Dimension 4: Citizens **interacting with AI systems** in a confident, critical and responsible way for learning, at work, and for participation in society

Focus: interacting with AI systems

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Dimension 4: Statement of knowledge, skill and attitude	
1.1 Browsing, searching and filtering data, information and digital content To articulate information needs; to create and update personal search strategies; to search for data, information and content in digital environments; to access and navigate between data, information and content.	**1** Data and information literacy
KNOWLEDGE 1. Aware that AI algorithms are used in search engines (e.g. Bing), social media (e.g. Instagram) and content platforms (e.g. Netflix) to generate responses that satisfy the user (an approach often called “personalisation”). The algorithms then adapt to what the user subsequently chooses/clicks. SKILLS 2. Can formulate an effective search query appropriate for a virtual assistant or smart speaker (e.g. Siri, Alexa, Cortana, Google assistant) to maximise the chance of being shown the user's desired information or content. ATTITUDES 3. Develops a responsible attitude as part of one’s personal search strategies in order to take advantage of how AI algorithms work (e.g. helping users find the desired information) and to avoid negative outcomes (e.g. compromising privacy and personal data, or the impact of commercial interests).	
1.2 Evaluating data, information and digital content To analyse, interpret and critically evaluate data, information and digital content.	
KNOWLEDGE 4. Aware that so-called “personalised” results (e.g. from search engines, social media, content platforms) are based on patterns and averages of interactions of millions of other users, and while appropriate for groups of users, can sometimes be unsuitable for individual users.	

5. Aware that AI-driven decision making (e.g. deciding what search results are displayed) can be opaque or unintelligible for humans, including the developers of the AI algorithms. This is often referred to as “black box” decision making.
6. Aware that the data, on which AI depends, may include biases that are embedded in the models that the AI algorithms build, such that those biases can be automated and exacerbated by the use of AI.

SKILLS

7. Is able to recognise “echo chambers” or “filter bubbles” in digital environments in which information reinforces one’s existing views without exposing them to opposing arguments (e.g. if a usual selection of social media posts favours a particular political ideology, additional recommended content can reinforce that ideology). Critically considers the resulting implications for one’s opinions, and political and social views.

ATTITUDES

8. Considers carefully the top/first search results (e.g. in content recommendations), as they are not necessarily the most appropriate results for the user's query but are generated by AI algorithms, have limitations and can reflect commercial interests.

1.3 Managing data, information and digital content

Organising, storing, and processing (analysing) data, and retrieving and applying the results of the analysis to new data.

KNOWLEDGE

9. Aware that AI-driven sensors (e.g. from wearable technologies, facial tracking, smart-city environments) and digital technologies (e.g. apps, software, digital advertisements, smart devices) collect large amounts of personal and other data.
10. Aware that the data collected includes text, images, sounds, mouse clicks and online behaviours which are digitally encoded (i.e. converted or "digitalised" to numerical data) so that they can be processed.
11. Aware that AI systems use statistics and algorithms to process (analyse) the data.
12. Aware that the results of the data processing are stored in "user profiles" and are used to recognise patterns (e.g. repetitions, shapes) in new data (i.e. other images, sounds, mouse clicks and online behaviours), as well as to predict future behaviours and to optimise and personalise online services (e.g. advertisements).
13. Understands that AI-driven Internet of Things (IoT) devices, no matter how small, may have the capacity to run AI algorithms, either locally or remotely.

SKILLS

14. Is able to modify user configurations (e.g. in apps, software, digital platforms) to enable or prevent the AI system tracking, collecting or analysing data (e.g. not allowing the mobile phone to track the user's location). ATTITUDES 15. Takes a critical attitude (i.e. identifies both the positive and negative implications) to the use (collection, encoding and processing) of all data, especially personal data, by AI-driven digital technologies.	
2.1 Interacting through digital technologies To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.	**2** Communication and collaboration
KNOWLEDGE 16. Aware that AI systems are being developed with the aim of providing human-like interaction with machines, e.g. conversational agents such as customer service chatbots. 17. Aware that AI systems learn from a user's interaction with online content (e.g. comments, tags, user ratings, mouse movements and clicks) but sometimes not reacting with the content can also be taken as a signal. SKILLS 18. Knows how to identify signs that indicate whether one is communicating with a human or an AI-based conversational agent when, for example, using a text based chat. 19. Knows how to adjust one's speech when interacting with AI-based conversational agents, in order to address the weaknesses of the AI, while still engaging successfully. 20. Can give appropriate comments or ratings to online content (e.g. advertisements, music or movie recommendations, social media posts) in order to attempt to influence what the AI system next recommends. ATTITUDES 21. Expects AI systems to empower human beings and support them to make informed decisions in accordance with their goals, not vice versa (e.g. a user actively decides whether to act upon a recommendation or not).	

2.2 Sharing through digital technologies

To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices.

KNOWLEDGE

22. Aware that everything that one shares publicly online (e.g. images, text or sounds), can be used to train AI systems. For example, to train facial recognition software commercial companies can use personal images shared online (e.g. family photographs).

ATTITUDES

23. Critically considers whether to add personal data (e.g. names) to online photographs of people as this can help AI facial recognition systems to improve their capability to automatically name that person in other images, which might not be desirable (e.g. breach of privacy).er images and so possibly contributing to commercial or law enforcement interests).

2.3 Engaging in citizenship through digital technologies

To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies.

KNOWLEDGE

24. Knows that AI is neither good nor bad in itself, but in terms of how it is used, by whom and for what purposes.
25. Knows that all EU citizens have the right not to be subject to fully automated decision making (i.e. a system that is autonomously taking a decision about them)[1].
26. Aware that even though the EU is striving to ensure that AI systems are trustworthy, not all AI systems are trustworthy, and not all AI systems developed in the world are regulated by the EU laws.
27. Recognises that all AI systems can have benefits and risks to society and citizenship which is why the EU considers to restrict its use in some cases. For example, whereas the use of surveillance through face recognition in publicly accessible spaces could help law enforcement to apprehend a dangerous criminal, such a system would also impact on fundamental human rights.

SKILLS

28. Identifies areas where AI can bring benefits and risks to various aspects of everyday life. E.g. in healthcare, AI might contribute to early diagnosis and in agriculture, it might better detect pest infestations. Critically considers risks (e.g. AI systems supporting surveillance of citizens, deny their access to civil rights and lead to biased outcomes).

29. Is able to contribute to the improvement of AI systems by reporting errors, risks, biases or misconceptions in the results that the algorithms provide or in original datasets made available (e.g. for machine-learning).

ATTITUDES

30. Is vigilant that proper oversight mechanisms are ensured in AI systems. E.g. in some contexts (e.g. sentencing criminals, job applications) AI recommendations should not be used without human intervention (e.g. such as human-in-the-loop, human-on-the-loop, and human-in-command)[1]
31. Willing to collaborate with AI projects for social good (e.g. design, evaluation, oversight, quality control) by sharing data so long as appropriate and robust controls are in place.
32. Considers taking part in citizen-led collective actions (e.g. through civic participation channels, opinion campaigns, voting, activism and advocacy) to oversight and push changes in AI services and products (e.g. business models, developments).

2.4 Collaborating through digital technologies

To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.

KNOWLEDGE

33. Aware that AI-based technologies, as well as virtual and augmented reality tools, can be used to support training humans to carry out tasks (e.g. at work, doing sports, in education)
34. Aware that AI-based technologies can also be used to replace human functions (e.g. customer service), which might lead to some job losses or reallocations.

ATTITUDES

35. Weighs the benefits of adopting the use of AI systems to improve the quality of human interaction, communication and collaboration (e.g. use AI generated replies to emails) with the risks (e.g. the dehumanisation of interactions).

2.5 Netiquette

To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.

KNOWLEDGE

36. Aware that AI is used to detect moods, sentiments and emotions automatically from one's online content and context, but that this application is not always accurate and can be controversial.

[1] Ethics guidelines, explained in the Glossary

37. Aware that AI systems are typically developed in English-speaking contexts which means that they might work less accurately in non-English contexts. For example, AI-based automatic translation systems work better with often used languages (e.g. English to Spanish) than less used ones (e.g. English to Finnish).
38. Recognises that AI engineers are typically from narrow demographic backgrounds (e.g. white males from higher-socio economic groups in higher-income countries) which can mean that the systems they develop are less sensitive to the needs of women, people from different ethnic minority groups, lower socio-economic groups, people who have disabilities, or citizens from lower-income countries.

ATTITUDES

39. Approaches pragmatically the results provided by AI systems, as their models are based on data scraped from the Internet. This can lead data to inherit the biases present on the Internet, for example, the words “men” and “doctor” or “women” and “nurse” often appear closer to each other than “women” and “doctor” or “men” and “nurse”.

2.6 Managing digital identity

To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services.

KNOWLEDGE

40. Aware that AI systems can collect and process various types of data related to users (e.g. personal, behavioural and contextual) for the purpose of creating user profiles and profiling users.
41. Aware that personal tracking identifiers related to one’s digital identity can be exchanged across IoT, mobile devices and digital environments and exploited by AI systems

SKILLS

42. Can use available tools or systems to control, manage or delete the data that is collected/curated by online systems for exploitation by AI systems
43. Can manage the exchange of data (e.g. user profile) between different devices (e.g. mobile phone and smart household devices) to take advantage of services based on AI (e.g. use voice assistant to give orders to a robot vacuum cleaner), while considering the possible risks of sharing such data.

ATTITUDES

44. Takes a critical attitude (i.e. considers the benefits and risks) when managing one or multiple digital identities across digital systems, apps and services that use AI to adjust for an individual's behaviour. 45. Has a disposition to learn and stay informed (e.g. by reading reviews and the documentation) about particular AI technologies.	
3.1 Developing digital content To create and edit digital content in different formats, to express oneself through digital means.	**3** Digital Content creation
KNOWLEDGE 46. Knows that AI can be used to automatically create content (e.g. texts, news, essays, tweets, music, images) that may be difficult to distinguish from human creations. 47. Knows that AI can be used to automatically create videos, known as deep-fakes, of events or persons that did not really happen (e.g. speeches by politicians, or celebrity faces on pornographic imagery) that are impossible to distinguish from real footage. 48. Aware that in journalism and news media, AI systems can be used for the whole production chain from automatic production and authoring of text to distribution of news based on users' online behaviour[1] 49. Aware that AI-developed digital content (images, music, texts) use existing (and sometimes copyrighted) images, music and texts as its source. SKILLS 50. Knows how to choose and use AI-powered applications to create new digital content (e.g. images, music). ATTITUDES 51. Is open to the various ways in which digital content is created with the help of AI, for example how musicians use it to generate melodies for their songs.	
3.2 Integrating and re-elaborating digital content To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.	
KNOWLEDGE 52. Aware that AI can be used for manipulating digital content, e.g. some photo editing software uses AI to automatically age a face, while some text systems use AI to suggest words, sentences and paragraphs.	

53. Recognises the role of humans in the use of AI to edit or manipulate digital content (e.g. the choice of source material and AI technology, and the selection of the most 'effective' output).

SKILLS

54. Can use AI systems to edit or manipulate content, for example use an AI music generation software to generate piano chords.
55. Can incorporate AI edited/manipulated digital content in one's own work (e.g. incorporate AI generated melodies in one's own musical composition).

3.3 Copyright and licences

To understand how copyright and licences apply to data, information and digital content.

KNOWLEDGE

56. Knows that copyright applies to the basic data (particularly images) used for AI training, but that there are exceptions to allow AI development to progress[2]
57. Aware that the ownership of personal data, as created for example by people using social media or students using AI systems in classrooms, is disputed. The business models of many AI commercial organisations depend on them being able to collate and analyse that data, while some have argued that that data belongs instead to the person who created it (like any other copyrighted materials such as texts, images or music).

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[1] https://data.consilium.europa.eu/doc/document/ST-6637-2019-INIT/en/pdf (Art 3a. p52)

3.4 Programming

To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.

KNOWLEDGE

58. Aware that AI is a product of human intelligence and decision-making (i.e. humans choose, clean and encode the data, they design the algorithms, train the models, and curate and apply human values to the outputs) and therefore does not exist independently of humans.
59. Knows that AI systems function by approximate solutions to problems as it is likely that exact solutions to those problems may not exist, or may not be known, or may require too much time to be computed.
60. Knows that to solve a real-world problem on a computer, it has to be modeled first in as a computational problem, this is called a "computational model"

[2] https://data.consilium.europa.eu/doc/document/ST-6637-2019-INIT/en/pdf (Art 3a. p52)

61. Knows that an algorithm describes what steps should be undertaken to solve a computational problem (as a metaphor, in cooking the problem might be to make a cake, the recipe is the algorithm, and the ingredients are the data). 62. Knows that various problem-solving strategies are used to devise and design algorithms. 63. Knows that an algorithm is presented in a form that is language independent but permits a judgment of its correctness (that it does what it is supposed to do) and efficiency (how efficiently it solves the problem). SKILLS 64. Knows how to develop and deploy AI systems. ATTITUDES 65. Considers ethics (including but not limited to human agency and oversight, transparency, non-discrimination, and biases and fairness) a core pillar when commisioning, developing or deploying AI systems.	
4.1 Protecting devices To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.	**4** Safety
ATTITUDE 66. Weighs the risks and benefits of using biometric identification techniques (e.g. fingerprint, face images) as they can affect safety in unintended ways (e.g. biometric information can be leaked or hacked and therefore become compromised).	
4.2 Protecting personal data and privacy To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a “Privacy policy” to inform how personal data is used.	
KNOWLEDGE 67. Knows that, in terms of the EU’s GDPR, personal data is any information that relates to an identified or identifiable living individual. Even voice interactions with a virtual assistant are personal data and can expose users to certain data protection, privacy and security risks. 68. Knows that processing of personal data encompasses the collection, recording, organisation, storage and modifications of the data. When an AI system links different pieces of apparently anonymous information together, it can lead to de-anonymisation, i.e. the identification, of a particular person.	

69. Understands that to develop and train their AI systems, developers automate the collection of personal and behavioural data in different ways (e.g. through engagement with virtual personal assistants).
70. Recognise that voice assistants, chatbots, smart devices and other AI technologies that rely on users' biometric and other personal data might process such data more than is necessary (i.e. it is considered disproportionate and violates the principle of proportionality specified by GDPR)

SKILLS

71. Can help mitigate the risks of personal data breaches by expressing concerns to relevant authorities relating to the usage of AI tools that collect data, especially if there is a suspicion that there is a violation of the GDPR or when the company does not make the information available.
72. If informed by data controllers that there has been a data breach affecting users, act accordingly to take actions to mitigate the impact (e.g. change all passwords immediately, not just the one known to be compromised).

ATTITUDES

73. Weighs the benefits and risks before activating a virtual assistant (e.g. Siri, Alexa, Cortana, Google assistant) or smart IoT devices as they can expose personal daily routines.
74. Weighs the benefits and risks before engaging with software that uses biometric data (e.g. voice, face images), checking that it complies with GDPR.
75. Weighs the benefits and risks before allowing third parties to process personal data, e.g. recognises that voice assistants that are connected to smart home devices can give access to the data to third parties (e.g. companies, governments, cybercriminals).

4.3 Protecting health and well-being

To be able to avoid health risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyberbullying). To be aware of digital technologies for social well-being and social inclusion.

KNOWLEDGE

76. Knows that some AI-driven applications on digital devices (e.g. wearables, smart phones) can support adoption of healthy behaviours through monitoring and alerting about health conditions (e.g. physical, emotional, psychological). However, understands that this requires the sharing of large amounts of personal data, and that the decisions proposed by AI systems could also have potential negative impacts on physical or mental health.

ATTITUDES

77. Takes a critical attitude (i.e. considers the benefits and risks) to recommendations on the internet (e.g. content) as some AI applications might have been designed to be manipulative and/or to weaken one's ability to be in control of decisions.	
4.4 Protecting the environment To be aware of the environmental impact of digital technologies and their use.	
KNOWLEDGE 78. Is aware that training AI is a resource intensive process in terms of data and computing power. In other words, energy costs can be high which can also have high environmental impact. 79. Knows that the devices and technologies used to develop, train and run AI systems use rare earth metals, consume large amounts of energy, and when discarded at end-of-life can damage the environment. ATTITUDES 80. Carefully considers whether the developers of AI systems take into account the environment, including other living beings, and their social and societal impact (e.g. the use of algorithmic management in delivery services). 81. Aims to stay informed about the development of AI systems and the types of resources used, particularly in environmentally impactful areas (e.g. computing power).	
5.1 Solving technical problems To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems).	**5** Problem solving
KNOWLEDGE 82. Understands that AI that is most effective today (e.g. auto translation between text in different languages) depends on large amounts of data and complex processing that a human would not be able to do. However, AI remains very poor at other things at which humans are very skilled (e.g. understanding, deciding what to do, what human values to apply, how to apply the outcomes). 83. Knows that many AI systems require a combination of AI techniques to function in real-world scenarios. For example, robots can rely on computer vision to sense the environment; use natural language processing to process instructions; and reasoning under uncertainty to predict consequences of potential actions (modified from Elements of AI). 84. Knows some examples of what AI systems can do and what they cannot do. For example, when using a GPS to get to a desired location, suggestions for navigation (shortest/fastest routes) are based on AI, especially if variables such as traffic conditions are taken into account. AI is not used to determine one's location as it uses signal processing and geometry (modified from Elements of AI).	

85. Understands that AI processing and the data it uses can be shared among several smart IoT devices, mobile devices, computers and the cloud (distributed AI)

5.2 Identifying needs and technological responses

To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility).

SKILLS

86. Can select and modify user configurations and preferences according to one's needs when using Internet of Things (IoT) products that track data (e.g. wearables, smart home appliances, smart health devices, smart spaces, smart city applications).

ATTITUDES

87. Is interested in experimenting with various types of AI systems depending on one's own personal needs (e.g. virtual assistant, image analysis software, speech and face recognition systems, autonomous cars, "embodied" AI such as robots) in order to find the right AI tools for one's needs.

5.3 Creatively using digital technologies

To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.[3]

KNOWLEDGE

88. Knows that AI can be used to support creativity (see Statements 54 and 62)

ATTITUDES

89. Recognises that AI's ability to be creative depends on and is not competitive with humans
90. Takes a critical attitude (i.e. considers the benefits and risks) towards engaging in collaborative processes to co-design and co-create new products and services based on AI systems that help, support and enhance citizens' participation in society, while noting the many ways in which AI systems might undermine human rights and welfare.

5.4 Identifying digital competence gaps

[3] If examples are needed, look here: https://aiyprojects.withgoogle.com/ or https://c3.ai/products/c3-ai-ex-machina/ or https://runwayml.com/

To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.	
KNOWLEDGE 91. Understands that keeping one's knowledge up to date about the advancements of AI is important in order to understand and to distinguish between realistic and unrealistic AI (science fiction vs. real life) - Elements of AI 92. Recognises that there are many mythological and hyperbolic claims about AI, and that it is important to dig beneath the headlines to achieve a better understanding. 93. Recognises that AI is a fast-moving field, that not everything in AI is mature or fixed, and that there are many disagreements about AI between the world's leading AI researchers and developers. SKILLS 94. Searches and finds training for safe, effective and responsible use of AI to enhance their knowledge and understanding of AI (for example, in the digital skills and jobs portal) ATTITUDES 95. Takes a critical attitude (i.e. considers the benefits and risks) and seeks to educate oneself about AI.	