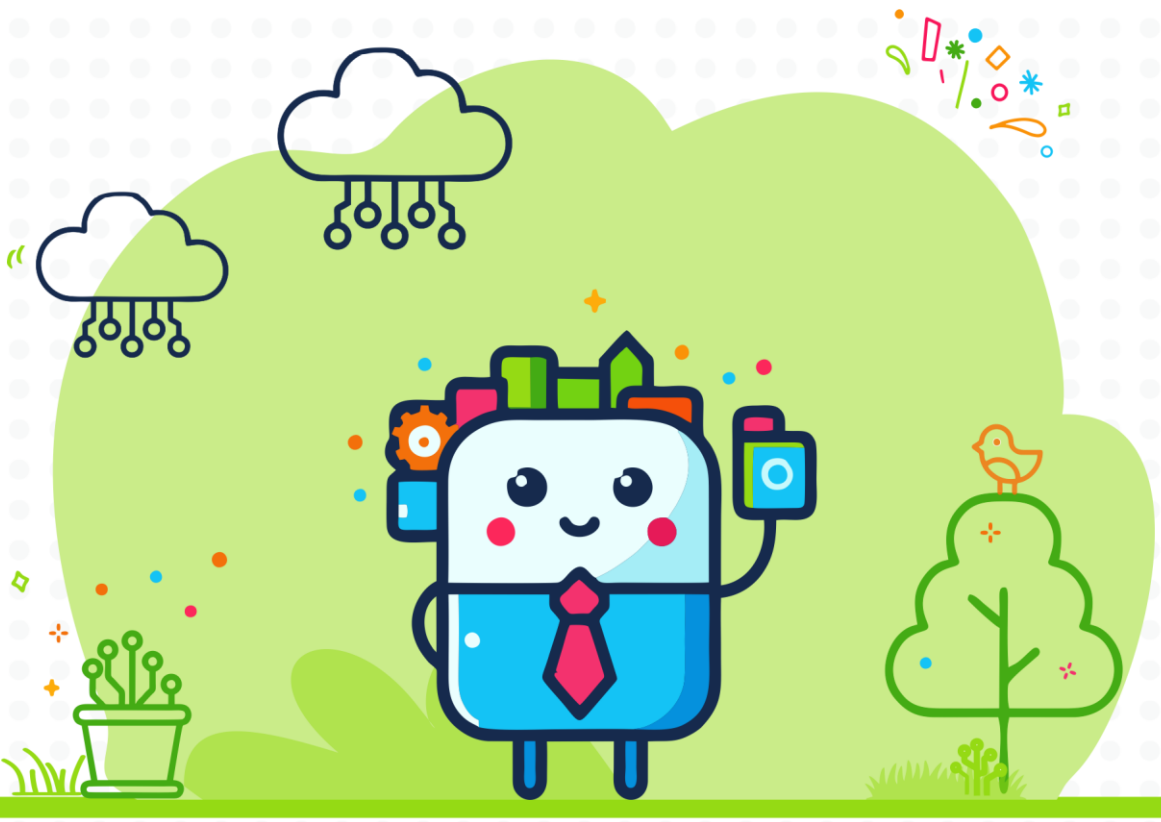
DIRECTORS

DIgital data-dRiven
EduCaTion fOR kidS



Teaching Data Literacy

to ISCED Level 1 Pupils

Curriculum guidelines

Teaching data literacy to ISCED level 1 pupils: Curriculum guidelines

Bastiaan van Loenen, Ivana Bosnić, Ana Kuveždić Divjak, Frederika Welle Donker

1. Introduction

Digital and data literacy are crucial today, especially for younger generations. The **DIRECTORS (DIgital data-dRiven EduCaTion fOR kidS)** project focuses on **promoting data literacy in primary education** through innovative teaching methods and materials. The project is implemented by the University of Zagreb in Croatia and the Delft University of Technology in the Netherlands, as part of the Erasmus+ programme co-funded by the European Commission.

As part of the DIRECTORS project, we developed **three workshops** for lower primary education (ISCED level 1), each consisting of two sessions. The workshops are structured around three levels of data literacy, with each level tailored to the age and prior knowledge of the pupils. Workshop 1: **Data in Our Hands (and Mobile Devices)** introduces basic data skills; Workshop 2: **Geospatial Data (and Maps) in Our Hands** targets intermediate skills; Workshop 3: **Data Sources** encourages the development of advanced data literacy.

Each workshop includes two sessions, and each session consists of two ~45-minute school periods. The activities are carefully designed to offer pupils hands-on experience through "learning by doing," enabling them to apply the acquired concepts in real-world contexts and covering the **entire data cycle** – from

(1) data collection carried out by the pupils in their own environment, through

(2) data processing in a "child-readable" format with error checking and cleaning if needed,

(3) data analysis by asking questions and drawing insights,

(4) data visualization to support clear communication and spatial thinking, to

(5) critical reflection and interpretation, drawing conclusions both from the data and about the data itself.

The approach was evaluated by teachers during workshop implementation and in the later seminars, aimed to provide teachers with concrete tools and materials for data literacy education. The materials were also evaluated by geography teachers / curriculum developer.

This report provides **curriculum guidelines for teaching data literacy** to ISCED level 1 pupils. It explains how **existing curricula** in **Croatia** and the **Netherlands** may **take advantage of the material developed by DIRECTORS**. We investigated the national learning outcomes for primary schools for Croatia (Chapter 2) and the Netherlands (Chapter 3). on topics related to our project and mapped these with the learning outcomes of the three DIRECTORS workshops (i.e., six DIRECTORS lessons).

Anyone can freely (re)use the DIRECTORS lesson materials. They are available on the DIRECTORS website: https://kidsdirectors.eu/

2. Croatia

2.1 Introduction

After several years of case studies, public discussions and pilot projects, the **National Curriculum Framework** was defined in 2019., comprising a set of documents on several education levels, and several levels of curriculum granularities.

Figure 1. The system of national curriculum documents that make up the complete National Curriculum
https://mzom.gov.hr/istaknute-teme/odgoj-i-obrazovanje/nacionalni-kurikulum/125

For our guidelines, the most important documents are definitions of curriculum for **each subject**, which are the most specific documents. Besides specific subjects, we also include one of **cross-curricular topics**, *Use of information and communication technologies for primary and secondary schools*. Such cross-cultural topics should span over several subjects and be intertwined throughout the education. In the next chapters, we will show the teachers' perception of the data literacy level in (primary) schools, show teachers' evaluation of our approach, and then move on to matching DIRECTORS learning outcomes to learning outcomes of specific courses and cross-curricular topics.

2.2 Current level of data literacy in schools in Croatia: survey results

On May 14th, 2025, a **seminar on data literacy and data teaching methods,** included in the catalogue of professional conferences of the Croatian Education and Teacher Training Agency, was held in Croatia as a part of this project. In total, **175 participants** – mostly teachers – attended the seminar to get introduced to our approach on teaching data literacy.

In the introductory part of the seminar, along with a brief presentation of the project objectives and previous project activities, a **survey** was conducted among teachers to collect

their opinions on the current level of data literacy in schools and **their attitudes towards this topic**. The survey results show that there is room for improvement in the teaching of data literacy in primary schools. Although teachers recognize the **importance** of this topic and feel sufficiently (56%) and feel more than sufficiently (20%) **competent** for primary teaching, they believe that the majority of pupils at the end of the 4th grade are **not sufficiently familiar with the basic concepts of data literacy**. Namely, 59% of teachers believe that students are partially familiar with concepts such as data collection, graphical representations and interpretation of simple data, while only 10% of teachers believe that students are excellently and very well familiar with these concepts.

Teachers are also interested in **additional professional development**, especially in the form of short online seminars and always-available online courses, with 58.9% of teachers stating that they are interested in further training, and 40% of them showing conditional interest, depending on the content and duration. Teachers also believe that they **lack quality educational materials and digital tools** for teaching this topic, with 44.8% of teachers believing that they do not have enough quality content for teaching data literacy. They expressed the **greatest need for the following digital content**: manuals/textbooks (officially published), printed worksheets (officially published), additional digital content, which e.g. comes with a textbook (officially published), additional digital content available on the web (created by faculties, associations, projects...).

With these guidelines, we hope to provide an **additional level of support** for teachers who requested help in teaching data education.

2.3 Teachers' evaluation of DIRECTORS approach on the seminar

At the end of the seminar, a **participant satisfaction survey** was conducted, which showed positive results with an average score of 9.85/10. 89% of participants rated the **novelty of the content** with high scores (8 to 10), while 87% of participants rated the seminar's **interestingness** in the same way. In terms of practical benefits, 78% of participants rated the seminars as **useful for their practice**. Participants particularly highlighted **useful ideas**, such as *"Ideas for drawing travel routes (e.g. route to destination, directions for tourists), work for students of the Tourism School ;))"* and *"Drawing on foils :), Map tasks"*. Based on these results, we can conclude not only that the seminar was successful, with high levels of interest in applying the learned concepts in teaching, but also that the **DIRECTORS resources are useful for supporting teachers in data education**.

Evaluation feedback from teachers across all DIRECTORS workshops implemented within the **first** and the **second cycle** in Croatian schools shows how a very high level of satisfaction and a strong alignment with the intended learning objectives. Most outcomes were rated between 4 and 5 (on a five-point scale), with many competencies—such as recognising and categorising real-world data, analysing and visualising datasets, understanding data quality, working with spatial layers and georeferencing, and using GPS and sensor-based tools—receiving average scores close to 5. Teachers particularly valued the hands-on, inquiry-based approach, noting

that activities like data collection, map layering, and digital visualization were highly engaging for pupils and directly applicable in classroom practice. Opportunities for pupil questioning and participation were consistently rated with the maximum score (5), and suggestions for improvement were minimal. Overall, the combined qualitative and numerical feedback confirms that the workshops are methodologically sound, relevant, and effective in supporting core digital and data literacy skills.

2.4 Subject curriculum alignment to DIRECTORS learning outcomes

In terms of **aligning learning outcomes of each subject** in the Croatian national curriculum to DIRECTORS workshops and learning outcomes, we have comprised the following tables, listing the relevant outcomes of subjects, their ID and title (translated to English). Each outcome is followed by the list of our workshops and sessions (for instance WS1.2 means Workshop 1, Session 2) and the specific workshop learning outcomes related to the curriculum learning outcome. The subjects listed are ***Nature***, ***Math*** and ***Informatics*** as workshops relate mostly to them.

This can help teachers select the appropriate workshop(s) for a desired learning outcome.

PLEASE NOTE: As our project is aimed specifically for pupils of lower grades of primary school (1st to 4th grade), only their learning outcomes are included. However, we have received **positive feedback from teachers of other subjects and older pupils,** even up to secondary education level, who consider our materials useful even in those education levels, in subjects such as *Mathematics*, *Physics*, *Geography* or *Informatics*. In that way, thanks to the high adaptability of materials, they can be adopted even for learning outcomes of other courses and advanced level of subjects.

2.4.1 Nature subject

Learning outcome ID and Description; matching DIRECTORS workshops and outcomes	
PID OŠ B.1.2.	**The pupil navigates through time cycles, demonstrates changes and relationships between them, and explains the connection between time cycles and activities in life.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem.

	✣ categorize the data obtained. ✣ describe that data can change over time. ✣ ask investigative questions that can be answered with real-life data.
DIRECTORS WS2.1	N/A
DIRECTORS WS2.2	N/A
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.
PID OŠ A.B.C.D.1.1	**The pupil describes and presents, under guidance, the results of observations of nature, natural or social phenomena in the immediate environment and uses various sources of information.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ ask investigative questions that can be answered with real-life data. ✣ make conclusions about the problem-based questions based on the obtained data.

DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colors used on the map. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships.
DIRECTORS WS2.2	✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
PID OŠ A.2.2.	**The pupil explains the organization of time and shows the chronological sequence of events.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data.

	✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ categorize the data obtained. ✣ describe that data can change over time. ✣ ask investigative questions that can be answered with real-life data.
DIRECTORS WS2.1	N/A
DIRECTORS WS2.2	N/A
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.
PID OŠ B.2.3.	**The pupil compares, predicts changes and relationships and shows changes in time.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ categorize the data obtained. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ describe that data can change over time. ✣ compare the data of different users.

	✣ compare the measured data with the initial data estimation. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ analyse how different layers (e.g. roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships.
DIRECTORS WS2.2	✣ interpret the results of spatial analyses and make decisions about next steps in real time. ✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.
PID OŠ B.2.4	**The pupil navigates through the space, creates, analyzes and checks the sketch of his/her movement.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.

DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc.
DIRECTORS WS2.2	✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field. ✣ interpret the results of spatial analyses and make decisions about next steps in real time. ✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
PID OŠ A.B.C.D.2.1	**The pupil describes and presents, under guidance, the results of observations of nature, natural or social phenomena in the immediate environment and uses various sources of information.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis.

	✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ ask investigative questions that can be answered with real-life data. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colors used on the map. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships.
DIRECTORS WS2.2	✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data.

	✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
PID OŠ A.3.3.	**The pupil draws conclusions about the organization of the local community, compares the representations of different spaces.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ compare the data of different users. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolisation, including what a map is and how GIS uses layers to represent spatial data. ✣ analyse how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.

	✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
PID OŠ B.3.4.	**The pupil navigates the space, interprets the site plan and the map of the homeland, draws up a plan of the immediate surroundings and draws conclusions about the connection between the spatial conditions of the homeland and the way of life of the people.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ compare the data of different users. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolization, including what a map is and how GIS uses layers to represent spatial data. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyze how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers.

DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related. choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe how data variables can be related. choose the appropriate method to obtain data depending on the needed purpose.
PID OŠ A.B.C.D.3.1.	**The pupil explains, under guidance, the results of his/her own research on nature, natural and/or social phenomena and/or various sources of information.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ ask investigative questions that can be answered with real-life data.

	✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ analyze how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
PID OŠ A.B.C.D.4.1.	**The pupil explains, under guidance, the results of his/her own research on nature, natural and/or social phenomena and/or different sources of information**
DIRECTORS WS1.1	✣ recognize the data in the real world.

	✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ ask investigative questions that can be answered with real-life data. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolisation, including what a map is and how GIS uses layers to represent spatial data. ✣ explain the differences between traditional paper maps and maps in a GIS, and describe how georeferencing helps to place a map in the correct location, i.e., aligning it with real-world coordinates. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyse how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colors used on the map.

DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time. ✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.

2.4.2 Math subject

Learning outcome ID and Descriprion; matching DIRECTORS workshops and outcomes	
MAT OŠ E.1.1.	**The pupil uses data and displays it with pictograms and simple tables.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data.

	✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ categorize the data obtained. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ describe that data can change over time. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ illustrate the possibility of low-quality or incorrect data. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolisation, including what a map is and how GIS uses layers to represent spatial data. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colours used on the map. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	N/A
DIRECTORS WS3.1	✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.

DIRECTORS WS3.2	✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
MAT OŠ E.2.1.	**The pupil uses data from the immediate environment.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ describe that data can change over time. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ illustrate the possibility of low-quality or incorrect data. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyse how different layers (e.g. roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors.

	✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
MAT OŠ E.3.1.	**The pupil uses different data representations.**
DIRECTORS WS1.1	✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data. ✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ categorize the data obtained. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ compare the measured data with the initial data estimation. ✣ illustrate the possibility of low-quality or incorrect data. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.

DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolization, including what a map is and how GIS uses layers to represent spatial data. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colors used on the map. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ choose the appropriate method to obtain data depending on the needed purpose.
MAT OŠ E.4.1.	**Conducts simple research and analyses the obtained data.**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data.

	✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ categorize the data obtained. ✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ describe that data can change over time. ✣ compare the data of different users. ✣ compare the measured data with the initial data estimation. ✣ discuss the questions of anonymization and privacy. ✣ illustrate the possibility of low-quality or incorrect data. ✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	✣ analyze how different layers (e.g. roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers.
DIRECTORS WS2.2	✣ interpret the results of spatial analyses and make decisions about next steps in real time. ✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.

DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.

2.4.3 Informatics subject

PLEASE NOTE: While there is only one **specific** learning outcome in the table for the *Informatics* subject, our workshops indirectly touch upon many different aspects and learning outcomes of informatics used while implementing workshops. They are not specified here as they are not the primary focus of our workshops.

A few examples of DIRECTORS side activities that would correspond to informatics topics:

- ✣ Filling out an online form (e.g. *Google Forms*)
- ✣ Learning about tools and applications for data analysis (e.g. *Microsoft Excel, Google Spreadsheet*, etc.)
- ✣ Using mobile phones for specific useful tasks (e.g. using *Google Maps*, *Digital Wellbeing*, pedometer apps, etc.)

Learning outcome ID and Description; matching DIRECTORS workshops and outcomes	
OŠ INF B. 3. 2	**After the third year of studying computer science in the domain of computational thinking and programming, the pupil organizes the data in a useful way.**
DIRECTORS WS1.1	✣ identify different types of data. ✣ classify, categorize, and group data.
DIRECTORS WS1.2	✣ prepare and input the data for analysis. ✣ categorize the data obtained.
DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc.

	✣ analyze how different layers (e.g. roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colours used on the map.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data.

2.5 Cross-curriculum topic alignment to DIRECTORS learning outcomes

There are seven cross-curriculum topics defined in the National curriculum. These are *Use of ICT*, *Civic education*, *Personal and Social development*, *Learning how to learn*, *Health*, *Sustainable development and Entrepreneurship*. For our workshops, the most important topic is **Use of ICT**.

In this topic, a number of learning outcomes can be matched by implementing our workshops, specifically 14 from the first two cycles (7 for cycle 1: grade 1 and 2; the other 7 for cycle 2: grades 3, 4 and 5). **Each of these outcomes will be fulfilled by many direct and indirect workshop outcomes.** Therefore, we will not be writing the tables, as they would be almost identical and contain almost all our outcomes. Instead, we will only give the IDs and the titles of the curriculum outcomes. The reader can see that the outcomes match; for example, pupils use the programs, devices, conduct research, etc. All of these are essential for our workshops.

PLEASE NOTE: Feedback received from the teachers showed that they have **additional ideas** to include our workshops in **other cross-curricular activities** and subjects, such as *Civic education* (working with maps of pupils' environment for life improvement). These suggestions are very welcome, and they are a good sign that our resources are highly adaptable for different educational purposes.

Use of ICT – Cycle 1: grades 1 and 2	
ikt A.1.1.	The pupil, with the teacher's help, selects the appropriate digital technology to perform simple tasks.
ikt A.1.2.	The pupil uses selected devices and programs with the teacher's help.
ikt A.1.3.	The pupil applies the rules for responsible and safe use of programs and devices.
ikt C.1.1.	With the help of the teacher, the pupil conducts simple research to solve problems in a digital environment.
ikt C.1.3.	The pupil, with the teacher's help, selects the necessary information from among those found.
ikt C.1.4.	The pupil, with the teacher's help, responsibly manages the collected information.
ikt D.1.2.	With the teacher's help, the pupil identifies and solves simple problems using ICT.

Use of ICT – Cycle 2: grades 3, 4 and 5	
ikt A.2.1.	The pupil, following the advice, selects the appropriate digital technology to complete the task.
ikt A.2.2.	The pupil independently uses devices and programs that are familiar to him.
ikt A.2.3.	The pupil uses programs and devices responsibly and safely.
ikt C.2.1.	The pupil, with occasional help from the teacher or independently, conducts simple research to solve problems in a digital environment.
ikt C.2.3.	The pupil, with the teacher's help or independently, compares and selects the necessary information from among those found.
ikt C.2.4.	The pupil, with the teacher's help, responsibly manages the collected information.
ikt D.2.2.	The pupil solves simple problems using digital technology.

3. The Netherlands

3.1 Introduction

The discussion about including of data literacy in the Dutch primary school curricula took off in 2018 (curriculum.nu, 2018). In 2022, the Dutch ministry of Education, Culture and Science assigned SLO to update the core objectives for primary, special and secondary education in the Netherlands. The national expertise center for the curriculum, SLO (Stiching Leerplan Ontwikkeling) is responsible for the development of the curriculum in primary, special and secondary education in the Netherlands.

In July 2025, SLO published the 'final draft core objectives citizenship and digital literacy' (*Definitieve conceptkerndoelen burgerschap en digitale geletterdheid*) as well as the final draft core objectives calculus and mathematics (*Definitieve conceptkerndoelen rekenen en wiskunde*). In 2024, they published the draft core objectives people and nature (*Conceptkerndoelen Mens en natuur*) and the draft core objectives people and society (*Conceptkerndoelen Mens en maatschappij*). These final draft and draft core objectives will be starting point for matching DIRECTORS learning objectives with these.

3.2 Learning objectives Citizenship and Digital Literacy (final draft)

The digital literacy core objectives are divided into three domains: the digitized world, design and making, and practical knowledge and skills.

The Tables below show how the DIRECTORS workshop relate to the core learning objectives for primary school education on citizenship and digital literacy in the Netherlands.

Core objective 22 A: Digital systems: The pupil uses digital technology and media.	
Core objective 22A1	**describing the components and functioning of digital systems in terms of input-processing-output;**
DIRECTORS WS1.1	N/A
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis.
DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolization, including what a map is and how GIS uses layers to represent spatial data. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyze how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.

	✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods.
DIRECTORS WS3.2	✣ use technology-based applications for obtaining and visualizing GPS data.
Core objective 22A2	**use the basic capabilities of software for communication, collaboration, drawing, calculation, word processing, presentation and image, sound and video editing;**
DIRECTORS WS1.1	N/A
DIRECTORS WS1.2	N/A
DIRECTORS WS2.1	N/A
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field.
DIRECTORS WS3.1	N/A
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data.
Core objective 22A3	**managing files in digital environments: structured organisation, storage and retrieval;**
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective
Core objective 22A4	**recognizing digital systems in one's own environment;**
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective
Core objective 22A5	**maintaining and adapting digital systems and solving problems with them.**
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective

Core objective 22 C Data: The pupil explores the use of data and data processing.	
Core objective 22C1	**describe how information is extracted from data through targeted collection, structure and processing of data;**
DIRECTORS WS1.1	✣ recognize the data in the real world. ✣ identify different types of data. ✣ classify, categorize, and group data.
DIRECTORS WS1.2	✣ categorize the data obtained.
DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyse how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ analyse the data based on visualizations. ✣ analyse the data over various factors. ✣ describe that data can change over time.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data.
Core objective 22C2	**show understanding of how the results of data processing depend on the origin, accuracy and completeness of the dataset used;**
DIRECTORS WS1.1	✣ analyse the similarities and differences in data.

	✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ analyse the data over various factors. ✣ analyse the data based on visualizations. ✣ describe that data can change over time. ✣ illustrate the possibility of low-quality or incorrect data.
DIRECTORS WS2.1	✣ explain the differences between traditional paper maps and maps in a GIS, and describe how georeferencing helps to place a map in the correct location, i.e., aligning it with real-world coordinates. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyse how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ illustrate simple examples of obtaining less accurate or correct data. ✣ describe issues related to data quality. ✣ describe how data variables can be related. ✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ describe issues related to data quality. ✣ describe how data variables can be related.

	✣ choose the appropriate method to obtain data depending on the needed purpose.
Core objective 22C3	**answering a question using a dataset;**
DIRECTORS WS1.1	✣ answer investigative questions that can be answered with real-life data.
DIRECTORS WS1.2	✣ ask investigative questions that can be answered with real-life data. ✣ predict the possible answers to problem-based questions. ✣ make conclusions about the problem-based questions based on the obtained data.
DIRECTORS WS2.1	N/A
DIRECTORS WS2.2	✣ perform simple spatial analyses (buffer operations, filter, counting, area measurement) to find an answer to a spatial problem. ✣ navigate in its direct environment using a GIS/map (*to find the missing person*). ✣ navigate in its direct environment with a GPS receiver (*to find the missing person*).
DIRECTORS WS3.1	✣ choose the appropriate method to obtain data depending on the needed purpose.
DIRECTORS WS3.2	✣ choose the appropriate method to obtain data depending on the needed purpose.
Core objective 22C4	**describing the use of data in one's own environment;**
DIRECTORS WS1.1	✣ recognize the data in the real world.
DIRECTORS WS1.2	✣ compare the data of different users. ✣ compare the measured data with the initial data estimation.
DIRECTORS WS2.1	✣ evaluate their own maps and the maps of their peers, discussing how accurately they represent the real-world objects and relationships, and how well the map is understood by a computer. ✣ create a layered map using transparency sheets, add symbology such as scale and north arrows, and construct a legend to explain the symbols and colours used on their map.
DIRECTORS WS2.2	N/A

DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors.
Core objective 22C5	**reflect on the fact that the user of digital technology consciously and unconsciously leaves data behind and that it can be used by others.**
DIRECTORS WS1.1	N/A
DIRECTORS WS1.2	✣ discuss the questions of anonymization and privacy.
DIRECTORS WS2.1	N/A
DIRECTORS WS2.2	N/A
DIRECTORS WS3.1	N/A
DIRECTORS WS3.2	N/A

3.3 Learning objectives Calculus and Mathematics (rekenen en wiskunde) (final draft)

Core objective 11: The pupil shows insight when acting with quantities and units.	
Core objective	The pupil measures, reasons and calculates with quantities and matching units. Examples: • length, area, volume, weight (mass), speed, time, money, temperature and memory size; • measuring with appropriate measuring instruments; • determining the circumference, area and volume of rectangular figures; • estimating and checking with reference measures and measurement references; • establish relationships between quantities and units, between quantities and between units themselves.
DIRECTORS WS1.1	N/A
DIRECTORS WS1.2	N/A

DIRECTORS WS2.1	✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyse how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ explain the existence of differences when obtaining data for the same purpose using different methods. ✣ describe how data variables can be related.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ describe how data variables can be related.

Core objective 12: The pupil interprets data	
Core objective 12	The pupil interprets and represents data Examples: • filling in tables for data; • calculating and interpreting an average; • making graphical representations of data and drawing conclusions from them; • interpreting graphical representations and reasoning whether the conclusions presented in the process are correct, incorrect or partially correct; • graphical representations: diagrams, graphs and infographics.
DIRECTORS WS1.1	✣ classify, categorize, and group data. ✣ analyse the similarities and differences in data.
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem. ✣ prepare and input the data for analysis. ✣ categorize the data obtained. ✣ analyze the data based on visualizations. ✣ analyze the data over various factors.

DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolization, including what a map is and how GIS uses layers to represent spatial data. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyze how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer. ✣ create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colors used on the map.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data.

Core objective 14	**Core objective 14: The pupil shows insight into geometrical action**
Core objective 14	The pupil reasons about geometric figures and positioning and performs geometric transformations. Examples: • reasoning with and about properties of geometric figures and concepts; • reasoning with lines of sight; • constructing and interpreting maps, route descriptions and signposts; • constructing and interpreting two-dimensional representations of three-dimensional figures and establishing relationships between two- and three-dimensional representations of figures;

	• geometric transformations: turning, mirroring, enlarging and reducing figures.
DIRECTORS WS1.1	N/A
DIRECTORS WS1.2	N/A
DIRECTORS WS2.1	✣ identify basic concepts related to maps, layers, and symbolisation, including what a map is and how GIS uses layers to represent spatial data. ✣ explain the differences between traditional paper maps and maps in a GIS, and describe how georeferencing helps to place a map in the correct location, i.e., aligning it with real-world coordinates. ✣ apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc. ✣ analyse how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers. ✣ evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location. ✣ interpret the results of spatial analyses and make decisions about next steps in real time. ✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field.
DIRECTORS WS3.1	N/A
DIRECTORS WS3.2	N/A

Core objective 16B: The pupil uses mathematical language and mathematical tools	
Core objective 16B:	The pupil uses measuring instruments and other mathematical instruments. Examples: • Rational choice for the use of an instrument based on its capabilities, limitations and measurement accuracy; • estimating measurement results and outcomes in advance;

	• use of an instrument and the associated mathematical language; • determining, interpreting and assessing the result
DIRECTORS WS1.1	✣ analyze the similarities and differences in data. [NB: using the step counter]
DIRECTORS WS1.2	✣ choose the data sources needed to investigate a posed problem.
DIRECTORS WS2.1	N/A
DIRECTORS WS2.2	✣ use coordinates and a GPS device or mobile navigation app to move to selected points in the field.
DIRECTORS WS3.1	✣ use technology-based solutions for obtaining data from real-world sensors.
DIRECTORS WS3.2	✣ use technology-based solutions for obtaining data from real-world sensors. ✣ use technology-based applications for obtaining and visualizing GPS data. ✣ choose the appropriate method to obtain data depending on the needed purpose.

3.4 Learning objectives People and society (*mens en maatschappij*) (draft)

Core objective 3: The pupil analyzes the world with geographical sources and from a personal perspective	
Core objective 3A	indicating the location of continents, oceans, mountains, rivers, countries and cities on topographical maps, using global location indications;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective
Core objective 3B	distinguish between different landscapes and geographical divisions and boundaries using topographical, overview and thematic maps;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective
Core objective 3C	making links between geographical characteristics of areas and their functions: housing, food supply, work, infrastructure and recreation;
DIRECTORS WS2.2	✣ apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.

Core objective 3D	describe population and cultural characteristics of areas;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.
Core objective 3E	describe how people give personal meaning to places;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.

Core objective 4: The pupil describes how human actions and the natural environment influence each other	
Core objective 4A	describe how people design the natural environment for housing, food supply, work, infrastructure and recreation;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.
Core objective 4B	describe how natural conditions influence the design of areas: water, soil and climate;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.
Core objective 4C	describing measures that will enable residents of the Netherlands to deal with the risks of climate change now and in the future;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.
Core objective 4D	describe how the use of natural resources leads to changes in nature: production, consumption, waste and transport;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.
Core objective 4E	describe how people design the natural environment for housing, food supply, work, infrastructure and recreation;
DIRECTORS WS	No DIRECTORS workshop can be linked to this objective.

3.5 Learning objectives People and nature (*mens en natuur*) (draft)

No learning objectives directly related to DIRECTORS WS.

4. Conclusion

This report provides curriculum guidelines for teaching data literacy to ISCED level 1 pupils. It explained how teachers using existing educational curricula in Croatia and the Netherlands may take advantage of the resources developed by DIRECTORS. We investigated the **national learning outcomes** for primary schools in Croatia and the Netherlands – particularly topics related to our project – and **mapped these with the learning outcomes of the three DIRECTORS workshops** (i.e., six DIRECTORS sessions).

In our analysis we found that DIRECTORS lessons are especially relevant to learning outcomes on the subjects of *Nature*, *Mathematics* and *Informatics* (Croatia). In the Netherlands, the DIRECTORS lessons are especially relevant to learning outcomes on the subjects *Citizenship and Digital Literacy*, Calculus and Mathematics, *People and Society*.

In our analysis of matching national curriculum learning outcomes with DIRECTORS learning outcomes we found **outcomes with a direct match**. For example, the Dutch *Citizenship and Digital Literacy* subject *Core objective 22 C Data* is "*The pupil explores the use of data and data processing*". Our *Workshop 1.2* outcomes (*analyze the data over various factors; analyze the data based on visualizations; describe that data can change over time; and illustrate the possibility of low-quality or incorrect data*) resonate directly with this outcome.

However, we also found **indirectly matching outcomes**. For example, in the Croatian *Nature* subject, *PID OŠ B.1.2* outcome, "*The pupil navigates through time cycles, demonstrates changes and relationships between them, and explains the connection between time cycles and activities in life*." In our *Workshop 1.1* pupils reported and analyzed their app use per day. This could vary depending on day of the week, or weekend but also on seasons: more use of games in winter, less in summer, etc. Therefore, we did connect the outcomes of this workshop to the learning outcomes of the Croatian *Nature* subject. We believe that even such relations can provide useful ideas for teachers.

In addition, we received **feedback** from teachers in Croatia and the Netherlands **teaching older pupils** (secondary schools) that they are also interested in teaching our materials in their classrooms with older pupils (age 12-15, in Croatia even up to 18). This could be implemented by making use of many different options provided in our lesson plans; the workshops are flexible and provide ideas for variable amount of available time and resources, variable number of pupils or variable age. For instance, Workshop 2.1 can be extended for older pupils by introducing more advanced spatial reasoning tasks or by linking the activities with existing civic education programs such as Zajednica aktivnih građana (Active Citizens Community – ACC/ZAG) – an extracurricular civic education activity currently implemented in 63 primary and 13 secondary schools in the City of Zagreb. We received feedback from a teacher that layered mapping, georeferencing and simple spatial analyses strongly support the aims of ZAG, which encourages pupils to reflect on fairness, sustainability and community well-being. Older pupils can therefore use Workshop 2.1 to map real issues in their neighborhoods – such as

accessibility barriers, insufficient public lighting, damaged benches or environmental hotspots – and propose data-based solutions. In the same light, Workshop *3.2* can be implemented outdoors with basic and quick measurement, or can include extensive GPX measurement over larger distances, with more detailed experiments.

Besides regular school activities and subjects, feedback shows that our workshops can also be adapted for use in cross-curricular activities and within the emerging full-day school (Cjelodnevna škola) model in Croatia. In this model, pupils spend the entire day in school, combining regular lessons with structured educational activities delivered in a more flexible and less formal setting. Teachers highlighted that DIRECTORS workshops fit well into these formats because they support hands-on, inquiry-based learning that can be carried out during project blocks, extended-day programs or thematic days. The materials allow pupils to learn in an engaging way while still developing curricular competencies, making them suitable for both cross-curricular projects and the broader educational goals of the full-day school system.

We conclude that our proof of concept to teach data science to lower grade primary school data literacy education **matches many learning outcomes for primary schools very well in both Croatia and the Netherlands**. Therefore, it can be recommended to teachers in primary schools, but also curriculum developers in other countries to use or be inspired by our work.

Interested in implementing our workshops? All materials are available on our website www.kidsdirectors.eu, and you can reach us at info@kidsdirectors.eu.

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Appendix DIRECTORS Learning Outcomes per Workshop

Workshop 1.1: Data in Our Hands (and Mobile Devices): Mobile Device Usage Data

Learning Outcomes – Teacher Language

By the end of this lesson, the pupil will be able to:

- recognize the data in the real world.
- identify different types of data.
- classify, categorize, and group data.
- analyse the similarities and differences in data.
- answer investigative questions that can be answered with real-life data.

Workshop 1.2: Data in Our Hands (and Mobile Devices): Collecting and Analysing Mobile Device Usage Data

Learning Outcomes – Teacher Language

By the end of this lesson, the pupil will be able to:

- choose the data sources needed to investigate a posed problem.
- prepare and input the data for analysis.
- categorize the data obtained.
- analyse the data based on visualizations.
- analyse the data over various factors.
- describe that data can change over time.
- compare the data of different users.
- compare the measured data with the initial data estimation.
- discuss the questions of anonymization and privacy.
- illustrate the possibility of low-quality or incorrect data.
- ask investigative questions that can be answered with real-life data.
- predict the possible answers to problem-based questions.
- make conclusions about the problem-based questions based on the obtained data.

Workshop 2.1: Geospatial Data (and Maps) in Our Hands: Smart Maps in Action: Trace, Overlay, and Discover!

Learning Outcomes – Teacher Language

By the end of this lesson, the pupil will be able to:

- Identify basic concepts related to maps, layers, and symbolization, including what a map is and how GIS uses layers to represent spatial data.
- Explain the differences between traditional paper maps and maps in a GIS, and describe how georeferencing helps to place a map in the correct location, i.e., aligning it with real-world coordinates.
- Apply georeferencing techniques by aligning transparencies with a base map and create different layers representing buildings, roads, trees, etc.
- Analyze how different layers (e.g., roads, buildings) interact when combined into a complete map and explain the importance of correct alignment of these layers.
- Evaluate the map they created and those created by peers, discussing how accurately they represent real-world features and relationships, and how understandable the map is to a computer.
- Create a layered map using transparencies, add a graphic scale and a north arrow, and design a legend that explains the symbols and colours used on the map.

Workshop 2.2: Geospatial Data (and Maps) in Our Hands: Escape (class)room! Spatial Data Analysis

Learning Outcomes – Teacher Language

By the end of this lesson, the pupil will be able to:

- Apply basic GIS operations (e.g. filtering, buffering, intersection) to narrow down the search area for a target location.
- Interpret the results of spatial analyses and make decisions about next steps in real time.
- Use coordinates and a GPS device or mobile navigation app to move to selected points in the field.

Workshop 3.1: Data Sources: From Our Bodies to Sensor Technologies

Learning Outcomes – Teacher Language

By the end of this lesson, the pupil will be able to:

- use technology-based solutions for obtaining data from real-world sensors.
- explain the existence of differences when obtaining data for the same purpose using different methods.
- illustrate simple examples of obtaining less accurate or correct data.
- describe issues related to data quality.
- describe how data variables can be related.
- choose the appropriate method to obtain data depending on the needed purpose.

Workshop 3.2: Data Sources: Technology to the Rescue! Or not?

Learning Outcomes – Teacher Language

By the end of this lesson, the pupil will be able to:

- use technology-based solutions for obtaining data from real-world sensors.
- use technology-based applications for obtaining and visualizing GPS data.
- describe issues related to data quality.
- describe how data variables can be related.
- choose the appropriate method to obtain data depending on the needed purpose.

DIRECTORS

TU Delft Delft University of Technology | University of Zagreb Faculty of Geodesy | University of Zagreb Faculty of Electrical Engineering and Computing

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Our goal is to **promote data literacy in primary education** through new teaching methods and materials. We aim to support the updating of existing curricula related to data education, with the goal of enhancing digital and data skills among **teachers and pupils**.

These open educational resources are the result of the DIRECTORS project's commitment to strengthening data literacy among young primary school pupils, offering **practical and age-appropriate** open content designed for both teachers and learners.

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