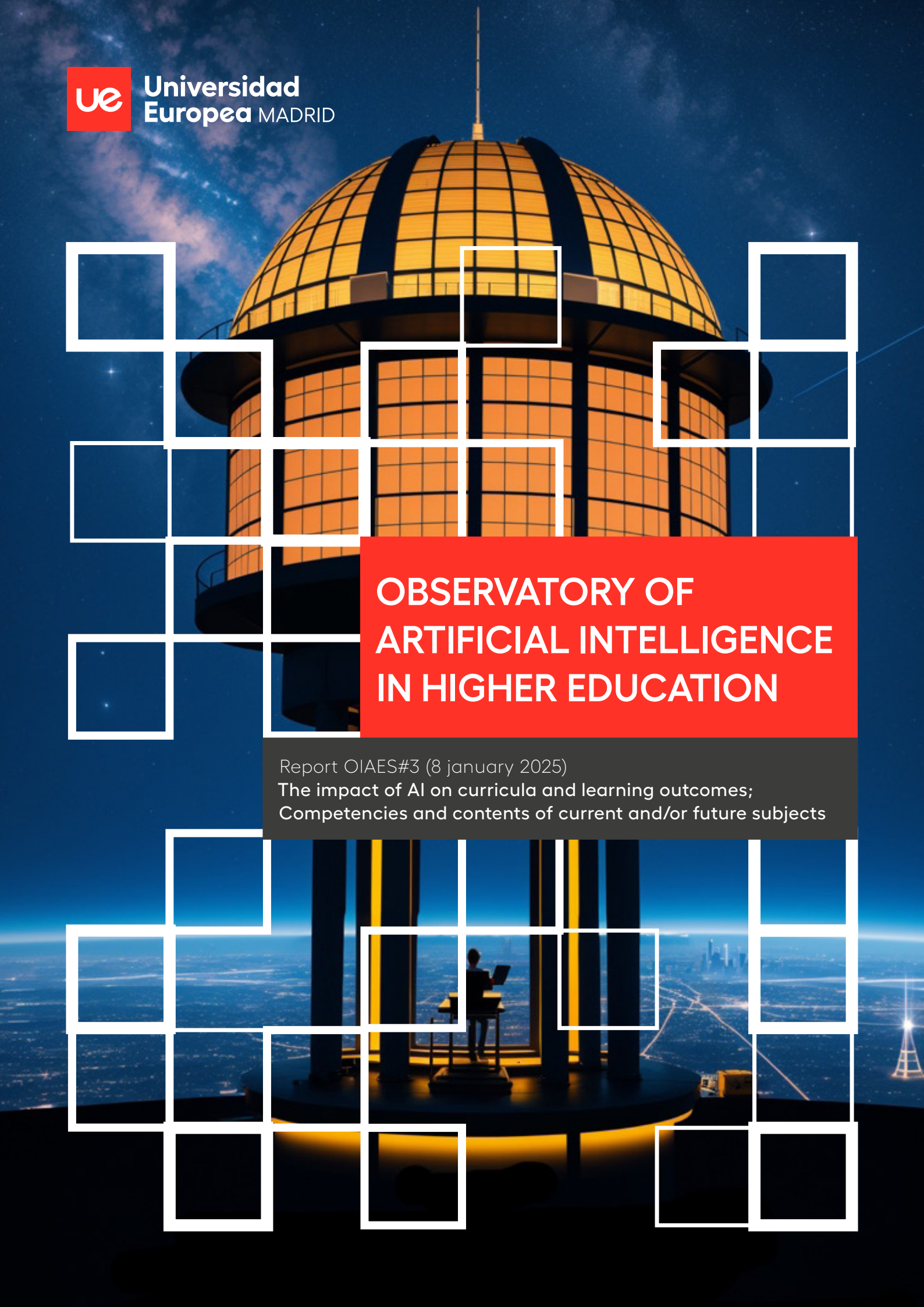

Universidad Europea MADRID

OBSERVATORY OF ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION

Report OIAES#3 (8 january 2025)

The impact of AI on curricula and learning outcomes; Competencies and contents of current and/or future subjects

EXECUTIVE SUMMARY

This paper analyses the impact of Artificial Intelligence (AI) on curricula and learning outcomes in higher education, highlighting the need to adapt educational skills and content to the demands of the contemporary labor market. The increasing integration of AI in various sectors has led to an increase in interest in its inclusion in academic training, which poses both challenges and opportunities for educational institutions.

CURRENT STATUS AND CHALLENGES

The review of relevant reports indicates that AI improves efficiency in administrative and pedagogical processes, facilitates more accurate assessments and requires new skills to interact with emerging technologies. However, their integration has focused mainly on technical disciplines, which highlights the need for a transversal approach that covers various areas of knowledge.

NECESSARY COMPETENCIES

The graduate's profile should evolve to include classical skills, such as critical thinking and communication, along with emerging competencies related to ethics and the responsible use of AI. A competency structure ranging from basic digital skills to an advanced mastery of AI tools is proposed, emphasizing the importance of continuous and adaptive learning.

EVALUATION STRUCTURE

Assessment must be transformed to reflect these new competencies, prioritizing a more competency-based and interdisciplinary approach. AI can be used as a tool to provide personalized feedback and improve evaluation processes, thus optimizing the educational experience.

REGULATION AND LEGAL FRAMEWORK

Recent AI legislation in Europe establishes a regulatory framework that influences how educational institutions should approach the teaching of this technology. It is critical that students not only learn how to use AI tools, but also understand their ethical and legal implications.

In conclusion, this document underscores the urgent need to adapt curricula in higher education to effectively integrate AI, ensuring that graduates are prepared to face the challenges of the future of work with a comprehensive training that combines technical and humanistic skills.

INTRODUCTION

Artificial Intelligence (AI) has emerged as a transformative force across multiple sectors, and higher education is no exception. In a context where technology is advancing by leaps and bounds, educational institutions are forced to adapt their curricula to prepare students for a labor market that demands new competencies and skills. While it is true that this irruption of AI at a transversal level is fundamentally due to the emergence of generative AI, we will talk during this report about AI in general, since it is too early to know how this discipline will evolve, and its use extensively, beyond the use of large language models and other forms of generative AI.

The growing interest in AI is determined by the effective development of certain technological advances such as Transformers models, greater computing capacities or the availability of huge amounts of data, among others. This, together with the popularization of certain tools such as ChatGPT and a certain FOMO (Fear Of Missing Out) effect related to not using the latest smart technologies, have also led academics, educators and legislators to reflect on their integration into education.

Through an exhaustive review of relevant reports, various dimensions of the impact of AI on teaching are identified, such as the improvement in administrative and pedagogical efficiency, the use of tools for more accurate assessment, and the need to develop ethical and critical competencies in students. The existing literature highlights that, although AI is being incorporated mainly in technical disciplines, there is an emerging consensus on its transversal integration in all areas of knowledge [1].

This report reflects on the new demands of the labor market, which require not only technical skills, but also humanistic competences that promote collaborative work and adaptability. As universities face these challenges, it is crucial that they act as active agents in the training of responsible and ethically conscious professionals in the use of emerging technologies. The recent regulation on AI in Europe provides a legal framework that directly influences how the teaching of this technology should be approached in the educational field.

The aim of this work, therefore, is to offer an analysis on how AI can be effectively integrated into university curricula and teaching methods, ensuring that graduates are not only technically competent, but also able to navigate an increasingly complex and dynamic work environment.

EXTERNAL EXPERTS

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2. Avila García, Orlando (ARQUIMEA).
3. Barro Ameneiro, Senén (Universidad de Santiago de Compostela).
4. Carrasco González, Ramón (Universidad Complutense de Madrid).
5. Gil Lizasoain, Elena (TELEFONICA).
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THE IMPACT OF AI ON CURRICULA AND LEARNING OUTCOMES; COMPETENCIES AND CONTENTS OF CURRENT AND/OR FUTURE SUBJECTS

STATE OF THE ART.
REVIEW OF RELEVANT PUBLISHED REPORTS

The increase in use and interest in Artificial Intelligence by all organizations has meant that the education sector considers it necessary to adapt or incorporate aspects related to this technology into the skills of students and professionals. In this way, the incorporation of AI in the curricula has captured the attention of academics, educators and legislators, given its transformative potential in education and the labor market.

In recent years, studies and guides have been developed that attempt to provide insight into the challenges and opportunities posed by AI in teaching, as well as the skills needed to make the most of its benefits. Carrying out an analysis of the current state of the art based on relevant published reports, we can point out that the existing literature addresses various dimensions of the impact of AI on education, among which the following stand out:

- **Efficiency:** improvement in administrative and teaching processes, such as the personalization of learning and the analysis of student performance.
- **Assessment:** Using AI-based tools to assess skills and knowledge more accurately.
- **Competencies:** identification of new competencies needed to interact with emerging technologies.
- **Ethics:** Reflection on associated risks, such as potential algorithmic biases or data privacy issues.

It should be noted that in most cases the integration of AI into curricula is mostly carried out in certain subjects, mainly in technical degrees, although a consensus is also forming on the need to integrate AI on a cross-cutting basis, considering AI as knowledge that should permeate various disciplines. This scheme is organized into five categories of knowledge:

- **Basic training:** practical use of AI-based tools.
- **Fundamentals and applications:** theoretical and practical understanding of the principles of AI.
- **Contextual applications:** skills to integrate AI in different sectors.
- **Critical appraisal:** ability to analyze AI solutions from a critical perspective.
- **Ethical and human-centered considerations:** focus on justice, accountability, and transparency.

This approach states that AI should not be exclusive to technical disciplines, but that it has applications, scope and impact in many other areas of knowledge. In addition, a parallel can be seen with the issues mentioned above.

There are two recently published guides that also highlight a balanced and cross-cutting approach. On the one hand, the UNESCO guide [2], a must-reference document, which structures AI-related competencies into four main areas, and with three levels of progression. In addition, the specific ones for students and teachers. A summary is included in the following table:

Competences	Acquire/Understand	Deepen/Apply	Create	Applies to
The person at the center	Agency	Responsibility	Active citizenship in the age of AI	Students and teachers
Fundamentals and applications of AI	Basic AI Techniques and Applications	Development of practical application competencies	Building AI Solutions	Students and teachers
Ética de la IA	Ethical principles and integrated ethics	Safe and responsible use of AI	Co-creation of ethical rules/ Ethics by design	Students and teachers
AI System Design	Delineating Problems	Architecture Design	Iteration and creation with feedback	Students
AI pedagogy	AI-assisted teaching	Integration of AI in pedagogy	Pedagogical transformation through AI	Teachers
Professional Development	Continuous professional learning with AI	Organizational Learning with AI	AI to support career transformation	Teachers

Again, not only the development of technical skills is emphasized, but also the importance of an ethical and humanistic approach, underlining the need to consider the risks and societal challenges associated with AI.

The other guide is that of INTEF [3], published in July 2024 in Spain, which specifically addresses the integration of AI in non-university educational stages. Its contributions include proposals to personalize student learning, but also tools to improve teaching practice, as well as educational centers and institutions, considering again the ethical impact of AI and the need for adequate regulation.

Regarding regulation, the European Commission's AI law [4], recently adopted, establishes a legal framework to regulate the use of AI in Europe. This framework offers an approach based on risk classification and considering the promotion of innovation. This legal framework will directly influence how education systems should approach the teaching of AI, ensuring that students not only learn how to use it, but also understand its legal and ethical implications.

THE PROFILE OF THE GRADUATE; LEARNING OUTCOMES

Despite the emergence of AI, the market continues to demand classic skills, such as critical thinking, and it is still more necessary than ever for the student of the degree to take certain transversal skills. The arrival of AI boosts the need to work on other skills such as ethics, adaptation to change and certain digital skills in the use of basic technological tools, especially Generative AI. These competencies, in addition to the basic transversal ones, can be structured as:

- **Humanistic transversal competences:** despite AI, companies still require people to work with people and require skills such as active listening and communication, teamwork or resilience.
- **Coverage of the new demand:** universities must respond to the evolution of professional profiles by providing a new graduate profile that can adapt to the new demands of society and the labor market in the era of AI (social awareness, entrepreneurship, innovation, etc.). Further personalization of learning is needed, for example, by inserting micromodules that complete and personalize the educational program.
- **Adaptation to technological change and continuous learning:** considering the speed at which technological changes occur, the student must be tremendously flexible in adapting and discarding technologies, procedures, tools, etc. Graduates of all degrees must have, in addition to basic skills (fundamentals) of what artificial intelligence is, notions of what other types of specific tools can provide (especially applied to their sector) and the risks that the use of these could entail.
- **Ethics and responsibility:** Students must know how to use available AI tools ethically and effectively and face ethical dilemmas associated with the use of artificial intelligence in decision-making in professional fields, considering aspects such as data privacy or algorithm bias.

LEVELS OF COMPETENCE AND IMPACT ON ASSESSMENT SYSTEMS

When facing the integration of AI in student training, we must be aware of two important aspects:

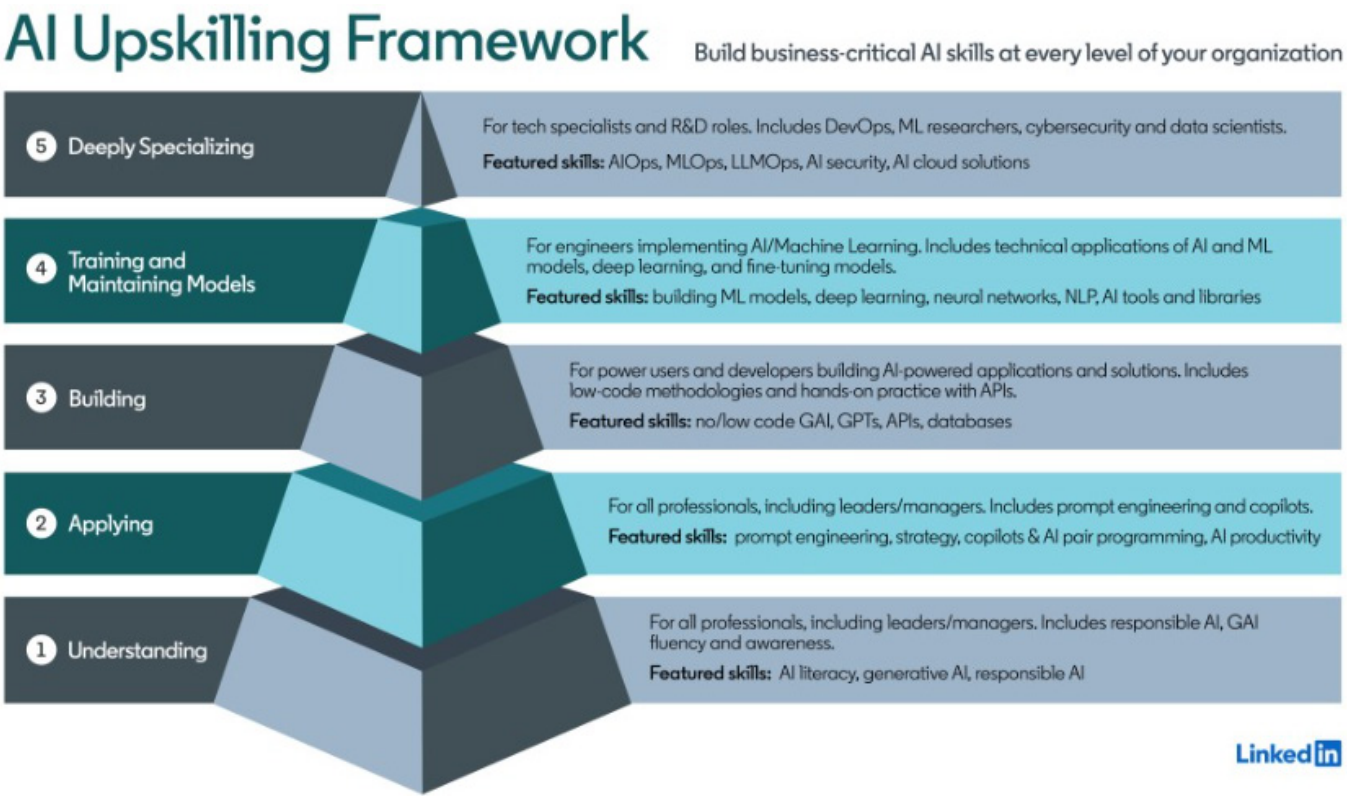
The first has to do with the fact that AI competence should be seen as a competence linked to digital competence and therefore no specific strategy should be established or as a new dimension, detached from a more general strategy of digital literacy at all levels and in all sectors.

What is important is to classify the relationship of AI with the rest of the competencies of any degree, identifying those whose acquisition is independent of AI, those that can, and probably should be acquired using AI tools to do so more effectively, and those that deal specifically with AI or the development of AI applications.

AI must be integrated into the curricula, distinguishing three levels of competence impacted to a greater or lesser extent by technology in general and AI in particular.

- **Transformative competencies at the human level:** ethical-social competence, communication, critical analysis, creativity, etc.
- **Digital skills:** responsible use of ICTs, communicating through ICT, managing digital information, creating digital content, etc.
- **AI Competencies:** responsible use of AI, communicate effectively with AI, manage information with AI, create with AI

Specifically speaking of AI competencies, several levels should be distinguished that could correspond to those in the following figure.



Source: Linkedin Learning [5]

It should be taken into account that the introduction of AI in our curricula should not mean the abandonment of certain learning. The fact that, from now on, AI can perform tasks without human intervention that could previously only be carried out by professionals, does not necessarily imply that graduates should no longer have the competencies (as well as the knowledge and skills) to carry them out, with and without AI.

What is new is that it will now be necessary to provide graduates with new skills to manage the change that will be continuous and unpredictable, generating a scenario of fluid skills. In this sense, universities will play a key role as an active and critical agent, when necessary and relevant, that trains responsible professionals in the use of AI.

New learning outcomes will probably appear or at least some of those that are currently included in the curricula will have to be reformulated. But, in addition, it is possible that some content will disappear (or that it will have to be adapted) with the appearance of new "ways of doing" in each profession and what will surely change will be the classroom dynamics that will have to adapt, as they have always done, to the tools that appear, whether they are based on AI or not, until AI, as an intrinsic part of these tools, become, in some way, transparent to the professional.

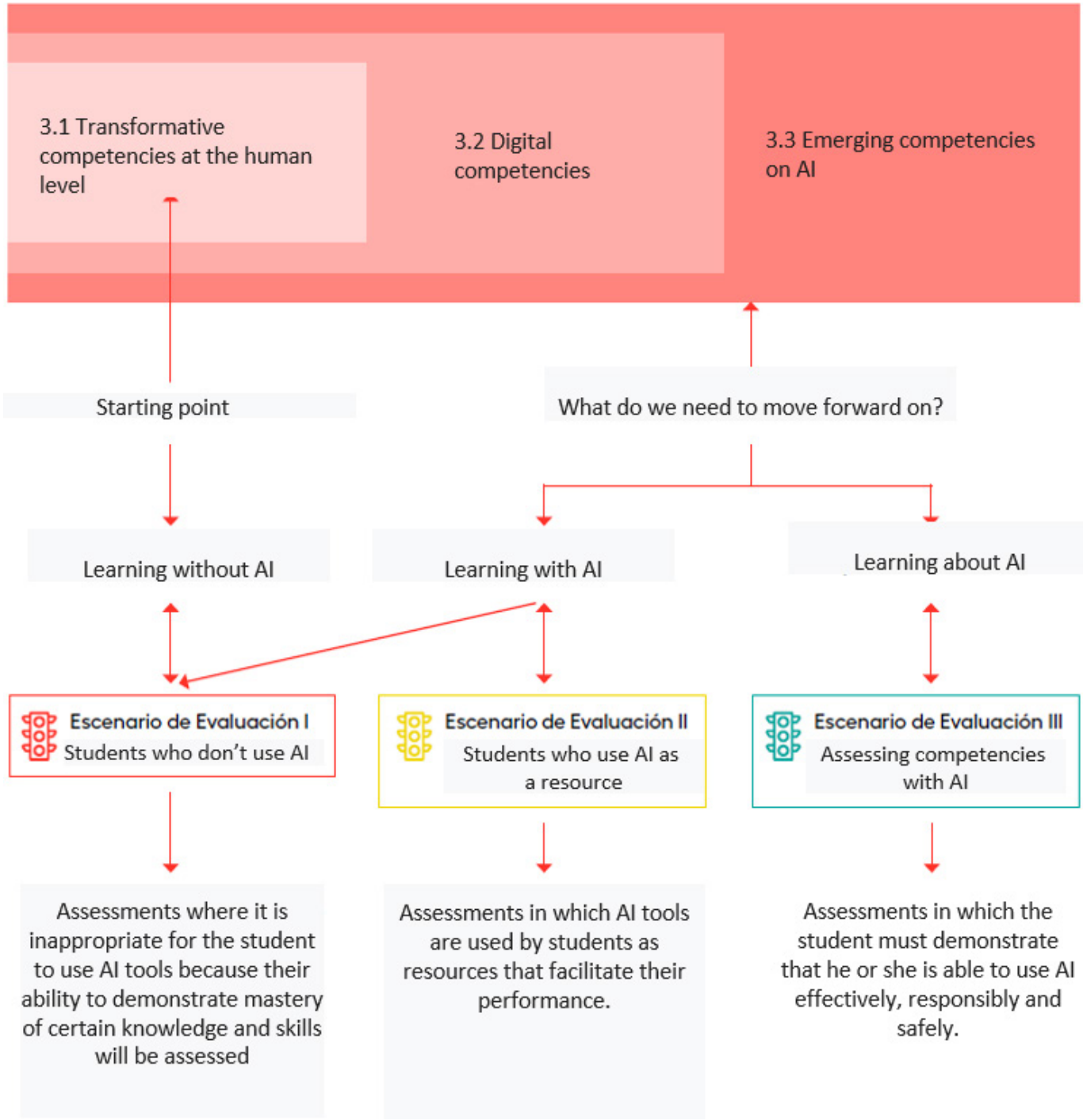
An evolution that will necessarily have to come from the hand of companies and regulators to adjust training to the demands of the market and the needs of society. Ideally, the definition of competencies in curricula could be defined by a multidisciplinary group that includes academics, technologists, industry representatives, regulatory bodies, students, and recent graduates, ensuring a comprehensive and up-to-date perspective.

EVALUATION
IN THE AGE OF AI

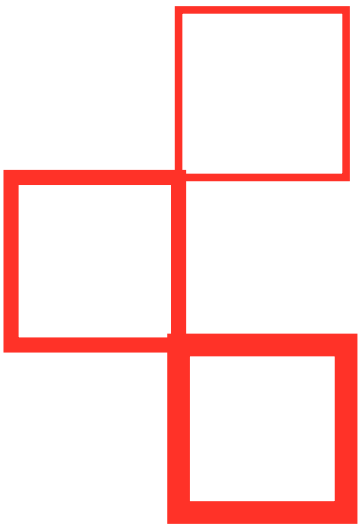
AI, in the future, will be an intrinsic part of training activity. In this context, AI is presented as a multifaceted phenomenon that poses various challenges and opportunities in academic and professional evaluation processes. On the one hand, it can be considered an aspect whose use should be regulated or even avoided in certain assessment scenarios, particularly those that seek to value intrinsic competencies and skills without the support of external tools. On the other hand, AI also emerges as a resource that must be understood and taken advantage of, which implies the need to integrate its use in the development of practical and theoretical skills.

From this perspective, the use of AI is emerging not only as a technical competence, but as a key competence that must be incorporated and evaluated in the university educational environment. For certain specialized profiles, it will be essential to acquire a deeper and more advanced knowledge of these technologies, including the ability to design, implement and optimize AI-based solutions. In this sense, the evaluation of capabilities related to the creation and development of AI systems could become a critical component, addressing aspects such as creativity, innovation and ethics in the design and use of these tools.

Taking for granted the distinction made in the previous section between transformative skills, digital skills and emerging skills in AI, the assessment of these skills in any university degree must follow a scheme similar to the one shown in the figure.



Source: Guide "Transforming assessment with AI from Universidad Europea", UEM [6]



According to this, the assessment must take into account in which of the scenarios the learning to be assessed is contextualized and must be adapted to that context to ensure that AI is not used when it should not, it is used as a resource when it is an appropriate tool for it and the way in which students incorporate it is evaluated and, Ultimately, the effectiveness, responsibility and safety with which they use it to do the task are evaluated.

In this way, AI is not only a learning objective to be achieved, but also a transversal competence that demands attention in multiple dimensions: from its basic and daily use to its advanced development in specialized areas. These implications reinforce the need to adapt university education and assessment systems to respond to the challenges and possibilities posed by artificial intelligence in contemporary society

In any case, it does not seem necessary to change the rules of evaluation that have been used until now, but it does adapt them to consider certain aspects that are impacted by the appearance of this technology. In this sense, it will be important to consider that:

- The student must be more involved and co-responsible, both for their learning and for the evaluation of the skills acquired. Students cannot be trained to use AI responsibly if they use it inappropriately in their assessment.
- Assessment systems must be changed to adapt them to the changes that also occur in classroom dynamics which, in turn, will lead to an assessment that is much more competency-based and not so knowledge-based, more interdisciplinary and not so silo-based, and more simulation-based and not so theoretical.
- It is necessary to identify and map the learning about AI that the student must achieve with the appropriate way to evaluate them.
- Ensure a good integration of companies and organizations in the education of students, including evaluation, for a greater guarantee that their training responds to the needs they have.

On the other hand, it is important to remember that the evaluation does not only have the purpose of certifying the student's progress towards the next academic level, but also plays a crucial role as a formative tool in the learning process. In this sense, evaluation should contribute to the continuous development of knowledge and skills, providing opportunities for reflection and constant improvement.

In this framework, AI can play a transformative role by enriching both the quantity and quality of feedback available to students. Thanks to its ability to process large volumes of data and analyze performance in detail, AI has the potential to generate personalized, immediate, evidence-based feedback, thus optimizing the learning experience.

An important aspect is that this feedback can be provided autonomously, without the need for constant supervision by the teacher. This not only frees up time for teachers, allowing them to focus on tasks of greater pedagogical complexity, but also facilitates more autonomous and adaptive learning for students. AI can, for example, identify patterns of error, suggest improvement strategies, and offer additional resources, tailored to each student's individual needs. In this way, the integration of AI in formative assessment not only expands the scope of this practice, but also fosters a culture of continuous and personalized learning, contributing to the integral development of students in a more dynamic and technologically advanced educational environment.

The questions on evaluation also open another debate related to how the model of verification and modification of reports should evolve to ensure a definition of competencies better adapted to the real situation of the profession. Although this will be discussed later, it will be necessary at least:

- To create more agile mechanisms so that the verified reports of the degrees have the flexibility to adapt to changes in the needs and technologies of each area.
- Identify how, when and by whom the official definition of competencies of the different degrees (RD, White Papers, CIN Orders) should be updated based on the evolution of technology in general, and AI in particular, in each profession. You have to be able to answer the question of how far the student should have the knowledge and skills of something that in the end a tool will be able to do and how their role as a professional should evolve and, therefore, what other things can be reinforced and evaluated, if that formative part is reduced.

PROCEDURE FOR REVIEWING AND UPDATING CURRICULA

As mentioned, the integration of artificial intelligence (AI) in higher education raises the need to review and possibly modify the competencies that students must develop. There is a consensus that digital technical skills, critical thinking and ethics are essential. However, it should not be assumed that students arrive at university with advanced knowledge in AI. Although they can handle computers, many do not have a solid foundation in computing, let alone AI.

It is essential that curricula include specific AI competencies, but also that they reinforce existing competencies that may become obsolete. The inclusion of AI should be governed by clear guidelines and ethical principles, ensuring that students learn how to use AI responsibly. Additionally, it is important for students to understand the fundamentals of AI tools and be able to explain the content on their own terms.

Regarding the structure of the curricula, the need to incorporate new specific AI subjects and modify the existing ones to adapt them to the new reality is raised. The flexibility and customization that AI enables must be integrated into the design of the curriculum. For example, the implementation of micromodules that allow for more personalized teaching adapted to the individual needs of students could be considered.

AI can also make it easier to create more liquid curricula, which adapt quickly to technological and labor market changes. This involves not only adding new subjects, but also continuously reviewing and updating the contents of existing subjects to ensure that students acquire relevant and up-to-date knowledge.

Teachers must have specific competencies in AI and be able to guide students in the use of these technologies. The role of the teacher is changing; it is no longer just a transmitter of knowledge, but a guide and facilitator of learning. Teachers must be critical and able to adapt to technological changes.

It is essential to clearly define the competencies that teachers should have in this new paradigm. In addition to technical skills in AI, teachers must be able to integrate these technologies into their teaching methods and assess their impact on student learning. Continuous training and professional development are critical to ensure that teachers are up to date with the latest advances in AI.

Some questions initially raised were left without a direct answer, opening up opportunities for future discussions and improvements. For example, the revision of white papers and CIN orders was not explicitly addressed, nor was the need to strengthen advisory committees with AI experts. In addition, although the importance of adopting new methodologies and flexibility in teaching was highlighted, the exact methodologies and the specific activities to be implemented were not detailed. Nor were the specific criteria for adapting educational facilities to the new needs of AI, nor the periodicity of review and feedback mechanisms discussed.

CONCLUSIONS

The integration of Artificial Intelligence (AI) in higher education represents a paradigmatic shift that requires an exhaustive revision of the curricula and competencies required for graduates. From the analysis presented, several key conclusions can be drawn:

1. **Need for adaptation of curricula.**
   The growing use of AI in various industries underscores the urgency of adapting curricula to include AI-related competencies . This not only involves teaching technical skills, but also incorporating an ethical and humanistic approach that prepares students to face the social and legal challenges associated with the use of AI.
2. **Transversal and Humanistic Competences**
   Despite technological advances, classic skills such as critical thinking, effective communication and teamwork are still essential. Universities must promote these transversal competencies, ensuring that graduates are not only competent in the use of technological tools, but also in their ethical and responsible application.
3. **Comprehensive Approach to Assessment**
   Assessment in the context of AI needs to evolve to reflect a more competency-based approach that is less focused on rote knowledge. It is essential that assessment systems adapt to the new dynamics of the classroom, promoting formative assessment that offers personalised and continuous feedback, facilitated by AI-based tools.
4. **Fundamental Role of Educational Institutions**
   Universities must act as active agents in the training of responsible professionals in the use of AI. This includes not only technical education, but also preparation to manage constant changes and adapt to new technologies, ensuring that graduates can contribute positively to their respective fields of work.
5. **Importance of Regulatory Framework**
   Recent AI legislation in Europe provides a necessary framework to guide the integration of this technology into education. Institutions must align with these regulations to ensure that students not only learn how to use AI tools, but also understand their ethical and legal implications.

In view of the analysis carried out, it can be concluded that the effective incorporation of AI in higher education is a complex process that requires a holistic approach, integrating technical, ethical and humanistic aspects that allow students to prepare for future work increasingly influenced by technology in general and by AI in particular.

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