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Bringing data literacy competencies in secondary schools

Portare le competenze di data literacy nelle scuole secondarie

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ABSTRACT The importance of developing data literacy skills in secondary schools has been increasingly recognised over the years. In order to achieve the successful development of data literacy skills among secondary school teachers and students, it is necessary to analyse current curricula, implement data literacy projects in school and focus on learning outcomes. It is important to follow the key challenges that teachers and students face in this process. This paper presents the survey results of the piloting study conducted in the framework of Data Literate and Dalfys - two European funded projects that aim at spreading data literacy skills in secondary school contexts. The results show a significant interest of teachers and students to develop data literacy skills but the introduction of data literacy in traditional curricula requires appropriate resources. Temporary solutions, such as introducing data literacy in specific subjects, should be promoted to promptly fill the existing gap in the development of these skills.

KEYWORDS Data Literacy competences; Secondary Schools; European Funded Projects.

SOMMARIO L'importanza di sviluppare competenze di data literacy nelle scuole secondarie è stata sempre più riconosciuta nel corso degli anni. Al fine di sviluppare le competenze di data literacy tra insegnanti e studenti della scuola secondaria, è necessario analizzare i curricula attuali, attuare progetti di data literacy a scuola e focalizzarsi sui risultati dell'apprendimento. Individuare le principali sfide che insegnanti e studenti devono affrontare in questo processo assume un ruolo di primaria importanza. Questo documento presenta i risultati di ricerca dello studio pilota condotto nell'ambito dei progetti Data Literate e Dalfys - due progetti finanziati dall'UE che mirano a promuovere la diffusione delle competenze di data literacy nel contesto della scuola secondaria. I risultati mostrano un notevole interesse degli insegnanti e degli studenti a sviluppare competenze di alfabetizzazione dei dati, ma l'introduzione dell'alfabetizzazione dei dati nei curricoli tradizionali richiede risorse adeguate. Dovrebbero essere promosse soluzioni temporanee, come l'introduzione della data literacy in specifiche materie di studio, per colmare tempestivamente il gap esistente nello sviluppo di queste competenze.

PAROLE CHIAVE Competenze di Data Literacy; Scuole Secondarie; Progetti Finanziati dalla Comunità Europea.

1. Introduction

In the last few decades, a rapid advancement in Information and Communication Technologies (ICTs) have influenced significant changes in all aspects of the society. Technological progresses have a significant impact on education and the potential of ICTs in education is still developing. In efforts to improve digital competencies in education, European Commission promoted the Digi-CompEdu framework aimed at building digital competences of educators (Redecker & Punie, 2017). Through the continuous work of the European Commission on the development of digital skills of teachers, the guidelines for teachers and educators on tackling disinformation and promoting digital literacy through education and training were published in 2022, as the key initiative of the Digital Education Action Plan 2021-2027, "*The Guidelines aim to generate a broader understanding of digital literacy achieved through education and training, to promote responsible and safe use of digital technologies, and to foster a better public awareness and knowledge regarding disinformation.*" (European Commission, 2022). All of the above highlights the importance and significance of digital literacy in education.

The usage of technology does not guarantee adequate development of digital competence at a satisfactory level. In this regard, Krumsvik highlights the essential role of teachers in promoting digital competence in students (Krumsvik, 2008), and it is essential to provide teachers with appropriate training for developing their digital literacy skills (Ndukwe & Daniel, 2020). Recent studies showed that educators can develop data literacy during the intensive one-year educations (Kippers, Poortman, Schildkamp, & Visscher, 2018).

Even though research in data literacy is increasing in the recent years (Ghodoosi, West, Li, Torrisi-Steele, & Dey, 2023), the focus on data literacy in secondary schools is underrepresented. This paper aims to introduce the results of two educational projects specifically aimed at spreading data literacy skills in secondary schools. These projects, named Data Literate and Dalfys, have been funded within the European Commission Erasmus+ Programme as Strategic Partnerships. The overall goal of these projects is not only to tackle the specific education challenges brought up by the Covid-19 pandemic (e.g. the implementation of distance learning), but also to address the European Commission's purpose to consolidate ongoing efforts and further develop the European Education Area, thus improving digital competences, facilitating international cooperation between education institutions, while promoting opportunities for teachers' continuous professional development. These projects were carried out by a consortium of partners with different expertise and know-how in strategic fields related to the data literacy domain. The Data Literate consortium, led by Vilnius University, includes two companies specialized in digital and data training initiatives (INOVA+ and Dataninja), and 4 secondary schools from Lithuania, Portugal, Spain and Italy[1]; whereas the Dalfys project, coordinated by the Italian secondary school "ITET Girolamo Caruso", includes four secondary schools, one training center, one research center and two SMEs with expertise in educational programmes from Lithuania, Poland, Germany, Italy, Romania and Turkey[2].

Both projects share a commin definition of the term "data literacy", namely the ability to "*read, write, critically assess, and communicate data in context, including an understanding of data sources*

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[1] Please refer to Data Literate website for further information about the consortium, accessed January 23, 2023, https://www.dataliterateproject.eu/partners/

[2] Please refer to DALFYS website for further information about the consortium, accessed January 23, 2023, https://www.dalfysproject.eu/consortium-en/

and constructs, analytical methods and techniques applied — and the ability to describe the use case, application and resulting value"[3].

In order to properly assess the outcomes of the pilot phases conducted in the projects, two surveys were designed for detecting teachers' and students' perception on data literacy competences. The surveys have been sent by e-mail to the teachers of the schools involved in the two projects, subsequently they shared the questionnaire amongst students. The answers provided have been analysed and the main insights are summarised in this paper.

The paper is structured as followed: section Background is related to general data literacy concepts and previous work on implementing data literacy learning experiences in secondary schools, in the section Data Literate and Dalafys projects, the two projects are presented, the Methodology section relates to the survey conducted. The results of the analysis of the survey are presented in the Insights and survey analysis section. Final conclusions and future work section summarizes the most relevant insights from the experience conducted.

2. Background

Several authors highlight the importance on giving focus to data literacy within education (Gebre, 2018; Rubin, 2020). Although data literacy is growing and important in building digital competences in education, data literacy education in secondary school context deserves further investigation.

Even though efforts in developing data literacy amongst students are made, Grebre states that the lack of comprehensive definition of what data literacy constitutes an obstacle to implement it in schools (Gebre, 2018). There are two ways of observing data literacy: competency-oriented and empowerment-oriented perspective (Gebre, 2018). Competency-oriented perspective is related to development of data literacy skills – finding, analysing, understanding and interpreting the data, while empowerment-oriented perspective is wider and consists of using data literacy to build equitable and democratic society (Boyd & Crawford, 2012; Gebre, 2018; Wolff, Gooch, Cavero Montaner, Rashid, & Kortuem, 2016).

When researching, developing and implementing data literacy in secondary schools, it is important to look at the development of skills, challenges and strategies from two equally key perspectives - teachers and students.

To ensure development of data literacy competences in students, it is essential to empower teachers with the necessary data literacy competences (Ndukwe & Daniel, 2020). It is important to understand what teacher data literacy refers to their "*ability to effectively engage with data and analytics to make better pedagogical decisions*" (Ndukwe & Daniel, 2020). Ndukwe and Daniel point out a very important dimension of why teachers struggle with understanding teaching dashboards – partly, they lack data literacy skills, but mostly, design of tools does not include teachers as partners (Ndukwe & Daniel, 2020).

It is necessary to give training to teachers for them to be able to effectively use the data, and it is a key prerequisite for them to be able to teach students in the data literacy manner (Mandinach & Gummer, 2016).

Filderman et al. proposed a data literacy training model for the teachers in order to determine the effects of data literacy training on teachers and identified the key concepts of the training to have comprehensive knowledge in data literacy of teachers such as data literacy knowledge and skills, beliefs

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[3] Definition adapted from Gartner, accessed January 24, 2023, https://www.gartner.com/smarterwithgartner/a-data-and-analytics-leaders-guide-to-data-literacy

on data use, the importance of training, sufficient duration of the training and coherence (Filderman, Toste, Didion, & Peng, 2022). In their review, they found that teachers training in data literacy has significant positive effects on teachers' knowledge and skills in general.

Data literacy is highly important for data-based decision making, especially for teachers (Schildkamp, van der Kleij, Heitink, Kippers, & Veldkamp, 2020). It is important for teachers to be able to collect different types of data, to analyse and interpret data, as well as to be able to transform data into information and knowledge, and when looking on teaching data literacy, the list goes even broader. There are theoretical and empirical works that identified different digital skills that teachers should have in order to use new technologies (Touron, Martin, Navarro Asencio, Pradas, & Inigo, 2018; Mei Wei, Yan Piaw, Kannan, & Moulod, 2016), however, those are rarely applied in practice (Rubach & Lazarides, 2021).

Shreiner and Dykes conducted a survey among 262 U.S. elementary and secondary teachers on social studies. They used mixed method analysis to evaluate teachers' practices, beliefs, and knowledge in data literacy (Shreiner & Dykes, 2021). The study was mostly directed towards data visualisation. Even though more than 60% of participants indicated that they "feel" like teaching data visualisations, only 24% of them were constantly positive in their responses to the questions about teaching data literacy. Authors highlight that among these who are regularly teaching data literacy group, 62% were secondary school teachers. Many students are not receiving data literacy instructions, especially from new teachers. Only 11% of the teachers felt confident and efficacious in their ability to help students achieve data literacy skills. The highlight of this study is that 97% of the teachers are underprepared to teach with data visualisations. Most of the teachers do not have knowledge needed to teach data literacy.

In summary, the existing literature shows that teachers have a lack of competence in data literacy, that they have a desire to advance their knowledge in this area, and that trainings have good results in creating data literacy skills in teachers. This is crucial to develop and promote these skills amongst students as well.

Often the intensive use of technology is identified with the development of digital skills amongst students and young population, but this does not mean that they necessarily have data and digital literacy competencies.

As mentioned above, to develop students' digital competences, it is important that their teachers have developed digital competences, as well as adequate knowledge to implement them in subject curricula. Digital competences lead to responsible and meaningful use of technologies.

Research shows that developing students' digital skills can help protect students from inappropriate use of technology and to reduce the risk of gaming addiction amongst children and adolescents (Tso et al., 2022). When observing data literacy skills from students' perspective, the importance of developing these competencies is not questioned, but the importance of emphasising that the use of technology does not necessarily mean the development of digital competencies. Research shows just the opposite - students who use online communication with their friends very often and that those who use social networks a lot, have lower levels of digital competence (Cabezas-González, Casillas-Martín, & García-Valcárcel Muñoz-Repiso, 2021). It is of high importance for educational institutions to implement curricular programs that could strengthen digital competences amongst students from early education.

3. Data literate and Dalfys projects

The project Data Literate and Dalfys aim at promoting data literacy skills development in secondary school contexts. They share the same approach concerning their implementation phases. Specifically, three main stages can be identified: Exploring, Designing and Piloting (Figure 1).

01
EXPLORING

Analysing the
state of art

02
DESIGNING

Producing learning
materials

03
PILOTING

Implementation
in schools
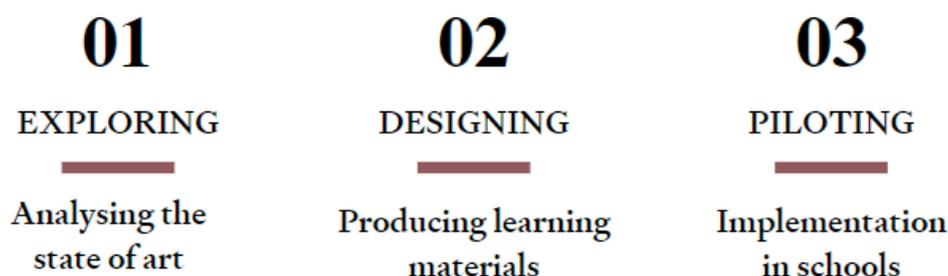
Figure 1. Three main phases of Data Literate and Dalfys projects.

The exploratory phase is dedicated to desk research activities aimed at mapping the "state of the art" of data literacy educational experiences in European secondary schools, highlighting if and how data literacy is included in school curricula. The desk research results are summarised in a report reused in the next steps of the project to specifically address the needs and expectations intercepted. Starting from the information gathered during the research, the designing step is focused on the development of educational content and learning materials to train teachers and students on data literacy topics. In this regard, the lessons designed both for Data Literate and Dalfys - regardless the specificity of each project - can be clustered into the following four main areas, referring to a framework that has at its core the basic competences related with the data workflow:

– **Finding data**: In this module participants will learn what data is and its difference with opinions, which helps at highlighting how data cannot be neutral. Moreover, it will be addressed the importance of fact checking and data verification in order to critically assess data. A specific focus on data sources, format and licences is included.
– **Cleaning data**: Before delving into analytics, it is crucial to understand the key role of the data cleansing process, exploring resources and techniques.
– **Analyzing data**: Elements of statistical literacy are at the core of this module, focused on some tips and tricks to analyse data.
– **Visualizing data**: Understanding data means also understanding how data is visually represented: the basic structure of a data visualisation, what are misleading graphs and how to avoid them, together with the basics of planning a dataviz are the main topics of this module. Eventually a list of different tools for visualising data and to support online classes will be presented.

During the implementation of the Data Literate project's, teachers have undertaken a training course based on 6 modules. In next phases of the project were dedicated to piloting methodologies and materials which teachers have worked on within their classes.

The pilot phase aims at promoting the development of Digital Data Literacy skills among students, while contributing to teachers' continuous professional development; overall, four schools successfully joined the pilot phase. Furthermore, each module includes the expected competences to acquire according to the Data Literacy Competence Model (Seymoens, van Audenhove, van den Broeck, & Mariën, 2020) and the proposed learning outcomes.

The educational materials designed in the second step of the project have been used by the teachers of the consortium as a starting point to create their own Learning Unit Plan (LUP). The LUP is the development of content for class-based learning units on data literacy that schools will use during the following piloting step. LUPs are based on a model of transferable learning resources that can be totally integrated in existing learning activities of secondary schools in a modular way. Interestingly, both

in Data Literate and Dalfys the teachers who designed the LUPs do not exclusively teach STEM subjects; this is key to underline interdisciplinarity of data literacy topics.

The LUPs stand for the conceptual backbone for including data literacy in secondary school courses, while promoting innovative study concepts and blended didactic resources for secondary school teachers. The LUPs creation and implementation through the piloting phase are core outputs of the educational projects, thus enabling the introduction of data literacy as a cross-cutting subject for secondary school students and providing not only concrete learning units but also strategies for course organizers.

4. Methodology

In order to properly assess the piloting phase outcomes, two surveys were conducted and answered by teachers and students of the schools who participated in the pilot of both projects. Dalfys participants could access the survey directly from the project's website, whereas for Data Literate project the survey was sent by email to the teachers, who were then responsible for sharing it with students.

The teacher questionnaire intended to evaluate the Learning Unit Plan creation and its implementation through the piloting phase, while the students survey was designed to measure their knowledge and confidence in terms of data literacy skills after the learning sessions. Each questionnaire was divided into two main subsections: "*Part A - General information*" and "*Part B - Evaluation of the piloting sessions*"; in the teacher survey an additional section dedicated to open comments was also included, this section particularly focused on the challenges faced by teachers during the piloting phase.

The questions were structured as multiple choice, Likert scale and - only in few cases - open questions. For example, concerning the evaluation of students' participation during the piloting session, teachers have been asked to rate it on a scale from 1 to 5, where 1 means "*Did not participate at all*" and 5 "*Actively Participated*". On the other hand, students have been asked to rate how much they enjoyed the topics of the learning session about data literacy on a scale from 1 ("Not at all") to 10 ("Totally enjoyed"). An example of multiple-choice question is the one aimed at assessing the usefulness of the educational content to develop the LUP: teachers had to express their agreement with the following statement "*The slides content was useful for the development of the Learning Unit Plan*" and the possible answers were: Totally disagree - Disagree - Agree - Totally agree.

Concerning the students' survey, the section dedicated to the evaluation of the learning sessions on data literacy included 4 open questions about new concepts learnt, the most enjoyable parts of the learning session and main difficulties encountered. For each question there were 100+ different answers, although in many cases the differences did not lie in the answers content, rather in the way they were spelled or written (e.g. How to make graphs - Making Charts). Moreover, many students answered in their mother tongue, so a translation was needed. In order to derive meaningful insights for the piloting overview report many answers have been clustered, e.g.:
– Finding your own data online → Data collection
– Diagrams, tables, different maps → Data visualisation

Focusing on the piloting phase of both projects, which took place in the second half of 2022, the partners involved were 7 schools (Agrupamento de Escolas Sebastião da Gama, Escola Virolai, ITET G. Caruso, Liceul Tehnologic Costache Conachi, Siauliu Didzdvario Gimnazija,Vilnius Jesuit High School, TED Bursa College) and the training center DC Edukacja. Generally speaking, the piloting phase aims at promoting the development of Digital Data Literacy skills among students, while contributing to teachers' continuous professional development.

5. Results and Discussion

Starting from the analysis of the surveys responses, the present section aims at giving an overview of the piloting phase's results in three main areas: 1) The creation of the Learning Unit Plan and the evaluation of the educational content; 2) The evaluation of the Learning sessions; 3) The challenges faced during the piloting phase.

Before delving into these aspects, it is worthy to give some general information about the sample, to better contextualize the results.

The teacher questionnaires gathered 33 responses; Concerning the teachers' years of professional experience, 87,5% of respondents had more than 10 years of teaching experience and the remaining 12,5% had between 6 and 10 years. The 3 main subjects taught by teachers who answered the survey are: English (25% of respondents), Computer Science (25% of respondents), Mathematics (19% of respondents). Other subjects are: Chemistry, Commerce, Electronics and Physics.

Overall, 744 students were involved in the pilot sessions, in particular: 215 from Agrupamento de Escolas Sebastião da Gama (Portugal); 102 from ITET G. Caruso (Italy); 315 from Escola Virolai (Spain); 112 from Vilnius Jesuit High School (Lithuania). The surveys addressed to students collected 465 answers in total: 248 from the Dalfys project and 217 from the Data Literate one. However, in the latter case, the number of students reached with the LUPs is higher because not every student who joined the pilot answered the survey. Overall, the piloting sessions had a quite gender-balanced participation in both projects, namely: 52,69% male, 44,09% female, 3,23% other. Regarding the age of participants, the large majority (nearly 70%) of students were 15-17 years old (figure 2).

Generally speaking, all the learning modules (Data Literacy, Understanding your data, Educational Data, Learning and Teaching analytics, Explore data literacy resources already available) have been presented to the students during the pilot, though with different shades (figure 3).

Every school presented more than one module to the students as shown in figure 4. The numbers indicate how many times a single module has been implemented in each school.

The final module of the teacher training course was dedicated to the design of a Digital Data Literacy plan for the students, in order to effectively integrate the use of digital technologies in learning
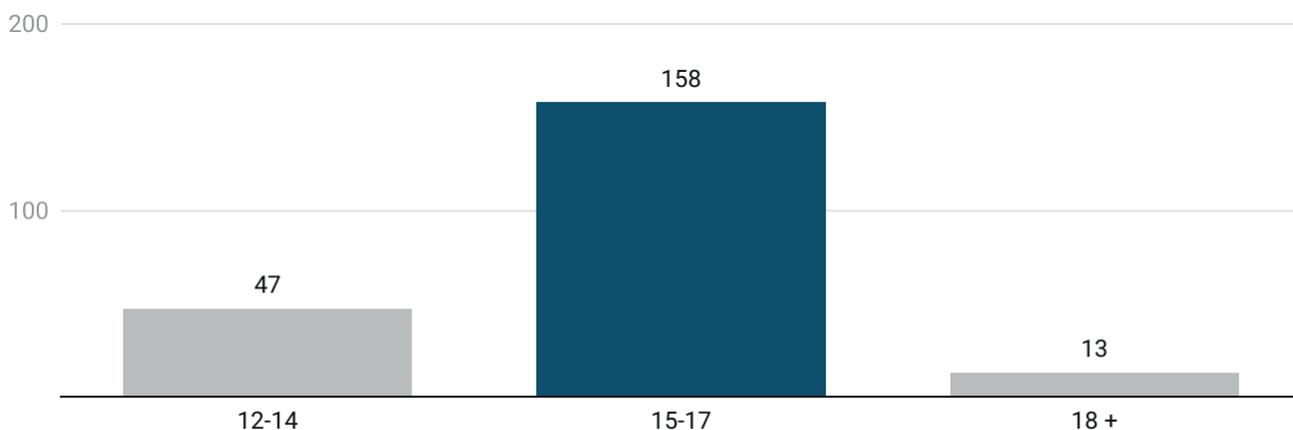
Chart: Dataninja for Data Literate project • Source: Students Piloting survey • Created with Datawrapper

Figure 2. Age groups of the students that participated in the survey.

Module 1. Data Literacy	82%
Module 2. Understanding your data	65%
Module 3. Educational Data	47%
Module 4. Learning and Teaching analytics	35%
Module 5. Explore data literacy resources already available	18%
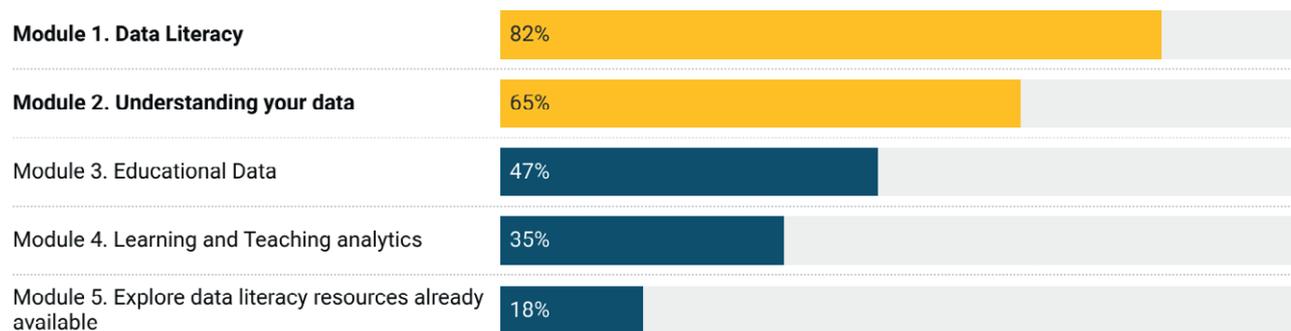
Grafico: Dataninja for Data Literate Project • Fonte: Survey conducted among teachers • Creato con Datawrapper

Figure 3. Presented modules to students during the piloting session.

Module Name	AESG- Agrupamento de Escolas Sebastião da Gama	Escola Virolai	ITET G. Caruso	Vilnius Jesuit High School
Module 1. Data Literacy	1	4	5	4
Module 2. Understanding your data	1	3	5	2
Module 3. Educational Data	2	2	3	1
Module 4. Learning and Teaching analytics	0	3	2	1
Module 5. Explore data literacy resources already available	0	1	2	0

Table: Dataninja for Data Literate project • Source: Teachers Piloting Survey • Created with Datawrapper

Figure 4. An overview of modules implemented in the pilot session by schools.

activities while facilitating students' understanding of working with data. During the piloting phase, almost 80% of the respondents implemented 2 Digital Data Literacy plans in their classrooms, which brings to 29 the total number of Digital Data Literacy Plans developed in the 4 school partners. Moreover, it is worthy to underline that some teachers implemented 1 Digital Data Literacy plan but in different classes, thus reaching a wide number of students.

5.1. Survey analysis

As explained above, teachers piloted in their classrooms the LUPs developed on the basis of the educational content about data literacy provided within the framework of both projects. Therefore, they have been asked to evaluate the learning content suitability for students aged 15-18 on a scale from 1 to 5; on this matter the results are positive, since over 80% of respondents answered either 4 or 5.

Moreover, as an example of multiple-choice question, they had to express their agreement with the following statement "The slide content was useful for the development of the Learning Unit Plan". Evaluating the usefulness of the educational content for the development of the LUPs the respondents unanimously agreed (37,5% totally agree, 62,5% agree). Therefore, all modules of the educational con-

tent (that can be clustered into the 4 core skills of data literacy: finding-cleaning-analysing-visualising data) have been used for the creation of the LUP. Concerning the evaluation of the educational content, students' feedback was also collected: 66% rated the difficulty of the LUP as "Average", 27,3% answered either "Easy" or "Very Easy" and only 6,7% either "Hard" or "Very Hard.

Regarding the evaluation of the learning session, both teachers and students' surveys aimed at investigating the extent to which students actively participated during the pilot session and their satisfaction. The feedback on these aspects is overall positive: on average, the students' level of participation and satisfaction has been rated 8,15/10. Furthermore, a noteworthy satisfaction level of students (82% of respondents) is also detected concerning the methodology used in the pilot session.

Other key insights are the one related to the measurement of the learning outcomes of the piloting session. The results for the two projects are here presented separately. Dalfys project's survey gives interesting insight about students' previous knowledge on Data literacy topics, which they should rate from 1 to 5: On average, students rated their previous knowledge 2,8/5. Thanks to the clustering process described in the previous paragraph, it was also possible to quantify the percentage of students who learnt new concepts and skills after the learning sessions. Indeed, the students stated that thanks to the LUP they learnt new skills (82,2%) and new concepts (89,5%).

On the other hand, Data Literate survey allows us to gather some qualitative insights useful to deeper contextualize what the term "new concepts" means. When asked both about data Literacy theme(s) they have been working on during the learning session and new concepts learned, it is interesting to note that students' answers can be clustered into two main groups: general concept(s) related to the content of the training (e.g. data collection, cleaning, analysis and/or visualisation), and more specific topic related to the project within they applied this knowledge (e.g. solar energy, mental health and covid-19, teens' shopping habits).

To conclude the survey analysis, it is worthy to focus both on the challenges faced by students and teachers during the piloting phase and on future perspectives. As far as the piloting session's challenging moments are concerned, the respondents highlighted 3 main areas:

– Challenges related to the educational content (e.g. no familiarity with spreadsheet, difficulty in finding the right dataset).
– Challenges related to students' attitude (e.g. lack of attention and/or interest).
– Challenges related to time management. Overall, many comments underline that there was not enough time to make students fully grasp all the concepts and to use data effectively for their learning. It is interesting to highlight the following suggestion given in the additional comment: "I would recommend dedicating a full elective subject to data training and more practical activities".

Eventually the survey results highlighted some potential future perspectives of the Learning Unit Plans piloted in several classrooms. Teachers had to rate from 1 to 5:

– The inclusion of the LUP within the curriculum of the class in which the pilot has been implemented (average rating: 4,2).
– The LUP implementation in other classes (average rating: 4,1).
– The possibility to use some content of the LUP of another partner of the consortium (average rating: 4,1).

Concerning the students of the Dalfys project, 231 students out of 247 think that data literacy should be implemented in schools and 212 would be interested in participating in similar activities in the future. While 86,98% of Data Literate students believe that data literacy should be implemented in schools.

6. Conclusions

This paper aimed to give an overview of the pilot phase outcomes of the EU funded project Data Literate and Dalyfs, based on the analysis of the surveys designed for teachers and students.

Results of the survey show the importance of promoting data literacy skills is widely acknowledged, both from the teachers' point of view and from students' one. In this regard, initiatives such as the Data Literate and Dalfys projects play an important role and the satisfaction level with the pilot phase is overall positive. Nevertheless, it is key to treasure the feedback collected for future implementation of similar piloting sessions, in particular: improve time allocation (lack of time emerged as a main challenge from teachers' surveys) and increase practical examples in the learning content.

Furthermore, the answers provided highlight a general positive evaluation of the effect of the Data literate project implementation on the institution. Namely, respondents have underlined how it helped to develop a different approach to data, thus acknowledging its impact and potential in improving some practices in schools. Moreover, respondents highlight how the piloting sessions were very useful as a starting point for a discussion on the need to implement a comprehensive Digital Data Literacy Strategy in the whole School. However, in order to launch the process of elaborating such a strategy, promoting more inclusion of teachers and leaders will play a key role.

Since data literacy was not given adequate attention in the classroom curriculum, many comments related to no time to fully grasp all the concepts and to use data effectively for their learning resulted in the idea that there should be one full subject on data training. This could ensure that the gap in data literacy competences is filled faster as well as to better catch up with the time lost in teaching/learning these skills. Certainly, until there are key changes in school curriculum and integration of the data literacy, projects like Data Literate and Dalfys ensure the satisfaction of teachers and students, raise their level of awareness and importance of knowing data literacy, and as the results have shown - improve their skills.

From the survey presented in this paper, we addressed some key challenges that could be useful when implementing similar solutions in schools, as well as the strong will of the teachers and students to teach and learn about data literacy. The understanding of the importance of data literacy in schools is high by teachers and students, which is the key foundation for the successful implementation of data literacy oriented courses.

In future work, longitudinal studies should be conducted that would show how over time teachers and students adapt to studying in a data literacy manner, as well as how "long-term" the effects of such projects are, that is, whether there are significant changes in teaching over the years.

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