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Cogni LearnEnhance
On the development of preliminary guidelines

by

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Abstract:

Few technologies have been attributed with a greater disruptive potential for transforming academia as we know it today then the promises brought forward by the *Cogni(r) LearnEnhance* and similar enhancement applications. However, expectations of transformations in scientific knowledge acquisition were accompanied by ethical concerns towards the fairness, inclusiveness and the wider societal consequences of such devices. Triggered by these discussions about the potentials, but also the possible dangers of learning technologies, a project team was tasked with developing a regulatory framework for the safe and fair use of novel educational Neurotechnologies by the Austrian Students' Union (Österreichische HochschülerInnenschaftschaft). This paper attempts to present the process of reflection along the ethical considerations that led to the development of the "Guidelines for Learning Technologies" (GuiLT) that were released in summer term 2035 to serve as a foundation paper from which user behavior and political demands can be derived.

Keywords: Neurotechnologies, Guidelines, LearnEnhance

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I. Introduction

The key technological developments of our time reflect and are caused by the ongoing breakthroughs in the field of neurotechnology, which, in the past years, evidently arrived in the social mainstream. Countless gadgets and applications, from automated attention surveillance to neurofeedback devices bare witness of neuromodulation becoming part of everyday culture. As is common knowledge nowadays, these developments are intrinsically linked to overcoming the problem of the invasiveness of BCIs (Brain-Computer-Interfaces) and therefore the necessity for surgical procedures that characterized previous decades. Until the late 2020s, neurological improvements were largely envisioned based on interfaces that had to be transplanted directly into the human brain, which had to be placed in the desired position either through a hole in the skull[1] or by being pushed through veins in users' necks[2]. These procedures were necessary to transfer and receive neurological data via directly interfacing brain cells and tissue. However, these surgical interventions, which from today's point of view seem absurd if not barbaric, were made unnecessary once and for all by the emergence of novel non-invasive methods sparked by the ongoing advantages in signal processing (esp. sensor sensitivity and stimulation intensity) and artificial intelligence (AI): While approaches such as Electroencephalography (EEG, measuring electrical activity of neurons), Functional Near-Infrared Spectroscopy (fNIRS, using near-infrared light to penetrate the scalp and detect brain activity), Magnetoencephalography (MEG, measuring the magnetic fields produced by neural activity) or Transcranial Magnetic Stimulation (TMS, modulating neural activity via magnetic fields) were not new, it was due to the advancement of machine learning algorithms, increasingly more precise sensors and shrinking size of hardware components that could combine measurements in a way that lead to results comparable to invasive BCIs. Not necessitating risky operations on users' open skulls, invasive approaches to neurotechnologies were soon made obsolete and a new era of human-machine configurations had begun.

With BCIs as small sensors that can be worn on the head (with latest versions barely necessitating diameters larger than 5cm), not only had the last years significantly developed a certain acceptance around the everyday use of neurotechnologies, but their ubiquity emerging from a wide range of applications throughout different domains users' lives has familiarized entire generations to their everyday use.

[1] https://neuralink.com/
[2] https://synchron.com/

Such common usage scenarios range from applications that use neurofeedback to confirm transactions, the signing into accounts via the distinctive footprint of one's neurowaves or agreeing to *cookie banners* simply by thinking about the respective button on a screen. They include cognitive state monitoring (e.g. for concentration in road traffic), sensory enhancement and sensory manipulation (e.g. stimulation of specific brain areas for mood manipulation, e.g. relaxation to tackle anxieties). However, and despite these developments throughout the last years, some use cases are still unattainable: For example, the widely discussed *Input Problem* of BCIs, and thus the targeted implantation of thoughts and memories, remains unsolved (and won't be in the near future, even when following optimistic accounts).

Despite the widespread reduction in costs and an increasing number of applications available, the impacts on medical fields and psychiatric treatments have been described to be by far the greatest [1]. However, the developments mentioned above have sparked discussions around further reaching transformations and disruptions: While it was long assumed that neuroenhancement could only be applied selectively and in specific situations, a start-up called *Cogni* recently made headlines with the announcement that new methods of multi-directional stimulation of certain areas of the brain had made it possible to fundamentally revolutionize human learning[3].

The functions of such a device, if promises made by company statements indeed proof to be true, are expected to have consequences for universities and education in general. Even if high expectations induced by ambitious marketing statements only manifest themselves partially or in certain sub-areas, they could initiate profound transformations of or understanding of learning, the practices surrounding it, and eventually our perception of higher education and knowledge transfer in general. It is due to these anticipations that the Austrian Students' Union (ÖH, Österreichische HochschülerInnenschaftschaft) of the University of Graz in the winter term 2034/35 has decided to initiate an evaluation process of novel neurotechnologies for learning enhancement (such as Cogni LearnEnhance, but not restricted to it) and commissioned the project team to develop guidelines for their use by students on campus and at home. Next to practical guidance, these efforts should also inform policy positions of the ÖH to further tackle the impacts expected by neuroenhancing on Austrian universities.

[3]We do not seek to reiterate the rather ambitious statements made by the company about their product here without further embedding them into a more critical perspective. However, as it might still be illuminating to the reader, a product flyer of *LearnEnhance* can be found in Appendix A

The following report describes the processes and considerations that led to the formulation of these guidelines. It is divided into the following sections:

- An introductory account of **debates around the 'enhancement'** of learning experiences situates technologies like *LearnEnhance* within broader discourses of previous attempts to influence/alter learning.
- Drawing from these considerations, we will address the **ethical concerns** that arose in the past around learning technologies and speculate on their relevance regarding novel enhancement technologies via BCIs. In addition to similarities and differences, this section also seeks to consider entirely new ethical aspects arising from technological refinement.
- In a further step, these findings will inform and guide the **development of the Guidelines for Learning Technologies**. To outline this step-by-step process, we will present the point of view of the project team that lead to preliminary guidelines and policy recommendations. To assess these findings, this section is followed by a presentation of the methodology used to evaluate the preliminary guidelines and the adjustments that were made as a consequence.
- A **concluding section** wraps up our findings and outlines further considerations on use and regulation of BCIs within the context of learning enhancement and higher education.

II. Enhancing Technologies

Neuroscience's development and establishment has not only provided profound insights into learning and impairments, but has also increased awareness of the use of these advanced technologies on *healthy* individuals. It is important to differentiate between three central elements when we talk about enhancement in education: Firstly pharmacological enhancement, secondly non-invasive technologies and lastly invasive technologies [2].

In general, when we talk about use cases for neurological technologies, we are usually talking about people who have a diagnosed learning disability, such as ADHD (Attention Deficit Hyperactivity Disorder). However, due to the constant increase in pharmaceutical cognitive enhancers in stressful examination phases among students, the discourse about pharmacological enhancement was stimulated and its relevance continues to this day. Pharmacological enhancement through the use of so-called *smart drugs* represents an emerging practice of performance enhancement in the educational sector [2].

An example was given by a sample of 1035 pupils and 512 university students (Medicine, Pharmacy, Economics) that participated in a questionnaire conducting knowledge, usage and effects of pharmacological enhancers. Their lifetime prevalence for using prescription stimulants was 1.55% for pupils and 0.78% for students [2], [3]. This describes the potential of the mental harmful notion that educational success tends to become more about competition rather than cooperation, which can result in performance pressure between students [4].
A concrete distinction is made between direct and indirect mediators. Direct mediators are so-called glutamatergic agents, influencing mechanisms that are responsible for synaptic plasticity. Indirect mediators, or so-called modulators, are able to indirectly adapt diffuse networks of neurons. These cognitive enhancements are currently being used in research to treat attention deficit or hyperactivity [2].

Non-invasive methods used to improve cognitive performance include transcranial magnetic stimulation (TMS), where an electromagnetic coil that uses immediate adaptation of magnetic fields is placed on the scalp to detect action potentials in specific brain areas. Single pulse TMS is used to conduct brain functioning, while repetitive TMS is used to stimulate brain areas. Research detected long-term impacts in perception, learning and memory performance after stimulation period [2]. Furthermore, another study has shown that the socio-economical status influences the cognitive development of children which can be conducted by analyzing grey matter through Electroencephalography (EEG) or functional

Magnetic Resonance Imaging (fMRI) techniques [5], [6].

Finally, invasive technologies are also one of the central elements of performance enhancement in education. This includes neural devices with improved resolution and accuracy for neural interfaces, which ultimately enable two-way channel communication from the device to the neurons and vice versa. This requires in-brain implants that enable direct stimulation of specific regions with the aim of improving cognitive and physical capacity. Due to their high costs, invasive brain-computer interfaces are mainly used in the medical field for neurological diseases [2].

The methods described have provided a general overview of possible applications of enhancement methods in education. But what are the current methods in practically applied educational research that are being used to read and stimulate brain waves? Some studies with a focus on non-invasive treatments are presented below.

One technique that has been used since the 1970s and has driven the development of further methods for the treatment of ADHD is neurofeedback. This method is based on EEG across different frequencies and thus supports a self-regulation technique that uses the BCI to influence processes of neuronal plasticity and neuronal efficiency [7].
The associated neuroregulation occurs due to the transmission of information to the individual, which becomes available via the electrical activity of the brain. Through training, individuals learn to modify their brain activity. This learning occurs through operant conditioning, which is when they get feedback that their brain activity is not matching the expected pattern. This approach is particularly effective for managing ADHD symptoms. Furthermore, recent advancements have made it possible to use this technique with mobile devices, expanding its usability. [7].

Another method that has achieved cognitive and behavioural progress in educational enhancement research is known as transcranial electrical stimulation (tDCS). It is a form of neural stimulation using electromagnetic stimulation and is used as an additional or alternative therapy to medication to relieve cognitive difficulties or support learning tasks in populations affected by neurological issues. There are multiple modalities that allow stimulation in a more or less invasive way and numerous research studies are looking at the technological settings of the interventions in order to optimise the results. The stimulation has also been shown to be beneficial for ADHD patients [7]. There are also promising findings when it

comes to increase arithmetical abilities.
A study had shown that it can improve students' maths skills. To investigate that, twelve students underwent nine 20-minute sessions of interactive learning activities. The experimental group was given a TRNS, targeting planning and reasoning areas whereas the control group wore no stimulating caps. The result had shown that even short settings of stimulation of certain brain regions cause increased long-term calculation performance, because it was detected that the TRNS-induced changes for solving arithmetical tasks still persisted for at least six months after completing the training [8].

Finally, one of the latest technologies in educational research, which is known as functional near-infrared spectroscopy (fnIRS) - or short *Hyperscanning* will be introduced. This method utilizes neurophysiological recordings to assess the neural synchrony between subjects. In many cases, learning and good social dynamics in the classroom depend not only on the cognitive abilities of the students, but also on the quality of interactions between them. The study explored the relevance of predicting learning outcomes for different types of tasks. Their findings in their meta-analysis show evidence that there is a positive correlation between such synchrony and good performance, which encourages the implementation in the academic field [7].
However, they concluded that this technology is by now not sufficiently developed to be used in the classroom. There are several reasons for this: firstly, it is necessary to consider that it is a technique that has a certain number of application variables (age, time of start and duration). Secondly, the equipment required for this technique, although very simple, may increase stigmatisation among peers. And thirdly, this technology requires a level of supervision that cannot be provided by the teacher. Therefore, the technology will be further developed in the clinical setting. [7].

III. The Ethics of Enhancement

Previous Research has shown, that the implementation into real world settings like classrooms asks for more holistic approaches that are able to consider further aspects of the integration of such technologies. In this context, especially ethics surrounding enhancement (in education, and in particular on universities) have been the subject of growing interest and much debate in the academic literature. The following is a brief overview of the general state of research in relation to ethical considerations or ethical frameworks that take into account the concept of enhancement. This is followed by a discussion of what this means for higher education and the arguments in favour and against.

Within the ethical debate on human enhancement, there are three main positions: restrictive, permissive and conservative [9].

The first ethical framework, the proponent or restrictive framework, argues that various forms of human enhancement are legitimate means of improving human welfare. This framework draws parallels with other genetic and environmental technologies that also enhance human capabilities [9]. Some would even argue that certain forms of enhancement are not only permissible, but that we have a moral obligation or responsibility to enhance ourselves and our children [10]. However, it is also suggested that only enhancements that are of general benefit and compatible with different lifestyles should be considered acceptable [9].

The second, or more restrictive, ethical framework has no fundamental objection to enhancement, but is concerned about the unintended consequences of specific enhancements. One of the concerns is equity. For example, a particular concern is that these enhancement technologies could exacerbate global inequalities. As it is argued, these technologies are not accessible to everyone, but only to the richest and most privileged [9]. But this aspect of equity and fairness is also discussed in the literature from other perspectives, for example within organisations, and is seen as a major concern [11]. Another major fear is that of cheating and the so-called *spirit of the game*. As these enhancement technologies can be seen as a form of cheating in areas such as academia, and therefore against the rules and ethos of fair competition. Their integrity could therefore change academia and the ethos of fair competition [9].

The third, conservative, ethical framework fundamentally rejects the use of enhancement technologies that significantly change humankind. This is justified, among other reasons, by the argument that such enhancement technologies *play God* by either exceeding the role of humans in nature or seeking to control

aspects of life that should remain in the hands of chance or *divine will*. Therefore, they could jeopardise social concepts such as humility and solidarity [9]. And this aspect, namely the concept of human nature and its possible modification through enhancement technologies, is a central point of contention in a growing body of literature [12], [13].

In addition to these ethical frameworks, there has also been research that introduces other ethical perspectives. Among them, a set of methodological guidelines have been introduced that go beyond the exchange of pros and cons and are intended to help minimise normative ambiguities. To this end, attention should be paid to whether enhancement is (i) feasible and effective, (ii) whether it stands in conflict with core moral values and norms, and (iii) whether it is in line with or promotes socio-political objectives of equality and justice [14].

This raises the question of whether and what neurotechnology should be introduced in universities and what ethical concerns should be considered. A number of papers have looked at ethical considerations in relation to the use of neurotechnology in education, and some of the key aspects that should be considered include:

- **Fairness and accessibility**: Ensuring that neurotechnology is accessible to all students and does not exacerbate existing educational inequalities is an ethical concern that has been raised several times and should be ensured when implementing these enhancements in educational settings [15], [16].
- **Data protection and privacy:** Another ethical concern that is often raised regarding the use of neurotechnology in educational settings is that of ensuring or safeguarding the privacy of students and the protection of their collected personal data [15], [16].
- **Acceptability:** Another ethical concern that is often raised is the need for students and their parents to give informed consent before participating in activities involving neurotechnology [17].
- **Governance:** Similarly, the need for ethical governance has been a recurring concern regarding the implementation of neurotechnology in educational settings. It is argued that there is a need to establish governance frameworks to regulate the use of neurotechnology in educational settings [18], [19].
- **Avoid harm:** One reason for the need for governance mentioned above is the recurring concern in the literature about harm to students from neurotechnology in educational settings. This concern includes both physical and psychological harm, as well as respect for their rights [19], [16].

Among other considerations, these ethical concerns, which recur repeatedly in the literature, should guide the use of neurotechnology in educational settings such as universities to ensure its responsible and beneficial use.

IV. Guidelines for Learning Technologies

As has become evident, efforts to ”enhance” brain activities for various reasons build on a long-standing history, as do the debates around ethical issues that are associated with them. Building on the considerations presented above, this chapter first introduces the Austrian Students' Union and its particular perspective, before presenting the preliminary guidelines for learning technologies based on advances methods of neuroenhancement as designed by the project team. To assess the integrity and feasibility of these guidelines, they were evaluated within two workshops addressing different stakeholders: current student representatives of the degree program ”Computational Social Systems” at the University of Graz as well as members of an expert group working on governance of novel neurotechnologies. After presenting the research design and research setting and describing the findings of the respective workshops, a final section will illustrate the adoptions of the guidelines that resulted from these evaluations.

A. Austrian Students' Union (ÖH)

Founded in 1946, the Austrian Students' Union is the legal representation of all students at various levels: for students within certain degree programs (”Studienvertretung”), for all students at their respective universities (”Hochschulvertretung”) as well as for all Austrian towards the responsible ministries (”Bundesvertretung”). All functions are elected directly, with elections happening every two years. In addition to improving the studying conditions at universities through various services, the Austrian Students' Union serves as the statutory voice of students with regard to universities and politics.[4] As the central representative body for all students at Austrian universities, the ÖH sees it as its task not only to comment on study conditions, but also to actively shape them. In addition to ensuring and monitoring the financial and personnel resources of universities, the availability of study places and socio-political agendas (housing and childcare, studying with disabilities, equality agendas, ...), this area of responsibility also includes technological developments (e.g., the debate around the so called ”e-Voting” [20])

B. Guidelines: Introduction

As representative body of all students at Austrian universities, it should be the goal of the ÖH to guarantee for the best studying conditions possible to be accessible for everyone. Understanding technological developments as a central tool for achieving this objective, the ÖH should intent to promote an enlightened

[4]https://www.oeh.ac.at/en/about-us/

and critical use of technological innovations to support the learning process of students in the best possible way. We therefore follow what has been called a proponent ethical framework that sees various forms of human enhancement as legitimate means of improving human welfare, i.e. by making studying more inclusive and by reducing barriers in higher education. We derive this perception from the ÖH's legal and institutional position as outlined above. Nevertheless, such an attitude must not result in a naive affirmation of potentially harmful technologies, but should, while advocating for beneficial uses, always include regulation in the interests of students. We are therefore calling on universities to not only remove barriers to access, but also to play an active role in facilitating teaching the skills required for an informed use. The guidelines drafted by us therefore represent a comprehensive statement on the innovations propagated by manufacturing companies such as "Cogni" and operate on several levels: As a call to action for university policy, as a position paper for further administrative steps and reforms (e.g. of teaching and the relationship between teaching staff and students) and as a guide for students on how to use them safely and fairly according to our current state of knowledge and conviction. The scope of such directives necessarily encompasses multiple levels of regulation (from university policy to EU law), addresses diverse stakeholders (from students to governments), and targets areas that are beyond the regulatory reach of the ÖH. That is why it already here becomes obvious that the term "guidelines" appears to be insufficient to describe the efforts presented here. However, we will continue to use this terminology for the sake of consistency, but always bearing in mind that the "guidelines" presented here refer not only to instructions for students and universities, but also to demands on politics and administration.

The guidelines address the key areas of transformations caused by advanced Neurotechnologies that were identified during the development process: the **transformation of perceptions of education** in general and the resulting wider **impacts on universities and academia**, the **removal of barriers and equity of access**, **potential health impacts and risks associated with Neurotechnologies** as well as **impacts on social and interpersonal interactions**.

C. Preliminary Guidelines

The first and most comprehensive demand with regard to the use of neurotechnologies is that their **use must be (and must always remain) voluntary**. This means that neither possession nor use of enhancing technologies is expected or necessary for the successful completion of a degree. It also follows from this criterion that the expectations placed on students must not be measured on the

basis of the existence of these technologies and that the content and scope of teaching must not be based on a necessity to use neurotechnologies.

Transformations of education

With the expansion of usage scenarios for advanced neuroenhancing technologies comes a profound transformation of what we understand as ”education” and ”learning” in which requirements to memorize are gradually replaced by critical reflection skills. This shift reflects an ongoing process in the history of education, however, being further accelerated by the removal of ”barriers” through enhancing-technologies where fewer time is necessary to memorize more content, must have consequences for both what we perceive as education and how it is being institutionalised. We are convinced that technology-supported learning must be seen as an opportunity that allows to prioritise teaching skills for critically evaluating knowledge as integral part of students academic education. At the same time, seemingly less effort to learn specialist knowledge must not lead to the subordination of university education under further efficiency imperatives.

The guidelines and demands for the transformations of education caused by neuroenhancing therefore are:

- Education must enable the acquisition of critical skills and must not be understood as mere memorization. We therefore call on universities to address the current changes in learning technologies and adapt teaching formats accordingly, prioritising critical reflection over the retrieval of factual knowledge.

- The use of neurotechnologies must not lead to an increase in learning pressure that is expected to be compensated for by technology.

- To ensure that neurotechnologies do not lead to an increase in learning pressure and to avoid an implicit obligation to use them, we call for the establishment of an independent monitoring authority to control the on campus use of neurotechnologies and that allows students to anonymously report suspected misuses.

Impact on universities and academia
The transformations that are being anticipated by today's knowledge about future enhancing technologies underline that they are likely to not remain on the level of personal usage (and associated risks), but will in fact profoundly disrupt our understanding of academic day-to-day operations. Examples of these changes could be:

- **Decreasing numbers of participants** in lectures. Especially at classes with little interactive elements and with the required learning material available in written form, students will have fewer incentives to physically attend lectures when their learning goals can be achieved by studying individually and with the use of neuroenhancement.

- Necessary **reassessment of examination modalities**, whereby the questioning of purely factual knowledge will increasingly lose relevance.

- **Transformations in teaching methods**, whereby a critical/comparative examination of the content will take on increasing importance compared to its mere reproduction and the memorization of facts.

Of course, the changes only roughly outlined here also imply further transformations in the academic world that must be neglected here, especially regarding scientific publishing, measurements to assess qualifications, or competition between universities. As student representatives, however, our demands for the best possible uptake of these technologies for students operate on two levels: Firstly, even if the principle of voluntary use must remain the top priority in teaching, teachers should be given the best possible support in integrating enhancing technologies into their teaching activities in a targeted manner. We therefore call on universities to offer appropriate support and workshops in which teaching methods involving enhancing technologies are made available to teachers in line with the latest state of knowledge. At the same time, a possible shift in learning times away from lectures towards individual periods for (neuroenhanced) self-study must not lead to a reduction in teaching staff, but on the contrary should result in a better availability of teaching staff outside of actual teaching times.

We therefore address the following recommendations and make demands on university policy and universities regarding literacy initiatives to guarantee the effective and safe use of neuroenhancing:

- The ÖH strongly recommends that universities organise workshops on digital literacy and the use of neurotechnology and make resources available for all students and staff. This should help to bridge digital divides by equipping students and staff with the necessary skills to effectively use the neurotechnology available to them in a beneficial way.

- The ÖH even goes so far as to recommend compulsory training on the development of neurotechnology and new findings on the recommendations for those university staff and students who already use or intent to use enhancing technologies.

- The ÖH supports the introduction of a buddy system for students and academic staff, allowing the adoption of this technology to everyone who wishes to.

Removal of barriers and equity of access
In addition to opportunities, new technologies always produce new exclusions and divides. While the possibility of acquiring skills has already been addressed, reservations remain that the acquisition of the latest neuroenhancing technologies will always be linked to economic investment and that financially disadvantaged students will therefore be excluded from equal access.

In order to guarantee equal access we recommend and demand:

- We recommend that Austrian universities ensure equitable access to neurotechnology for all students by providing subsidised equipment and free equipment to be borrowed or rent.
- Even if debates currently strongly revolve around a particular device, we call on universities to avoid lock-in effects by only focusing on one manufacturer and instead to represent the variety of options on offer in their portfolio through regular market evaluation.
- In particular, we call on universities to invest in devices based on free and open source software to further avoid proprietary lock-ins.
- We call on universities to prioritise manufacturers who develop neurotechnology applications in an ethical way. We also demand for governance frameworks that allow manufacturers who do not comply with ethical standards to be blacklisted for the use of their products on campus.

Health risks associated with neurotechnologies
Even if, according to the current state of knowledge, there are no known health effects resulting from enhancing technologies, it is in the interest of all students to minimize any negative effects of use should they occur. Especially long-term effects cannot be ruled out, particularly when used by neurodiverse people or by people with diagnosed mental health problems.

To minimize eventual health risks resulting from neurotechnologies we demand:

- We urge students to use neuroenhancing technologies only for the purposes specified by the manufacturers and for the maximum recommended duration of use
- We urge students to consider preexisting health conditions and possible cross-effects with medication in their considerations of usage of neuroenhancing.
- In particular, this means that neuroenhancing should be used exclusively for learning and not for coping with other problems (stress, anxiety, etc.).
- We also recommend that Austrian universities fund independent research into this technology to prevent health problems such as addiction and anxiety, and to offer recommendations for students with preexisting conditions such as epilepsy.
- To support this, we recommend that Austrian universities provide comprehensive psychological support services. These services should include accessible counselling facilities, mental health contacts and trained mental health professionals who are familiar with the specific challenges of using neurotechnology.
- In particular, we call for a rigid and mandatory monitoring of types of use that could indicate a potential for addiction in order to enable rapid and targeted interventions.

Impacts on social and interpersonal interactions
In addition to the acquisition of knowledge, a central function of universities is their creation of discursive spaces for broad and controversial discussions. Since the effects of neurotechnologies on social interactions have not yet been researched to any great extent, we call for a critical examination of possible effects on discussion and social learning situations.

- In particular, we recommend that the explicit consent of all participants is always obtained for the use of neurotechnologies within group settings on campus.
- Although we explicitly support the exploration of neuroenhancing technologies within classes, we would like to state that the final decision on their use should remain with the respective lecturers.

D. Evaluative Workshops

After the formulation of these preliminary guidelines, they were evaluated in two workshops. Two groups of participants, each with a distinct background and perspective on neurotechnologies, have agreed to support the project team with their respective expertise. First was the student representatives of the Master's degree program in "Computational Social Systems", who not only contributed expertise on the overlap between technology and society, but also the normative perspective specifically required for the project. Second, an interdisciplinary group based at the University of Graz and working on the topic of "neurorights" was then asked to examine the proposed guidelines with regard to their practicability and the expected social, ethical, psychological effects and legislative possibilities.

E. Research Setting

Both workshops were held in consecutive 1.5 hour slots on January 19 2024. Starting with three CSS student representatives and followed by three "experts" of the neurotechnologies research group, participants were facing each other in a round-table discussion. The workshop was visually accompanied by the interactive presentation tool "Miro", which displayed the respective questions to the experts and the guideline to be evaluated. One member of the project team acted as workshop leader and moderator, while the other two added the input from the discussions to the presentation via attaching "notes" to it.

After the introduction of the scenario and the possibilities to "enhance" learning (as advertised by the start-up "Cogni"), participants were first asked about their

own assessments of the changes to the education system and the impact on universities. They were then asked to develop possible steps to mitigate the negative effects identified and to promote the positive ones along the question of ”what should be considered when this technology is being introduced?”. This approach was chosen not only to immerse the experts in the scenario introduced, but also to avoid confronting them with the guidelines invented by the project group. Not ”manipulating” their perception with preconfigured categories was thought to provide openness to include aspects that were previously not considered. Only after initial proposals for regulation and recommendations to higher education policy had been collected, the guidelines developed were presented. Guidelines were then discussed individually and based on the structure outlined above along the five main areas. Participants were asked about practicability, feasibility and usefulness of every guideline. Additional ideas were derived from their considerations in the first step.

The following sections describe the contents of the respective workshops and thus attempt to document the process of adapting the guidelines (see below) in a transparent manner.

F. Student Representatives Workshop

The student representatives were able to familiarise themselves with the scenario, and shared many of the assessments developed by the project team regarding the expected changes for universities: In their opinion, neuroenhancing could lead to a higher learning effort and increasing pressure to perform, as well as intensifying competition (between students, but also between universities competing internationally). This ”race to the top”, they anticipated, could be initiated by neurotechnologies even if they lead only to marginal performance improvements. However, due to a perceived slow and static nature of Austrian Universities, they believed that students rather than institutions will be responsible for an initial uptake of such technologies and pushing possible transformations. Interestingly, by naming possible abuses of such technology and relating them to the discourses around Ritalin, they also located the discussions around neurotechnologies within wider discourses of (pharmacological) enhancement. Reservations were expressed with regard to economic barriers to the purchase of such devices and the consolidation of a ”two-tier education system”. Other concerns addressed fears of possible manipulation (hacking and the neurological damage it might cause) and data protection. Students could profit from this technology by allowing them to structure their own learning process better and adapt it according to their needs. However, this opinion envisioning an actual improvement for stu-

dents, remained the only ”positive” anticipation within their assessment of possible changes. Further expectations related to the fact that this technology would be predominantly (and abusively) used to induce states of relaxation, but also that its use in the private sector and for professional performance enhancement would allow broader application scenarios than in the university sector discussed here.

Concerning the recommendations developed by the participants, there was extensive overlap with the guidelines envisioned by the project team: The student representatives also insisted on the imperative of voluntary use, the provision of workshops to make knowledge on safe and responsible use widely available, and the ongoing development and monitoring of ethical standards, preferably with the involvement of the university ethics committee or a department attached to the ÖH. At the same time, the market developments should be taken into account with regard to competing providers in order to avoid lock-in effects by focussing only on one provider. The universities and the ÖH should take responsibility with regard to the availability of equipment (subsidising devices for disadvantaged target groups and offering on-campus device sharing) and at the same time actively engage in independently researching possible risks. Examinations in which only factual knowledge is tested should have to be adapted accordingly, and the permission to use enhancing technologies should be restricted only to specific tasks (learning facts vs. creative work). Particular hurdles in the introduction and especially the democratic integration of these technologies would arise from possible social divisions (not only due to financial barriers, but also due to people who willingly refuse to use them), questions of data ethics (who owns data, how is it stored/used, who manages it?) and generally the question of whether and to what extent the promised optimizations are even real and desirable. Dealing with legal issues in Austria’s university laws relating to use and regulations during lessons and assessments has been described as a key challenge that would require detailed examination.

The final part of the workshop, the evaluation of the guidelines, led to the following results:

Transformations of education

- The ”independent monitoring authority” described in the guidelines was perceived as too vague, particularly with regard to the question of where such an authority should be located given its powerful role. The view prevailed among the participants that the ÖH should create such a contact point for criticism as a ”counterpart” to university policy.

- The other two demands of this area envisioned by the project team were largely in line with those made by the participants in the previous step.

Impact on universities and academia

- It was pointed out that learning requirements are very individual. These are reflected in the decisions of learning form and methods that students make. Some students will always, despite or with ”enhancing”, prefer to attend lectures in person, which therefore should not be discontinued due to new learning technologies. This also reflects on the imperative of voluntary use, where ”non-enhanced” learners will still need to be given equal chances to learn.
- This means that the teaching of learning material should be offered in a broader form through technological possibilities (e.g. by recording lectures), but must not be substituted.
- Subsequently, technologies could therefore also contribute to a better consideration of different learning types by creating the best individual learning situation.
- The participants noted the close overlap between these demands and today’s discourses around generative AI and remarked that our demands could be applied to them almost interchangeably.
- One discussion that arose in the context of this section revolved around whether there would be any demand for neuroenhancing technologies at all and whether they would therefore become established in everyday university life.

Removal of barriers and equity of access

- Although the possibility of borrowing devices (or their purchase by the university) was positively received, this should only take place once all security issues regarding their use have been fully clarified. Interestingly, the universities’ perceived responsibility to provide equal access to devices seems to collide in this point with demands that only technologies that are guaranteed to be safe should be acquired, revealing an inherent tension of values.
- The idea of focusing on open source was received very positively by some participants.
- On the question of whether and when neuroenhancers should be permitted in exams, it was suggested that permission should only be granted from the point at which all students could afford such a device.
- Even though the participants agreed to a binding code of ethics, the require-

ment formulated by the project team that companies should be branded as ”trustworthy” was criticized as being too vague for its practical application.

Health risks associated with Neurotechnologies

- The first three demands in particular were criticized as being somewhat ”toothless”, as the recommendations they contain place too much focus on personal responsibility. Alternatively, manufacturers should be made more responsible for guaranteeing safe use.
- The second demand should be extended by calling for the comprehensive investigation of possible effects and influences of psychosomatic drugs and their combination with neurotechnologies.
- The participants were concerned about possible negative effects and expressed mistrust of manufacturers, whose aim is ultimately to either actively create certain ”dependencies” among customers or passively accept them in order to maximize their own sales. To counteract this, demands were voiced for a comprehensive legal framework that would enable these technologies to be regulated at national or EU level.
- A legal framework as such could be used to clarify issues relating to data protection and the GDPR, but also act as a ”constitution” for a general approval of devices. Furthermore, it could be used to define regulatory and control authorities, the creation of which was desired by the participants due to the risk of accidents or misuse associated with neurotechnologies.

G. ”Neurorights” Group Workshop

The participants of the second workshop consisted of three PhD students. One is a researcher in the field of virtual reality and neuropsychology, another one from the field of participation and algorithmic accountability and a researcher from the field of law and data privacy as well.

For the experts who worked on a project concerning neurorights, and accordingly know the current literature and the state of research in detail, it was a little more difficult to imagine or to step out of knowledge and really speculate on something (that might not even be desirable or critical to them).

After presenting our product we again initiated the brainstorming phase. The first thoughts collected with regard to the question *how could this change the university?* raised two main questions: firstly, what health consequences would such a device have if certain areas of the brain were overused? In general, there

were questions about how healthy it is to introduce such a device. The second aspect relates to privacy. The researchers had concerns about the design, who can observe and see which processes from the outside? Is it really secure? For example, would teaching staff be able to obtain recorded data in order to justify changes to the curriculum? The subsequent question ”What should be considered when introducing these technologies?” gave rise to three major blocks of topics: the first question the experts asked themselves was, what added value the CognilearnEnhance represents. Specifically, it was not apparent to the experts why such a device should be introduced for the broad masses in the education system, as the argument such as improved school performance wouldn’t be a valid reason to justify it’s use. They took a closer look at the term ”efficiency” that was used in the product flyer by the Cogni as one of the major incentive of use and asked what exactly is meant by ”increasing efficiency”. In this context, one participant’s position was quite clear. According to her, new technologies such as smartphones or smartwatches had always been advertised with the argument that they would increase one’s own performance, but ultimately increased study time. Furthermore, she pointed out that using traditional tools like pocket calculators or notebooks as a basis for comparison is not valid, because, unlike these necessary tools for solving tasks, neurotechnological devices are not essential. She backed up her opinion by pointing to a study in the UK in which a school banned smartphones from everyday school life and the students have shown a much better performance since then. She also personally spoke more in favor of sleep as a measure for performance enhancement instead of a cognitive device. She also referred to another study from Denmark, in which an app for mental hygiene was developed, in which research was explicitly carried out against overexertion instead of optimization or increasing efficiency, whereby in the latter there was in addition a particularly high risk of social pressure spreading. Furthermore, they claimed that such a device would not promote self-responsibility.

The second block is related to this, namely the negative potentials. The participants feared that such a device could possibly lead to overuse of certain areas of the brain, e.g. grey matter decreases and with that a potential cognitive change as some brain areas would be used more then others. As such solving tasks could lead to a change of the distribution within the brain. Furthermore, they were concerned about the high potential for addiction, as is the case with computer games. In addition to that a potential of misuse should be taken into account as well.

The last block is made up of ideas for redesigning university infrastructures and secure implementation. Finally, they emphasized that such technology should

only be integrated in a controlled and iterative process in which the users themselves also have a say in how this technology is used. The technology should therefore be specifically tested in an educational institution like a so-called 'living lab' before it is actually integrated into everyday university life. It should also be borne in mind that there are serious differences between universities.

In the final part of the workshop, they generally criticized our guidelines in that they are not directed enough at specific instances that will be part to of the invention of this technology. In other words, they called for the guidelines to be formulated in such a way that it is very clear to whom they are specifically addressed, e.g. to 'policy makers', 'students', or 'universities'. They also criticized the fact that the guidelines sound less like directives and more like principles of appeals, and that this also needs to be reformulated.

In terms of the recommendations developed by the experts, there was further overlap with the guidelines envisaged by the project team: Like us, the experts also talked a lot about the increasing pressure to use such technology. If this technology is introduced or required in universities, what about people who do not want to use it? And consciously choose not to use "optimisation technology"? The issue of voluntarism was also much discussed and thought upon. But the experts went on to argue, contrary to us, that just because you support a few disadvantaged students or have a few university places with access to this technology, it does not make it voluntary.

Transformations of education

- The "independent monitoring authority" described in the guidelines was criticized same as in the previous workshop as too unclear, particularly they asked to be clear on "who that monitoring authority would be" - question of responsibility and autonomy.
- Furthermore the question arose, how could lecturer profit from it, would it be possible to see, when students are more resilient during the semester and when they are not.
- They also mentioned that new university management will be required because they believe this technology possesses such disruptive potential that it will necessitate a new infrastructure to handle the emerging responsibilities. With that they asked for more clarity in what exact situations, or lectures this device is approved to be used and how lectures will possibly be reorganized. They advocated against adjusting the required ECTS per course, despite

potential cognitive enhancements, arguing that fairness must be maintained for those who choose not to use such devices.
- It's important to note that significant differences exist between universities, such as between humanities and technical institutions, making generalizations problematic.

Impact on universities and academia

- They criticized our buddy system because they perceived it as an abdication of responsibility by the start-up.
- Furthermore, they questioned how to ensure that the system would work without leading to exclusion, especially when students can't afford the LearnEnhancer on their own. They highlighted the difficulty in determining who is genuinely socially disadvantaged at the university, noting that financial support from parents isn't always guaranteed even when the means exist. This leads to a situation where, for some students, purchasing the device is a minor inconvenience, while for others, it requires significant financial sacrifices, such as forgoing holidays. This discrepancy, they argued, creates an unfair power imbalance among students. They used the example: 'If I have to pay 1,000 euros for this device, it's 1,000 euros I'm taking away from something else I could have enjoyed, like a holiday.
- In their opinion, neurotechnology should be introduced into universities by addressing university-related problems, which can vary from university to university. For the experts, the question of how this could change universities is therefore a question that cannot be answered universally.

Removal of barriers and equity of access

- The question of accessibility came up and how this is to be ensured. An online lending system was mentioned as an example of how to secure good places in the library, for example. However, if these are quickly sold out, then there is the potential for unequal distribution of devices.
- Furthermore they highlighted several times, that the usage of the device needs to be voluntary and not forced by anyone.
- They questioned also how we really want to ensure the ethical production of the product. And how can this be ensured by the ÖH, because it has no legislative power. They raised the question of what is understood to be ethical, as there would be major differences and gray areas that we simply could not rely on.

Health risks associated with Neurotechnologies

- It has to be clearly communicated that its use is always voluntary and should not result in coercion.
- They also mentioned that there is an increasing potential for performance pressure between students given, thereby reduces mental well-being and results as negative impact on health.
- Another negative health consequence can be misuse of the device or addiction. They have therefore recommended that the product must be tested for safe use in a 'living lab' before it can be authorised on the market and, in particular, at a university.

H. Adaptions

The discussions resulting from the evaluative workshops presented above lead to an adoption of the proposed guidelines. These adjustments reflect the attempt to incorporate the knowledge gained into the final guidelines, however, and as becomes evident from the workshop descriptions, not all comments could be taken into account: Questions about whether a device like LeranEnhance would be desirable at all or actually represents an improvement are outside the focus of this work. Similarly, comments that addressed a general criticism of technological developments and the ideas of ”efficiency” they contain could not be taken into account. As a working group tasked with developing guidelines and demands, we can neither assess nor influence the market conditions for enhancing technologies. However, we see it as our duty to try and counteract any negative effects before they become apparent and support beneficial ways of using as soon as they manifest. The final guidelines and demands represent an attempt to ensure exactly that.

I. Final Guidelines Demands

Transformations of education

- Education must enable the acquisition of critical skills and must not be understood as mere memorization. We therefore call on universities to address the current changes in learning technologies and adapt teaching formats accordingly, prioritising critical reflection over the retrieval of factual knowledge.
- The use of neurotechnologies must not lead to an increase in learning pressure that is expected to be compensated for by technology. Furthermore, to reinvent lectures and their pedagogical elements, the LearnEnhancer should offer the opportunity for lecturers to see, when students are more resilient during the semester. This allows the educational concept to be adapted to the needs of the students.
- We also call for this disruptive technology to be supervised by a management team that assesses the opportunities and risks with the aim to advise students and lecturers. For this, we propose to hand over the responsibility for administration and organization to the respective ethics commission at universities.
- In addition to that for taking into account the diversity and the different structures and cultures in the organization *university* itself, the ethics commission also offers the opportunity to facilitate the individual organization of the LearnEnhancer.

Impact on universities and academia

- The ÖH strongly recommends that universities organise workshops on digital literacy and the use of neurotechnology and make resources available for all students and staff. This should help to bridge digital divides by equipping students and staff with the necessary skills to effectively use the neurotechnology available to them in a beneficial way. Furthermore, the ÖH will not force anyone to use this technology, the usage has to remain as an individual choice.
- The ÖH even goes so far as to recommend compulsory training on the development of neurotechnology and new findings on the recommendations for those university staff and students who already use or intent to use enhancing technologies.
- For the consideration of various study habits, lectures should not be fully replaced by recordings, but it should be possible for anyone who does not want to use this technology not to be disadvantaged and thus indirectly forced to do so. Even if this is a subjective and thus individual perception and can't be entirely steered by external actors or measures.

Removal of barriers and equity of access

- We recommend that Austrian universities ensure equitable access to neurotechnology for all students by providing subsidised equipment and free equipment to be borrowed or rent. For ensuring that the ÖH demands to implement a phase funding plan, that social disadvantaged people and/or people with a low socio-economical status are not feared to be excluded, when they can't afford the device fully themselves.
- We also recommend to offer in certain specified learning areas, as the the library to implement an online lending system, for specified dates and times to minimize the potential of exclusion and to encourage a fair distribution of the LearnEnhancer as much as possible.
- Even if debates currently strongly revolve around a particular device, we call on universities to avoid lock-in effects by only focusing on one manufacturer and instead to represent the variety of options on offer in their portfolio through regular market evaluation.
- In particular, we call on universities to invest in devices based on free and open source software to further avoid proprietary lock-ins
- We demand for governance frameworks that allow manufacturers who do not comply with ethical standards to be blacklisted for the use of their products on campus.

More precisely, we call on universities as a heartfelt recommendation to prioritise manufacturers that produce these devices ethically. It is clear, that this is not easy and fully realizable by now, but nevertheless, the provider that offers the fairest alternative and not the cheapest one should be chosen.

Health risks associated with Neurotechnologies

- We demand that the LearnEnhancer is tested and proven as safe and reliable. To ensure that the device needs to be analyzed and inspected in experimental settings and so-called *living labs*, that verification must happen on a regular base, to make a secure usage and an implementation on universities possible.
- We urge students to use neuroenhancing technologies only for the purposes specified by the manufacturers and for the maximum recommended duration of use.
- We urge students to consider preexisting health conditions and possible cross-effects with medication in their considerations of usage of neuroenhancing, to verify the usage of the device and being safe to use. Further, if students take pharmaceuticals, they need to consult professional medical staff in order to rule out any risks.
- In particular, this means that neuroenhancing should be used exclusively for learning and not for coping with other problems (stress, anxiety, etc.).
- We also recommend that Austrian universities fund independent research into this technology to prevent health problems such as addiction and anxiety, and to offer recommendations for students with preexisting conditions such as epilepsy.
- To support this, we recommend that Austrian universities provide comprehensive psychological support services. These services should include accessible counselling facilities, mental health contacts and trained mental health professionals who are familiar with the specific challenges of using neurotechnology.
- In particular, we call for a rigid and mandatory monitoring of types of use that could indicate a potential for addiction in order to enable rapid and targeted interventions.

V. Conclusions

In this study, we initiated an explorative journey through designing fiction and participatory methods to craft and refine guidelines for the responsible use of neurotechnologies in university settings. Design fiction served as a creative and speculative tool, enabling us to construct a plausible future and engage with the ethical, social, and technological implications of neurotechnologies. By involving representatives from both the student body of the Computational Social Systems Master's degree and experts from the Neurorights group, we ensured a diverse range of perspectives were considered for the evaluation of our preliminary guidelines.

As we draw our investigation to an end, it is essential to reflect on the insights gained from these participatory dialogues. The feedback and discussions with our participants have been insightful, revealing views and considerations that extend our initial guidelines. Now, in our conclusion, we aim to make use of the outcomes of the design fiction approach to critically assess and revise our guidelines. In the following part we reflect on the process itself. Our reflection contains three parts: how we perceived it, which insights we got when it comes to the term ”education” and what does the workshop imply about the perception of innovative technologies.

How do we perceive the process and how did we experienced it?
The student representatives were critical yet showed a more open attitude towards the LearnEnhancer, mainly focusing on its potential to enhance their academic and learning experiences. They were open minded and engaged with our design fiction scenario, imagining university life in the year 2035 and how such technology could change the current education in universities.

In contrast, the group of researchers displayed a more cautious and skeptical view. Their deep and detailed understanding of neurotechnologies, marked by profound knowledge and some biases, influenced their perception, particularly regarding the safe implementation of the LearnEnhancer. This skepticism seemed rooted in their extensive research and awareness of the technology's potential impacts. Consequently, we found ourselves needing to present stronger arguments to showcase the technology's benefits over its risks. Unlike the students, these experts found it challenging to immerse themselves in the design fiction, as their questions often reflected concerns with the current applications of neurotechnologies, and showed a struggle to place them in the context of academic education. This difference indicates that their in-depth knowledge affects their perspective on neurotechnologies.

Both groups, with their distinct perspectives, highlighted new aspects we hadn't considered within our four-member team. Particularly, the expert group pointed out a crucial detail: our guidelines closely resembled rather a position paper, with the first two guidelines mirroring principles more than traditional guidelines.

Which notions of "education" were reflected in the workshops?
Besides investigating the evaluation of our guidelines, it was indeed particularly insightful to explore different perspectives on the purpose of education with the stakeholders involved. Especially the discussion with the expert group revealed that they don't necessarily see education as a ground for trying to enhance someones performance through ever more effective technologies in order to be better and faster way.

One participant stated that education should empower individuals to lead independent, self-determined lives. The participant continued by arguing that if neurotechnologies would be something essential to have but not free and accessible to everyone, this would determine choices in favour for individuals able to afford this technologies. Her statement was enriched with an analogy to affording a vacation expressing metaphorically it would put her in chains, if she had to find a way to afford or get access to this technology.

Another participant also views traditional notions of education as being in crisis due to the widespread introduction of such devices and therefore also questions the concept and system of education as it stands. The participant calls for a redefinition of education's purpose in light of these devices' ubiquity. It was argued in favour of innovative pedagogy and emphasized that traditional learning methods no longer make sense. Furthermore, the increasing pressure to learn and perform caused by the neurotechnological device within a university or classroom was mentioned and pointed out with importance to consider. This is also closely linked to the fear of a further neoliberalisation and isolation of education. This means that the students would become more individualised through the devices which in turn would neglect a collaborative and social spirit in educational settings.

What do the workshops show about how technologies are perceived today?
Based on the feedback we received, we were ultimately able to obtain a solid impression of the attitudes of the respective groups towards innovative and disruptive technologies. The LearnEnhancer represented in our design fiction scenario can be seen from our perspective, as a disruptive technology, because it was presented as an affordable device (at least for certain populations) and offers to optimize someones effectiveness and performance, a highly desirable outcome

mirrored by today's neoliberalistic societies. With aiming at the performance increase it touches therefore also on a social aspect. Thus, there the device has potential to lead to a widespread use and reinvent the understanding of learning and education at university level.

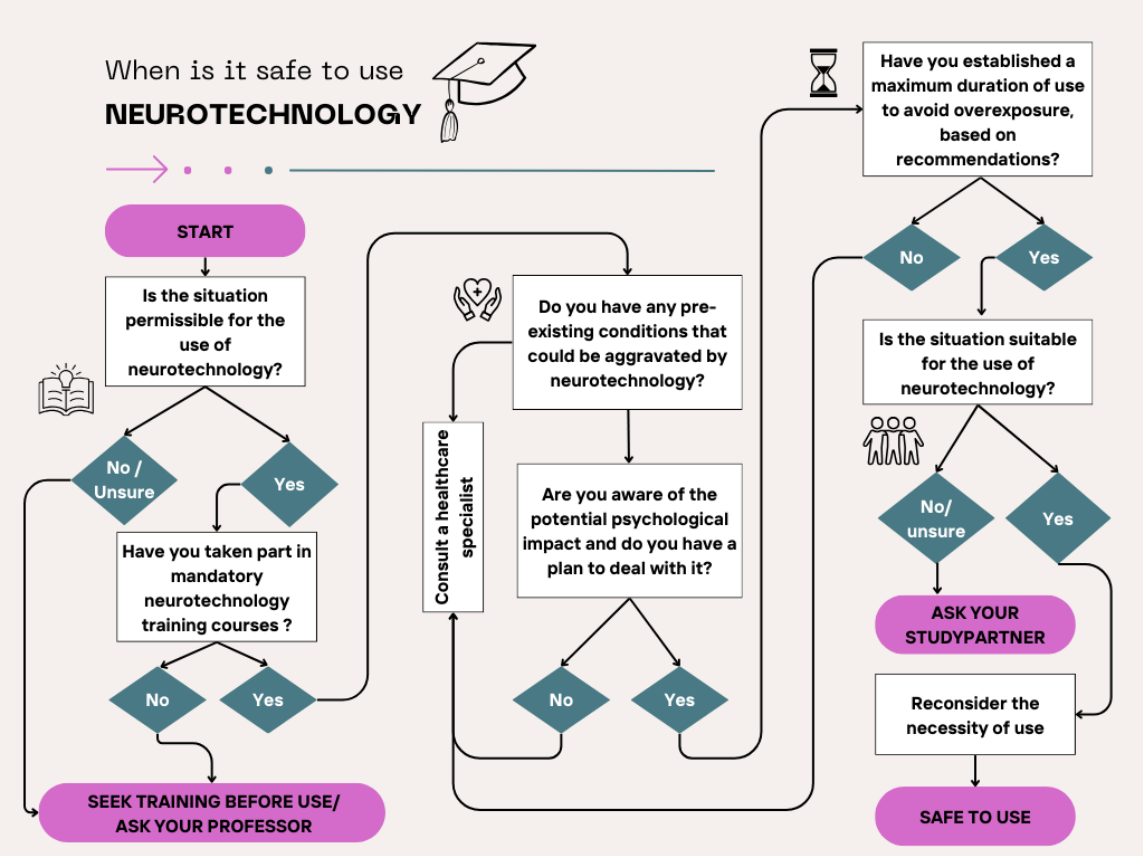
Above all, we noticed that although people were not afraid of the product, they expressed their concerns. We observed that through their reserved and sceptical attitude towards the LearnEnhancer. In the expert workshop was mentioned that the psychological stress caused by the regular use of social media is only now becoming apparent and that the use of artificial intelligence, such as ChatGPT, is also viewed critically. In addition, the health consequences of the use of neurotechnologies cannot be estimated by now. According to the expert workshop, there exists already the assumption that it leads to a a reduction of grey matter in the brain.

Lastly, it can be concluded based on the procedures of the two workshops, that they expressed overall a critical attitude towards the LearnEnhancer. Especially when it comes to equity and necessity of the product. For example in the expert workshop it was mentioned that it can lead to power imbalance between students. That those who can't afford it or don't want to use it feel pressured and this can lead to exclusion.

However, an openness towards the LearnEnhancer was also stated, that the product could be very useful and also makes life of students easier. For example, it was mentioned that if it would be possible to see when students are more stressed during the semester, the lecturer could use this insight and plan their tests to dates, when students are less stressed and tend to have more capacity to focus. However, it has to meet the pre-requisite that this technology is considered and proven as safe by professional, trustworthy institutions, e.g. living labs, medical observations, etc. In general, when it comes to the realisation, a safe implementation is inevitable and therefore, these described experimental frames, like the so-called 'living lab', for testing the product to be proven by professionals as safe have to be taken into account.

To sum up, individuals recognize both the benefits and risks of technologies, particularly their significant impact on society as a whole. This is because it seems that the integration of technologies often fails to accommodate the diversity of needs in the real world, instead promoting certain values as desirable for society at large.

APPENDIX


When is it safe to use
NEUROTECHNOLOGY
START
Is the situation permissible for the use of neurotechnology?
No / Unsure
Yes
Have you taken part in mandatory neurotechnology training courses ?
No
Yes
SEEK TRAINING BEFORE USE/ ASK YOUR PROFESSOR
Consult a healthcare specialist
Do you have any pre-existing conditions that could be aggravated by neurotechnology?
Are you aware of the potential psychological impact and do you have a plan to deal with it?
No
Yes
Have you established a maximum duration of use to avoid overexposure, based on recommendations?
No
Yes
Is the situation suitable for the use of neurotechnology?
No/ unsure
Yes
ASK YOUR STUDYPARTNER
Reconsider the necessity of use
SAFE TO USE

GET READY TO BOOST YOUR

ACADEMIC PERFORMANCE

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