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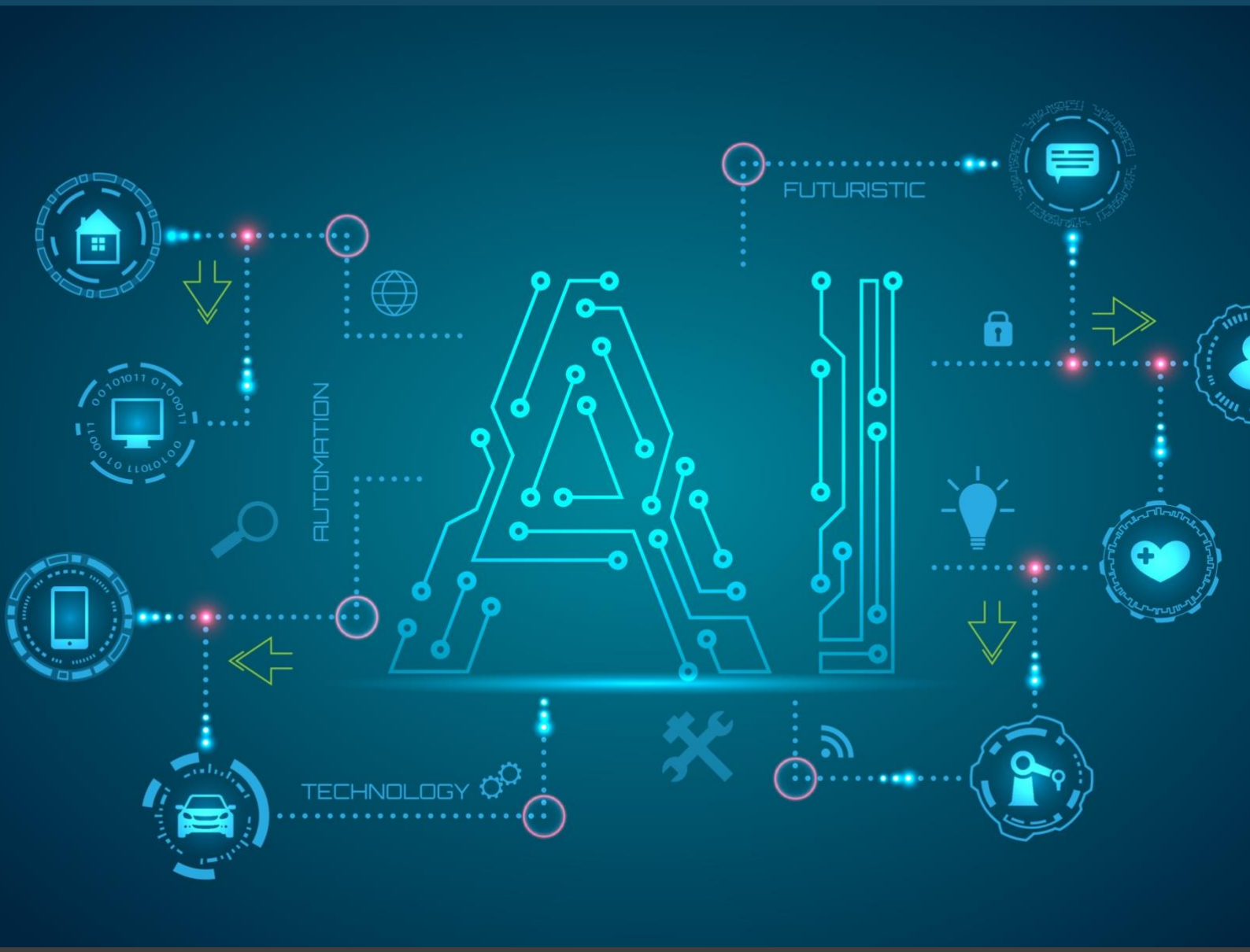

Work package 3

Deliverable 3.7

Policy Brief

This project receives funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060107.

D3.7 Policy brief

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1. INTRODUCTION

Artificial Intelligence (AI) has become a transformative tool across various sectors, with its impact being realized in many industrial domains. In the realm of manufacturing, AI algorithms and equipments have been seamlessly integrated into the production process, which not only amplifies the productivity of assembly lines but also enhances the efficiency and precision. A notable example is robotic arms (such as FANUC's intelligent robots and ABB's YuMi), which have not only achieved unprecedented levels of accuracy but also demonstrate a level of flexibility that was once thought impossible. AI-driven insights are also assisting manufacturers in optimizing their supply chains, designing more efficient engines and condition-based monitoring. Also, predicting consumer trends to ensure the supply process is not only smarter but also more in tune with market demands. In the automotive sector, autopilot or driver-assistance systems powered by AI can now be commonly found in many vehicles, offering features such as automatic emergency braking, lane keeping assistance and adaptive cruise control. AI algorithms analyze the data gathered from various sensors, allowing cars to obtain situation awareness by themselves and make decisions on their own. Across these sectors and many others, AI is not just an added feature but a foundational pillar that is redefining the way industries operate.

The integration of AI into the education sector is also noteworthy. By leveraging AI-driven algorithms and applications, educational institutions and teachers have explored new avenues for making learning more accessible, personalized, and adaptive to learning styles of the individual student. The COVID pandemic has also accelerated the public needs of digital learning and instructional platforms and hastened the development of AI driven solutions for students at different educational levels. The capability of AI to curate content based on individual learning styles, pace, and preferences is revolutionizing how knowledge is constructed and disseminated, and promising a future where learning is more student-centric and evidence-driven. This shift not only optimizes the learning journey for each student but also paves the way for a more innovative and dynamic education industry as a whole.

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However, the introduction of AI is not without challenges, both in the industrial sectors and education domain. Many fear ethical concerns and controversial statements have been overlooked in AI development and deployment. In this analysis, we have reviewed policy documents at the international and national level pertinent to the development and deployment of AI across diverse settings.

This document also delves into discussions surrounding AI applications in various levels of education. A special attention is further placed on the unique challenges and considerations of integrating AI within professional certification education, and maritime education in particular. The findings aim to pave the way for informed research and contribute to the establishment of evidence-based policy decisions.

1.1.Research questions

There are 3 questions guiding this policy analysis:

Research question 1: What is the current status of policies and guidelines established for AI applications?

Research question 2: What are the ethical issues as perceived by different groups surrounding AI applications in various levels of education?

Research question 3: What are some of the necessary features and characteristics of an ethical AI?

With these research questions, we hope to achieve a level of understanding of the present landscape of AI policy development and the associated ethical considerations.

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1.2.Scope, varieties and quantity of reviewed AI policy documents

Recognizing the role individual countries play in guiding the growth and application of AI within their national contexts, our analysis began by examining the policy guidelines and strategic measures officially released by these nations. The OECD's Artificial Intelligence Policy Observatory OECD.AI, (https://oecd.ai/en/) provides a continuously updated and extensive collection of policy initiatives. This includes a repository of 1,615 individual policy documents from a total of 69 countries and the EU.

To further understand the distribution of AI engagement and policy development, we conducted a descriptive statistical analysis using the public data available on this OECD.AI platform. This analysis offers a more systematic insight into AI policy trends, alignments, and potential gaps across the global landscape.

Over the course of our policy analysis, we also scrutinized 35 policy documents originated from the following international organizations and UN agencies:

- European Union (EU): With various directives and research funding schemes, the EU actively leads AI discussions and is driving advancements in artificial intelligence.
- Organisation for Economic Co-operation and Development (OECD): The OECD focuses on global development and economic cooperation and has been active in framing guidelines for trustworthy AI.
- UN: As a global body, the UN addresses the broader implications of AI on global development, peace and security.
- United Nations Educational, Scientific and Cultural Organization (UNESCO): UNCESCO has looked into AI effects on education, culture and science.
- World Bank (WB) and International Monetary Fund (IMF): WB and IMF have relevant documents on AI in the context of global economic trends and development goals.
- World Economic Forum (WEFORUM): WEFORUM provides thought leadership on global economic issues and addresses technological advancements, including AI issues in various sectors.

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- World Intellectual Property Organization (WIPO): WIPO discusses AI impact on ethics and IPR.

These guidelines and polices, originated from different international organizations and individual countries, represent a diverse array of perspectives, strategies and policy directions.
Our intention in casting such a wide net was to gain a holistic understanding of the overarching policy themes at the global level and hope to contrast the directions, concerns and strategies and thereby providing a more nuanced understanding of the AI policy landscape.

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2. National AI policies and strategies

2.1. Statistical analysis of national AI policies and initiatives

The data from OECD.AI underscored the growing significance of AI on the global stage. Whether for economic competitiveness, innovation, or other strategic reasons, nations worldwide are increasingly integrating AI into their national agendas. Table 1 displays the number of AI policies and strategies of 69 countries, highlighting their respective percentages in relation to the global total stored within OECD.AI.

Table 1. Number of AI policies and strategies by country and the EU

Country	Number of AI policy documents	%	Country	Number of AI policy documents	%
Argentina	26	1.6	Latvia	10	.6
Armenia	2	.1	Lithuania	9	.6
Australia	66	4.1	Luxembourg	9	.6
Austria	14	.9	Malta	14	.9
Belgium	44	2.7	Mauritius	2	.1
Brazil	29	1.8	Mexico	12	.7
Bulgaria	6	.4	Morocco	4	.2
Canada	26	1.6	Netherlands	24	1.5
Chile	19	1.2	New Zealand	11	.7
China	26	1.6	Nigeria	2	.1
Colombia	90	5.6	Norway	21	1.3
Costa Rica	9	.6	Peru	11	.7
Croatia	2	.1	Poland	7	.4
Cyprus	3	.2	Portugal	14	.9
Czech Republic	26	1.6	Romania	4	.2
Denmark	26	1.6	Russian Federation	16	1.0
Egypt	20	1.2	Rwanda	10	.6
Estonia	21	1.3	Saudi Arabia	13	.8
European Union	82	5.1	Serbia	43	2.7
Finland	20	1.2	Singapore	38	2.4
France	61	3.8	Slovak Republic	8	.5

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Germany	61	3.8	Slovenia	16	1.0
Greece	5	.3	South Africa	3	.2
Hungary	29	1.8	Spain	41	2.5
Iceland	5	.3	Sweden	14	.9
India	28	1.7	Switzerland	7	.4
Indonesia	2	.1	Thailand	6	.4
Ireland	56	3.5	Tunisia	19	1.2
Israel	9	.6	Türkiye	59	3.7
Italy	13	.8	Uganda	3	.2
Japan	35	2.2	Ukraine	1	.1
Korea	51	3.2	United Arab Emirates	11	.7
Kenya	6	.4	United Kingdom	87	5.4
Kazakhstan	10	.6	United States	116	7.2
Uzbekistan	3	.2	Uruguay	10	.6
Viet Nam	8	.5	**Total**	**1614**	**100.0**

Among these countries, as can be seen in Figure 1, the US stands out with the highest number of AI policies at 116, accounting for 7.2% of the global total, which signals the nation's active engagement in AI development and governance. There are 90 AI policy documents from Colombia and 87 policies from UK. The European Union as an entity has 82 policies or guidelines as of present, accounting for 5.1%. The distribution is diverse, with both developed countries and developing economies showcasing a commitment to AI policies and strategies. This indicates a global recognition of the importance of AI in future development.

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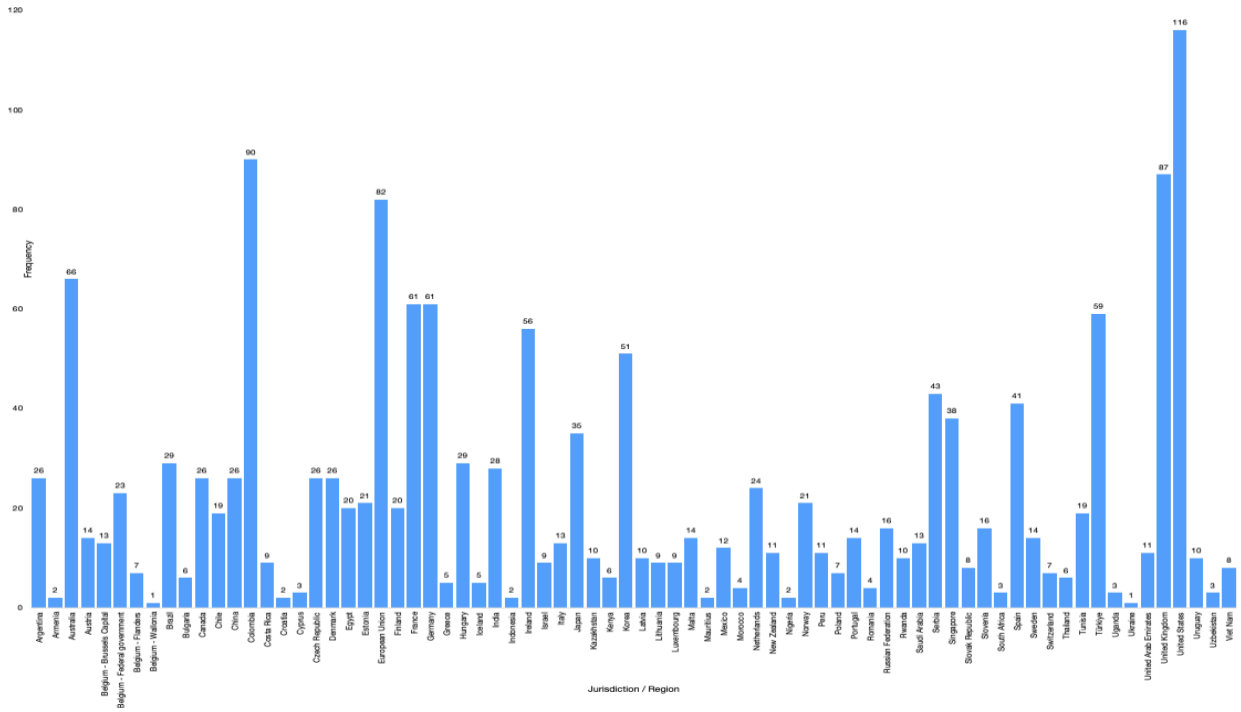

Figure 1. Number of AI policies by country

In an analysis of the themes of AI policies, the emphasis on the role of AI in national frameworks is evident as most of these policy documents pointed out the necessity of formulating policies that prioritize the trustworthiness and human-centric nature of AI, and highlighted mechanisms for AI policy coordination and monitoring. Figure 2 shows the focus areas of the 1614 documents, 268 of them are related to national strategies, plans and agendas. Priority has been placed on having a clear, overarching vision and direction for AI integration into national frameworks. Regulatory considerations are also evident with 201 policy documents towards emerging AI-related regulations and underscores the urgency to frame regulations ensuring the responsible and ethical development and deployment of AI. 141 documents are from public consultations involving stakeholders or experts, and 128 policy documents relate to networking and collaborative platforms. This

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suggests a bottom-up approach in policy formation and an emphasis on gathering diverse perspectives and expertise to shape AI policies.

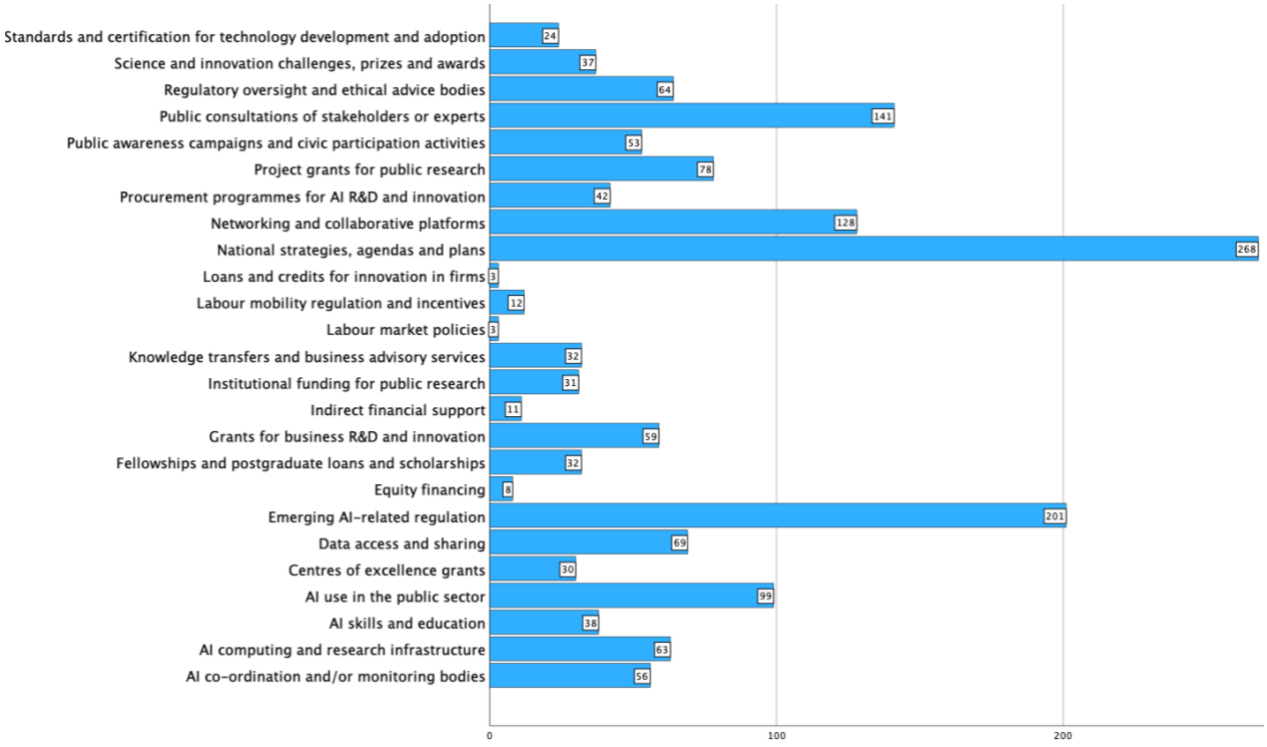

Figure 2: Focus areas of the policy documents

The top 4 jurisdiction or region (i.e., USA, Colombia, UK, and EU) policy objectives are analysed, and keywords are extracted. Figure 3 points out encouraging keywords which spotlights a positive approach by top nations for AI relevant policy development.

As shown in the Figure 3, “technologies” is the term most frequently mentioned in policy documents from the USA. In Colombian documents, “public entities” stands out as a key phrase. In the UK, the AI policies emphasize “data” and “innovation”. Meanwhile, "digital platform" and "data" are the most frequently mentioned keywords in EU-level policies and guidelines.

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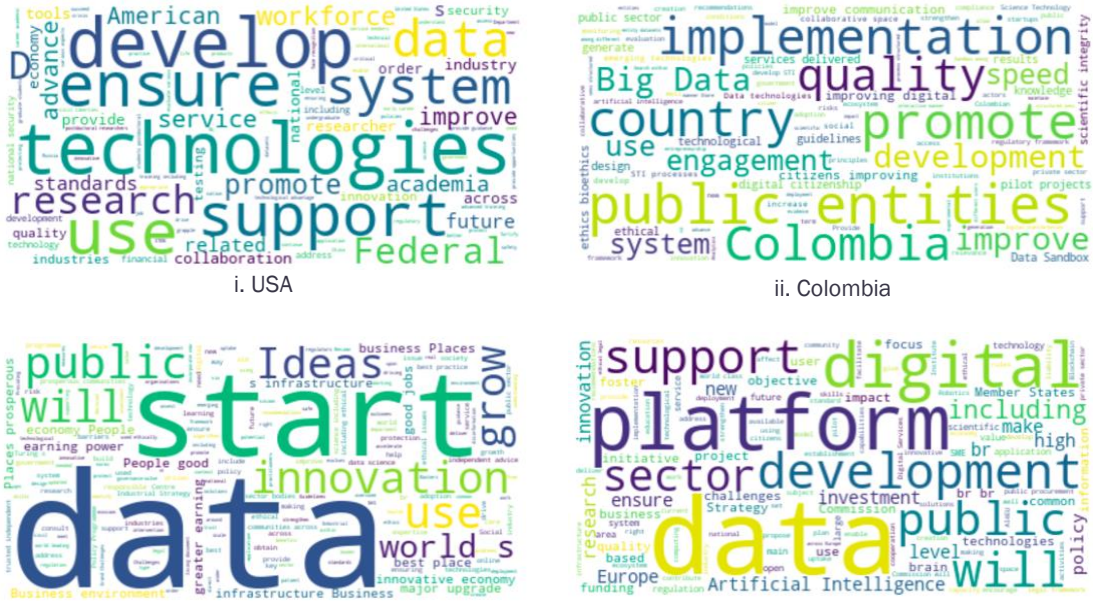

i. USA ii. Colombia

iii. UK iv. EU

Figure 3. Focus areas of the policy or strategies

From the AI policies stated in Table 1, the education sector was also scrutinized under policy scope of listed countries. Figure 4 shows that Ireland has the most policies concerning the education domain among all the countries. UK and Australia along with Serbia followed next in education relevant AI policies.

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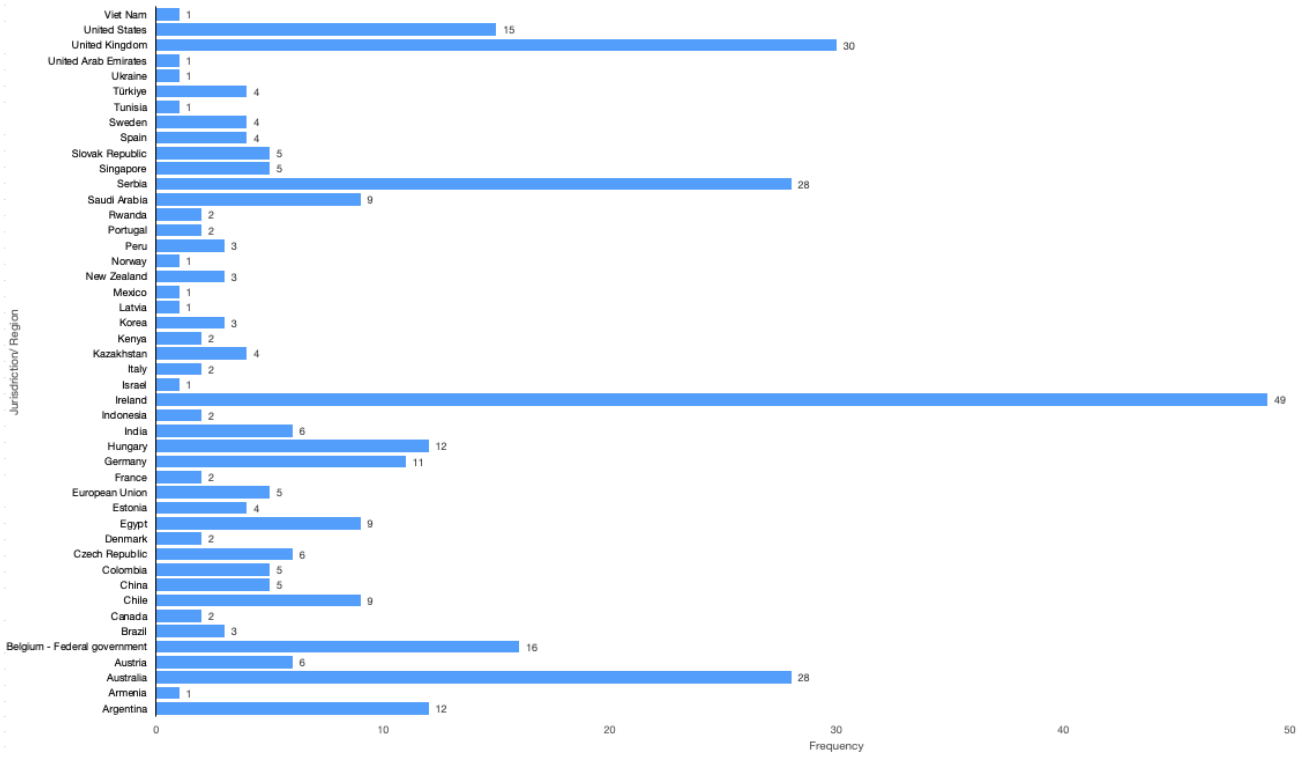

Figure 4. Education relevant AI policies worldwide

The Figure 5 presents a chronology of the global formulation of AI policies from 1969 to 2022. It's evident from the figure that there is an exponential growth in AI policy creation from 2016 onwards, indicating a heightened global interest in AI regulation and governance. The year 2019 stands out prominently, accounting for 24.2% of the total AI policies introduced till 2022. This increase underscores AI emergence as a technological frontier, prompting nations to develop guidelines, regulations, and strategies to navigate its implications.

There is no immediate increase in AI policies following the onset of the COVID-19 pandemic in late 2019 and 2020. The year 2019 had the highest number of AI policies (391 policies),

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followed by a decline in 2020 and 2021 with 344 and 225 policies, respectively. It is not possible to claim that the pandemic has accelerated the development of AI regulations.

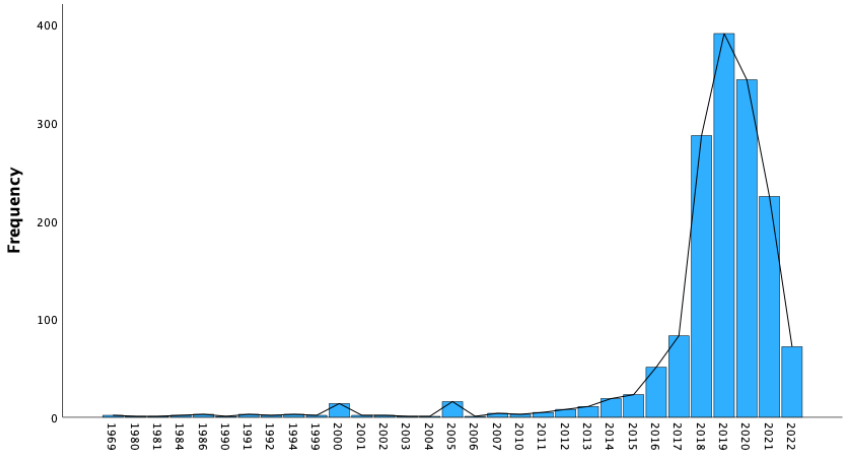

Figure 5. Frequency of AI policy by year

When considering the disclosed budgets, most AI policies seem to operate on modest funds as shown in Figure 6, with the majority 11.4% having less than 1M. however, it is noteworthy that there is a sizeable number of policies with significant financial support, especially the 5.1% with more than 500M, highlighting the importance and priority some entities place on AI development.

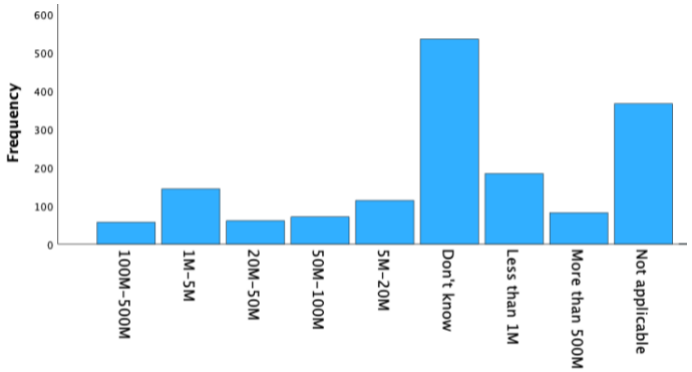

Figure 6. Budget allocations towards AI development

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2.2.Qualitative analysis of national AI policies and initiatives

In the dataset including the 1,614 AI policies from OECD.AI, the “description” and “policy instrument mini-field(s)” offered qualitative insights into the specifics, conditions and narratives of various AI policy documents. From the descriptions, several key observations can be made.

Many nations are prioritizing the development of ethical frameworks for AI. The overall emphasis is on AI governance, with a focus on vertical and horizontal coordination and regular progress evaluations. Although no specific societal challenges are emphasized in many of these policy documents, there are indications towards addressing health, aging populations, inclusiveness, and environmental sustainability.

Some policies focused on capital and co-investment funds as mechanisms for fostering AI development. Financial mechanisms play a significant role in these policies. Various grant opportunities exist, with amounts ranging from less than 100K euros to more than 1M euros. The duration of these grants varies, but many are designed to support medium-term projects (e.g., 13 to 36 months). The grants often require beneficiaries to contribute matching funds and may necessitate collaboration with international partners, higher education institutes, public research entities or industrial partners. The share of funding coming from the private sector varies widely and could be from 0% to more than 75%. Selection criteria for grants are multifaceted, encompassing the track record of the applicants, feasibility of the project, alignment with national strategic priorities, perceived societal and commercial impact and specific regional considerations. The types of activities funded under these grants range from basic research to applied research and experimental development.

Based on the qualitative analysis, we can observe a consistent push towards international collaboration, as seen in several policies emphasizing building international linkages, coordinating AI developments, and sharing national data. Exchanges primarily occur through meetings, events, and online platforms, leaning towards technology and research-oriented objectives. Intellectual property (IP) considerations are also notable, with some

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initiatives leading to shared IP rights between public and private sectors, while others have exclusive IP ownership for private entities.

In the context of regulatory measures, it is clear from these 1614 AI policies that there is a move towards technology-based regulations, with the government playing the role of safeguarding public values and societal interests. This seems to be involving a blend of formal regulation and enforcement of self-regulation through goal-oriented approach, codes of conduct or guidelines. Stakeholder engagement is often promoted, with many mechanisms such as expert groups, committees, participatory workshops, and seminars facilitating inputs at various policy stages. The size of these engagement activities varies significantly, with numbers ranging from less than 25 to up to 500. Stakeholders contribute to different phases such as problem definition, policy objective formulation, policy design and policy evaluation. Furthermore, infrastructure support and promoting access to AI enabling resources also appeared as recurring themes in these policy documents, aiming to foster greater science-industry collaborations and ensure an effective AI ecosystem. It is also evident from the dataset that countries are continuously updating their AI policies.

In summary, the analysis of the 1614 documents revealed a balanced approach with stakeholder engagement, funding, collaborative research, and IP management central to the policies and strategies. There is a clear emphasis on promoting innovation, ensuring responsible AI development, and advancing socio-economic benefits through these AI policies.

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3. International AI policies and strategies

Analyzing international AI policies provides a lens into the varied and converging approaches towards governing, integrating and optimizing the use of AI across various domains. The list of international AI-related policies and strategies analyzed are detailed in the table 2.

Table 2. List of AI-related policies or guidelines at international level

No.	Name of the document	Year	Published by
1	The Impact of Artificial Intelligence on Learning, Teaching, and Education	2018	European Union
2	Ethics guidelines for trustworthy AI	2019	European Commission
3	A definition of AI: Main capabilities and disciplines	2019	European Commission
4	Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators	2022	European Commission
5	EU guidelines on ethics in artificial intelligence: context and implementation	2019	European Parliament
6	United Nations activities on Artificial Intelligence (AI)	2022	ITU
7	AI and the future of skills, Volume 1, capabilities and assessments	2021	OECD
8	The 2023 EC-OECD science, technology and innovation policy (STIP) survey	2023	OECD
9	OECD science, technology and industry policy papers	2019	OECD
10	Policies for the digital transformation of school education: proposed analytical framework and methodology	2023	OECD

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11	Policies for a future-ready teaching profession in the digital age (declassified)	2023	OECD
12	Resource guide on artificial intelligence strategies	2021	UN
13	AI and education Guidance for policymakers	2021	UNESCO
14	Beijing consensus on artificial intelligence and education	2019	UNESCO
15	Recommendation on the ethics of artificial intelligence	2022	UNESCO
16	ChatGPT and artificial intelligence in higher education	2022	UNESCO
17	Reporting on artificial intelligence	x	UNESCO
18	Ethical principles for the development of artificial intelligence based on the diversity of cultural expressions	x	UNESCO
19	Adopting AI responsibility: guidelines for procurements of AI solutions by the private sector	2023	World Economic Forum
20	AI procurement in a box: AI Government procurement guidelines	2020	World Economic Forum
21	Artificial intelligence for children	2022	World Economic Forum
22	Feeling safe in the home of the future: A product life-cycle approach to improve the trustworthiness of smart home products and services	2020	World Economic Forum
23	Chatbots RESET framework Rwanda artificial intelligence (AI) triage pilot	2022	World Economic Forum
24	Chatbots RESET framework pilot projects: using chatbots in healthcare	2021	World Economic Forum
25	Designing artificial intelligence technologies for older adults	2021	World Economic Forum

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26	Earning digital trust: decision-making for trustworthy technologies	2022	World Economic Forum
27	Empowering AI leadership: AI C-suite toolkit	2022	World Economic Forum
28	Future series: Cybersecurity, emerging technology, and systemic risk	2020	World Economic Forum
29	Global technology governance report 2021	2020	World Economic Forum
30	Chatbot RESET: A framework for governing responsible use of conversational AI in healthcare	2020	World Economic Forum
31	Human-centered artificial intelligence for human resources: a Toolkit for human resources professionals	2021	World Economic Forum
32	Shaping the future of the internet of bodies: new challenges of technology governance	2021	World Economic Forum
33	The AI governance journey: development and opportunities	2021	World Economic Forum
34	A policy framework for responsible limits on facial recognition	2022	World Economic Forum, UNICRI, INTERPOL and Netherlands Police
35	Forging new pathways: the next evolution of innovation in financial services	2022	World Economic Forum, UNICRI, INTERPOL and Netherlands Police

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3.1. EU-level AI guidelines

In 2018, the Joint Research Centre (JRC) published a report on the influence of AI on education, highlighting the potential impact on cognitive development and stressing the need for a forward-thinking approach (Tuomi, 2018). This report analyzed the systemic impact of AI, policy challenges related to AI awareness and ethics, and noted the necessity to re-think the role and objective of education in the society.

For the purpose of the AI ethics guidelines, the definition of AI was updated by the high-level expert group (HLEG) on AI, set up by the European Commission, as *"Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analysing how the environment is affected by their previous actions. As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems)."* (European Commission, 2019a, p. 6).

This updated definition provided a comprehensive view of what constitutes AI systems. It is academically sound. The effectiveness of it will certainly be determined by how this can be operationalized in policies and guidelines.

In the same year, HLEG has also presented a document on "Ethics guidelines for trustworthy AI" and requested that the AI should be lawful, ethical and robust and put forward 7 requirements to assess if the AI system is trustworthy (European Commission, 2019b). Central to this requirement is the human agency and oversights. The guidelines

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from HLEG noted that AI should not diminish human autonomy but rather should augment human capabilities. Technological robustness and privacy are also required, as AI should be capable of solving complex tasks with reliability and should not misuse sensitive information. The decision-making processes and datasets should be clear and understandable, ensuring transparency and have mechanisms to hold developers and users accountable for outcomes.

The guidelines introduced at the EU-level emphasized on key ethical principles in AI design and deployment, but the challenges lie in how these principles can be translated into vast and varied applications and in designing enforcement mechanisms for non-compliance.

3.2. OECD

The OECD has multiple documents focusing on science, technology, and innovation policy, as well as the effects of AI on education. In their 2021 study "AI and the future of skills, Volume 1, capabilities and assessments" (OECD, 2021), pointed out that there are critical differences between human intelligence and AI. The document also indicated that it is premature to think that AI has reached or surpassed human intelligence. While AI could excel in certain tasks, the general intelligence is still a work in progress. They also discussed that it is challenging to compare AI capabilities and advancement accurately. Given the rapid advancements in the AI field, standardized assessments could be a measure to ensure that there is a baseline of understanding of AI capabilities, which could facilitate better AI performance evaluation and smoother interoperability between different AI systems.

The document on "policies for the digital transformation of school education: State of play and key policy responses" (OECD, 2023) has offered a comprehensive exploration of digital education from strategic vision to policy responses and evaluation with examples from various OECD countries. This policy document stressed that it is important to have a coherent and coordinated digital education strategy and ensure its alignment with the

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wider policy ecosystem. Many OECD countries are updating their curricula to ensure students develop digital and data literacy skills. These changes include either creating new subjects dedicated to these skills or embedding them within existing curricula. Digital platform selection and interoperability is a concern, and the government plays an important role in this digital transformation and implementation process.

3.3. UNESCO

UNESCO, a specialized agency of the UN for education, has projected that the value of AI in education will reach 6 million dollars by 2024 (UNESCO, 2021). In the document "AI and education: guidance for policy-makers", UNESCO has noted that there are many diverse cross national and regional policies regarding AI and education which can be broadly categorized into three different approaches: independent, integrated or thematic. The independent approach means crafting dedicated policies specifically for AI. The integrate approach merges AI considerations into pre-existing policies or existing educational initiatives. The thematic approach does not focus on a particular facet of AI but on the overall ICT, data law or digital framework. Different countries utilize different or combined approaches to address AI issues in their education system.

The "Beijing consensus on artificial intelligence and education" from UNESCO (2019) provided recommendations for governments and stakeholders about how to address challenges and opportunities presented by AI in education. It emphasized the importance of ensuring that AI in education is inclusive, equitable and focused on lifelong learning, also considering ethical, financial and societal factors.

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3.4. World Economic Forum (WEF)

The World Economic Forum (WEF) has a multifaceted approach to AI guidance through a wide array of AI documents. Guidline such as "AI procurement in a box: AI Government procurement guidelines" provided key variables to consider in a risk assessment and guidance for government to follow when investing in AI technologies. On the other hand, sector-specific documents such as "Chatbot RESET: A framework for governing responsible use of conversational AI in healthcare" underline the commitment to ensure that AI technologies such as chatbots, are implemented responsibly in critical sectors like healthcare.

3.5. UN

The International Telecommunication Union (ITU) reported the "United Nations Activities on Artificial Intelligence (AI)" in 2022 (ITU, 2022), which introduced the activities at various agencies of the UN and also the diverse projects on how UN is leveraging the potential of AI to address global challenges and SDGs. According to the report (ITU, 2022), a major emphasis has been on SDG 3, 9, 10, 16, and 17. SDG 16, peace, justice, and strong institutions, has seen a surge in focus. However, more attention is needed towards other SDGs 6, 7, 12, 14, and 15. Collaboration remains central to the UN's approach, with 40% of projects working with UN entities and 25% with academia and government (ITU, 2022). The AI for Good platform, https://aiforgood.itu.int backed by ITU and multiple UN agencies, has achieved over 260,000 online views and engages with over 180 countries (ITU, 2022).

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4. Critical analysis of national and international AI policies and strategies

We reviewed the status of AI policy development at both national and international levels. Nationally, policies vary significantly and the approaches adopted could be independent, integrated or thematic. Some countries prioritize setting AI rules to manage potential risks, while others lean towards fostering innovation and market growth with more high-level guidelines and R&D investments. There is a notable emphasis on including a wider range of voices in the policy-making process. To ensure policies are grounded and practical, contributions from technology developers, end users, and the public were deemed essential.

At the international level, organizations such as the UN, UNESCO and OECD face the challenge of crafting AI guidelines that cater to a vast range of countries, each with its distinct set of challenges. A recurrent theme is the challenge to create policies that are universally applicable yet flexible enough to be adapted to specific regional contexts and application areas (e.g., healthcare, education).

To guide AI development ethically, transparently and responsibly seems to be a global ambition, but the practicalities of policy-making are intricate and demand systemic approach and renewed collaboration among the stakeholders through research and continuous monitoring.

For the field of education, the opportunities and benefits of AI are widely acknowledged in national and international AI policies. AI has the potential to be a transformative force in numerous ways, reshaping traditional pedagogies and fostering more personalized learning experiences. Concerns about data privacy, ethics, personal information, the potential for reinforcing biases, and over-reliance on technology have been highlighted. As educators and institutions embrace AI, there is a pressing need to do so carefully, ensuring that technology enhances, rather than replaces the human elements of teaching and learning.

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4.1. AI in professional education

In the specific domain of vocational education, AI platforms and learning systems have good potentials to enable more dynamic adaptive skill development experiences. For instance, simulation tools augmented by AI could allow the practitioners or professionals in fields like aviation, maritime, medicine, engineering, or finance to engage in realistic scenarios and develop their skills and judgment in risk-free environments. This form of experiential learning ensures that professionals can apply theoretical knowledge practically.

The use of AI-driven analytics in assessing performance status, knowing the skill gaps, and then develop personalized training modules to address those specific gaps could also be a significant improvement for professional education. This ensures that learning trajectory is transparent and promotes a more effective and inclusive learning experience.

However, in professions where quick and accurate decision making, judgment, ethics, and interpersonal skills are important, over-reliance on AI tools rather than long-developed human skills (e.g., seamanship) can risk skill degradation and overshadow the importance of human intuition and empathy. There is also a potential danger of becoming overly reliant on AI tools and not developing critical thinking or problem-solving skills.

4.2. AI in maritime education

The field of maritime education has historically played a crucial role in training maritime professionals with the necessary maritime skills and competencies. This is aimed to ensure seafarers are prepared to navigate the challenges of the marine environment, maintain vessel operations, and promote safe and sustainable maritime activities. With the rapid advancements in ship technology and global trade dynamics, continuous evolution in the maritime education and training sector also becomes important to keep pace with the new demands of the industry.

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Traditionally, maritime education relied heavily on instructor-led, experience-based training methods, often tied to physical simulators and on-board experiences. The increasing adoption of AI learning systems and automation in maritime operations has opened many new possibilities that could enable digitalized national performance assessments and real-time performance feedback which could give more insights into the individual learning progress.

Recognizing this potential, the i-MASTER project is designed to conduct research about how to integrate AI and ML algorithms into the maritime simulation process, creating a learning environment that continually adapts to individual learners' needs.

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5. Research questions

5.1. What is the current status of policies and guidelines established for AI applications?

The previous sections have reviewed different policies and guidelines established for AI applications. As of present, there are various national and international bodies have taken steps to establish policies and guidelines for AI applications. At the international level, organizations such as the UN, European Commission, OECD, UNESCO, and the World Economic Forum have released guidelines or recommendations emphasizing ethical and trustworthy AI. Nationally, many countries have formulated AI policies and strategies that encompass regulatory frameworks, ethical considerations, and directions for development and deployment. These policies generally focus on transparency, fairness, accountability, privacy, and safety. However, these documents are still at a high level and application-specific AI polices are rare. The maturity, depth, and coverage of these policies varies significantly across regions and organizations.

5.2. What are the ethical issues as perceived by different groups surrounding AI applications in various levels of education?

Ethical issues related to AI in education seem to be multifaceted, and perceptions vary among stakeholders e.g., educators, students, educational institution, and policymakers. There are several commonly raised issues.

Data privacy and security

The predictive function of AI often needs collecting and analysing vast amounts of student data and previous school records, leading to concerns about personal data protection and potential misuse of background data.

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Equity and access

There are also fears that AI could worsen the existing educational inequalities for some groups of students, as students who do not have access to advanced technologies could be left behind.

Transparency issue of AI-decision making

The AI decision making process could be perceived as a "blackbox" as it could be difficult to understand the internal working process of some deep learning models. The complexity of the data and the parameters involved is often beyond human's capability to calculate and comprehend in a linear and logical way. This raises questions about how decisions are made, particularly in the field where explainability demand is high, for example on how a decision is made in student performance assessment, adaptive learning or automated grading systems.

Bias and fairness

AI models, if trained on biased data, could also reinforce existing prejudices, which could lead to unfair or skewed educational outcomes. The accuracy of data input is difficult to control and review.

Over-reliance on AI

Some educators and educational institutions are concerned about overemphasis of AI tools in educational processes as it could diminish the value of educational institutions, human interaction and critical thinking in learning environments.

5.3. What are some of the necessary features and characteristics of an ethical AI?

Many international policies set the goals for ethical AI. Although these documents are framed in different ways, they have some common features and characteristics that a good AI system should possess.

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The first is transparency: AI systems should be clear and understandable. Even if the intricate details of a model can be complex, its high-level decision-making process should be explainable to its users.

The second feature is fairness. The system should operate without biases to human development, ensuring that outcomes do not favor or disadvantage any group unfairly.
In cases where the AI system inflicts actual harm, there should be mechanisms to hold the developers or operators accountable. Hence, accountability should also be a feature of AI systems.

Furthermore, as data privacy is often a concern for AI usage, data safety and privacy preserving are also an important consideration of ethical AI. The AI system should function predictably without privacy concerns.

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6. I-MASTER-SPECIFIC POLICY RELEVANCE

The initial twelve months of the i-MASTER project have progressed according to plan and achieved several research milestones. The project commenced with the development of the i-MASTER conceptual framework that laid the groundwork for the project, outlining the methodologies for integrating AI and ML technologies into maritime simulator-based training, which served as a fundamental step that set the direction for subsequent stages of the project. To ensure the effectiveness of the learning analytics, a detailed analysis of user and system requirements was also performed. The perception towards AI integration in the maritime training process was evaluated and end user feedback was captured for further development. Through validation effort, the project team also assessed the concept alignment with educational standards, pedagogical principles, and requirements, making necessary adjustments to refine the architecture. This progress made in the first year serves as a solid foundation for the project, indicating the direction and offering the potential to continue achieving its objectives in subsequent stages.

By leveraging AI in maritime education, the i-MASTER project could offer many benefits for the stakeholders in the maritime education sector. Through adaptive learning, the i-MASTER system tailors the learning experience to individual student needs, maximizing learning outcomes and efficiency. Students do not have to rely solely on their instructors but are also able to independently access resources, engage in self-paced learning, receive personalized feedback, and engage in interactive learning remotely. By providing personalized feedback and enabling real-time performance assessment, the system raises the quality of the training and learning experience. Instructors can monitor student progress, identify areas for improvement, and adapt their teaching methods accordingly. The data-driven approach enables instructors to identify patterns, trends, and areas of improvement, allowing them to implement pedagogical strategies that align with student needs.

The integration of AI technologies in maritime education and training goes beyond individual learning experiences. It has the power to catalyse a transformative shift within

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the maritime industry. By embracing these technologies, the sector can drive education innovation and enhance operational efficiency together with competitive advantage. Personalized learning, real-time performance assessment, and scenario-based training simulations tailored to individual student needs can foster a highly skilled maritime workforce capable of effectively navigating the complexities of their roles. Moreover, by setting new standards in maritime education, the integration of AI can also cultivate a culture of continuous learning and innovation to address the future skill demands.

The journey towards the integration of AI into maritime education and training is not without challenges. One of the key barriers is the resistance to change. Maritime is often perceived as a conservative industry where new changes are not promptly adopted in the business process. Many educators and trainers may feel threatened by the prospect of AI and ML, perceiving them as replacements rather than tools to enhance their teaching efficacy.

Another challenge is the lack of AI technical proficiency and understanding. The successful implementation of AI and ML technologies necessitates a certain level of technical understanding, which many stakeholders currently lack, and further development effort is needed.

Additionally, ethical considerations surrounding AI usage, including potential bias in AI algorithms, data privacy and consent, also need to be thoroughly addressed. It is crucial to ensure that the use of these technologies aligns with ethical guidelines and respects individual rights.

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7. RECOMMENDATIONS

As we consider the future of maritime education and training, it is apparent that the integration of AI will be instrumental in preparing maritime professionals for the digital future. Accordingly, we offer the following policy recommendations:

Foster a culture of digital literacy within the maritime sector

This should be the initial step towards the wider adoption of AI in maritime education and training. Initiatives should be launched at various levels, including individual institutions, national education systems, and transnational bodies to educate stakeholders about these technologies and their potential benefits. Specific emphasis should be placed on resolving the misconceptions about AI and ML and addressing fears regarding their implementation. Stakeholders should be encouraged to view these technologies as tools to enhance their teaching efficacy and improve learning outcomes, rather than as threats or replacements.

Strengthen the technological infrastructure and availability to education

The integration of AI and ML into maritime education and training necessitates technological infrastructure. This includes not only the physical hardware, such as simulators and servers, but also software and networks that can handle the complex computations involved in AI and ML processes. Consideration should also be given to the security of these systems to ensure that they are resistant to potential cyber threats. Widening the infrastructure availability for education institutions, in line with data security and data privacy guidelines is challenging, thus requiring collaborative efforts from governments, educational institutions and industry stakeholders.

Advocate for increased investment in AI and ML in maritime education and training

It is essential to advocate for increased investment in AI and ML technologies and highlight the long-term benefits of these technologies for learning effectiveness and maritime safety. Furthermore, emphasize the importance of aligning these investments with the broader digital transformation strategy of the maritime sector.

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Develop specific ethical guidelines for the use of AI and ML in maritime education and training

As we integrate AI and ML technologies into maritime education and training, we must ensure that this is done in an ethical and transparent manner. These guidelines should address issues such as data privacy, consent, potential bias in AI algorithms, and the use of AI in assessment procedures. It is crucial that the rights of individuals are respected and that the use of AI and ML in education follows individual consent.

Promote interdisciplinary collaboration

AI is an interdisciplinary field and fosters collaboration among educators and instructors from the maritime sector, AI and ML specialists, policymakers, and industry representatives are essential. We need to stress the significance of interdisciplinary collaboration to ensure that the integration of AI meets the needs and standards of the maritime industry, while leveraging the latest advancements in AI technologies.

Support continuous professional development

Emphasis should also be placed on providing educators and trainers with the necessary support to adapt to the evolving educational landscape. The need for professional development and training in the use of AI and ML in education cannot be overlooked. Educational institutions should stress the benefits of sustained support during the implementation process, enabling instructors to feel comfortable and confident in utilizing these technologies. Ultimately, this support will enhance the learning experience for maritime professionals.

Encourage further research and innovation

As we move forward, it is also crucial to continuously explore and harness the potential of AI in maritime education and training process. This includes continuously advance research to further understand the benefits and challenges of different ML models, as well as the development of innovative applications that can further increase the efficiency in the maritime education and training. It is important that we remain responsive and adaptable to the evolving landscape of the maritime industry, ensuring that maritime

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education and training continues to meet the needs of maritime professionals in the digital age.

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8. CONCLUSION

In conclusion, this deliverable reviewed AI policies at both national and international levels and discussed the relevance and impact of AI across various sectors, with an emphasis on its application in education. At a national level, we observed diverse policies and initiatives, as elaborated through both statistical and qualitative lenses. At the international level, entities such as the EU, OECD, UNESCO, WEF, and the UN have initiated guidelines and frameworks and set the high-level target for AI development and deployment. A critical analysis revealed the transformative potential of AI in many education segments, including general, professional, and maritime education.

The i-MASTER project, with its specific focus on integration of AI in maritime education and training holds promise to harness the power of these new technologies to enhance learning outcomes and increase training efficiency in the maritime sector. The recommended strategies include fostering digital literacy, strengthening infrastructure, advocating for investment, developing ethical guidelines, promoting interdisciplinary collaboration, supporting professional development, and encouraging research and innovation, provide a roadmap for the wider adoption of AI and ML technologies. By embracing these recommendations, we hope the maritime education and training sector can effectively prepare the workforce for the digital future and position itself at the forefront of the global maritime industry.

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