Train DL

Teacher training for Data Literacy & Computer Science competences

D5.3 - Development of policy and curricula recommendations (CS teachers)

1. Executive Summary

This deliverable reports and discusses the evolution of policy recommendations from their initial conception to the changes implemented based on two iterations of policy refinement and policy experimentation. As illustrated in Figure 1, the Centre for Public Impact defines the elements to achieve a greater public impact of policy through policy experimentation to be the policy itself, the legitimacy of the policy and its actionability[1].

THE PUBLIC IMPACT FUNDAMENTALS

Stakeholder Engagement
Political Commitment
Public Confidence

LEGITIMACY

ACTION

Clear Objectives
Evidence
Feasibility
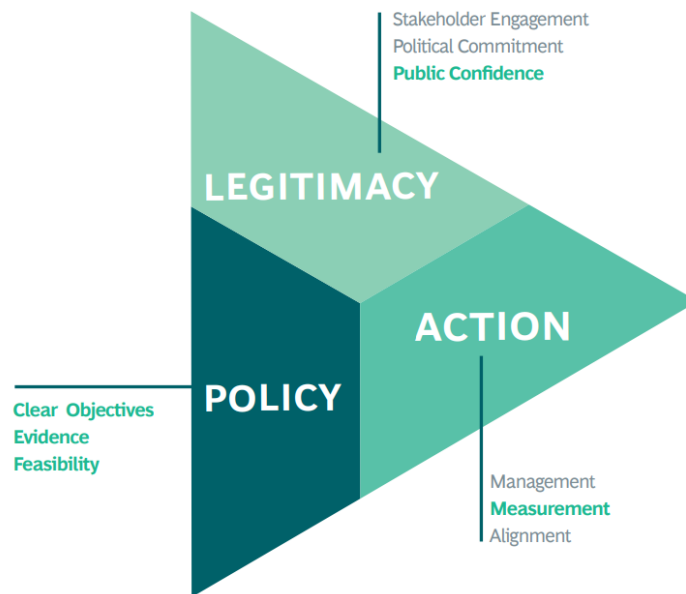
POLICY

Management
Measurement
Alignment

Figure 1: Impact of policy experimentation

A good overview of the complexities and available mechanism for policy experimentation can be found in this report by the European Commission[2].

This deliverable relies on evaluating the legitimacy and actionability of policy recommendations through hypotheses generation, stakeholder engagement in two rounds of stakeholder workshops, and evidence-based policy experimentation through target group interventions as well as associated quantitative and qualitative evaluation of the expected impact.

---

[1] Centre for Public Impact (2018) A brief introduction to… Policy experimentation. https://www.centreforpublicimpact.org/assets/documents/CPI-A-brief-intoduction-to-Policy-experimentation.pdf

[2] European Commission/EACEA/Eurydice (2017). Support Mechanisms for Evidence-based Policy Making in Education. Eurydice Report. Luxembourg: Publications Office of the European Union.

In this context, three rounds of evolution of policy recommendations were conducted:

1. Initial definition of policy recommendations, based on
   a. state-of-the-art analysis of relevant policy documents and definition of a policy monitor, as reported in D1.1 and D1.2; and
   b. national policy dialog workshops in the context of WP1 with project relevant stakeholders (policy makers and representatives from education institutions from Germany, Austria and Lithuania), as reported in D1.3.

   Initial policy recommendations were phrased based on the analysis of stakeholder expectations, success factors and potential challenges derived from those workshops, as presented in D5.2. Those initial recommendations have been assessed by external experts, as reported in D5.4. Those initial policy recommendations are reported in Section 2 of this deliverable, complemented by a set of hypotheses developed for the first round of interventions with computer science (CS) teachers, which will act also as a guiding principle for further iterations of the policy recommendations.

2. Refinement of the policy recommendations based on the outcomes of a joint policy building workshop with policy makers and representatives from education institutions from Germany, Austria and Lithuania, with the emphasis on how AI&DL education could be implemented on an international level, as reported in D1.6. The results of the refinement of policy recommendations based on this input are reported in Section 3 of this deliverable. In this context, the initial recommendations were complemented by actionable "mechanisms" to implement policy, in line with the project developments. Policy recommendations often go hand-in-hand with a list of mechanisms as to how to implement the recommendation, as is illustrated in the example of the Lithuanian AI strategy[3]. Those mechanisms were discussed and refined together with the stakeholders in the joint policy building workshop.

3. Refinement of the policy recommendations based on the evaluation of the outcomes of the first round of policy experimentation through interventions conducted in the context of WP2 (reported in D2.3 and D2.4). The context of those interventions is to pilot content developed during the project to implement AI&DL policy with selected groups of secondary education in- and pre-service teachers, educators, didacticians and trainers for these teachers. The first round of interventions focuses on computer science (CS) teachers. The outcomes of those interventions are monitored based on the quantitative

---

[3] Create Lithuania – Ministry of the Economy and Innovation. LITHUANIAN ARTIFICIAL INTELLIGENCE STRATEGY - A Vision of the Future.
https://eimin.lrv.lt/uploads/eimin/documents/files/DI_strategija_ENG(1).pdf

and qualitative evaluation conducted in the context of WP4 (and reported in D4.4). The results of the refinement of policy recommendations based on this evaluation is also included in the work presented in Section 3 of this deliverable.

The results and conclusions of this iterative process for deriving policy recommendation in the AI&DL context are discussed in Section 4 of this deliverable. It should be noted that, while stakeholder input in all iterations was valid and important to form the recommendations, the main source for shaping the policy recommendations were the quantitative and qualitative evaluation results from the first round of interventions, allowing to base the recommendations on a solid scientific basis. There are some known limitations in the evaluation process this data is based on, which are described in detail in the deliverable D4.4, presenting the evaluation results of the first round of interventions. The recommendations in this deliverable should be read with those limitations in mind.

The main result of this iteration is a set of concrete policy recommendations aimed at the CS target group, picking up on the general recommendations and hypothesis derived in the previous iterations, and providing a concrete set of actionable mechanisms to implement those recommendations. Guided by the scientific evaluation of the first round of interventions with the CS target group, two concrete issues emerged as dominant, one relating to the general growing importance of AI and DL education, and the other relating to the methodological and didactical aspects of teaching and training in AI and DL, which were then consolidated into two recommendations and 12 actionable mechanisms (4 relating to the first recommendation, and 9 relating to the second).

1. Policy recommendation - first iteration

The results reported in this section are based on (a) state-of-the-art analysis of relevant policy documents and definition of a policy monitor, as reported in D1.1 and D1.2; and (b) national policy dialog workshops in the context of WP1 with project relevant stakeholders (policy makers and representatives from education institutions from Germany, Austria and Lithuania), as reported in D1.3. Initial policy recommendations were phrased based on the analysis of stakeholder expectations, success factors and potential challenges derived from those workshops, as presented in D5.2. Those initial recommendations have been assessed by external experts, as reported in D5.4. Following recommendations resulted from this first iteration:

Policy Recommendations (from first iteration)	
Recommendation 1	All people, regardless of their profession, should be aware of the importance of AI and data in their lives in order to be able to act independently in a world that is increasingly digitally networked and shaped by AI technologies. They should be familiarized with the basic concepts of AI at an early stage and acquire basic data skills.

Recommendation 2	Teachers should enable students - with the help of the curriculum and methodologically and didactically well-prepared lessons - to be able to cope with AI and data in a self-determined manner.
Recommendation 3	Providing methodologically and didactically well-prepared teaching content and the consideration of these topics in the curricula increases the awareness, understanding and judgment of teachers and students with regard to the functionality and effectiveness of AI and data.
Recommendation 4	Competencies for coping with AI and the underlying data should be developed at an early stage, across disciplines and in different age groups. For this reason, adequate further training offers in these subject areas must be created, especially for teachers at the primary level.

Based on those recommendations, and in preparation for the first round of interventions aimed at CS teachers, the project has developed a set of guiding hypotheses in order to be able to formally validate the outcomes of the interventions. Besides evaluation, which is reported in detail in the context of WP4 (deliverables D4.3 and D4.4, which also details the limitations of the evaluation), those hypotheses and subsequent evaluation results were also crucial in guiding the iterations on policy recommendations as reported in Section 3 of this document. The following guiding project hypotheses have been formulated based on the results of this policy iteration, the input from stakeholders (as reported in deliverable D5.2), and have further been refined and extended through discussion by the relevant project partners in several dedicated meetings:

Guiding project hypotheses	
Hypothesis 1	If in-service computer science (CS) teachers with a solid background in CS participate in a 1-day AI&DL teacher training workshop, they then are able to integrate AI&DL as a new topic in their CS classes.
Hypothesis 2	If in-service STEAM / primary teachers without any prior knowledge in CS receive a 1-day teacher training, covering basic of CS and AI&DL, they then are aware what significance AI&DL have for their subject and they then are able to integrate selected AI&DL topics into their regular teaching.
Hypothesis 3	If pre-service STEAM / primary teachers participate in a specific lecture on AI&DL teaching methodologies, covering basics of CS and AI&DL, they then are aware what significance AI&DL have for their subject and they then have a positive attitude towards integrating AI&DL into their future teaching.
Hypothesis 4	If pre-service CS teachers participate in a specific lecture on AI&DL teaching methodologies, they then have a positive attitude towards integrating AI&DL into their future teaching.

Hypothesis 5	The level of motivation to acquire AI&DL competences differs between CS teachers and STEAM / primary teachers.

3. Policy recommendation – subsequent iterations

The results presented in this Section are based on the outcomes of a joint policy building workshop with policy makers and representatives from education institutions from the partner countries Germany, Austria and Lithuania, as well as other European countries (D1.6), with the emphasis on how AI&DL education could be implemented on an international level. In the workshops, the recommendations as well as actionable mechanisms to implement the recommendations as defined by the project were reviewed and refined with the participating stakeholders. Furthermore, the results are based on the outcomes of the first round of policy experimentation through interventions conducted in the context of WP2 (D2.3 and D2.4) and evaluated in the context of WP4 (D4.3 and D4.4). The context of those interventions is to pilot content developed during the project to implement AI&DL policy with selected groups of secondary education in- and pre-service teachers, educators, didacticians and trainers for these teachers with specific focus on the computer science subject. As a result, a set of dedicated recommendations and associated actionable mechanisms have been developed for the CS target group. The resulting recommendations have been influenced by the recommendations and hypothesis defined in the previous iteration. For this target group, hypotheses 1, 4 and 5 were the most relevant ones. The table below lists the resulting recommendations. The recommendations have been grouped into "**general**" recommendations, and recommendations related to "**teaching and training**". For each recommendation, a set of actionable mechanisms to assist the implementation of the recommendation is listed.

CS Recommendation 1 (General)
Artificial Intelligence (AI) is already part of our everyday life as well as the work world and is becoming increasingly important. Data are the driving force and fundament for AI. Hence AI and data literacy (DL) should be considered together. Without DL and a basic understanding of AI, people will not be able to succeed in a data-driven and automatized world. Being aware of the importance of AI and data for our life and having a basic understanding of AI&DL is key to ensure an economic and social participation and to reduce the digital skills gap. All people, regardless of their profession, should be aware of the importance of AI and data in their lives in order to be able to act independently in a world that is increasingly digitally networked and shaped by AI technologies.
Recommended mechanisms to implement CS recommendation 1
- People should be familiarized with the basic concepts of AI and acquire basic data skills at an early stage of school education (latest secondary I), because AI and data are already affecting many aspects of people's lives.   - Competencies for coping with AI and data should be fostered and developed at an early stage of school education and across different disciplines and age groups, because domain knowledge is essential for effective

deployment of AI technologies and a basic understanding of the growing relevance of AI&DL in society and economy.

- Even though AI&DL is part of the larger field of computer science, it requires special attention, both in the training of teachers as well as in the teaching of students (for instance, in form of mandatory trainings or school subjects). This is important because many concepts and methods of AI&DL are specific and are not part of other computer science topics.
- Given the growing importance of AI and data, the topic of AI&DL is of profound societal importance and should therefore be integrated into teacher education and curricula.

CS Recommendation 2 (Teaching and Training)

Teachers should enable students to be able to cope with AI and data in a self-determined manner. Providing methodologically and didactically well-prepared teaching content and the integration of these topics into curricula, increases the awareness, understanding and judgment of teachers and students with regard to the functionality and effectiveness of AI and data. Next to the integration of AI&DL into curricula, pre- and in-service teachers also need to receive tailored and extensive teacher training to be confident to integrate AI&DL topics into their teaching and to teach AI&DL to school students.

Recommended mechanisms to implement CS recommendation 2

- Teacher trainings need to be designed and implemented to provide the confidence to teach these topics whilst also making clear that teachers do not need to have an all-encompassing AI&DL knowledge.
- The relevance and importance of AI&DL for different school subjects needs to be highlighted.

- For teachers, in order to support the integration of AI&DL into their teaching, ready-to-use teaching materials developed and tested by qualified experts, as well tools and self-running courses, utilizing a constructionist approach and tailored to the school level, need to be provided.
- A combination of unplugged teaching materials and tools to actually "do AI" - which implies not just using an AI driven pre-trained system, but evaluating data with AI methods - is recommended.
- In order for in-service computer science teachers to know what objective knowledge about AI&DL they already have or in which areas they need to improve, a self-assessment test of their factual AI&DL knowledge is recommended.

- Short and half-day trainings/workshops (1.5h-4h) for in-service computer science teachers are suitable to spark their interest in AI&DL topics.
- Regular teacher training and workshop formats (short/half-day duration) are not suitable for enabling in-service computer science teachers to teach AI&DL topics to their students.

- Full-day trainings/workshops for in-service computer science teachers are suitable to spark interest in AI&DL topics and to ease the usage of provided ready-to-use teaching materials in their teaching, but they are not enough to allow them to further adapt/develop and implement AI&DL independently.
- For pre-service computer science teachers, a specific mandatory university lecture on AI&DL topics, the potential of AI as well as teaching methodologies should be envisaged.

5. Discussion and Conclusion

Given the more general policy recommendations and hypothesis achieved in previous iterations of policy experimentation, further input during subsequent iterations allowed to consolidate and focus the policy recommendations on the CS target group. The joint policy workshop with stakeholders from the partner countries and beyond, but especially the first round of interventions with CS teachers that provided tangible results that were evaluated in a methodical and scientific way, provided the evidence based groundwork input for this iteration.

It became clear that especially hypothesis 1, 4 and 5 are particularly relevant for this target group, allowing to formulate two concrete CS education relevant policy recommendations, one relating to the general growing importance of AI and DL education, and the other relating to the methodological and didactical aspects of teaching and training in AI and DL.

Based on those policy recommendations, a set of actionable mechanisms was proposed for each recommendation, with each mechanism supported by concrete evidence derived through the evaluation of the first round of interventions.

It should be noted that the recommendations and mechanisms of this round of policy experimentation are still in a draft state. The project has further actions of development and experimentation planned. Subsequent rounds will focus on policy recommendations for STEAM (reported in deliverable D5.5) and primary education (reported in deliverable D5.7). A final deliverable that will report on the last iteration of policy experimentation, with a consolidated set of policy recommendations and actionable mechanisms for CS, STEAM and primary education target groups (D5.9) to be delivered towards the end of the project. This last iteration will further elaborate, revise and extend the recommendations. Methodologically, the next steps will focus on a review of the recommendations from these iterations by consortium partners, taking into account data from further interventions, as formulating, refining and adapting recommendations is a continuous process. The experience from the first round of interventions has shown that through the formal evaluation process, a lot of data has been collected and analysed, forming the basis for the recommendations presented in this deliverable. Further experimentation and validation (including other target groups like STEAM and primary education) will undoubtedly further enrich the understanding of the project regarding the concrete needs of the stakeholders, challenging the project in condensing the vast and comprehensive results achieved through experimentation into expressive and pointed policy recommendations.