

¹¹ Ibid.

learning difficulties, notably through neuroimaging and diagnosis. This will allow teachers, parents and counselors to support students and intervene earlier to prevent negative consequences, such as low self-esteem. A better awareness of neurodiversity and identification of a student's learning difficulties and/or mental pathologies can also lead to adapting learning tools and systems for the student, as permit AI algorithms for personalized learning.

However, participants emphasize the importance of avoiding confining people into boxes or categories, to reduce them to their digital profile or neurological characteristics. Thus, participants express that labeling children with mental pathologies or learning difficulties can also lead to discrimination and stigmatization, and this would be detrimental for the person. In Portugal, participants underlined that enhancing our practices for identification of children with low or high cognitive faculties can lead to overfocusing on cognitive performances, thereby to overstimulating or understimulating concerned children with the belief that there is no possibility of improvement and change.

Ideas from local syntheses mobilized in this nexus of complexity:

- [\(Education – Global\): Preserving \(cultural\) diversity and human singularity](#)
- [\(Education – Global\): Improving self and mutual understanding with NS and AI](#)

Expertise input:

A. Learners' categories as various way of functioning

Laura Di Rollo, Juan R. Vidal,

To avoid reducing a person's identity to just a few characteristics, we should view these learners' categories as various ways of behavior-under-constraints (rather than as mental disorders), which may lead different persons to express unique abilities in adapting to specific contexts and environments. These abilities can evolve over time and vary depending on situations. Tests and diagnoses, whether provided by a physician or an AI system, offer insights into a person's cognitive functioning and this information is valuable for understanding her needs. It may enable to offer her appropriate support. However, techniques and technology will always extract data and provide parameter values, but it does not fully grasp an individual's complexity, and this includes his/her inwardness, such as feelings and affect, and how they interact with learning processes. Global understanding of a person's uniqueness and depth cannot be grasped if it weren't through human relationships and interactions. While machines, tests, and evaluation tools can provide useful data, they fall short in capturing the full integrated spectrum of human singularity and its genuine complexity in which the individual recognizes himself. This also includes knowledge and influences from within the inter-subjective space of interaction. The behavior of the teacher has a profound effect on the motivations and effort-display of students towards the learning process. The dimension of relationships, therefore, is essential in an embodied approach to understanding people. Still, categorization and related information can be helpful for decision-making, as long as it focuses on helping humans to flourish rather than merely being more productive in a reductive framework of evaluation. Logically, categorization, though indicative, should not lead to an automated decision that could bear discrimination and/or exclusion, but should instead support social inclusion.

B. Individualization and the difference dilemma

Although inclusion is promoted in the 21st century, it also brings challenges and dilemmas. One dilemma, as expressed by Ruth Cigman,¹² involves how we handle differences:

We either treat all children as essentially the same, which means treating them as fairly as possible but with the risk of neglecting individual differences. Or we treat them differently, with the consequences that some are better off than they would otherwise have been, but there is a risk of being unfair by devoting more resources or expertise to some than others.

Furthermore, individualization can lead to over-adapting environments to meet the individual needs, as seen with current trends in personalization (like with AI applications). This approach, taken to the extreme, could potentially hinder collective growth and limit people's ability to learn and adapt to various contexts. If the environment is always tailored to fit individual needs, humans may lose the crucial skill of adapting to different situations, and to display the effort to develop the adaptation skill, a vital ability for thriving in the world, for adaptation does not rise passively in living organisms. Even genetically driven adaptations are to be included in modified behavior. Therefore, we need a balanced approach that considers the socio-environmental constraints (achieving performance?) but also biological constraints (learning through self-driven effort), and a balance that maintains a general standard of equality while still allowing room for differences and (neuro)diversity. Achieving this balance is no simple task.

In short, we need a holistic approach to understand people as complex beings, each with a unique personality, history, with unique beliefs and desires. Such complexity cannot be known through simple categories or labels. While learner categories can offer helpful insights into a person's way of functioning in a specific period, they cannot grasp all the potentialities of individuals. Nothing is set in stone, humans evolve, change and can express new potentialities to learn. Moreover, categories can lead to uniformization, while, for instance, there is no single way for conditions like ADHD or Dyslexia (and others) to manifest in individuals.

C. A debate underlying the issue: the relationship between mental faculties and brain

Federico Giorgi and Nathanaël Laurent

The debate on the manner to acknowledge and integrate neurological information and other inputs from natural sciences for better understanding humans being, especially in the field of education, may be negatively influenced by a somewhat narrow perspective regarding the relationship between mental faculties—such as learning—and the brain. Although it is currently fashionable to reduce the mind to the brain, the idea that any learning difficulty can be foreseen through neuroimaging techniques appears both questionable and dangerous.

It is questionable from a scientific standpoint for different reasons. First, one must be very cautious with empirically established correlations between mental phenomena and neurological or physiological events. Correlations between mental states and brain states may prove insufficient. One should also investigate whether these correlations signal causal or

¹² Cigman R. (2007), *Included or Excluded? The Challenge of the Mainstream for Some SEN Children* (Oxford Routledge). op. cit., p. 137. Cigman, R., & Davis, A. (Eds.). (2009). *New philosophies of learning* (Vol. 2). John Wiley & Sons.

identity relations (Manzotti & Moderato, 2014).¹³ This second layer of exploration can prove extremely complex. Moreover, it is also important to point out a second difficulty. In past decades, neuroscience often reduced the brain's functioning to its neurons only, using the computer as a metaphor for brain activity. Through such reductions and metaphors, the brain's functioning tended to be identified with the execution of a program. This approach, largely coming from cognitive sciences, suggested that the brain operates much like a computer. However, this perspective was criticized as "neuro-centrism" for ignoring the roles of the body and emotions. Nowadays, neuroscience has become more inclusive, recognizing that the brain's functioning is closely linked to other organs and the rest of the body. For example, research now highlights the importance of the intestine and microbiome's role in mental health¹⁴ or the influence of breathing and heart rate on brain activity.¹⁵

In addition to these criticisms one can address to reductionism based on biology and neurosciences, reductionism also raises particularly acute practical issues. For instance, it may lead a student to believe that their difficulties have a physiological origin—even when this is not the case—and they may come to think that their struggles are insurmountable.

Of course, we do not intend to deny that brain injuries can have very serious consequences on a person's mental faculties, nor that there are cases in which such negative effects are unfortunately irreversible. What we do challenge, however, is the reductionist view—dominant today—which holds that every mental phenomenon can be exclusively understood by appealing to neuroscientific knowledge, or in other words, that psychology is entirely reducible to neurology. By definition the domain of psychology is the one of individuals as an integrated whole. Neuroscience focuses on understanding the neural underpinnings and component processes of this integrated whole, by exploring bottom-up and top-down mechanisms. Yet it is far from delivering a simple and accessible perspective of the integrated whole. A too simplistic and reductionistic perspective is especially harmful for young people who, above all, need a sense of freedom and open possibilities to find ways to cope with their learning difficulties, no matter how big or small they may be.

You can also find this complexity on the NHNAI website: <https://nhnai.org/focus-on-nexus-es-of-complexity-education-3/>

¹³ R. Manzotti & P. Moderato, "Neuroscience: Dualism in Disguise", in A. Lavazza & H. Robinson (eds.), *Contemporary Dualism. A Defense*, Routledge, 2014, pp. 81-98.

¹⁴ Morais, LH., Schreiber, HL, Mazmanian SK (2020). The gut microbiota-brain axis in behavior and brain disorders. *Nat Rev Microbiol.* 2021 Apr;19(4):241-255. doi: 10.1038/s41579-020-00460-0. Epub 2020 Oct 22.

¹⁵ Engelen, T, Solca M, Tallon-Baudry C (2023) Interoceptive rhythms in the brain. *Nat Neurosci.* 2023 Oct;26(10):1670-1684. doi: 10.1038/s41593-023-01425-1. Epub 2023 Sep 11.

Does AI impoverish or reinforce creative abilities?

Participants highlight the importance of preserving creativity, an ability largely perceived as unique to humans, sometimes emerging from relationships or practice.



Figure 6: AI can inspire us, but nothing prevents us from doing without AI

Excessive use of AI in education may threaten this ability, for instance with the use of ChatGPT to obtain ready-made answers and homeworks. Overreliance and overdependency on AI could compromise childrens' critical thinking and creative abilities, notably by reinforcing laziness and procrastination. Moreover, AI might also contribute to impoverish creativity by easily generating products that are similar to those of human artists, reducing the willingness of artists and students to commit to creative jobs or studies.

However, some participants also highlight that AI and notably GenAI can be useful to stimulate creativity, find inspiration and news ideas, etc. Even finding the right prompts to write can be considered as a creative task.

Ideas from local and global synthesis mobilized in this nexus of complexity:

- [\(Global – Education\) Preserving human creativity](#)
- [\(Global – Education\) Fostering creativity with AI](#)

Expertise inputs:

Based on insights from Juan R. Vidal, Federico Giorgi, and Nathanaël Laurent

A. The frequency of use

The question of the relationship between AI and creativity cannot receive a binary answer. Rather than a yes OR no, we may better think in terms of yes AND no ... depending on the context. For example, intensive use of AI may impoverish cognitive and creative capacities of humans, but in small doses it may be used to positively stimulate and to suggest new alleys for thought. The effects and consequences are thus dependent on **the frequency of use**.

B. Questioning the purpose of education

The current widespread trend of using AI software to complete tasks related to one's education more quickly and efficiently seems to trigger not only the risk of developing a dependency on such technologies but also, perhaps, a crisis within the educational system as a whole. Students who choose to delegate to machines the tasks assigned to them by teachers or professors appear to have no ambition beyond simply obtaining a diploma. Yet the true purpose of education should be to guide students through a learning process that is, above all, a path of self-development. Such progress, however, can only be achieved through effort, hard work,

trial, and error. The excessive use of ChatGPT by many students thus appears strongly connected to the general devaluation of the role of teachers and professors in schools and universities in many countries. Human creativity—though at times seemingly mimicked by technology—is, in the case of students, closely tied to the development of their abilities in a specific field. But the task of guiding students in the discovery of their talents belongs to schools and universities, not to algorithms.

You can also find this complexity on the NHNAI website: <https://nhnai.org/focus-on-nexus-es-of-complexity-education-4/>

What is the purpose of education in the age of AI?



Figure 7: The education path: do we choose the fast way or the slow one?

Participants acknowledge that AI and NS can help us improve our (cognitive) performance and become more efficient and productive. AI can also support us in, or release us from, the most boring and tedious tasks, possibly freeing time for more meaningful or agreeable activities. Many participants highlight the transformative potential of AI on the manner we work and on economic realities. AI also deeply transforms education with the difficult questions related to assessment processes and homework assignments, but also with stimulating opportunities for new ways of teaching and learning (personalized learning, AI tutoring, assistance to self-testing ...).

Participants thus largely recognize that education should adapt to these new realities, not only within educational institutions, but also more broadly in society at large. Pedagogical approaches need accounting for new possibilities offered by technology to children and students (the negative as well as the positive ones). Education ought to prepare them for the future socio-economic context they will live in.

However, many participants suggest that merely adapting is not enough. For instance, one could wonder about what motivates judgments about what we should go on learning or not. Such judgments should of course respond to new technological possibilities, but they also reflect the manner jobs are valued and recognized, which can also be questioned. More broadly, discussions point out that education should prepare children and students to face and address the deep and complex challenges humanity encounters. In this perspective, merely adapting to the evolution of digital technology could even prove extremely dangerous. Participants notably insist upon the importance of opposing some harmful technological trajectories such as those threatening people's autonomy (e.g. when fostering motivation of children and students through surveillance or gamification, or with AI taking too much space in people's life when recommending information and actions). Education should thus foster the development of autonomy and critical thinking. It should also support children and young people in finding their own path and reflecting upon the meaning of life. It should not be reduced to knowledge and skills acquisition (enabling one to ensure a function in society) but should also be about how to deal with emotions and social relationships, or about values, ethics and moral decision-making.

Finding the right balance between helping children and students to adapt to the future society they will live in and supporting them in their ability to question and transform it is a key question and challenge education needs to confront with.

Ideas from local and global synthesis mobilized in this nexus of complexity:

- Transformation of educational and societal realities and need for education to adapt to it:
 - (Education – Global) [Using AI to improve performance and innovation](#)
 - (Education – Global) [Using AI to free time for human flourishing](#)
 - (Education – Global) [Updating educational approaches \(student assessment, teacher training...\)](#)
 - (Education – Global) [Using AI and NS to better teach and learn](#)
- Merely adapting is not sufficient:
 - (Education – Global) [Considering all professional more equitably](#)
 - (Education – Global) [Preserving human autonomy](#)
- Need to enlarge the scope of the reflection:
 - (Education – Global) [Making people's flourishing a top priority](#)
 - (Education – Global) [Fostering critical thinking, AI & NS ethics and literacy](#)

Expertise input:

A. The importance of fostering critical thinking and autonomy

Federico Giorgi & Nathanaël Laurent

The idea that schools should not only adapt to the changes taking place in the world but, above all, educate students in critical thinking is absolutely and entirely valid. This is especially true when it comes to the major shift represented by the rise of AI, whose effects on students' psychological and emotional well-being are still not fully understood or assessed. It is therefore essential, first and foremost, to raise students' awareness of the risks associated with

digitalization—such as the potential to develop some form of technology dependency—by providing them with the tools and support they need to protect themselves. Of course, this does not mean ignoring the fact that AI also offers opportunities to carry out stimulating projects. However, students who are aware of the limits of AI technologies and accustomed to critical thinking will undoubtedly be better equipped to distinguish between beneficial uses of such technology and harmful ones.

Juan R. Vidal

Education is also important to help us understand each one own complex life through time. The understanding of our interactions with our world, of our emotions, our values, our experiences also feed on learning from education. Beyond the purpose of skills acquisition for integration within the job market, education also builds in us a thought-matrix through which we navigate and which we enrich with new knowledge and new skills, but also new memories and emotions. Understanding what happens at all times is a challenge in an ever-increasing complex world and constitutes a global sense to one's existence. If education is diminished in its quality by not only reducing critical thinking but also reducing individuals' sense for autonomy, then uses of AI may affect our deepest sense of humanity.

As AI technology pervades educational systems beyond its control, it is important for the latter to stimulate educational practices that foster critical thinking, slow thinking, reading, complex problem solving. It is hardly possible to completely forbid access to and use of AI systems. But it is possible to reduce the time students use it, for instance through moments and activities where it is not allowed, accessible or useful. This notably means reducing digital interfaces by engaging in activities devoid of them. It could come down to reading a good paper book and analyzing its content collectively, with guidance of human teachers that stimulate critical thinking, but also curiosity, which is an important motivater for self-interest in everything and anything.

B. In what ways does the integration of AI into education challenge or redefine our humanity?

Jane Nambiri,¹⁶ and Paschal Wambiya¹⁷

To be human in the time of AI in education means affirming and nurturing the uniquely human qualities that machines cannot replicate such as empathy, moral reasoning, creativity, relationality, self-awareness, and the capacity for meaning-making. While AI can enhance learning through personalization, automation, and data analysis, it is important to note that it cannot replace the depth of human relationships, the wisdom of ethical discernment, or the holistic development of the person. In this context, being human in education means recognizing that learners are not merely data points or performance outputs rather, they are individuals with dreams, emotions, cultural identities, and spiritual dimensions.

Therefore, education must involve fostering critical thinking, dialogue, and interpersonal connection, instead of reducing learning to algorithmic outcomes. Moreover, neuroscience

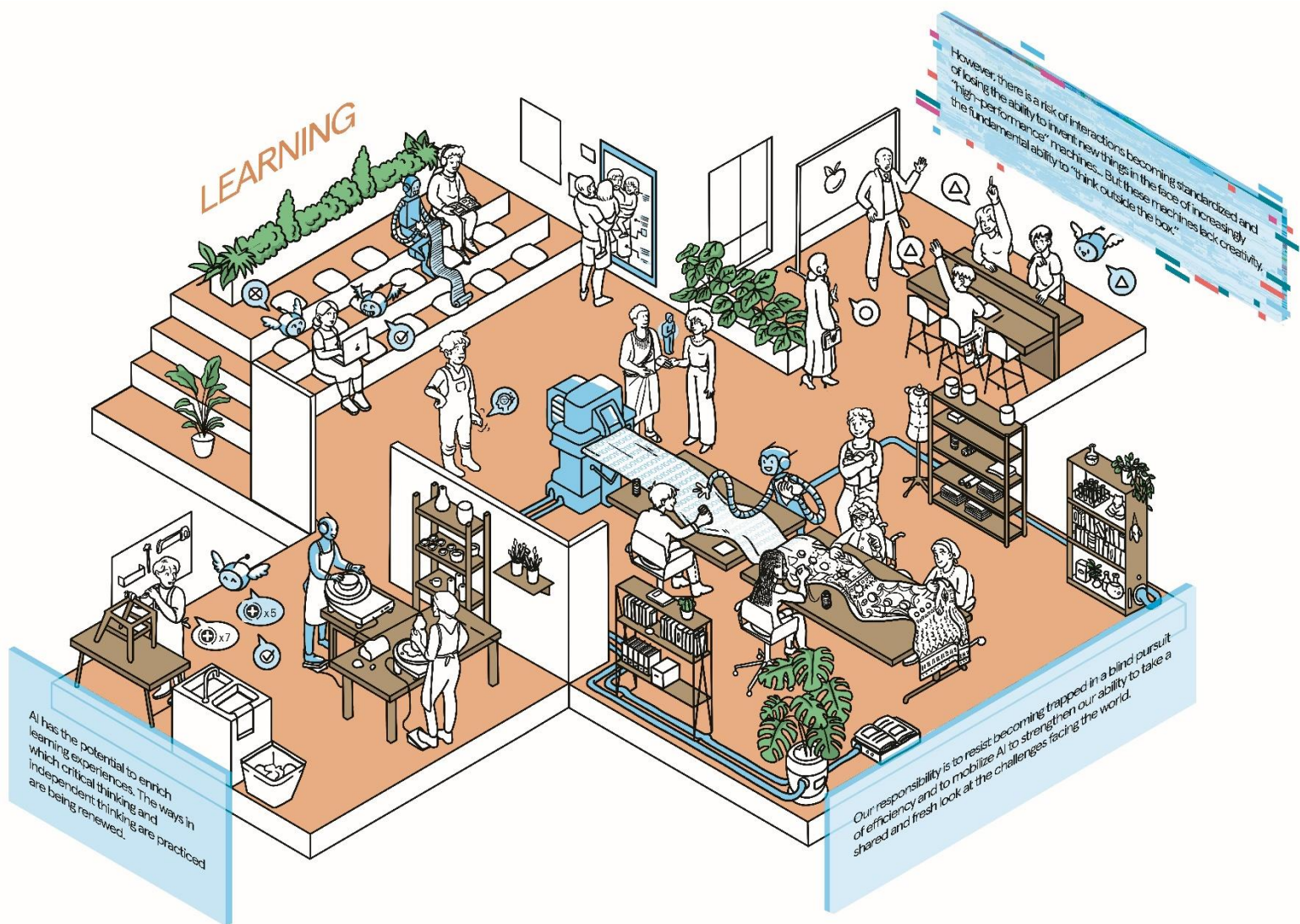
¹⁶ Educationist and researcher affiliated with CUEA, Educational Research and Evaluation - Research Fellow, Directorate of Research at Catholic University of Eastern Africa (CUEA).

¹⁷ Lecturer and researcher at the Catholic University of Eastern Africa (CUEA), Educational Research and Evaluation.

supports this view by emphasizing the importance of emotional safety, social interaction, and embodied learning for cognitive development. Ultimately, to be human in the age of AI is to ensure that technology serves human dignity and flourishing, rather than the other way around. Consequently, it challenges educators to balance innovation with compassion, and to use AI not to replace, but rather to amplify, the best of what it means to teach and to learn as human beings.

Human beings are complete in themselves, which expresses a profound belief in the inherent dignity, worth, and wholeness of every person. It means that each human being possesses within him or herself the potential for growth, meaning, and fulfillment, without needing to be defined or completed by external tools, technologies, or systems. This view is supported by humanistic psychology, which sees people as naturally oriented toward self-actualization, and by theological traditions that affirm the sacredness of the human person as created in the image of God. In the context of education and the rise of artificial intelligence, this idea reminds us that while AI can support learning and development, it cannot replace or complete what is already whole. Human beings bring to education qualities that machines cannot replicate: empathy, conscience, creativity, relationships, and the capacity for reflection and moral decision-making. Recognizing that people are complete in themselves does not deny the value of community or the benefits of support systems like AI, it simply affirms that human value is not dependent on technological enhancement. Instead, technology should serve the human person, not define or diminish their completeness.

You can also find this complexity on the NHNAI website: <https://nhnai.org/focus-on-nexuses-of-complexity-education-5/>



Illustrations realized by UsersMatter

Part 2: Other global-education ideas **(not involved in nexuses of complexity)**

Encouraging ethics in education

For participants in discussions, ethics should be an important component of education, including at school and not solely as a reflection that accompanies new technologies. Although the acculturation to AI technologies should include an ethical awareness of the societal issues it raises, ethics should be a priority in education in a broader sense, notably for learning how to live together and avoid individualism, which may threaten the common good.

Corresponding ideas from local thematic syntheses:

4 countries (CH, FR, IT, PT), 9 claims / ideas

1st wave / 2nd wave

- (Chile – Education): Ethics and professionalism in education
- (France – Education): Sharing a common ground
- (France – Education): Importance of values in the decision-making
- (France – Education): Desirable: We need to be careful regarding the increasing inequalities and the individualism that AI can bring
- (Italy – Education): Ethical literacy and mindset
- (Portugal – Education): Desirable: education should be based on values
- (Portugal – Education): Technology is harmful to social relationships
- (Portugal – Education): Desirable: Ethics should be included in school curricula
- (Portugal – Education): Undesirable: Individualism is increasing

Reinforcing regulatory measures

AI and NS development can bring tremendous benefits to education and human flourishing, but can also deeply threaten them (depending on what is developed and how it is used). Risks are multiple and multifaceted (cognitive impoverishment, inequalities exacerbation, cybersecurity, ...). Therefore, participants agree upon the fact that the use of AI in education calls for more regulatory measures in order to ensure the protection of humans. Collaboration between governments, educational institutions, scientific experts and citizens and other societal actors is desirable to settle proper regulation of AI.

Corresponding ideas from local thematic syntheses:

5 countries (CH, KE, PT, TW, US), 9 claims / ideas

1st wave / 2nd wave

- (Chile – Education): Ethics and Professionalism in Education
- (Kenya – Education): AI related challenges in education
- (Kenya – Education): Technology risks
- (Kenya – Education): Desirable: ethical / legal guidelines
- (Kenya – Education): Collaboration
- (Kenya – Education): Vulnerability
- (US – Education): AI should never harm people
- (Taiwan – Education): Desirable: Need more efficient regulatory measures
- (Portugal – Education): Desirable: Regulation is needed to ensure the safe use of artificial intelligence

Reducing the risk of cognitive impoverishment: the role of developers and engineers

Developers and engineers should also deal with this risk, for instance by limiting the development of some functionalities in generative AI models to preserve human thinking.

Corresponding ideas from local thematic syntheses:

1 country (FR), 2 claims / ideas

1st wave / 2nd wave

- (France – Education): Modifying algorithms to fight against informational bubbles
- (France – Education): Desirable: Restricting development and use of Generative AI to preserve the cognitive development

Complete version of the idea [here](#)

Preserving human autonomy: data protection

In the field of education, participants also worry about student's personal data being used without their informed consent, without them knowing their personal data are used for educational purposes.

Corresponding ideas from local thematic syntheses:

3 countries (FR, IT, KE), 3 claims / ideas

1st wave / 2nd wave

- (France – Education): Preserving informed consent of students regarding their personal data
- (Italy – Education): Protecting learners' privacy and autonomy
- (Kenya – Education): Undesirable: Exploitation

Complete version of the idea [here](#)

Not exacerbating social and economic inequalities with AI: job loss and social exclusion

AI can propagate and exacerbate existing biases and discrimination. For instance, automation of repetitive tasks can create job loss for poor and low-qualified people. It is important to ensure that AI remains accessible to all, AI softwares as well as infrastructures and resources needed.

Corresponding ideas from local thematic syntheses:

2 countries (FR, TW), 3 claims / ideas

1st wave / 2nd wave

- (France – Education): Undesirable: Using AI to release human from repetitive tasks
- (Taiwan – Education): AI can result in job loss, leading to social inequality
- (Taiwan – Education): Undesirable: Job loss leading to social inequality

Complete version of the idea [here](#)

Appendix: Global-Education ideas involved in nexuses of complexity

Being human in the time of NS and AI means ...

Making people's flourishing a top priority

Although participants in discussions recognize that preparing children and students for their future work (for them to be productive and efficient) is an important educational objective, they also claim that the reflection on the purposes of education needs to be wider and to make room for all the dimensions of human life. Even if working would become unnecessary, humans still ought to seek education. Learning and acquiring new knowledge can be valued for its own sake. Moreover, education is not only about making children and students acquire theoretical or practical knowledge. It is also about helping them to find their own path and to reflect upon the meaning of life (through work but also more broadly). In that perspective, education should also be about how to deal with emotions and social relationships, or about values, ethics and moral decision-making. Teachers should thus be trained and supported in those dimensions.

Making room for all these dimensions of life and meaning is crucial. Overfocusing on success and on (cognitive) abilities or performance may threaten human development. It can for instance lead some students to consume medication to enhance their cognitive performance.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

4 countries (CH, FR, IT, PT), 17 claims / ideas

1st wave / 2nd wave

- (Chile – Education): Education and success-oriented society
- (Chile – Education): Comprehensive training and curricular contents
- (Chile – Education): Opportunities and Value of Holistic Education
- (Portugal – Education): Humans' search for life meaning should be a priority
- (Portugal – Education): The use of medication to improve academic performance among healthy students is harmful
- (Portugal – Education): Overvaluing children's cognitive abilities may be harmful
- (USA – Education): The human purpose of education and how AI aligns
- (USA – Education): Desirable: Education is desirable regardless of economic usefulness
- (USA – Education): Religion, human purpose, and AI
- (Chile – Education): Ethics and professionalism in education
- (France – Education): Sharing a common ground
- (Portugal – Education): Desirable: education should be based on values
- (Portugal – Education): Dedicated time to fulfilling activities is essential for individuals to exert their humanity
- (Portugal – Education): Undesirable: the dominance of work in daily life turns humans into robots
- (Portugal – Education): Desirable: education also occurs outside the classrooms
- (Portugal – Education) Desirable: Social and emotional skills should be promoted in school
- (Portugal – Education): Desirable: More free time is needed for humans to develop several skills

Updating educational approaches (student assessment, teacher training...)

According to many participants in the discussions, education should take distance with any excessive focus on knowledge acquisition and focus more on other dimensions and skills (critical thinking, self-control, moral decision-making, creativity, ability to understand complex societal challenges, adaptability, ability to live within uncertainty, ...). The development of AI reinforces this urge. Education should prepare children to live in a rapidly transforming world thanks to technological developments, and therefore to adequately balance worries and hopes about technology.

For participants, educational practices should be updated with respect to the new technological context marked by AI, especially with respect to students' assessments. It is crucial to avoid focusing too much on the products (such as getting good grades and obtaining degrees for students, or reading good exam papers for teachers) at the expense of the process (with genuine learning and enrichment). In that perspective, one should be cautious with gamification processes that could reinforce motivations linked to the products only (collecting points, enhancing one's reputation).

Teachers will need training and support to navigate these transformations.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

4 countries (PT, CH, US, KE), 16 claims / ideas

1st wave / 2nd wave

- (Chile – Education): Challenges of the educational system
- (Chile – Education): Challenges in teacher training
- (Chile – Education): Uncertainty and future challenges
- (Chile – Education): Role of the school in the face of technological changes
- (Chile – Education): Spirit of the era and changes in AI
- (Chile – Education): Challenges and optimism facing the future
- (Chile – Education): Continuous adaptation in a post-pandemic education
- (Kenya – Education): Undesirable: dehumanization and Technology
- (Kenya – Education): AI and teacher training
- (Portugal – Education): Educational priorities should be reviewed
- (Portugal – Education): Desirable: Social and emotional skills should be promoted in school
- (Portugal – Education): Desirable: School should change to better tackle cognitive impoverishment
- (US – Education): Challenge of student assessment due to AI changing education and educational practices
- (US – Education): Cheating in education by using AI (4 extracts)
- (US – Education): Undesirable: Using AI to "gamify" education
- (US – Education): Education

Preserving human relationships and in-person interactions

The discussions converge on the idea that face-to-face interaction is a core component of what it means to be human, especially with respect to human (cognitive) development. Face-to-face interactions seem to be a fundamental space to learn how to communicate and behave with others, how to live with others in society, and to learn emotions and self-control. That is why school is not just a place to learn facts and theories but remains a fundamental place where social skills are learned and moral values are transmitted. These interactions enable discussions and confrontations of different points of views, which open up the space for debate. On top of that, there is an affective dimension within the relationship

between teacher and learner that could play a major role in learners' motivation and attention, with a major role for the teacher's face-to-face presence and passion. Non-verbal communication and body language are important in these face-to-face interactions. School is where humans learn how to make society altogether and how to behave on the basis of an ethical reasoning that is built through face-to-face and social relations. AI systems and technology may stifle human relations as digital devices and AI tools are used more frequently for pedagogical aims and learners are learning in front of their screens. AI tools cannot replace human presence. As a result, technology may thus foster individualism and people may be less motivated to invest in human relationships.

For participants in discussions, AI technologies should never replace humans but rather support students and teachers in their job. The teacher-learner relationship and face-to-face interactions should be preserved and maintained even in the era of online courses and virtual interactions.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [AI and NS in education with respect to human development](#)
 - [I- Inclusion, personalization and human relationships](#)

Corresponding ideas from local thematic syntheses of the 1st wave:

8 countries (BE, CA, FR, IT, KE, PT, TW, US), 32 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): AI technology as a threat to the students' education
- (Belgium – Education): The psychological risks associated with a highly digitalized education
- (Belgium – Education): Pros and cons of employing technology at school
- (Canada – Education): Preserving the human contact of the teacher-student relationship in education
- (Canada – Education): Online connections between students are no substitute for human interaction
- (Canada – Education): Face-to-face interaction with teachers and between students must not be substituted by online courses supported by AI technologies
- (Canada – Education): Undesirable: The use of AI technologies (such as chatbots and companion robots) must not interfere with or restrict human relationships
- (Canada – Education): Valuing the importance of human contact for human development
- (Canada – Education): Experiencing emotion, such as empathy and love, is exclusive to humans
- (Canada – Education): Transmitting social values is an important part of school education
- (Canada – Education): Undesirable: Activities or jobs that require emotions such as empathy must not be delegated to AI technologies
- (France – Education): Maintaining human contacts and preserving the teacher-learner relation
- (France – Education): Human replacement
- (France – Education): Desirable: We need to be careful regarding the increasing inequalities and the individualism that AI can bring
- (France – Education): Preserving the human contact and the teacher-learner relation
- (France – Education): Decision-making and mode of transmission are inherently human
- (Italy – Education): The relationship between student and teacher remains paramount
- (Kenya – Education): Undesirable: Human replacement by machines
- (Kenya – Education): Undesirable: Humans as robots
- (Kenya – Education): Social participation
- (Portugal – Education): Technology is harmful to social relationships
- (Portugal – Education): Experiencing emotion is exclusive to humans
- (Portugal – Education): Humans should maintain a prominent role in educational contexts
- (Portugal – Education): Education also occurs outside the classrooms
- (Portugal – Education): Human relationships are fundamental to development
- (Portugal – Education): Online interactions are of less quality than in-person interactions
- (Portugal – Education): Undesirable: Having close relationships with artificial intelligence is detrimental to human relationships
- (Portugal – Education): Undesirable: Individualism is increasing
- (Portugal – Education): Undesirable: Technological advances may contribute to emotional dysregulation
- (Taiwan – Education): There is something unique about human beings that cannot be algorithmized

- (USA – Education): Competition between human teachers and AI in the field of education
- (USA – Education): Teaching, Learning and Teacher-Learner Relationship

Reducing the risk of cognitive impoverishment

A widely shared concern runs through the discussions: AI technologies can harm human development in all its fundamental spheres (physical, psychological, cognitive and social), especially for children.

One can wonder about the risk of cognitive impoverishment AI can lead to, notably by replacing humans in several tasks. Moreover, cognitive abilities such as creativity or problem-solving must be developed through practice. Students' use of AI technologies like ChatGPT can hinder the development of these skills. In addition, intensive use of technologies can also create addiction, trouble sleeping, cyberbullying and isolation that can be harmful for human development.

Excessive use of AI and technologies may seriously impact the cognitive development of youth, notably by catching their attention, generating addictions and dependence, rendering children unable to think or do things by themselves. Moreover, personalization of learning through AI may, by reducing the opportunities to confront to various new experiences, impede the development of adaptation skills. Learning requires personal and cognitive effort, the demand of which technology is increasingly reducing.

Educators such as teachers at school must prevent those risks. Some propositions are made by participants: limiting the use of technologies like generative AI and encourage critical thinking, privileging technology-free activities. Developers and engineers should also deal with this risk, for instance by limiting the development of some functionalities in generative AI models to preserve human thinking.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [AI and NS in education with respect to human development](#)
 - [Support, automation and cognitive development](#)

Corresponding ideas from local thematic syntheses:

9 countries (BE, CA, CH, FR, IT, KE, PT, TW, US), 30 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): The psychological risks associated with a highly digitalized education
- (Belgium – Education): Uncontrolled use of AI technologies
- (Belgium – Education): The problems that arise from excessive use of AI in studying
- (Canada – Education): Developing human cognitive skills through practice
- (Canada – Education): The use of AI technologies must not hinder the development of cognitive skills considered important for human beings
- (Canada – Education): Fighting against cognitive impoverishment: human cognitive abilities (such as critical thinking and creativity) may be compromised by the use of AI technologies
- (Canada – Education): Undesirable: AI technologies can be used to make humans more efficient, but it must not compromise the development of cognitive skills considered important for human beings
- (Chile – Education): Risks of AI dependency and critical thinking
- (France – Education): Accepting difficulty and fostering self-improvement
- (France – Education): Preserving human autonomy
- (France – Education): Fighting against cognitive impoverishment
- (France – Education): automation of uninteresting tasks
- (France – Education): Modifying algorithms to fight against informational bubbles
- (France – Education): making learning easy
- (France – Education): Preserving personal effort to avoid cognitive impoverishment
- (France – Education): Learning is essential for human beings

- (France – Education): Desirable: Restricting development and use of Generative AI to preserve the cognitive development
- (Italy – Education): Risks of cognitive impoverishment
- (Italy – Education): Desirable: limit the use of AI and encourage critical thinking, training and relationships to avoid cognitive impoverishment
- (Kenya – Education): Technology promotes laziness
- (Kenya – Education): Undesirable: overdependence
- (Portugal – Education): Humanity derives from having a mind and a body
- (Portugal – Education): Technology is harmful to development
- (Portugal – Education): Undesirable: Artificial intelligence harms cognitive skills
- (Portugal – Education): Desirable: School should change to better tackle cognitive impoverishment
- (Portugal – Education): Desirable: Technology-free activities should be routine
- (Taiwan – Education): Overdependence on AI will reduce human thinking ability
- (Taiwan – Education): Overdependence on AI systems
- (Taiwan – Education): Overdependence on AI can lead to loss of cognitive ability
- (Taiwan – Education): Undesirable: overdependence on AI systems
- (US – Education): Education
- (US – Education): Risks, Harms, Fears, esp. privacy, data (not jobs, not medical, not education)

Using AI and NS to better teach and learn

Participants highlight that AI technology can facilitate learning due to a better accessibility of didactic material (online platforms, videos...), by making some tasks easier and faster to complete and by assessing learning outcomes. As such, AI can be beneficial in preventing school failure. AI can be used to compensate human limits and could, potentially, lead to develop new kinds of cognitive skills that will be necessary in a future of work and innovation.

However, some participants stress that an understanding of the functioning of AI technology is necessary to use it to be more productive in a way that genuinely serves humans.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [AI and NS in education with respect to human development](#)
- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

8 countries (BE, CA, CH, FR, IT, KE, PT, TW), 19 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): Pros and cons of employing technology at school
- (Belgium – Education): The potential applications of AI in studying
- (Belgium – Education): AI as a tool for verification and self-assessment
- (Canada – Education): Desirable: The use of AI technologies can complement the teaching provided by a human teacher to enable personalized learning
- (Chile – Education): Education as personal responsibility
- (France – Education): Undesirable: fighting against informational bubbles
- (France – Education): Compensating human biases
- (France – Education): Desirable: Using AI to fight against school failure
- (France – Education): Desirable: Using AI to better orientate ourselves and navigate in the flow of information
- (Italy – Education): AI as a facilitator for accessing and understanding information
- (Kenya – Education): Monitoring and evaluation
- (Kenya – Education): Opportunity to learn other languages
- (Kenya – Education): AI assisted education
- (Kenya – Education): Desirable: Time saving
- (Kenya – Education): Desirable: Evaluation and Technology
- (Portugal – Education): Humans have limited cognitive and performance abilities
- (Portugal – Education): Desirable: Artificial intelligence is beneficial in educational contexts
- (Taiwan – Education): AI can enhance human capacities

- (Taiwan – Education): Desirable: Human-AI cooperation in education

Preserving (cultural) diversity and people's singularity

Participants in discussions insist on the fact that humans are complex living-beings who cannot be reduced to their data or their brain. We may tend to have the impression that, thanks to AI and NS, a human being can be understood by creating a complete profile (based on data or neuroscientific explanations only) and predict his future behaviors or thoughts. Nevertheless, the discussions converge on the idea that we should prefer a holistic approach that includes biological, psychological, social, and spiritual spheres and aspects of the human life, an approach that cannot be reduced to scientific or digital data. Humans are all different. This difference is a richness for humanity that we should preserve from the threat of uniformization AI and NS can bring.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [Improving our understanding of the human being while not giving in ontological reductionism](#)

Corresponding ideas from local thematic syntheses:

4 countries (FR, PT, KE, TW), 11 claims / ideas

1st wave / 2nd wave

- (France – Education): Preserving diversity and accounting for human beings' singularity
- (France – Education): Fostering self and other-understanding thanks to NS and AI
- (France – Education): Taking care of not reducing persons to categories
- (France – Education): Data reveal only partial knowledge about humans and humanity... We need to remain critical about the reliability of the data
- (Kenya – Education): AI must be context-driven
- (Kenya – Education): Conflicting spiritualities
- (Kenya – Education): AI and individual differences in Education
- (Kenya – Education): Digital divide in education
- (Portugal – Education): Undesirable: overvaluing children's cognitive abilities may be harmful
- (Portugal – Education): Desirable: Ethics should be included in school curricula
- (Taiwan – Education): There is something unique about human that cannot be algorithmized

Preserving human autonomy

Participants largely acknowledge autonomy as a fundamental value to preserve in the time of AI, especially in education. Autonomy allows humans to grow and become capable of thinking by themselves and make informed decisions. AI may impact this autonomy by creating dependency, by rendering comprehension less accessible, and by creating a surveilled world. The manner AI algorithms organize for us information on social networks and the internet may impede one's ability to develop her own opinions, and may thus lead to uniformization and conformism.

In the field of education, participants also worry about student's personal data being used without their informed consent, without them knowing their personal data are used for educational purposes.

In general, participants insist upon the fact that humans should remain entirely responsible for AI decisions.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [AI and NS in education with respect to human development](#)

- [Support, automation and cognitive development](#)
- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

8 countries (BE, CA, CH, FR, PT, KE, TW, US), 16 claims / ideas

1st wave / 2nd wave

- (France – Education): Preserving human autonomy
- (France – Education): Preserving informed consent of students regarding their personal data
- (France – Education): Decision-making and mode of transmission are inherently human
- (Canada – Education): Preserving autonomy
- (Canada – Education): Preserving human autonomy
- (Canada – Education): Undesirable: Human beings must not lose their autonomy to AI tools
- (Italy – Education): Protecting learners' privacy and autonomy
- (Chile – Education): Socioemotional skills and development of identity and autonomy
- (Belgium – Education): Undesirable: Uncontrolled use of AI technologies
- (Chile – Education): Education and human development
- (Taiwan – Education): Humans should be ultimately responsible for the decisions made by AI
- (US – Education): New AI-powered objects and sensors: the internet of things
- (US – Education): Meaning and purpose
- (Portugal – Education): Undesirable: Technological advances increase the potentially negative impact of social influences
- (Kenya – Education): Undesirable: Exploitation
- (Kenya – Education): Ethical dilemma

Fostering critical thinking, AI & NS ethics and literacy

For participants, critical thinking counts as a fundamental human ability in the time of AI. It is crucial to encourage the development of this ability at school, especially because AI might bring more disinformation, compromising the relationship between humans and knowledge (or truth). In addition, it seems important to foster AI & NS literacy at school for teachers and learners, to enable them to be more aware of the ethical, societal and environmental issues raised by these technologies, and to be more able to properly reflect on the latter and their uses. In this perspective, it is very important to foster children's and students' reflection upon what a technology such as AI can do or not, and upon what is or should remain specific to human beings.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

7 countries (BE, CH, FR, IT, PT, KE, TW), 24 claims / ideas

1st wave / 2nd wave

- (France – Education): Developing critical thinking
- (Italy – Education): Fostering critical thinking
- (Portugal – Education): Desirable: as disinformation increases, the promotion of critical thinking in school is key
- (Portugal – Education): Intelligence is exclusive to humans
- (Portugal – Education): Undesirable: knowledge is becoming unimportant
- (Portugal – Education): Desirable: Parents should foster children's critical thinking
- (Belgium – Education): AI should serve human civilization
- (Belgium – Education): Desirable: an ecological employment of AI technologies
- (Belgium – Education): Desirable: AI technology as an instrument of social sensibilization
- (Belgium – Education): The limitations of artificial intelligence
- (Belgium – Education): Desirable: Students must learn to use new technologies consciously

- (Belgium – Education): Undesirable: One should not abuse new technologies
- (Chile – Education): Integration of AI in Teaching
- (Chile – Education): Ethical use of AI and technologies in general
- (Chile – Education): Risks of AI dependency and critical thinking
- (France – Education): Possessing a minimal level of literacy about science & technology
- (France – Education): Fostering AI & NS literacy
- (France – Education): Fostering critical thinking and AI literacy
- (France – Education): Data reveal only partial knowledge about humans and humanity... We need to remain critical about the reliability of the data
- (France – Education): Educating people about digital technologies is crucial to understanding the environmental challenges they pose
- (Kenya – Education): AI and teacher training
- (Kenya – Education): Inaccuracy of AI in education
- (Portugal – Education): Desirable: The value of humans should be highlighted
- (Taiwan – Education): Undesirable: AI can lead to potential abuse through disinformation

Using AI to free time for human flourishing

Participants in discussions consider leisure or work-free time as precious for exerting humanity and for focusing on human flourishing. Since AI can replace humans in several tasks, we should take this opportunity to release humans from repetitive and annoying tasks, thus liberating time for focusing on the essential, such as relationships or anything that fosters human flourishing.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [What is the purpose of education in the age of AI?](#)
- [AI and NS in education with respect to human development](#)
 - [II- Support, automation and cognitive development](#)

Corresponding ideas from local thematic syntheses:

5 countries (CA, FR, PT, KE, US), 12 claims / ideas

1st wave / 2nd wave

- (US – Education): Education is instrumentally for work and intrinsically for leisure
- (US – Education): Religion, human purpose and AI
- (US – Education): Benefits
- (US – Education): Meaning and purpose
- (France – Education): Liberating time for focusing on the essential
- (France – Education): Desirable: automation of repetitive or uninteresting tasks
- (France – Education): Desirable: Using AI to release human from repetitive tasks
- (Kenya – Education): Technology supplements education
- (Kenya – Education): Desirable: Time saving
- (Portugal – Education): Desirable: machines replacing humans in certain tasks is efficient and liberating
- (Canada – Education): Automating uninteresting tasks through AI technologies
- (Canada – Education): Desirable: AI technologies can automate repetitive and uninteresting tasks and leave time for focusing on the essential

Preserving human creativity

Even if generative AI can be used for creativity, many participants think that creativity is something that belongs to humans and sometimes appears through the relation between humans, sometimes through practice. Excessive and exclusive use of AI technologies in education may undermine human creativity.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [Does AI impoverish or reinforce creative abilities?](#)

Corresponding ideas from local thematic syntheses:

8 countries (CA, CH, FR, IT, PT, KE, US), 11 claims / ideas

1st wave / 2nd wave

- (France – Education): Does AI cause creative abilities to be lost or create new ones?
- (Belgium – Education): AI technology and the job of a teacher
- (Belgium – Education): Integrating AI technologies with traditional pedagogy
- (Canada – Education): Developing human cognitive skills through practice
- (Chile – Education): Risks of AI Dependency and critical thinking
- (Italy – Education): Fostering critical thinking and creativity
- (Italy – Education): AI and risk for creativity
- (Kenya – Education): Technology promotes laziness
- (Portugal – Education): Creativity is exclusive to humans
- (Portugal – Education): Desirable: School should change to better tackle cognitive impoverishment
- (US – Education): Creativity, Art, Music, Process and Product

Fostering creativity with AI

Some participants believe that AI, and notably generative AI, can be useful to stimulate creativity, find inspiration and new ideas, etc. Even finding the right prompts to write can be considered as a creative task.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [Does AI impoverish or reinforce creative abilities?](#)

Corresponding ideas from local thematic syntheses:

5 countries (BE, FR, PT, TW, US), 5 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): AI as a tool for stimulating creativity
- (France – Education): Does AI cause creative abilities to be lost or create new ones?
- (Portugal – Education): Desirable: Artificial intelligence may foster creativity
- (Taiwan – Education): AI can enhance education in terms of efficiency, creativity, and personalized learning
- (US – Education): Creativity, Art, Music, Process and Product

Not exacerbating social and economic inequalities with AI

Participants worry about the rapid development of AI that may increase the already existing social and economic inequalities, thus rendering this technology accessible, in good conditions, almost exclusively to rich and favored people. This could lead to social control by a few. Moreover, AI can propagate and exacerbate existing biases and discrimination. For instance, automation of repetitive tasks can create job loss for poor and low-qualified people. It is important to ensure that AI remains accessible to all, AI softwares as well as infrastructures and resources needed.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [Inclusion, personalization and human relationships](#)

Corresponding ideas from local thematic syntheses:

8 countries (BE, CH, FR, IT, KE, PT, TW, US), 20 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): The problem of countering economic speculation
- (Chile – Education): Social challenges for educational progress
- (France – Education): Desirable: We need to be careful regarding the increasing inequalities and the individualism that AI can bring
- (France – Education): Undesirable: Using AI to release human from repetitive tasks
- (Italy – Education): Equitable access to AI in education
- (Italy – Education): Desirable: allowing access to technology and quality education to all
- (Kenya – Education): Desirable: more resources and financial costs for vulnerable people
- (Kenya – Education): Desirable: taking account of AI bias for more inclusivity
- (Kenya – Education): Undesirable: exclusion of African indigenous knowledge
- (Kenya – Education): AI and educational exclusion
- (Kenya – Education): Undesirable: social exclusion
- (Kenya – Education): Undesirable: underdeveloped AI infrastructure
- (Kenya – Education): Undesirable: AI bias / non inclusivity
- (Kenya – Education): Undesirable: automation in education
- (Portugal – Education): Undesirable: Technology may increase inequalities
- (Taiwan – Education): AI will deepen the social inequalities
- (Taiwan – Education): Undesirable: Power imbalance leading to social control
- (Taiwan – Education): AI can result in job loss, leading to social inequality
- (Taiwan – Education): Undesirable: Job loss leading to social inequality
- (US – Education): Concern about harms caused by AI

Fostering social inclusion thanks to AI technologies

Participants in discussions acknowledge that AI technologies can be used to foster social inclusion through different uses, such as personalized learning. In fact, personalizing exercises depending on the level and rhythm of the learner may be helpful to prevent dropping out of school or to avoid too large of a gap between students, notably for students with learning difficulties. It is also a manner to consider the diversity and differences between learners. In addition, AI-assisted digital debates may be an opportunity for shy people to express themselves with others. Translations app can help strangers with language difficulties or vulnerable/disabled people. AI and digital technologies also enable everyone to be rapidly informed of what happens in the world.

Neurosciences also contribute to this social inclusion by shedding some light on neurodiversity and on possible learner's difficulties (such as dyslexia, ADHD...).

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [AI and NS in education with respect to human development](#)
 - [I- Inclusion, personalization and human relationships](#)

Corresponding ideas from local thematic syntheses of the 1st wave:

9 countries (BE, CA, CH, FR, IT, KE, PT, TW, US), 21 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): AI technology and social inclusion
- (Canada – Education): The use of AI technologies can complement the teaching provided by a human teacher to enable personalized learning
- (Canada – Education): The use of digital and AI technologies can be an additional way of getting students to debate with each other
- (Canada – Education): Overcoming loneliness with AI technologies
- (Canada – Education): Enabling personalized learning for every human being with AI technologies
- (Chile – Education): AI as an educational tool
- (Chile – Education): Technology as a reflection of society

- (Chile – Education): Education as personal responsibility
- (France – Education): Desirable: personalizing learning thanks to AI
- (France – Education): Desirable: Fostering knowledge acquisition and cultural inclusion
- (Italy – Education): Desirable: personalized learning might be only used for students with learning difficulties
- (Kenya – Education): Deaf and Hard of Hearing Supported by AI App
- (Kenya – Education): Opportunity to learn other languages
- (Kenya – Education): Technology can help bridge the gap in access to educational resources for the Vulnerable groups
- (Kenya – Education): Vulnerable people
- (Kenya – Education): Desirable: social consequence and Technology in education
- (Kenya – Education): Empowerment of PWDs
- (Portugal – Education): Online interactions are of no less quality than in-person interactions
- (Taiwan – Education): Desirable: Human-AI cooperation in education
- (Taiwan – Education): AI can enhance education in terms of efficiency, creativity, and personalized learning
- (US – Education): Human social interaction

Considering all professions more equitably

Some participants point out a possible inequality in the manner professions and cursuses are recognized. AI may increase this inequality by leading to overvaluetecnological professions at the detriment of other jobs that are nonetheless key in our societies.

Involmt in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

2 countries (FR, PT), 2 claims / ideas

1st wave / 2nd wave

- (France – Education): Desirable: fairer recognition of all types of courses and jobs
- (Portugal – Education): Undesirable: technological professions may become overvalued

Using AI to improve performance and innovation

Many participants in discussions recognize that AI technologies can help us improve our performance and become more efficient. AI can offer new possibilities to foster innovation, particularly in education but also concerning life conditions on Earth, such as life expectancy.

Involmt in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [AI and NS in education with respect to human development](#)
 - [II- Support, automation and cognitive development](#)
- [What is the purpose of education in the age of AI?](#)

Corresponding ideas from local thematic syntheses:

6 countries (BE, CA, CH, PT, TW, US), 10 claims / ideas

1st wave / 2nd wave

- (Belgium – Education): Desirable: AI technologies as a tool to improve life conditions on earth
- (Belgium – Education): The FLOSS approach as an innovative educational tool
- (Belgium – Education): AI as a tool to save time
- (Belgium – Education): Desirable: It is right to take advantage of the opportunities that AI offers in terms of cost reduction and increased efficiency
- (Canada – Education): Making humans more efficient
- (Chile – Education): Integration of AI in teaching

- (Portugal – Education): Desirable: scientific and/or technological innovations are beneficial to education
- (Taiwan – Education): Human-AI cooperation in education
- (Taiwan – Education): AI can enhance education in terms of efficiency, creativity, and personalized learning
- (US – Education): Usefulness efficiency speed

Improving self and mutual understanding with NS and AI

Some participants point out the advancement of knowledge in psychology, neurosciences and the rapid development of AI tools in these domains, which can help us to better understand ourselves as individuals. Moreover, these progresses may lead to identifying cognitive particularities as well as mental pathologies more quickly, which could help students at school. For instance, this can help to prevent low self-esteem that could result from a misunderstanding of cognitive functioning.

Involvement in nexuses of complexity (see below [Part 2: Global-Education nexuses of complexities](#)):

- [Improving our understanding of the human being while not giving in ontological reductionism](#)

Corresponding ideas from local thematic syntheses:

2 countries (FR, PT), 2 claims / ideas

1st wave / 2nd wave

- (France – Education): Fostering self and other-understanding with NS and AI
- (Portugal – Education): Desirable: Scientific and/or technological advances are beneficial to education