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Transversal skills in applied Artificial Intelligence – the case of the financial sector

Abstract

Different aspects of modern society can be transformed by the deployment of Artificial Intelligence (AI). AI-powered tools have promoted changes in the financial industry by applying inventive methods for data analysis and automating processes, efficiency enhancement, cost reduction and more personalised services to customers. However, AI algorithms may activate significant ethical and regulatory concerns that should be addressed by the industry and society as a whole. In line with the Erasmus+ project Transversal Skills in Applied Artificial Intelligence – TSAAI (KA220-HED – Cooperation Partnerships in higher education), which aims to establish a training platform, this paper focuses on an analysis of study programmes in formal tertiary education across consortium countries (Spain, Estonia, North Macedonia, Croatia, Germany, and Slovenia) with a special focus on applied artificial intelligence and development of curriculum that will integrate teaching guidelines covering the areas of application of AI technology in the financial and insurance sectors. To this end, a Systematic Review of Literacy (SRL) on the web methodology identifying the existing employability requirements in AI and the Learning-Centred Syllabus (LCS) methodology for curriculum development was applied, with the presented curriculum expected to serve as a framework to develop teaching materials to help students, academics and employees enhance their professional skills, thus satisfying labour market needs.

Keywords: transversal skills, artificial intelligence, curriculum development; teaching platform, financial sector

Introduction

The rapid advancement of Information and Communication Technology (ICT) has ushered in a digital era, transforming various sectors of society and the economy (WIPO, 2019; Xu et al., 2021). At the forefront of this transformation is Artificial Intelligence

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(AI), technology that promises unparalleled benefits and poses unique challenges. AI's impact spans healthcare, transportation, education, environmental management, and many other domains (Shiohira, 2021). However, its transformation is particularly significant in the financial sector, where AI revolutionises operations, decision-making and risk management. Harnessing the power of AI, new paths have been opened for data analysis and process automation to reduce costs, enhance efficiency, and deliver highly personalised services to clients. AI-powered technology has the potential to drive economic growth and create new job opportunities (WIPO, 2019; 2021). Market analyses have shown a rapid increase in the application of AI technologies in finance. In 2022, AI in Banking, Financial Services and Insurance (BFSI) participated with the highest 16.82% market share compared to the other economic sectors, and this trend is expected to continue until 2032 (Precedence Research, 2023).

In this context, our paper explores the concept of "transversal skills" within the realm of AI (Egana del Sol & Joyce, 2021), particularly in the context of the financial sector. Transversal skills, often referred to as cross-cutting skills, are competencies that transcend specific domains or disciplines, encompassing a wide range of abilities, including problem-solving, critical thinking, communication, adaptability and teamwork. These skills are essential in today's dynamic and AI-driven world, enabling individuals to navigate complex challenges and work effectively across various fields and contexts (OECD, 2021b). Transversal skills empower individuals' success in various domains, foster personal growth, and contribute to a more adaptable and innovative society. Cultivating and honing these skills should be a priority for individuals, educators and organisations. Due to the fast development of Natural Language Processing (NLP) and Machine Learning (ML) as subsets of AI, digital skills have become crucial skills required in various jobs. This is of particular importance, as long-life learning is redirecting the focus on "real-world contexts and work-based learning", which have been demonstrated to "motivate learners more than traditional approaches" (OECD, 2021b).

Artificial Intelligence (AI) is not a new field, with studies and research in AI having been performed for almost five decades (WIPO, 2019; Xu et al., 2021), and an advance in computational theories and models has been noticed. Over the last few years an Applied Artificial Intelligence (AAI) boom in the industry, especially in the private sector, has been observed (WIPO, 2019). It is worth mentioning that technological companies worldwide, such as IBM, Google, Apple and Facebook, have led the research and development of the application of computer models to solve real problems in the industry. However, Applied AI has been very distant from the needs required today.

Considering that AI is a transversal discipline (Egana del Sol & Joyce, 2021), we can assume that the demand for employment of such profiles has grown and will continue to experience noteworthy growth in the coming years. Nevertheless, the research in AI has been restricted to a small number of universities (WIPO, 2019), with regards to the number of patent applications, and it would not be possible to cover a wide range of application areas if restricted to the national level only. Raising this issue to the rank of the European Union, the possibility increases for finding a higher number of universities experienced in AI applications covering an extended spectrum of economic sectors (Egana del Sol & Joyce, 2021).

Our hypothesis centres on the pivotal question that frames our paper: To what extent are areas associated with Applied AI incorporated into the currently accredited curricula within universities in the consortium countries participating in the Erasmus+ project "Transversal Skills in Applied Artificial Intelligence" (TSAAI)? This inquiry serves as the overarching thesis for our research. Our goal is to investigate accredited ICT study programmes, with a particular emphasis on AI, in the TSAAI consortium countries. We aim to identify the degree to which these programmes integrate Applied AI concepts, particularly within the domain of the financial sector.

Our methodology involves a systematic review of the literature (SRL) available on the web in order to analyse existing study programmes and their alignment with the objectives of the TSAAI project. We also employ the Learning-Centred Syllabus (LCS) methodology for curriculum development, ensuring that the educational content aligns with the needs of students and the dynamic AI landscape.

The contribution of this paper lies in its potential to shed light on the current state of AI education and the presence of transversal skills in accredited curricula, specifically in the financial sector. This analysis is vital for several reasons. Firstly, the financial industry's reliance on AI is growing rapidly, necessitating a workforce equipped with the right skills. Technology based on AI algorithms is enhancing user experiences in various domains. As encouraged by users, Generative AI systems and Natural language processing enable applications like GPT-4, ChatGPT and similar OpenAI tools to create various forms of text, images or other content, including advanced chatbots, virtual assistants and language translation tools. By early 2023, some emerging generative AI systems had garnered a user base exceeding 100 million (Darktrace, n.d.). Marsh McLennan Insurance company officially introduced a trademarked AI assistant known as LenAI across their business units in autumn 2023, and within one month they reached 15 000 different users (UK Finance, 2023). AI-based algorithms also power personalised recommendations on e-commerce platforms, streaming services and social media, tailoring content to individual preferences (OECD, 2021a). Systems based on AI technology can analyse vast amounts of data, optimise operations, and identify opportunities for cost savings and process improvements, leading to increased productivity (WIPO, 2019; 2021). A pioneered AI-based anti-money laundering solution launched by HSBC, one of the largest banking

and financial institutions in the world, in partnership with Google Cloud in 2021, showed the AI system outperforming compared to traditional monitoring systems not only in enhanced accuracy and efficiency, but by reducing the data processing time from one month to two-three days (UK Finance, 2023). Secondly, ensuring a balance between AI-driven innovations and ethical considerations is paramount for society's well-being. Lastly, closing the skills gap and promoting continuous learning are essential for individuals to thrive in an AI-driven economy.

In the subsequent sections, we will delve into a detailed analysis of the identified study programmes, the current state of the ICT industry in the TSAAI consortium countries, and the proposed teaching platform "FuturIA". By doing so, we aim to provide valuable insight into the evolving landscape of AI education and its intersection with transversal skills. Readers can expect a comprehensive exploration of these topics, with implications for academia, industry and policymakers in the AI and financial sectors.

Benefits and drawbacks of Artificial Intelligence in finance

The remarkable development of Information and Communication Technology (ICT) has caused a high of digitalisation of business operations and standard working processes in both public and private organisations (Shiohira, 2021). Digitalisation and Artificial Intelligence undoubtedly alter our world, significantly affecting our personal, occupational and societal lives (WIPO, 2019; 2021). Whether aware of it or not, we are all witnessing the infiltration of AI in numerous spheres, such as healthcare (Lekadir et al., 2022), transportation and logistics, education (Shiohira, 2021), environmental and energy network management (Nti et al., 2022), etc. AI technology is increasingly being used for automation, guiding workforce transformation (Shiohira, 2021).

With the emergence of AI, the financial industry is among the most prominent sectors experiencing a significant transformation. AI systems can identify patterns, trends and anomalies that humans may miss, allowing financial firms to make data-driven decisions with greater precision and efficiency. It is collaboration between humans and machines, where AI assists human judgment rather than taking over completely. This approach enables technology advantages while supporting responsibility and control in decision-making. It may be necessary to prioritise the human role in decision-making (Zarsky, 2016), especially in critical use cases, such as lending decisions, to ensure that human judgment retains its significance and influence (OECD, 2021a). With continuous monitoring and analysing of vast amounts of real-time data, AI-powered algorithms can detect and mitigate risks more effectively. The assistance of AI technology in conforming to complex regulatory requirements is accomplished by monitoring transactions, detecting suspicious activities, and ensuring compliance with anti-money laundering regulations (OECD, 2021a).

The influence of AI in finance is seen in many aspects, such as asset management, investment analysis, trading (OECD, 2021a) and crediting (Albanesi & Vamossy, 2019), accompanied by fraud detection, risk assessment and customer support. AI-powered technology has the potential to drive economic growth and create new job opportunities (WIPO, 2019; 2021).

Analyses of the market have shown a rapid increase in the application of AI technology in finance. In 2020, the market value of AI in banking was $3.88 billion, according to Allied Market Research, and it is projected to reach an astounding $64.03 billion by 2030 (Business Wire, 2022). Other estimations, e.g. that of Statista (n.d.), predict even higher values, expecting the Asia Pacific region alone to generate $99 billion by 2030. Regardless of which prediction we choose, it is clear that AI will continue to be widely implemented in finance, which could bring substantial revenue growth.

Achieving the right balance between innovations and ethical consideration is critical in shaping the future of AI and its impact on society. While AI can potentially automate routine and repetitive tasks, resulting in increased efficiency and productivity, concerns about job displacement arise (Shiohira, 2021). It becomes imperative to reskill and upskill the workforce through continuous learning to adapt to the changing demands of an AI-driven economy.

The Randstad Report (2021) predicts that adopting AI in companies worldwide will lead to a 34% increase in employability. Companies need to develop a workforce with the necessary skills, one that will effectively address AI technology (OECD, 2021a; Southworth et al., 2023). However, the current pace of training and education programmes falls short of meeting this growing need, underscoring the urgency to bridge the skills gap and equip individuals with the necessary expertise (Shiohira, 2021).

Another important aspect is the transformation of roles in job profiles due to the digitalisation of business processes and standard operations in private and public organisations. One of the drawbacks that the social agents highlight with impetus is the destruction of employment from the digitalisation and automation of some tasks, especially in private companies. Transforming these roles into empowering digital positions is vital to mitigate the devastating effects of job loss; and investing in upskilling and reskilling these individuals is undeniably the optimal solution we should wholeheartedly rely on (European Commission, 2022).

Research objectives

The Erasmus+ project "Transversal Skills in Applied Artificial Intelligence" (TSAAI) – KA220-HED aims to support the horizontal priority of the endeavour "Addressing digital transformation through the development of digital readiness, resilience, and capacity." This paper is part of the TSAAI project,

which aligns with the EU strategy on digitalisation and reinforcement in technology, particularly in artificial intelligence. In line with this objective, the project seeks to establish a teaching platform called FuturIA, which includes pedagogical resources for instructors in higher education who want to experience and incorporate transversal competencies in AI in their teaching. Furthermore, the platform can benefit companies with a high demand for AI profiles, undergraduate and postgraduate students of diverse degrees who are interested in training and working in AI profiles, as well as adults who require vocational training reconversion to align their skills with the digitalisation demands of the job market. Additional priorities include the teaching material that covers competencies demanded in the business field not taught in accredited curricula in higher education.

The initial phase of this paper involved identification of the existing employability requirements in the field of AI across consortium countries (Spain, Estonia, North Macedonia, Croatia, Germany, and Slovenia) from social, educational and business perspectives. The choice of partner entities was made based on their knowledge and experience in Applied Artificial Intelligence in order to be able to meet a broad spectrum of fields of application in the different sectors of the industry. Knowledge in e-learning was also taken into account, research experience in IIA to Industry 4.0 with its project in energy efficiency in industrial and residential facilities (controlling a district heating plant that uses biomass), as well as the automated recognition of defects in road pavements, nanomedicine applied to cancer and other health applications, expertise in digital voice and image processing and deep learning in medical image analysis and explainable artificial intelligence in medicine, as well as expertise focused on business intelligence for process optimisation in companies. The geographical position of the countries covers most of the economic regions in Europe, with Spain belonging to south-western Europe, Germany to the western part, Slovenia and Croatia to central-southern Europe, Estonia to the north-east and North Macedonia belonging to the south-east region of Europe, while at the same time being part of the Balkan region. With the exception of North Macedonia, all the other countries are members of the European Union. We feel that the findings in these countries reflect the trend in the wider region, i.e. the whole European region. The differences among the countries refers to their geographic position, living standard, GDP, income per capita, education, healthcare, transportation, communication systems, industrial, infrastructural, and technological advancement, etc.

The objectives of this paper relate to the analysis of the study programmes related to ICT, with a specific focus on AI in the countries participating in the TSAAI project, to identify the extent to which they integrate Applied AI concepts, especially in the context of the financial sector, and to propose a teaching programme centred around the finance sector.

Study methodology

To address the major research objectives of analysis of study programmes related to Applied AI and creating curriculum frameworks to develop professionals, we addressed the analysis of data available on the web, known as the Systematic Review of Literacy (SRL) (Kitchenham et al., 2009; Lame, 2019). We tried to exclude the programmes concerning general AI and to include only those concerning applied AI topics. The analysed study programmes are shown in Table 1 in the Appendix.

This stage of the project follows the phase of the deep analysis of available data via SRL on the web (Kitchenham et al., 2009; Lame, 2019), including the following phases: 1. Analysis of the evolution of ICT in general, and AI in particular, relying on reports on the employment of ICT specialists obtained from the Labour Force Survey (LFS). 2. Information from public institutions, national employment services, public services of employment, national chambers of commerce, and international employment services.

In the systematic review method, the previous research's findings are observed to identify reliable and repetitive data. The well-managed and highly organised qualitative analysis, where researchers tend to cover fewer materials from fewer databases, differentiates SRL from the conventional literature review process (Tinmaz et al., 2022).

Well-defined forms were prepared and used by our partners to collect data related to the current status of the ICT industry classified into indicators as follows:

1. General macroeconomic indicators (Nominal Gross Domestic Product (GDP), GDP growth rate, GDP per capita, unemployment rate, and average monthly wage).
2. General ICT performance (Number of economically active companies and the share of companies in the ICT industry in the total number of companies).
3. Employee-related performance (Number of employees in the ICT industry, distribution of persons employed as ICT specialists by gender, education attainment level, age, the average annual rate of change for the number of employees in the ICT sector, the share of the labour force with an ICT education by labour status, the share of employed persons in the labour force with an ICT education, the average annual rate of change for the number of employed persons with an ICT education by educational attainment level, and education/training provider in the ICT industry).

Learning-Centred Syllabus (LCS) methodology will be used in the development of the curriculum and later in the preparation of teaching units (BYU, 2021). This practice will focus on students' needs and learning processes, with particular attention to obtaining significant academic progress.

The results related to the current position of the ICT industry in the partner countries obtained from

the ICT specialist employment report, as well as information from public institutions, was already presented (Porjazoska Kujundziski et al., 2023). Here, we will briefly elaborate on some of the key observations.

Current state of employability in the ICT sector

Previous studies (Porjazoska Kujundziski et al., 2023), based on the SRL on the web, summarised the current position of the ICT sector in the six countries, our partners in the TSAAI project. Through an analysis of general ICT reports (Eurostat, 2022), we focused on three main divisions of indicators: 1. General macroeconomic indicators, including the Nominal Gross Domestic Product (GDP), the GDP growth rate, GDP per capita, the unemployment rate, and the average monthly wage. 2. General ICT performance, involving the number of economically active companies and the share of companies in the ICT industry among the total. 3. Employee-related performance in the ICT industry, covering aspects such as the number of employees, gender distribution, education attainment, age, etc.

Due to the unavailability of specific statistical reports on AI, we relied on statistics linked to the general ICT industry, assuming that the trends in this sector reflect the position of AI application across various areas in the countries – partners in the TSAAI project.

Here we will present the indicators showing the general performance of the ICT sector in the six partner countries, while the indicators related to the general macroeconomics, such as the nominal Gross Domestic Product (GDP), the GDP growth rate, GDP per capita, the unemployment rate, and the average monthly wage, were elaborated in our previous work (Porjazoska Kujundziski et al., 2023). Yet, these and other indicators such as inflation, industrial production, retail sales for the real sector, trade, exchange rates, stock prices, and others, recognising the level of financial development in a country, are not part of this analysis.

The status of the overall performance of the ICT sector streamlines the determination of the necessary strategies for creating a favourable business environment in a country. The highest growth rate of the number of economically active ICT companies compared with the total number of economically active companies for the period 2020–2021 is about 90% for Spain, 16% for Estonia, 6.98% for Croatia, 6.3% for North Macedonia and 5% for Slovenia, as indicated in Table 2 (see appendix) (Bitkom, 2022; DZS, n.d.; GZS, n.d.; HGK, 2021; INE, n.d.; ITA, 2024; MAKSTAT, n.d.; MINECO, n.d.; Porjazoska Kujundziski et al., 2023; Statistics Estonia, n.d.).

The analysis addressing the inconsistency between the number of qualified employees needed and the output that the educational system provides is very challenging if one is concerned about the current status of the business environment (Eurostat, 2022; Porjazoska Kujundziski et al., 2023).

Table 3 (appendix) presents part of the data related to the general ICT performance. The share of employees in the ICT industry in the total number of employees was between 2.3% and 4% for all countries in 2020, showing an increasing trend in 2021 (Bitkom, 2022; DZS, n.d.; GZS, n.d.; HGK, 2021; INE, n.d.; ITA, 2024; MAKSTAT, n.d.; MINECO, n.d.; Porjazoska Kujundziski et al., 2023; Statistics Estonia, n.d.).

The appendix presents information about employee-related performance in the ICT sector for the partner countries in Tables 4 and 5. All the countries showed an unbalanced gender distribution of ICT specialists (Eurostat, 2022; Porjazoska Kujundziski et al., 2023) in the period 2012-2021. The highest percentage of ICT specialists, around 56% on average, was observed in North Macedonia, while in the case of the other countries the highest share concerned employees over 35 years old.

As indicated in the ICT report from 2021 (Eurostat, 2022; Porjazoska Kujundziski et al., 2023), Estonia has the highest share (96.8%) of the labour force holding ICT education, with the share of the labour force declining among the countries in the following order: Slovenia (96%), Croatia (91.2%), North Macedonia (87.7%), and Spain (73.91%). A rise of 15.3% in employed ICT specialists in ten years (2012-2021) was observed for North Macedonia, whereas for other countries it was significantly lower, ranging between 3.7 and 6%.

The level of education is often a measure of the developed skills of a labour force. Most ICT industry employees in Germany and North Macedonia, Table 4 (appendix), acquired their skills in non-tertiary education, while in the other countries, tertiary education provided the demanded competencies (Eurostat, 2022; Porjazoska Kujundziski et al., 2023). This observation aligns with the companies' readiness report on their participation in the informal education of the ICT labour force, Table 5 (appendix). Vocational education training centres are the leading providers of ICT skills in North Macedonia and Croatia. For Spain, this is the role of business institutions and national chambers of commerce. These observations are in line with those on the increasing digitalisation of business (Randstad Report, 2021; WIPO, 2019; 2021), presenting the ICT sector and applied AI technologies as an essential part of developed societies.

Analysis of the current status of the ICT industry indicates its impact on the economy, influence on the development of national strategies to satisfy the need for qualified professionals, and how to support internationalisation and education. In the context of the full progress of the digital age and the use of artificial intelligence (AI) in companies, job automation will increase by over 30% by 2030 (OECD, 2021b), impacting the high demand for employment in artificial intelligence profiles that cannot be covered by the existing curricula in the formal education and at the training rates we have today (MASIT, 2021). The shift toward digitalisation requires modifications in formal educational programmes and more significant support from the business sector. Consequently, the FuturIA teaching platform of the TSAAI project will facilitate the achievement of this objective.

Education programmes analysis

In line with the above-mentioned mission of the TSAAI project, an all-encompassing educational portal with a comprehensive curriculum will be developed, the main objective being to make the extensive training content available to many interested individuals.

The main focus of this initiative is to provide a comprehensive interdisciplinary AI training programme covering fundamental AI technology, practical applications in computer science and other fields, and addressing societal, ethical and legal aspects. This ambitious goal, along with the previous ICT industry analysis, involves analysing accredited study programmes related to AI, especially master's degree programmes, in the participating countries of the TSAAI project: Spain, Estonia, North Macedonia, Croatia, Germany and Slovenia. The aim is to bridge the gap between fundamental AI knowledge and the increasing demand for specialists in specific AI techniques. Table 1 (appendix) lists all the analysed programmes.

Analysis of the study programmes related to AI in higher education in Spain focuses on two bachelor's degrees and ten master's degrees. With regard to undergraduate studies, the analysis has shown that some programmes refer not only to Artificial Intelligence but also to Data Science. More focus on Artificial Intelligence could be applied in master's programmes – between 30 and 60 ECTS – where a block considering areas of application in biomedical informatics, linguistic engineering, web science, natural language processing, and automatic planning is offered. Some master's programmes have a clear orientation to Deep Learning, focusing on Neural Networks and specifications in training, testing, and validation, and practices with predefined models. Degrees focused on Software Engineering mainly cover theoretical components of AI, and include parts of education, finances, health, autonomous vehicles, Natural Language Processing (NLP), smart cities and manufacturing, and even entrepreneurship in AI. This is a model worth following. On the other hand, some universities follow a programme divided into modules concentrated on Linguistics and Cognitive Neuroscience, Cryptography and Security (including Biometric identification), and Neural Computation. Although some courses still require a deeper focus, they can give an idea of the wide range of applications of AI, e.g. focusing on shape recognition applications.

An analysis of the educational programmes at universities in Estonia reveals that they primarily focus on Computer Science, Systems, Computer Engineering and Software Engineering. Master's programmes typically last for two years (120 ECTS). Subjects covering various aspects of AI, including data mining, Machine Learning, computer vision, speech processing and applied data science in the energy sector, are part of the Computer Science curriculum. However, only a few courses in Computer and Software Engineering programmes address the application of AI in smart and intelligent systems, robotics and other disciplines.

Undergraduate programmes in North Macedonia typically span either 3 or 4 years, amounting to 180 or 240 ECTS, respectively. Likewise, graduate programmes last either 1 or 2 years, providing students with 60 or 120 ECTS, respectively. The first-cycle study programmes focused on Machine Intelligence and Robotics delve into topics of probability, linear systems and stochastic processes. They introduce the fundamental principles of cognition, automatic reasoning, and search decision theory, underlying courses covering basic and advanced training in robotics. In the second cycle of these programmes, the focus shifts to the Control of Systems and Processes, Computer Engineering techniques applied across various technical disciplines, medicine, management and more.

In Croatia, the second-cycle programmes typically last for two years and require the completion of 120 ECTS. Programmes in computing primarily focus on subjects such as programming, algorithms and data structures. However, they also offer elective modules that contain Machine Learning and its practical applications, such as robotics, image processing, and speech and language processing. Programmes in Computing, with a specialisation in Data Science, provide wide-ranged knowledge of Data Science techniques for management, analysis of Big Data, and application in several fields. The Programme of Computer Science – Internet of Things and Artificial Intelligence in the second cycle of studies orients toward building skills in data science and full-stack Internet of Things (IoT) developer roles, from the design and implementation of intelligent solutions to data analytics and hardware management.

Undergraduate programmes (3.5 years with 210 ECTS) offered at German universities focus on applied Artificial Intelligence, providing a comprehensive and scientifically grounded education in modern AI technologies, including Machine Learning, Deep Learning, visual analytics and autonomous systems. In addition to the principal skills for AI practitioners, the study programme also addresses powerful aspects, such as AI security, robustness, and ethical and legal considerations of intelligent systems. The curricula in Computer Science master's programmes focus on software architectures, parallel computing and Artificial Intelligence. The Business Information Systems curriculum offers courses in data science and Applied AI. Master's programmes specialising in Machine Learning and Data Analytics provide education on various Machine Learning techniques and their correct and efficient application. Moreover, the programmes address ethical and societal aspects related to AI.

The undergraduate programmes available at universities in Slovenia in Computer Science and Informatics/Information Technology primarily focus on programming and algorithms, and include blocks dedicated to Artificial Intelligence, Informatics, Software, Computer Systems and Networks, and Media technologies. The Artificial Intelligence specialisation offers courses in intelligent systems, development of intelligent systems, machine perception and data

mining. Third-cycle programmes deliver knowledge in evolutionary algorithms, data mining and knowledge discovery, intelligent systems and agents, and the application of AI in other disciplines.

Following the analysis of programmes in the partner countries of the TSAAI project, one could conclude that AI's knowledge builds in broader fields of computer science, computer and system engineering, information and communication technology, or the practical application of AI technologies in various disciplines. However, ICT programmes linked to the application of AI are not in line with the type of profiles created in formal education and the skills demanded by the business sector.

Following the review of the ICT study programmes, specifically those focused on Artificial Intelligence, and the study on the requirements for profiles in business applications of AI across various industry sectors, the TSAAI project consortium has suggested a curriculum consisting of nine modules for an Expert Course, with each module being allocated 2 ECTS. The curriculum is structured into three blocks, each comprising three modules.

Development of the curriculum

The curriculum suggested by the TSAAI consortium is concentrated around three key components:

- a theoretical introduction to the world of AI,
- a practical introduction to general AI,
- AI applied to specific Fields.

The phases of curriculum and teaching material creation use Learning-Centred Syllabus (LCS) methodology (BYU, 2021; Machac, 2022), which maintains a permanent focus on two key points: proximity to the profile and environment of the student, and maximum interest in the topics to be developed without falling into unnecessary complexities. The teaching guides will emphasise the competencies acquired, mainly transversal and specific, in line with the European Higher Education Area (EHEA, n.d.).

Figure 1 visualises this breakdown, where the three central boxes represent these main components, while the nine prominently outlined boxes represent the proposed modules.

This project aims to train graduate students from different academic backgrounds (Southworth et al., 2023) in applied AI to a wide diversity of fields so that they can discover the sectors in their institutions that will benefit from the application of Artificial Intelligence. They are also expected to recognise the data sources to support AI applications, which is why the pillars will be developed to have different loads.

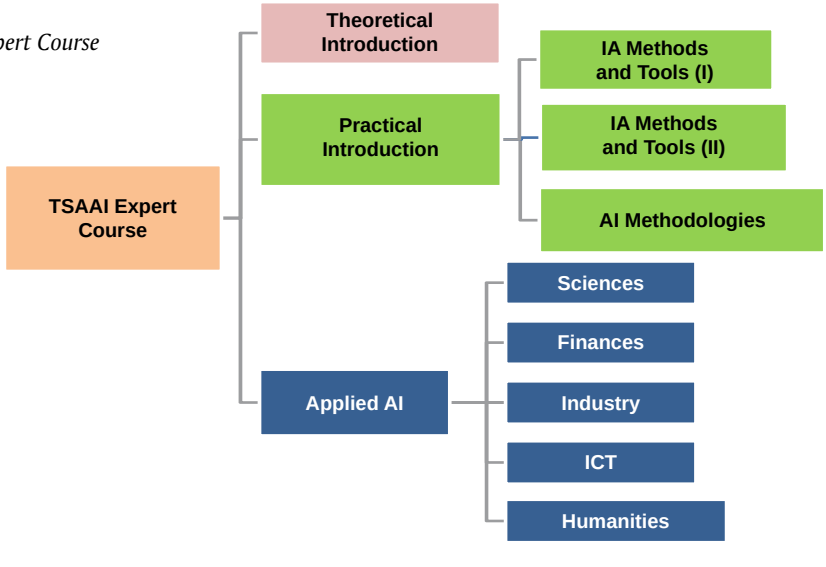
The module related to the Theoretical Introduction to Applied AI is planned to give a solid base for students, allowing them to understand the nature of AI and its potential implications (Gouëdard et al., 2020; Southworth et al., 2023). This module (2 ECTS) should cover the following topics: application of AI to other scientific disciplines, AI as an area of interdisciplinary knowledge, sub-areas of AI, great achievements in AI, and social, ethical and legal implications of AI.

The following modules should focus on practical applications, providing theoretical explanations alongside immediate hands-on exercises that students can follow independently.

The comprehensive scope of concepts and the numerous practical exercises required to train students in general techniques and approaches utilised in AI involves a subdivision of the pillar Practical Introduction into three modules, with 2 ECTS allocated for each. Two modules are concentrated on exploring the inherent elements of AI (e.g. Computational Intelligence, Evolutionary Computing, Machine learning, Deep Learning, Natural Language Processing, etc.). The third module promotes best practices (AI Methodologies) in all AI applications.

Once students have gained proficiency in AI methods, tools and methodologies, shifting the focus toward the specific domains in high demand within the current job market becomes crucial. In the previ-

Figure 1
Hierarchical schema of the TSAAI Expert Course



Source: authors' own work.

ous study we recognised five major fields to prioritise in the third pillar: Sciences, Finances, Industry and Internet of Things, Information and Communication Technology, and Humanities, with 2 ECTS each.

Our focus will be primarily on the module covering the application of AI in finance, the stock market and insurance.

The proposed curriculum for the finance module

In line with the previous discussion in mind during the preparation of training resources, in cooperation with our associated partners from the financial sector (banks and insurance companies), we developed content composed of six main topics. Our suggested curriculum aims to support the current applications of AI-powered technologies and indicates their future trends (OECD, 2021a; Southworth et al., 2023). It covers the following subjects:

1. AI Approaches in Finance
   - 1.1. Fundamental Analysis (Regression and Equity Analysis; Linear Regression; AI-powered Financial Analytics)
   - 1.2. Regression in Finance (Machine and Deep Learning as Model Estimation in Finance; Logistic Regression for Modelling Bank Failures)
2. Predictions in Risk Assessment, Fraud Detection, and Management
   - 2.1. Risk Management (Types of Risk in the Banking and Insurance Sector; Machine Learning and Deep Learning in Risk Assessment; Risk Management Tools; Analytics and Big Data Tools in Risk Management)
   - 2.2. Fraud Detection (Fraud and Benefits of Using Artificial Intelligence for Fraud Detection in Banking; Surveillance of Conduct and Market Abuse in Trading)
   - 2.3. Modelling (Credit Risk and Revenue Modelling)
   - 2.4. Ethics (Ethics and Appliance with the General Data Protection Regulation – GDPR)
3. AI in Customer Behaviour Analysis
   - 3.1. Customer Behaviour (AI Customer Behaviour Analytics and Predictive Analytics; Impact of AI on Consumer Buying Behaviour)
   - 3.2. Interaction (AI in Customer Interaction; AI-powered Virtual Assistants in Banking)
4. Automated Decision-Making (loans, credit cards, insurance policies, …)
   - 4.1. Analysis, Monitoring and Decisions (Credit Decisions, Insurance Decisions; Monitoring and Collections; Deepening Relationships)
5. General Market Forecasts and Correlations
   - 5.1. Analysis and Predictions (Machine Learning and Deep Learning Predictive Approaches; Real-time Financial Time Series Analysis)
   - 5.2. Hidden Information Extraction (Feature Extraction in Potential Market Opportunities)
6. Automation of processes and workflow
   - 6.1. Operations Automation (Automation of trade finance; Automation of banking regulations and compliance; Automation in anti-money laundering (AML) and sanction screening)
   - 6.2. Workflow Automation (Automation of cash management operations; Automation of document workflow and internal processes).

The course implementation introduces innovative formats and content, utilising novel didactic methodologies such as micro-training and interactive computing. The FuturIA platform fosters collaborative learning, recognising that learning is a social, interactive and informal process taking into account students' experiences. The dynamic community enables the acquisition of new knowledge while practising. Each module comprises twenty units, explaining concepts, demonstrating examples and case studies, and addressing the order of content delivery, as well as potential challenges that students may encounter. The general introduction modules do not require prior knowledge. All the courses will be based on problem-solution-practice triads that 1) present a clear, concise problem close to the student, 2) propose an intuitive and reasonable way to solve it, and 3) offer a practical guide to solve the problem. Online practices via interactive computing allow for the participation of a larger audience due to the lack of required investments in equipment.

The proposed curriculum was developed with the help of associated partners, in this case the banking and insurance sector, and is one of a kind, following the current trends in competencies required in the business field that are not taught and covered by formal higher education in the partner countries. The FuturIA teaching platform is expected to promote internationalisation, since teachers and students are among all the partners. In addition, students will have access to AI jobs in all the countries participating in the programme. The remarkable development of "Information and Communication Technology (ICT)" led to the high degree of digitalisation of business processes and standard operating processes in both public and private organisations. The anticipated outcome throughout the progression of this project, and thus this paper, includes the development of professionals within the field of Applied AI, curricular advancements in the field of Applied AI, the creation of educational resources aimed at acquiring transversal skills, and production of audio-visual materials for the course in the format of a Massive Online Open Course (MOOC). At first, this free-of-charge online course will be offered in the partner countries, but it will be accessible to attendees from other countries in Europe and all over the world, i.e. to anyone who finds it beneficial.

Further details about the didactic units' development and profound discussion about their contents will be part of future work.

Conclusions

The framework of the Erasmus+ project "Transversal Skills in Applied Artificial Intelligence" (TSAAI) is in line with the EU strategy on digitalisation and reinforcement in technology and focuses on Applied Artificial Intelligence. The TSAAI project aims to create teaching materials, i.e. the FuturIA teaching platform, providing its' educational content to a wide range of interested groups and keeping it updated on fast-evolving AI technology. The fast digitalisation of industries creates a discrepancy between required profiles on the labour markets and the rate with which the formal educational system provides such experts.

This paper centres around the analysis of the formal tertiary education programmes in consortium countries (Spain, Estonia, North Macedonia, Croatia, Germany and Slovenia), covering Applied Artificial Intelligence, as well as developing the curriculum and educational material, including the areas of application of AI technology in the financial and insurance sectors. To this end, the TSAAI FuturIA teaching portal is expected to diminish this gap. Systematic Review of Literacy (SRL) on the web methodology has been applied to pinpoint the present employability requirements in AI, while the curriculum development relied on Learning-Centred Syllabus methodology. An Expert Course focusing on the required specific and transversal skills related to Applied Artificial Intelligence in the financial sector has been suggested in this paper, and is expected to assist students, educators, and professionals in enhancing their skills to meet the evolving demands of the labour market.

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The appendix is available in the online version of the journal.

References

Albanesi, S., & Vamossy, D. (2019). *Predicting consumer default: A deep learning approach*. National Bureau of Economic Research. https://doi.org/10.3386/w26165

Bitkom. (2022). https://www.bitkom.org/sites/main/files/2022-07/Erwerbst%C3%A4tige_inkl._CE_Extranet_Juli_2022_neu.pdf

Business Wire. (2022, January 31). *The Global AI in Banking Market Will Grow to $64.03 Billion by 2030, at a CAGR of 32.6% During 2021-2030 – ResearchAndMarkets.com*. https://www.businesswire.com/news/home/20220131005583/en/The-Global-AI-in-Banking-Market-Will-Grow-to-64.03-Billion-by-2030-at-a-CAGR-of-32.6-During-2021-2030---ResearchAndMarkets.com

BYU. (2021, August 30). *Syllabus design*. Center for Teaching and Learning. https://ctl.byu.edu/tip/syllabus-design

Darktrace. (n.d.). *Generative AI definition*. Retrieved January 19, 2024, from https://darktrace.com/cyber-ai-glossary/generative-ai

DZS. (n.d.). Drzavni Zavod za Statistiku [Croatian Bureau of Statistics]. Retrieved July 29, 2022, from https://web.dzs.hr/

Egana del Sol, P., & Joyce, C. (2020, January 2). *The future of work in developing economies*. MIT Sloan Management Review. https://sloanreview.mit.edu/article/the-future-of-work-in-developing-economies/

EHEA. (n.d.). European Higher Education Area. Retrieved June 1, 2023, from https://www.ehea.info/index.php

European Commission. (2022). *The impact of Artificial Intelligence on the future of workforces in the EU and the US*. https://digital-strategy.ec.europa.eu/en/library/impact-artificial-intelligence-future-workforces-eu-and-us

Eurostat. (2022). *ICT specialists in employment*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_in_employment

Gouëdard, P., Pont, B., Hyttinen, S., & Huang, P. (2020). *Curriculum reform: a literature review to support effective implementation*. Organisation for Economic Co-operation and Development Directorate. https://one.oecd.org/document/EDU/WKP(2020)27/En/pdf

GZS. (n.d.). Gospodarska zbornica Slovenije [Chamber of Commerce and Industry]. Retrieved July 19, 2022, from www.gzs.si

HGK. (2021). *Analiza stanja hrvatske IT industrije* [State analysis of the Croatian IT industry]. Hrvatska Gospodarska Komora. https://hgk.hr/documents/analiza-stanje-hr-it-industrije-2020-finale61af63d15c67c.pdf

INE. (n.d.). Instituto Nacional de Estadística [National Statistics Institute, Spain]. Retrieved July 19, 2022, from https://www.ine.es/jaxi/Tabla.htm?tpx=48985&L=0

ITA. (2024). *Information and Communications Technology*. International Trade Administration. https://www.trade.gov/country-commercial-guides/slovenia-information-and-communications-technology

Kitchenham, B., Brereton, O. P., Budgen D., Turner, M., Bailey, J., & Linkman, S. (2009). Systematic literature reviews in software engineering – A systematic literature review. *Information and Software Technology, 51*(1), 7–15. https://doi.org/10.1016/j.infsof.2008.09.009

Lame, G. (2019). Systematic literature reviews: An introduction. *Proceedings of the Design Society: International Conference on Engineering Design*, *1*(1), 1633–1642. https://doi.org/10.1017/dsi.2019.169

Lekadir, K., Quaglio, G., Garmendia, A. T., & Gallin, C. (2022) *Artificial intelligence in healthcare. Applications, risks, and ethical and societal impacts*. European Parliament. https://doi.org/10.2861/568473

Machac, R., (2022, May 25). *Curriculum template: 8 steps to follow to make an effective curriculum*. Education Advanced. https://educationadvanced.com/resources/blog/curriculum-template-8-steps-to-follow-to-make-an-effective-curriculum/

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