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Learn2Analyze (L2A)

An Academia-Industry Knowledge Alliance for enhancing Online Training Professionals' (Instructional Designers and e-Trainers) Competences in Educational Data Analytics

Learn2Analyze

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R2. Report on the analysis of existing competence frameworks and professional development programs for Instructional Designers and e-Trainers (environment scan review)

Disclaimer:

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Executive Summary

The scope of **Result 2** (*Report on the analysis of existing competence frameworks and professional development programs for Instructional Designers and e-Trainers (environment scan review)*) is to provide an **environment scan** on the 2 core topics of the Learn2Anayse project, namely, the ***Educational Data Literacy (EDL)***:

- **Competence Profile (CP)** framework for Instructional Designers, e-Tutors of Online and Blended Courses and Educators, at large;
- Professional Development and University **Courses**

so as to propose the initial version of the Learn2Analyse **Educational Data Literacy (EDL) Competence Profile (CP)** framework for e-Learning Professionals and Educators (consisting of 6 Competence **Dimensions**, and 21 Competence **Statements** which aim to describe these dimensions) that will be validated in R3 (Report on the emerging competences for Instructional Designers and e- Trainers (expert-based survey)) through an *expert-based questionnaire-driven online survey* with *210 experts* from *Higher Education Institutes* and *eLearning Industry Enterprises*.

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1. Scope

The scope of **Result 2** (*Report on the analysis of existing competence frameworks and professional development programs for Instructional Designers and e-Trainers (environment scan review)*) is to provide an **environment scan** on the 2 core topics of the Learn2Anayse project, namely, the ***Educational Data Literacy (EDL)***:

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The document is organised in 2 parts:

- **Part A** presents the environment scan on the definition of the Learn2Analyse Educational Data Literacy (EDL) Competence Profile (CP)
- **Part B** presents the environment scan on existing professional development and university courses and/or programs on the topic of Educational Data Literacy

PART A: EDUCATIONAL DATA LITERACY COMPETENCE PROFILES

A1. Educational Data Literacy: overview of the current landscape

As daily interactions with data become commonplace and individuals more frequently make judgments from data and decisions regarding the use of their own data (Haddadi et al., 2015), data literacy is increasingly considered to be a life competence. Competence is defined as **a set of skills, knowledge and attitudes** that are possessed or need to be acquired to perform an activity within a specific context, whereas performance may range from the basic level of proficiency to the highest levels of excellence (Sampson and Fytros, 2008). In the context of professional development, competence is the capacity to apply a set of related skills, knowledge and attitudes for the successful performance of "critical job functions" in a given job setting. As such, a Competence Profile (CP) captures and describes the **set of competences needed for a particular job or role** in a certain profession. As such, it can be used for the design of professional development courses as well as for the building of competence assessment and course accreditation instruments in professional learning.

The definition of an Educational Data Literacy Competence Profile (EDL CP) **for the roles** of Instructional Designers (ID) and e-Tutors (eTUT) of Online and Blended (Professional Development and/or Higher Education) courses is an essential extension of existing competence frameworks of these two key roles in digital learning industry. Towards capitalizing on and extending previous frameworks, the critical questions that guided the research concern (a) the conceptualizations of the notion of EDL, (b) its dimensions, and (c) the related competences it includes, **with respect to the two key roles**. These questions have been defined as follows:

1. *How is EDL defined in existing EDL research? Are there any substantial differences/ similarities between these definitions? Can a common **EDL definition** be proposed?*
2. *Which are the **main EDL dimensions** that are identified in existing EDL Competence Frameworks (CF)?*
3. *Which are the **key competence statements** of existing EDL CF in general and, specifically for Instructional Designers and e-Tutors of Online and Blended (Professional Development and/or Higher Education) courses?*

The phases of the development of the Learn2Analyze EDL CF for ID/eTUT of online/blended courses are depicted in Figure A.1.

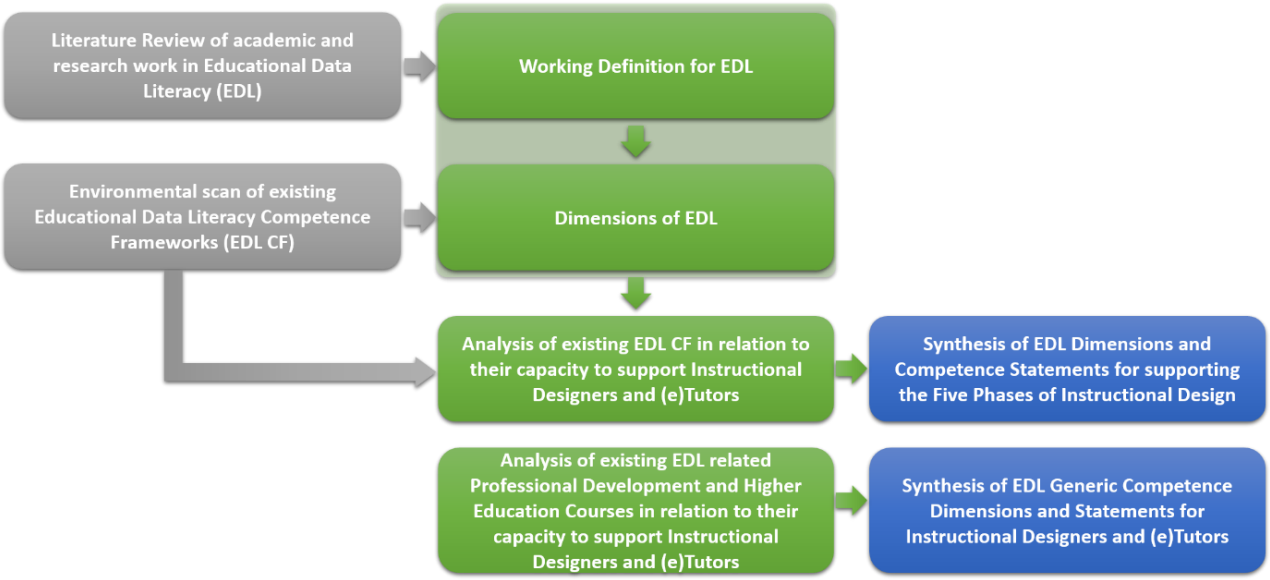

Figure A.1: Main phases of the study for the Learn2Analyze EDL Competence Framework

Specifically, in order to address the research questions, to produce a common definition for EDL and to propose an EDL CF that establishes the **extension** of existing CFs with new competences for both job roles (i.e., ID/eTUT), and can be taken as a **benchmark** by any professional development initiative which aims at exploiting EDL competence-based online/blended courses, we therefore first perform:

- a literature review of selected articles relevant to EDL concepts to propose a working definition for EDL,
- an environmental scan of existing EDL or EDL-relevant competence profiles to identify key EDL dimensions and core competence statements per dimension, and
- an analysis of the design of EDL-relevant higher education and professional development courses and initiatives to identify key EDL-related objectives.

We understand here as EDL CF an instrument for the development or assessment of EDL Competences according to a set of criteria, which establishes descriptors of intertwined competences aimed at enhancing the EDL of the specific target groups, i.e., ID/eTUT. Therefore, we selected Online and Blended (Professional Development and/or Higher Education) courses and initiatives intended to tackle EDL, as well as articles or reports which propose a systematisation or interpretation to shape the EDL landscape.

The studies presented here have been identified and collected after an extensive and iterative search in the international databases of authoritative academic resources and publishers. Scans of concepts related to EDL (i.e., *educational data literacy; educational data literacy framework; educational data literacy competences; data literacy; data literacy framework; educational data analytics use; use of educational data for teaching; use of educational data for instruction; use of educational data for instructional design; educational data-driven decision making; educational data-driven instructional design; educational data-driven courses; educational data usage for training*) were conducted in (a) academic publication databases (i.e., Web of Science; ERIC; Scopus; Google scholar; Sciencedirect), (b) selected academic Journals and Conference Proceedings (e.g.,

IEEE International Conference on Advanced Learning Technologies, Learning Analytics and Knowledge Conference), and (c) simple Google search[1]. We also searched for grey literature and identified articles and white papers. As this is an emerging field, we generally found that the courses and workshops, and associations and organizations were more current. The time frame of the search was bound within the last decade (2005-2018), in which emergence of data literacy has grown.

Non-statistical methods were used to analyze the collected resources, to evaluate and interpret findings of the collected resources, to build the EDL competence profiles and to conduct the synthesis of this report. The findings are functionally organized: how educational data and data-driven decision making in educational settings are defined, how data literacy and educational date literacy are defined, and how we establish a common definition of educational data literacy, and which dimensions and competence statements it includes.

A1.1. Literature Review of academic and research work in Educational Data Literacy

As the scope of the literature review was to develop a **common understanding** and a **working definition of EDL**, as well as to build a draft for an EDL competence profile for the two target job roles, at the end of the resource collection stage, we determined the criteria for inclusion/ exclusion of the gathered resources. The identification of cases to be included in this collection depended highly on the relevance of the scope of this study. Although comprehensive examples of EDL initiatives has been collected, a second step in the selection of the works to include in the review aimed at reducing the body of cases under what constituted a "framework", i.e., any organised conceptualisation of the competences and sub-competences related to EDL. As such, emphasis was given to works reporting on existing EDL or EDL-relevant competence profiles, especially the ones that provide detailed competence statements, as they are the core references to analyse. Another limitation concerned terminology issues, as the terms "competence" and "literacy" are used with different meaning in different contexts.

A1.1.1. Educational Data and Data-Driven Decision Making in Educational Settings

Educational data can be broadly defined as "information that is collected and organised to represent **some aspect of schools**. This could include […] any relevant information about students, parents, schools, and teachers derived from qualitative and quantitative methods of analysis" (Lai & Schildkamp, 2013 - p. 10). Beyond the common misconception that educational data is restricted to students' grades in national and standardised exams, the above definition suggests that educational data comprises **a wide range of data** generated by **various and multiple sources**, both internal (school-wide and classroom-specific data) and external (state and/or district data) to the school.

Ikemoto and Marsh (2007) categorized educational data into *input data* (e.g., school expenditures, student demographics), *process data* (e.g., data on financial operations, data on the quality of instruction), *outcome data* (e.g., dropout rates, student test scores), and *satisfaction data* (e.g., opinions from teachers, students, parents, or the community). Extending this categorization of educational data, Lai and Schildkamp (2013) proposed a broader layout that includes *context data*

[1] The simple Google search facilitated the identification of published research work - beyond the academic articles - as well as for the identification of the professional development courses.

(e.g., curriculum, school human resources, infrastructure, financial plans, school culture), *input data* (e.g., student characteristics like demographics and prior academic performance, and teacher characteristics like teacher competences, academic qualifications or professional experience), *process data* (e.g., lesson plans, methods of assessments, classroom management), and *outcome data* (e.g., students' achievements, wellbeing, social and emotional development).

Having as objective the **improvement of students' learning and schools' performance**, the U.S. Department of Education and the Institute of Education Sciences suggested Data-Driven Decision Making (DDDM) as a process that involves stakeholders (i.e., educators, principals, and administrators) who systematically collect and analyze various types of educational data **to inform and guide a range of decisions** and reconsiderations (through reflection) towards achieving this objective (Hamilton, et al., 2009). DDDM in schools has been defined as "the systematic collection, analysis, examination, and interpretation of data to inform practice and policy in educational settings" (Mandinach, 2012, p.71). Moreover, Marsh and Farrell (2015, p. 3) defined DDDM as a process that "refers to teachers, principals, and administrators systematically collecting and analysing various types of data […] to guide a range of decisions to help improve the success of students and schools". Adopting a similar perspective, Schildkamp and Kuiper (2010, p.482) argued that DDDM concerns "systematically analyzing existing data sources within the school, applying outcomes of analyses to innovate teaching, curricula, and school performance, and, implementing (e.g., genuine improvement actions) and evaluating these innovations". Essentially, DDDM in schools refers to a continuous cycle of identifying, collecting, combining, analysing, interpreting and acting upon educational data from different sources, in order to report, evaluate and improve the resources, the processes and the outcomes of schools. This conception of DDDM implies a set of *"data literacy"* competences that may be **needed to engage in meaningful data use** and move from data, to information, to knowledge, to action (Knapp et al., 2006; Means et al., 2011).

A1.1.2. Data Literacy and Educational Data Literacy

The overall human **capacity to understand, learn from and use data** as part of everyday thinking and reasoning for solving real-world problems is synopsized under the term Data Literacy (DL). Vahey et al. (2006, p.1) proposed that DL "includes the ability to formulate and answer questions using data as part of evidence-based thinking; use appropriate data, tools, and representations to support this thinking; interpret information from data; develop and evaluate data-based inferences and explanations; and use data to solve real problems and communicate their solutions". Mandinach and Gummer (2013, p. 30) define DL as "the ability to understand and use data effectively to inform decisions". According to Prado and Marzal (2013), DL enables individuals to access, interpret, critically assess, manage (i.e., preserve and curate), handle and ethically use data. Much like literacy as a general concept, DL focuses on the competencies involved in working with data (e.g., read, understand, create and communicate data) through an inquiry process, with consideration of ethical use of data.

Further focusing on DL in the educational setting, i.e., Educational Data Literacy (EDL), Means et al. (2011) identified five skill areas that cover the **different aspects of data use that teachers need to master** if they are to use student data to improve instruction, including data location, data comprehension, data interpretation, question posing, and data use for instructional decision making.

Love (2012) proposed that EDL is "the ability to accurately observe, analyse and respond to a variety of different kinds of data for the purpose of continuously improving teaching and learning in the classroom and school". In a broader definition, North Carolina Department of Public Instruction (2013) considered one's level of understanding of how to find, evaluate, and use data to inform teaching and learning under the term of EDL, whereas, a data literate educator should possess the knowledge to gather, analyze, and graphically convey information and data to support decision-making at various levels of the educational process.

From a similar perspective, the Data Quality Campaign (2014) raised the ethical dispositions that data-literate educators should adopt when continuously and effectively access, interpret, act on, and communicate multiple types of data from state, local, classroom, and other sources to improve outcomes for students, in a manner appropriate to educators' professional roles and responsibilities. According to Mandinach and Gummer (2013, p. 30), EDL is defined as "the ability to understand and use data effectively to inform decisions […] composed of a specific skill set and knowledge base that enables educators to transform data into information and ultimately into actionable knowledge". In this definition, the authors determine the **skill set** to include "knowing how to identify, collect, organize, analyze, summarize, and prioritize data", and the **knowledge base** to include "how to develop hypotheses, identify problems, interpret the data, and determine, plan, implement, and monitor courses of action". According to this definition, EDL is grounded on: (a) **a set of skills** and (b) **a base of knowledge**; that facilitates *educators* in improving teaching and learning through data-driven reflection, and *educational leaders* in improving educational institutions performance through data-driven evidence analysis. More recently, Ridsdale et al. (2015, p.2) define EDL as "the ability to collect, manage, evaluate, and apply data, in a critical manner". Furthermore, according to Wolff et al. (2016, p. 23), EDL is "the ability to ask and answer real-world questions from large and small data sets through an inquiry process, with consideration of ethical use of data. It is based on core practical and creative skills […] that include the abilities to select, clean, analyse, visualise, critique and interpret data, as well as to communicate stories from data and to use data as part of a design process".

Table A.1. summarizes the key definitions of Educational Data Literacy as presented in literature.

Initiative	**EDL Definition**
Means et al. (2011)	Skills in data location, data comprehension, data interpretation, question posing, and data use for instructional decision making
Love (2012)	The ability to accurately observe, analyse and respond to a variety of different kinds of data for the purpose of continuously improving teaching and learning in the classroom and school.
North Carolina Department of Public Instruction (2013)	One's level of understanding of how to find, evaluate, and use data to inform teaching and learning - a data literate educator should possess the knowledge to gather, analyze, and graphically convey information and data to support decision-making at various levels of the educational process.
Mandinach and Gummer (2013)	The ability to understand and use data effectively to inform decisions […] composed of a specific skill set and knowledge base that enables educators to transform data into information and ultimately into actionable knowledge.
Data Quality Campaign (2014)	Data-literate educators continuously, effectively, and ethically access, interpret, act on, and communicate multiple types of data from state, local, classroom, and other sources

	to improve outcomes for students in a manner appropriate to educators' professional roles and responsibilities.
Ridsdale et al. (2015)	The ability to collect, manage, evaluate, and apply data, in a critical manner.
Wolff et al. (2016)	The ability to ask and answer real-world questions from large and small data sets through an inquiry process, with consideration of ethical use of data. It is based on core practical and creative skills […] that include the abilities to select, clean, analyse, visualise, critique and interpret data, as well as to communicate stories from data and to use data as part of a design process.

A1.2. Environmental scan of existing Educational Data Literacy Competence frameworks

The search in literature yielded **five (5) major approaches for Educational Data Literacy competence frameworks (EDL CFs)**. Each framework consists of different numbers of conceptual dimensions and covers the competences that correspond to each one of these dimensions. Furthermore, a set of tasks that are linked to these competences is proposed by the research groups/authors in most cases.

More precisely, Ridsdale et al. (2015) proposed an EDL competence framework consisting of **five (5) dimensions**: 1) Conceptual Framework, 2) Data Collection, 3) Data Management, 4) Data Evaluation, and 5) Data Application. The authors defined the core skills and competences that comprise EDL, using a **thematic analysis of the elements** of data literacy described in peer-reviewed literature. The included terms are **broadly defined** and involve a variety of elements considered core to EDL. The competencies and their skills, knowledge, and expected tasks are organized under the top-level elements of the EDL definition (data, collect, manage, evaluate, apply) and are categorized as conceptual competencies, core competencies, and advanced competencies. Figure A.2 illustrates the EDL CF proposed by the research group. In this figure, the blue colour corresponds to conceptual competencies, the green colour is used to describe core competencies and the red colour is used for annotating advanced competencies.

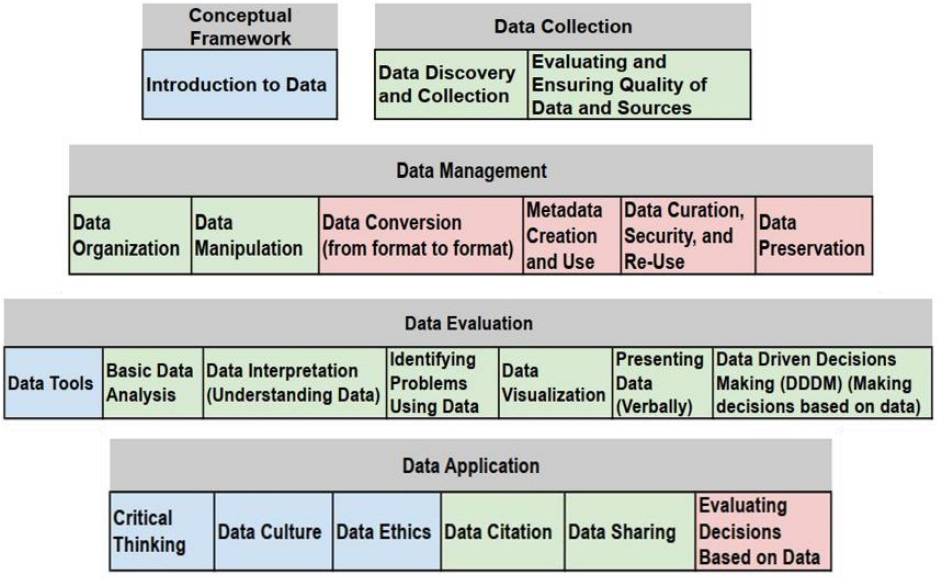

Figure A.2: The EDL CF dimensions as proposed by Ridsdale et al. (2015)

Mandinach and Gummer (2016) provided a broader definition of what they call data literacy *for teaching*: "*the ability to transform information into actionable instructional knowledge and practices by collecting, analyzing, and interpreting all types of data (assessment, school climate, behavioral, snapshot, longitudinal, moment-to-moment, and so on) to help determine instructional steps. It combines an understanding of data with standards, disciplinary knowledge and practices, curricular knowledge, pedagogical content knowledge, and an understanding of how children learn*" (p. 367). In line with this definition, their framework for data literacy for teaching combines **seven (7) key knowledge areas** that integrate with **five (5) data use aspects** in the inquiry process. The knowledge areas include a) content knowledge, b) general pedagogical knowledge, c) curriculum knowledge, d) pedagogical content knowledge, e) knowledge of learners and their characteristics, f) knowledge of educational contexts, and g) knowledge of educational ends, purposes and values. All these knowledge dimensions **can be efficiently applicable** in DDDM **only if the educators are *skilful in handling data***, and given that the technological tools to support the development of DDDM are available. The data use for teaching domain is then comprised of five components under which we have associated specific knowledge and skills. The five data use domains include: 1) identify problems and frame questions, 2) use data, 3) transform data into information, 4) transform information into a decision, and 5) evaluate outcomes. Figure A.3 demonstrates the EDL CF proposed by the authors.

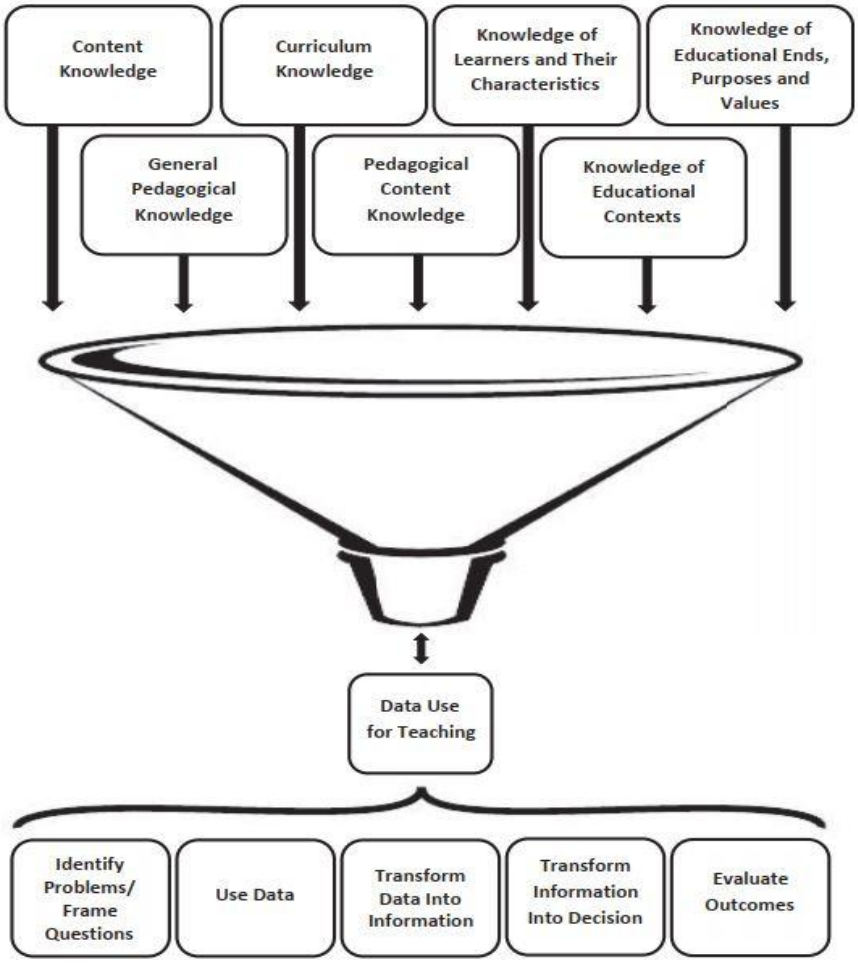

Figure A.3: The EDL CF dimensions as proposed by Mandinach and Gummer (2016)

Furthermore, Means et al. (2011) identified **five (5) dimension** of Educational Data Literacy: 1) Data location (i.e., finding the relevant and available pieces of data in the data system or display), 2) Data Comprehension (i.e., understanding what the data signify), 3) Data Interpretation (i.e., figuring out what the data mean), 4) Data Use for Instructional Decision Making (i.e., selecting an instructional approach to address the situation identified through the data) and 5) Question Posing (i.e., framing instructionally relevant questions that can be addressed by the data in the system). For evaluating these five dimensions, the research team collected **data scenario responses (interviews) from individual teachers and small groups** of school staff. Conducting both individual and group interviews provided information about how teachers reason independently about data as well as about how they build on each other's understanding when they explore data in small groups.

In another attempt, Marsh (2012) outlined an EDL competence model of **five (5) components of the data use process**, including: 1) accessing or collecting data, 2) filtering, organizing, or analyzing data into information, 3) combining information with expertise and understanding to build knowledge, 4) knowing how to respond and taking action or adjusting one's practice, and 5) assessing the effectiveness of these actions or outcomes that result. The author introduced this framework in order to facilitate the understanding of what research tells us about **interventions designed to support the process of educational data use** and to **identify where there are possible gaps**. More specifically, the core questions the framework targets at concern the dimensions or core features of these interventions, the types of data and data users that were targeted, the implementation of interventions, as well as their outcomes. Figure A.4 presents the framework envisaged by the author[2].

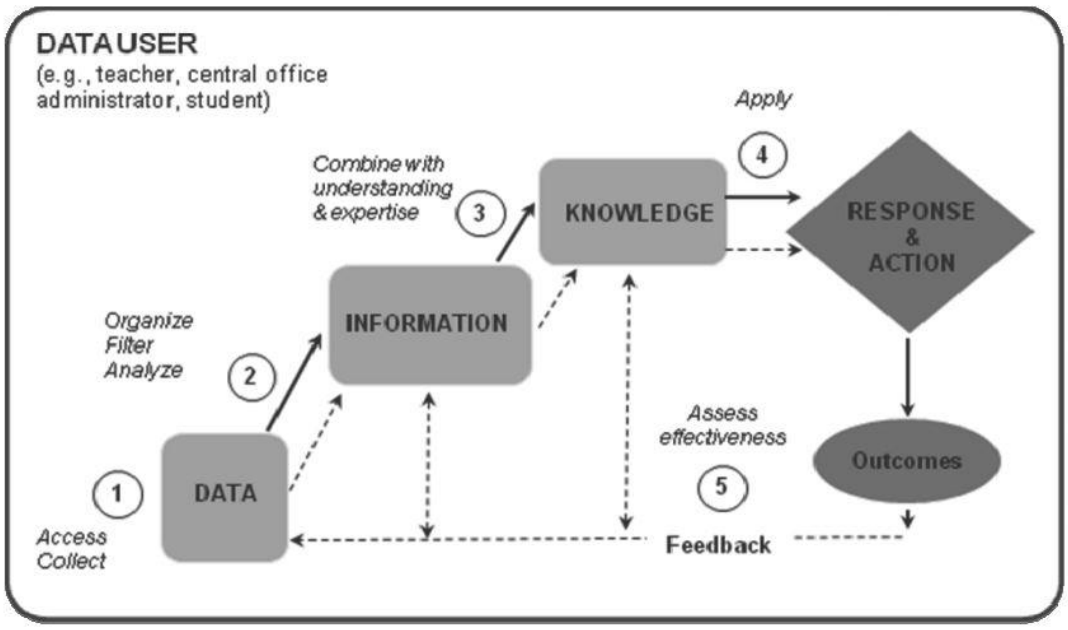

Figure A.4: The EDL CF dimensions as proposed Marsh (2012)

In addition, the EDL framework suggested by Prado & Marzal (2013) was inspired by the general structure of information literacy standards and includes **five (5) generic dimensions**: 1)

[2] It should be noted that in this approach, to the EDL dimensions of the EDL framework were not further particularized in specific competence statements.

Understanding Data, 2) Finding and/or obtaining data, 3) Reading, interpreting and evaluating data, 4) Managing data, and 5) Using data. Additionally, the framework associates a number of competences to with each dimension and translates these competencies into instructional topics or units to facilitate interpretation and direct implementation.

A1.3. A Working Definition of Educational Data Literacy

In view of the above, effective educational data use at all levels requires going beyond understanding the educational data and their properties, to making meaningful and actionable interpretations of these data. In other words, data literate educators must interpret the educational data in a meaningful manner and to translate these data into actions that inform instruction, to improve teaching and learning; similarly, data literate educational leaders must adopt a data-driven evidence analysis perspective to improve the overall school performance. As Mandinach and Gummer (2016) pointed out, the decisions that educators need to use educational data to inform are multiple and diverse, and educational data literacy is tailored to the specific use (context-aware). An important aspect in this process, highlighted in literature, is the ethical considerations that should be consistent throughout all phases of data manipulations.

When it comes to determining EDL for instructional designers and e-tutors of online and blended courses, the previous definitions require additional particularization, and the corresponding frameworks need to be adjusted accordingly. We argue that Educational Data Literacy for Instructional Designers and e-Tutors of Online and Blended (Professional Development and/or Higher Education) courses covers much more than technical skills. As such, in the Learn2Analyze initiative, Educational Data Literacy can be synopsized as:

"The ability to collect, manage, analyse, comprehend, interpret and apply upon educational data in an ethical, meaningful and critical manner".

This definition was **synthesized from the seven core existing EDL definitions and the five EDL competence frameworks,** and it was **refined by the L2A consortium members**. It has been developed to **focus on the competence set** which is required to be possessed by the educators to give meaning to and act upon educational data from different sources, with the aim of continuously improving the teaching, learning and assessment process, in an ethical aspect. Furthermore, this brief definition uses **six loaded terms**, which we use as the **top-level of a hierarchy of competences** and tasks that comprise EDL: collect, manage, analyze, comprehend and interpret, apply, and data ethics.

As such, the working definition for Educational Data Literacy with a focus on ID and eTUT of Online and Blended (Professional Development and/or Higher Education) courses pertains to the ethical, systematic and iterative collection, management, analysis, comprehension and interpretation of educational data to determine actionable decisions and policy in online/blended learning settings. As a context-aware process, EDL is an inquiry cycle that involves: a) data collection (e.g., location, discovery and access) and management (e.g., cleaning, organization and preservation) (*data level*), b) data analysis (e.g., coding, analytics extraction, reporting on them), comprehension and interpretation (e.g., transforming the information from analytics into usable knowledge) (*data*

analytics level), and c) data application (e.g., deciding adaptations, providing feedback) (*acting upon data level*) to be used to inform instructional design of online/blended courses (ID), and to inform students' guidance-support during online/blended courses (eTUT). In the beginning of the process, identifying the objectives/problems and setting a purpose is required. In the broader definition of EDL and throughout the inquiry cycle, ethical and legal aspects catalyse the context-aware process cross-phase. This process is synopsized in Figure A.5.

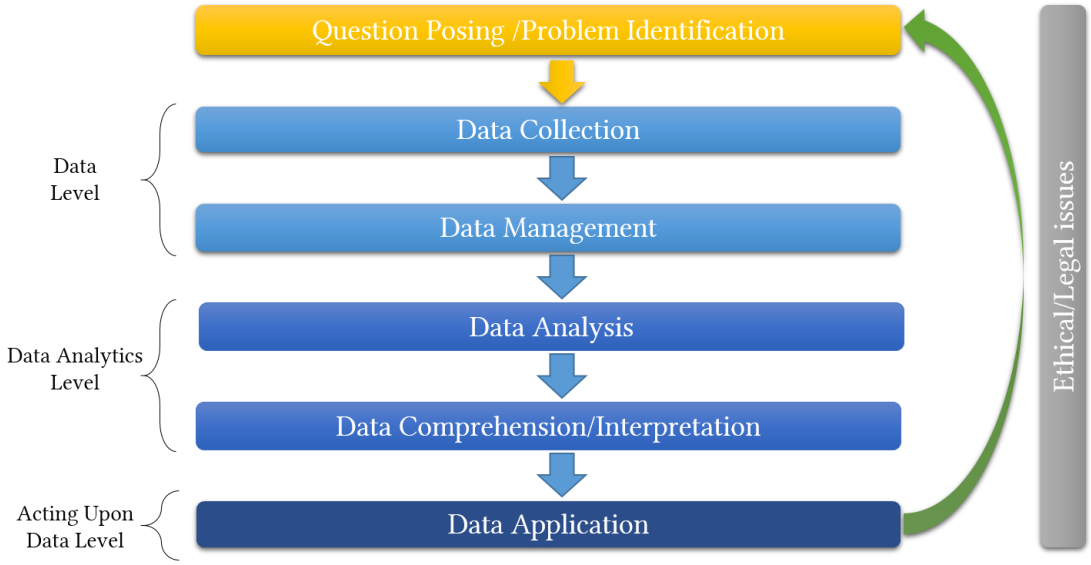

Figure A.5: The Learn2Analyze EDL CF dimensions for the roles of ID/eTUT

A2. Towards an Educational Data Literacy Competence Profile for e-Learning Professionals and Educators

A2.1. The Dimensions of Educational Data Literacy

Based on the EDL definitions (demonstrated in Section A1.1.2), as well as on the EDL CFs identified in Section A1.2, Table A.2 demonstrates an synopsis and synthesis of EDL dimensions in relation to both the existing definitions and the proposed EDL CFs.

Table A.2. Identified EDL dimensions according to the EDL definitions and EDL Competence Frameworks

		EDL Definition/ EDL CF[a]									
	Identified EDL Dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9[b]**	**10**
Generic	Professionalism								X		
	Content-Curriculum								X		
	Pedagogy								X		
	Ethics				X			X			
	Question posing/Identify Problems	X						X	X		
- e	Data Location/Access/Collection	X		X	X		X	X		X	X

Data Comprehension	X				X					X
Data Interpretation/Transform to information	X		X	X	X		X	X	X	X
Data Use/Application/Act on	X	X	X	X	X	X	X	X	X	X
Data Analysis		X	X				X		X	
Data Observation		X								
Data Evaluation			X			X	X	X	X	X
Data Management						X	X		X	X

[a]1. Means et al. (2011); 2. Love (2012); 3. North Carolina Department of Public Instruction (2013); 4. Data Quality Campaign (2014); 5. Mandinach and Gummer (2013); 6. Ridsdale et al. (2015); 7. Wolff et al. (2016); 8. Mandinach and Gummer (2016); 9. Marsh (2012); 10. Prado & Marzal (2013)

[b] This framework consists of five dimensions that by themselves are competence statements, and that are not further particularized to more fine-grained statements.

Based on the this table, most of the existing EDL definitions and competence frameworks share common data-related dimensions: a) Data location, access and collection (in 7 out of 10), b) Data interpretation and transformation to information (in 8 out of 10), c) Data use, application and action upon (in 10 out of 10), d) Data analysis (in 4 out of 10), e) Data evaluation (in 6 out of 10) and f) Data management (in 4 out of 10). Throughout the EDL process, question posing and problem identification (in 3 out of 10), as well as data ethics (in 2 out of 10) should be also considered.

Therefore, according to this analysis and in agreement with the proposed EDL definition (see section 5.3), we propose: a) 2 broader EDL dimensions, and b) 6 highly data-oriented, fine-grained EDL dimensions. The identified dimensions are briefly described in Tables A.3 and A.4.

Table A.3. Generic Dimensions of the Learn2Analyze EDL CF

Generic EDL Dimension	Short Description	Citing Frameworks
Ethical/Legal issues	Considering ethical restrictions and concerns, including security, confidentiality, privacy, informed consent, anonymity of peoples' data.	Data Quality Campaign (2014); Wolff et al. (2016)
Problem identification	Formulating hypotheses about students' learning needs, asking questions that can be researched using data, aligning learning goals with available data, as well as articulating and highlighting problems about a topic area, an aspect of instruction, or the curriculum.	Means et al. (2011); Gummer & Mandinach (2016), Wolff et al. (2016)

Table A.4. Data-Related Dimensions of the Learn2Analyze EDL CF

Educational Data-related Dimension	Short Description	Citing Frameworks
Data collection	Determining fit-for-purpose data, finding and accessing the right data, collecting qualitative and quantitative data from multiple sources, using methods such as conducting interviews, creating surveys, making observations, and taking	All except Love (2012); Mandinach & Gummer (2013); Mandinach & Gummer (2016)

	measurements, etc.	
Data management	Organizing, cleaning and preserving data, converting data (from format to format), creating and utilizing metadata, curating data, etc.	Ridsdale et al. (2015); Wolff et al. (2016); Marsh (2012); Prado & Marzal (2013)
Data analysis	Understanding the measurement error, the influence of sample size on the ability to generalize, understanding uses of data quality (e.g., accuracy, completeness), etc.	Love (2012); North Carolina Department of Public Instruction (2013); Wolff et al. (2016); Marsh (2012)
Data Comprehension/ Interpretation	Reading and understanding charts, tables, and graphs, using data displays and representations, assessing patterns and trends, moving fluently between alternative data representations, probing for causality, understanding statistics and psychometrics, etc.	All except Love (2012); Ridsdale et al. (2015)
Data Application	Making instructional adjustments, applying the knowledge produced to create the appropriate environment and applying the right strategy and plan to facilitate learning, adjust practices using student performance data, integrating data use with curriculum instruction and assessment, evaluate intervention, etc.	All

A2.2. Analysis of existing Educational Data Literacy Competence frameworks in relation to their capacity to support e-Learning Professionals and Educators (including Instructional Designers and (e)Tutors)

This section presents the review of existing EDL Competence framework in relation to their capacity to support Instructional Designers and (e)Tutors of Online/Blended courses. The objective of this section is to cover in detail the specific competence statements proposed in the existing frameworks that are associated to each EDL dimension identified in the respective approaches. The analysis of these frameworks will be useful to deeper understand which exact competences are necessary to be possessed or acquired by ID/eTUT to effectively inform their design and/or support students in online/blended courses.

EDL-CF1: Strategies and Best Practices for Data Literacy Education (Ridsdale et al. (2015))

Ridsdale et al. (2015) synthesized a set of skills and abilities that together comprise various levels of data literacy, presented in a **data literacy competencies matrix**, organized by the **five (5) core dimensions** they proposed in their data literacy definition (data, collection, management, evaluation, application). The objective of this matrix was to constitute **a standard for assessing and evaluating levels of data literacy**, and to inform the creation of learning outcomes in data literacy education. Elaborating more on the dimensions of this proposal, the **Conceptual Framework** dimension here has been introduced to capture the general knowledge and understanding about data and the uses and applications of data. In a sense, it corresponds to an understanding of how instructional decisions are informed by data and of how to use educational data in support of evidence-based decision-making. This dimension includes one (1) competence statement. The **Data**

Collection dimension covers skills and knowledge related to data discovery and collection from multiple educational sources by ensuring quality of datasets, and includes two (2) competence statements. In a way, both roles should be able to recognize faulty information and create "valid, data-based arguments" (Vahey et al, 2012, p. 183). The **Data Management** concept pertains to the skills that mostly relate to data organization, preservation, manipulation, curation and security, and involves six (6) relevant competence statements. This dimension encompasses these skills and knowledge that allow IDs and eTUTs to have control over the data in the data-based decision making processes. The **Data Evaluation** construct focuses on skills that are related to data analysis, presentation, interpretation and to making instructional decisions from data, and, it contains seven (7) competence statements in total. Finally, the **Data Application** dimension is orientated to knowledge and skills that are needed to share and cite data, to evaluate decisions based on data and to work with data in an ethical manner, and it includes six (6) competence statements. The research team followed a thematic analysis of the elements of data literacy described in peer-reviewed literature, and concluded to **23 competencies** (categorized as conceptual competencies, core competencies, and advanced competencies) with **64 core skills knowledge, and expected tasks**. In particular, the exact competence statements (with specific skills) per dimension are illustrated in Table A.5.

Table A.5. Data-Related Dimensions with Competence statements of the EDL CF1

EDL CF1 (Ridsdale et al., 2015)	
EDL Dimensions **5**	EDL Competence statements **23**
Conceptual Framework	Introduction to Data (*Knowledge and understanding of data; Knowledge and understanding of the uses and applications of data*)
Data collection	Data Discovery and Collection (*Performs data exploration; Identifies useful data; Collects data*)
	Evaluating and Ensuring Quality of Data and Sources (*Critically assesses sources of data for trustworthiness; Critically evaluates quality of datasets for errors or problems*)
Data management	Data Organization (*Knowledge of basic data organization methods and tools; Assesses data organization requirements; Organizes data*)
	Data Manipulation (*Assesses methods to clean data; Identifies outliers and anomalies; Cleans data*)
	Data Conversion from format to format (*Knowledge of different data types and conversion methods; Converts data from one format or file type to another*)
	Metadata Creation and Use (*Creates metadata descriptors; Assigns appropriate metadata descriptors to original data sets*)
	Data Curation, Security, and Re-Use (*Assesses data curation requirements; Assess data security requirements; Curates data*)
	Data Preservation (*Assesses requirements for preservation; assesses methods and tools for data preservation; Preserves data*)
Data Evaluation	Data Tools (*Knowledge of data analysis tools and techniques; Selects appropriate data analysis tool or technique; Applies data analysis tools and techniques*)

	Basic Data Analysis (*Develops analysis plans; Applies analysis methods and tools; Conducts exploratory analysis; Evaluates results of analysis; Compares results of analysis with other findings*)
	Data Interpretation -Understanding Data (*Reads and understands charts, tables, and graphs; Identifies key take-away points, and integrates this with other important information; Identifies discrepancies within the data*)
	Identifying Problems Using Data (*Uses data to identify problems in practical situations; Uses data to identify higher level problems*)
	Data Visualization (*Creates meaningful tables to organize and visually present data; Creates meaningful graphical representations of data; Evaluates effectiveness of graphical representations; Critically assesses graphical representations for accuracy and misrepresentation of data*)
	Presenting Data (Verbally) (*Assess the desired outcome(s) for presenting the data; Assesses audience needs and familiarity with subject(s); Utilizes meaningful tables and visualizations to communicate data; Presents arguments and/or outcomes clearly and coherently*)
	Data Driven Decisions Making (DDDM) (*Prioritizes information garnered from data; Converts data into actionable information; Weighs the merit and impacts of possible solutions-decisions; Implements decisions-solutions*)
Data Application	Critical Thinking (*Aware of high level issues and challenges associated with data; Thinks critically when working with data*)
	Data Culture (*Recognizes the importance of data; Supports an environment that fosters critical use of data for learning, research, and decision making*)
	Data Ethics (*Aware of legal and ethical issues associated with data; Applies and works with data in an ethical manner*)
	Data Citation (*Knowledge of widely-accepted data citation methods; Creates correct citations for secondary data sets*)
	Data Sharing (*Assesses methods and platforms for sharing data; Shares data legally, and ethically*)
	Evaluating Decisions Based on Data (*Collects follow-up data to assess effectiveness of decisions or solutions based upon data; Conducts analysis of follow-up data; Compares results of analysis with other findings; Evaluates decisions or solutions based on data; Retains original conclusions or decisions, or implements new decisions-solutions*)

EDL-CF2: Conceptual framework for Data Literacy For Teachers – DLFT (Mandinach & Gummer, 2016)

The conceptual framework introduced by Mandinach & Gummer (2016) includes seven (7) key knowledge areas that integrate with **five (5) data-related components** throughout the inquiry process. The five data-related dimensions of this framework have been associated with specific knowledge and skills, and include: identify problems and frame questions; use data; transform data into information; transform information into a decision; and evaluate outcomes. Specifically, the first dimension (**Identify problems/ frame questions**) focuses on how educators identify the problem, topics, issues, or questions to be addressed, and includes five (5) statements. The **Use Data** component consists of twenty-seven (27) statements and pertains to the fundamental knowledge and skills that most directly relate to actual data use. This dimension covers an extensive area of

skills educators should acquire, varying from identification of data sources to developing sound assessment design and implementation and from understanding how to analyze data to articulating inferences and conclusions from the analysed information. The research team point-outs that there might be some degree of overlap in these sub-components and elements. The **Transform Data into Information** dimension is essentially about moving data toward information on which actions can be taken using the learning context to make meaning and inform decisions, and includes nine (9) competence statements. The **Transform Information into Decision** construct covers the sets of knowledge and skills a teacher should acquire regarding the instructional steps that should be taken based on the inquiry cycle. Five (5) statements were identified for this dimension. Finally, the **Evaluate Outcomes** dimension pertains to examining the impact of the decision making process, employing a total of five (5) statements. The **competence statements** identified in this framework were **53 in total**, and are mapped to each data-related dimension as shown in Table A.6.

Table A.6. Data-Related Dimensions with Competence statements of the EDL CF2

EDL CF2 (Mandinach & Gummer, 2016)	
EDL Dimensions	EDL Competence statements
5	**53**
Identify problems/ frame questions	articulate a problem of practice (*identify the problem and explain the issue or question*)
	Understand the context at the student level (*Contextualize the learning, behavioral, or motivation issues*)
	Understand the context at the school level
	Involve other participants or stakeholders
	Understand student privacy (*protection of student privacy and confidentiality*)
Use data	Identify possible sources of data
	Understand the purposes of different data sources
	Understand how to generate data
	Understand assessment
	Use formative and summative assessments
	Develop sound assessment design and implementation
	Understand data properties
	Use multiple measures/sources of data
	Use qualitative and quantitative data
	Understand specificity of data to question/problem
	Understand what data are appropriate
	Understand data quality (*validity, timeliness, and consistency of the data*)
	Understand elements of data accuracy, appropriateness, and completeness
	Understand how to access data
	Find, locate, access, and retrieve data
	Use technologies to support data use (*data warehouses, assessment systems, student information systems, and other relevant technologies that provide access to, analysis, and reporting of data*)
	Understand how to analyze data

	Understand statistics and psychometrics
	Manage data
	Organize data
	Prioritize data
	Examine data (*scrutinize or inspect them in a meaningful way to address a question, hypothesis, or issue*)
	Integrate data
	Manipulate data
	Drill down into data
	Aggregate data
	Disaggregate data
Transform data into information	Consider the impact and consequences
	Generate hypothetical connections to instruction
	Test assumptions
	Understand how to interpret data (*give meaning to data - explanations*)
	Understand and use data displays and representations
	Assess patterns and trends
	Probe for causality
	Use statistics
	Synthesize diverse data
	Articulate inferences and conclusions
	Summarize and explain data
Transform information into a decision	Determine next instructional steps
	Monitor student performance
	Diagnose what students need
	Make instructional adjustments.
	Understand the context for the decision
Evaluate outcomes	Re-examine the original question or problem
	Compare performance pre- and post-decision
	Monitor changes in classroom practices
	Monitor student changes in performance
	Consider the need for iterative decision cycles

EDL-CF3: Teachers' Ability to Use Data to Inform Instruction (Means et al., 2011)

The framework developed by Means et al. (2011) consists of **five (5) data-related dimensions**, focusing on better understanding teachers' strengths and weaknesses in working with data and towards informing the design of more effective teacher training and professional development. Specifically, these dimensions include Data location; Data Comprehension; Data Interpretation; Data Use for Instructional Decision Making; and Question Posing. More precisely, **Data Location** refer to the educators' ability to find relevant data that will be used to inform their decisions about students and includes two (2) competence statements. **Data Comprehension** is about making sense of the data and is particularized in four (4) competence statements. **Data Interpretation** refers to going

beyond comprehension per se to interpreting the meaning of the data, and involves four (4) competence statements. **Data Use for Instructional Decision Making** concerns the abilities that teachers have to plan and provide differentiated instruction, tailored to the needs of the students, through techniques. Three (3) statements were identified in this dimension. Finally, **Question Posing** refers to forming a question about a set of data and expressing it as a data query, and includes three (3) related statements. The research team examined the perceptions of 50 individual teachers and 72 small groups regarding how they think about student data in schools. The research was based on the assumption that the detailed description of teachers' thinking can be proved helpful to inform those who are responsible for training teachers in data-driven decision making about the kinds of difficulties and misconceptions teachers are likely to encounter. In the same report, the authors provide material that can be used in training teachers on the use of data to guide instruction. Table A.7 describes the **16 competence statements** of this approach.

Table A.7. Data-Related Dimensions with Competence statements of the EDL CF3

EDL CF3 (Means et al., 2011)	
EDL Dimensions	EDL Competence statements
5	**16**
Data Location	Finding relevant data in a complex table or graph
	Manipulating data from a complex table or graph to support reasoning
Data Comprehension	Moving Fluently Between Alternative Representations of Data
	Understanding a Histogram
	Interpreting a Contingency Table
	Distinguishing Between Cross-sectional and Longitudinal Data
Data Interpretation	Examining score distributions.
	Understanding the effect of outliers.
	Appreciating limits on generalizability.
	Understanding measurement error.
Data Use for Instructional Decision Making	Understanding the Value of Subscale Scores
	Providing Differentiated Instruction Based on Data
	Synthesizing Data from Different Sources
Question Posing	Aligning questions with purpose and data.
	Forming queries that lead to actionable data.
	Appreciating the value of multiple measures

EDL-CF4: Incorporating Data Literacy into Information Literacy Programs (Prado & Marzal, 2013)

The framework introduced by Prado & Marzal (2013) focuses on the data literacy competences that should be covered when designing instruction. The framework was inspired by the general structure of information literacy standards and includes most of the common competences identified by the authors in their literature scan. Specifically, in the presented approach, the framework consists of **five (5) generic data-related dimensions**: Understanding Data; Finding/obtaining Data; Reading, interpreting and evaluating Data; Managing Data; and Using Data. Regarding the first dimension, **Understanding data** refers to general knowledge and awareness of data, how they are generated

and what are the different types and sources of data, and it includes two (2) related competence statements. The second dimension, **Finding/obtaining data**, pertains to the skills required to access and assess data sources, and it also enumerates two (2) competence statements. The third dimension, Reading, interpreting and evaluating data, concerns the necessary competences that are relevant to presenting data and to critically evaluating them. In this framework the authors suggest two (2) statements in this dimension. Regarding the **Managing data** dimension, it is related to metadata data management repositories and data reuse, and is synopsized in one (1) competence statement. Finally, the **Using** data dimension - with three (3) statements – covers skills and knowledge that are needed to properly and ethically handle and synthesize data. The 10 competence statements included in this framework and assigned to each dimension are illustrated in Table A.8.

Table A.8. Data-Related Dimensions with Competence statements of the EDL CF4

EDL CF5 (Prado & Marzal, 2013)	
EDL Dimensions **5**	EDL Competence Statements **10**
Understanding Data	knowing what is meant by data and be aware of the various possible types of data Data in society: a tool for knowledge and innovation
Finding and/or obtaining data	Data sources (*awareness of the possible data sources, ability to evaluate them and select the ones most relevant to an informational need or a given problem*) Obtaining data (*detect when a given problem or need cannot be (totally or partially) solved with the existing data and obtain new one*)
Reading, interpreting and evaluating data	Reading and interpreting data (*knowing the various forms in which data can be presented (written, numerical or graphic), and their respective conventions, and be able to interpret them*) Evaluating data
Managing data	Data and metadata collection and management *(aware of the need to save the data selected or generated and of descriptive or other data associated therewith, for due identifcation, management and subsequent reuse*)
Using data	Data handling *(prepare data for analysis, analyze them in keeping with the results sought and know how to use the necessary tools*) Producing elements for data synthesis (*Producing elements for data synthesis*) Ethical use of data

A2.3. Initial analysis of existing Educational Data Literacy related Professional Development and Higher Education Courses in relation to their capacity to support e-Learning Professionals and Educators (including Instructional Designers and (e)Tutors)

The initial (2018) environment scan yielded **12** Professional Development and Higher Education Courses that were related to introducing or teaching Educational Data Literacy skills or fundamentals of learning analytics concepts and usage. The selection of the courses was based on **the target audience with a focus on Instructional Designers and eTutors**, whilst some of the courses are available to broader audiences. Seven (7) of the courses were offered in Higher Education programs and the remaining five (5) were offered for supporting Professional Development. The courses were

viewed and analysed with respect to their **learning objectives**, having in mind how they could **launch EDL skills**. Table A.9 summarizes the analysis of the objectives of the identified courses.

Table A.9. Objectives of the identified Professional Development and Higher Education courses

	Professional Development and Higher Education courses[c]											
Learning Objectives	1	2	3	4	5	6	7	8	9	10	11	12
Understand and use data effectively					X				X			
Efficiently collect educational data and metadata from a wide range of data sources for future analyses										X	X	X
Manipulate the educational data-sets that capture the learning experience										X		X
Conduct (basic) data wrangling and analyses					X	X	X	X		X		X
Employ teaching analytics to analyse the lesson plans				X								
Inform teaching and learning decisions				X					X		X	
Deploy personalized support actions for the students												X
Use data-driven methods to answer practical educational questions				X		X	X	X				
Address evaluation issues, key diagnostic metrics and their uses, and validity issues							X					
Reflect on the teaching practice by combining insights from both teaching and learning analytics				X								
Raise ethics and privacy considerations	X				X							
Other learning objectives (non data-related)	3	4	6	1	2	1	3	2	0	5	1	0

[c] 1. Digital Competence[3]; 2. Digital Literacy - Smart Learning[4]; 3. Data Literacy 01[5]; 4. Analytics for the Classroom Teacher[6]; 5. Learning Analytics Fundamentals[7]; 6. Big Data and Education[8]; 7. Data, Analytics and Learning[9]; 8. Practical Learning Analytics[10]; 9. Data Literacy for School Teachers - EDPZ6012[11]; 10. Advancing computational and data literacy skills schools for life scientists[12]; 11. Introduction to Data Wise: A Collaborative Process to Improve Learning & Teaching[13]; 12. Using Data to Provide Personalized Student Support[14]

[3] https://www.ntnu.edu/studies/courses/EDU3084#tab=omEmnet
[4] https://www.ntnu.edu/studies/courses/SOS2020/2017/1#tab=omEmnet
[5] http://artofeducating.com/online-courses/
[6] https://www.edx.org/course/analytics-for-the-classroom-teacher
[7] https://www.edx.org/course/learning-analytics-fundamentals-utarlingtonx-link-la-fundx
[8] https://www.edx.org/course/big-data-education-pennx-bde1x-0
[9] https://www.edx.org/course/data-analytics-learning-utarlingtonx-link5-10x
[10] https://www.edx.org/course/practical-learning-analyticsmichiganx-plax
[11] https://sydney.edu.au/courses/units-of-study/2018/edpz/edpz6012.html
[12] http://www.nhm.ac.uk/our-science/courses-and-students/advancing-computational-and-data-literacy-for-life-scientists.html
[13] https://www.edx.org/course/introduction-to-data-wise-a-collaborative-process-to-improve-learning-teaching?source=aw&awc=6798_1528751625_af527528449614f1594dcc5313473d52&utm_source=aw&utm_medium=affiliate_partner&utm_content=text-link&utm_term=301045_https%3A%2F%2Fwww.class-central.com%2F
[14] https://www.edx.org/course/using-data-provide-personalized-student-utarlingtonx-link-la-ssax

As seen from this table, among the objectives of these courses are: (a) to understand and use data effectively; (b) to efficiently collect educational data and metadata from a wide range of data sources for future analyses and to manipulate these educational data-sets that capture the learning experience; (c) to conduct (basic) data wrangling and analyses; (d) to employ teaching analytics to analyse the lesson plans; (e) to inform teaching and learning decisions and to deploy personalized support actions for the students; (f) to use data-driven methods to answer practical educational questions; (g) to address evaluation issues, key diagnostic metrics and their uses, and validity issues, as well as to reflect on the teaching practice by combining insights from both teaching and learning analytics; (h) to raise ethics and privacy considerations. It should be noted that none of the identified courses was directly linked to any of the existing EDC CFs.

A2.4. Analysis of existing Data-Ethics Frameworks to inform Data-ethics related competence statements

In parallel, and since the ethical consideration of data throughout the data-driven decision making process is acknowledged as a core dimension of EDL, the analysis of Data-related Ethics frameworks was performed, as well. Although some authors put emphasis on data ethics, the majority fail to make note of it. However, in order for IDs and eTUTs to understand and critically think about the larger issues regarding EDL, thus must have an understanding and awareness of the ethics surrounding data. This section presents the competence statements related to data ethics as a synthesis of statements from existing Data-Ethics frameworks. It should be noted that none of the existing EDL CFs provides explicit competence statements regarding the data-ethics dimension. Thus, we searched for more general data-ethics frameworks that contain relevant statements.

Specifically, six (6) data-ethics related frameworks were identified during the scan of relevant literature. Table A.10 summarizes the competences that concern the ethical treatment of data.

Table A.10. Data-ethics related competence statements according to the Data-Ethics Frameworks

	Data-Ethics Framework[d]					
Competence Statement	1	2	3	4	5	6
Protect individuals' data privacy, confidentiality, integrity and security	X	X	X	X		
Understand authorship, ownership, data access (governance), re-negotiation and data-sharing		X	X		X	X
Clarify who is responsible for storage, management and access to data			X			
Respect the individuals to whom the data pertains, organizations that originate the data, organizations that aggregate the data and those that might regulate the data					X	
Use of informed consent (notice and transparency, authentication of subjects, use limitations, anonymisation, benefits)	X	X	X	X	X	X
Individuals must be made aware of when personal information about them is collected, by whom, and for what purpose			X			
Justify the primary purpose/benefits for using this data						X
Ethical data use should be done with an expectation of tangible benefit - define the usefulness or merit that comes from solving the problem					X	

Understand the limitations of the data, data source(s) and how they are being mitigated	X

[d] 1. Demchenko & Belloum (2017); 2. Zook et al. (2017); 3. Clark et al. (2015); 4. Hancock (2018); 5. IAF (2014); 6. ODI (2017)

As seen from this table, all data-ethics frameworks highlight the need to make use of informed consent when it has to do with collecting data from the subjects. In addition, most of the frameworks focus on the protection of the individuals' privacy, confidentiality, integrity, security, authorship and ownership. The issues of data governance, re-negotiation and data-sharing are also met on most frameworks as well. The specific data-ethics statements from all frameworks are available in Appendix A.

A2.5 Synthesis of Educational Data Literacy Generic Competence Dimensions and Statements for e-Learning Professionals and Educators (including Instructional Designers and (e)Tutors)

Based on the above analysis, we have developed a draft **Educational Data Literacy (EDL) Competence Profile (CP)** framework for Instructional Designers and e-Tutors of Online and Blended Courses which is summarised in **Table A.11**. This competence profile consists of **6** Competence **Dimensions** and **21** Competence **Statements** which aim to describe these dimensions.

Table A.11. Initial L2A EDL Competence Dimensions & Statements

L2A EDL Competence dimension	**L2A EDL Competence statements**
1. Data Collection	1.1 Know where to find the right data/data sources
	1.2 Know how to obtain/access data
	1.3 Understand data quality and limitations (e.g., accuracy, completeness)
2. Data Management	2.1 Identify the technologies to preserve data
	2.2 Know and apply data manipulation methods
	2.3 Know and apply data curation and data re-use methods
	2.4 Understand Data Description (Metadata)
3. Data Analysis	3.1 Know and apply the basic data analysis methods
	3.2 Understand and apply the basic data analysis process steps
	3.3 Understand and apply the basic data presentation methods
4. Data Comprehen-sion & Interpretation	4.1 Understand data (e.g., measurement error, discrepancies within data, key take-away points)
	4.2 Understand statistics
	4.3 Know how to interpret data (e.g., explanations of patterns, identification of hypotheses, connection of multiple observations)

	4.4 Generate potential connections to instruction
	4.5 Make decisions based on data
5. Data Application	5.1 Use data to inform instruction
	5.2 Know how to share and cite data
	5.3 Evaluate the data-driven intervention
6. Data Ethics	6.1 Explain the use of informed consent
	6.2 Know how to protect individuals' data privacy, confidentiality, integrity and security
	6.3 Understand authorship, ownership, data access (governance), re-negotiation and data-sharing

PART B: EDUCATIONAL DATA LITERACY PROFESSIONAL DEVELOPMENT AND UNIVERSITY COURCES

Scope

The scope of this part is to list professional development or university courses and/or programs on the topic of Educational Data Literacy that can be consider as relevant and useful for the environment scan provide a very short description and a justification on why they can be consider relevant and useful to include in the review and invest time to study to process further.

Methodology:

The presented courses were retrieved after extensive search of the keywords "Educational Data" and "Learning Analytics" in:

(a) MOOC providers:

- EdX (https://www.edx.org/)
- Udemy (https://www.udemy.com/)
- Udacity (https://www.udacity.com/)
- Coursera (https://www.coursera.org/)
- FutureLearn https://www.futurelearn.com/)
- Canvas Network (https://www.canvas.net/)
- Stanford Lagunita (https://lagunita.stanford.edu/)
- Miríadax (https://miriadax.net/home)
- SWAYAM (https://swayam.gov.in/explorer)

(b) MOOC aggregators:

- mooc-list.com (https://www.mooc-list.com/)
- classcentral.com (https://www.classcentral.com/)
- EMMA - European Multiple MOOC Aggregator (https://platform.europeanmoocs.eu/)
- EPALE – Electronic Platform for Adult Learning in Europe (https://epale.ec.europa.eu/en)

(c) Google search

The time period of the search is from 2010 to 2019. The search was performed from 19 to 23 of September 2019.

Criteria for inclusion were that the courses should be:

- in English
- accessible online
- meet the topic of the study

We excluded courses that were related to data analytics in other contexts apart from education and courses related to digital literacy and other educational competences apart from educational data literacy.

All courses were characterized according to the following fields:

- Title of the Course
- Type of the Course
- Targeted Audience
- Offered by
- Means of Delivery
- Cost
- Duration
- Expected Workload to Study the Course
- Learning Objectives
- Link with Existing EDL Competence Framework
- Structure
- Method of Assessment

Limitations:

There could be courses addressing the same topic but use different terms. There could be universities offering online courses in their own platform that are not included in this search.

Critical questions:

1. *What are the main Learning Objectives that are identified in the selected courses?*
2. *What are the Competences related to these Learning Objectives?*
3. *What are the main Dimensions of Competences that we can identify in these courses?*

Results:

Overview of the identified courses

Taking into account the selection criteria the environmental scan yielded **18 university/professional development courses**, most of which were related to fundamentals of learning analytics concepts and usage with a duration of 5 weeks on average. None of them is linked to an existing EDL Competence Framework, not even the five professional development courses (See **Appendix B1** for courses' overview).

Type of Course

As illustrated in Figure B.1, thirteen of the courses are university courses, eight of which are offered by EdX (Figure B.2).

Table B.1 Type of Course

Type of course	**Course**
University course	[2], [3], [4], [5], [6], [7], [9], [10], [11], [12], [13], [15], [18]
Professional Development	[1], [8], [14], [16], [17]

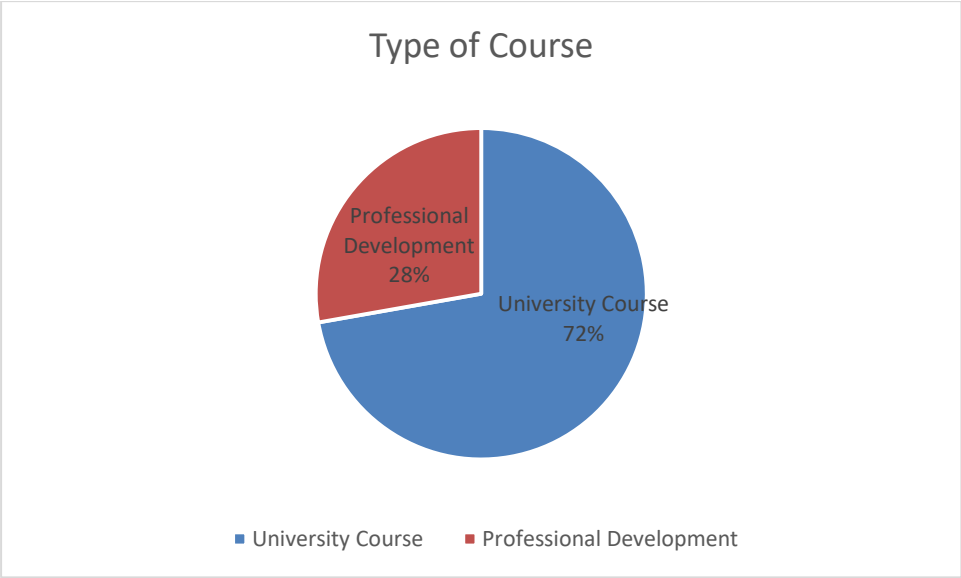

Figure B.1. *Type of Course*

Offered by

Table B.2. Offered by

Offered by	**Course**
Art of Educationg	[1]
EdX	[2], [3], [4], [5], [6], [9], [10], 12]
University of Sydney	[7]
National History Museum	[8]
Open Universiteit (***OUNL***, The Netherlands) via OpenEdX	[11]
Maastricht University	[13]
Canvas	[14], [16]
IIT Bombay via NPTEL	[15]
FutureLearn	[17]
The University of Edinburgh	[18]

As shown in Figure B.2, the majority of courses are offered by the EdX platform.

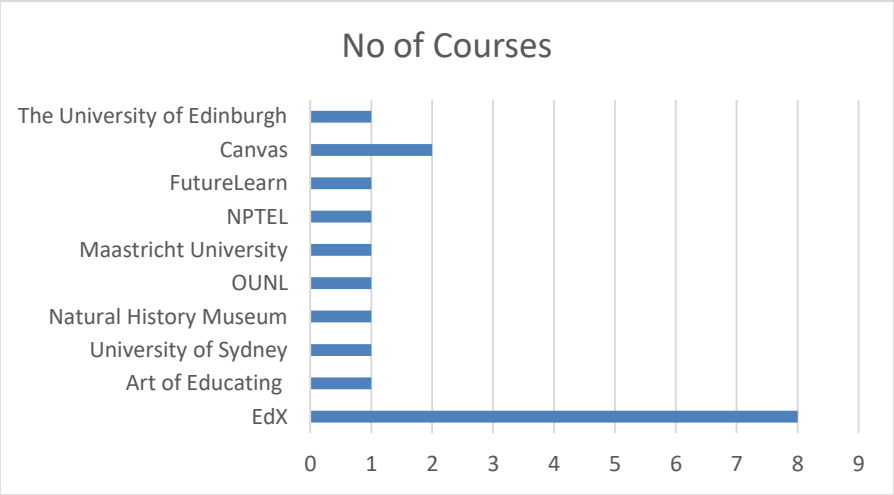

Figure B.2. *Offered by*

Cost

Four courses have fees for attending, while fourteen courses are free (Figure B.3).

Table B.3. Cost

Cost	**Course**
Free	[5], [6], [11], [13], [14], [15], [16]
Free (Open) - Verified Certificate (Paid)	[2], [12] , [17], [3], [4], [9], [10],
Fees are applied	[1], [7], [8] , [18]

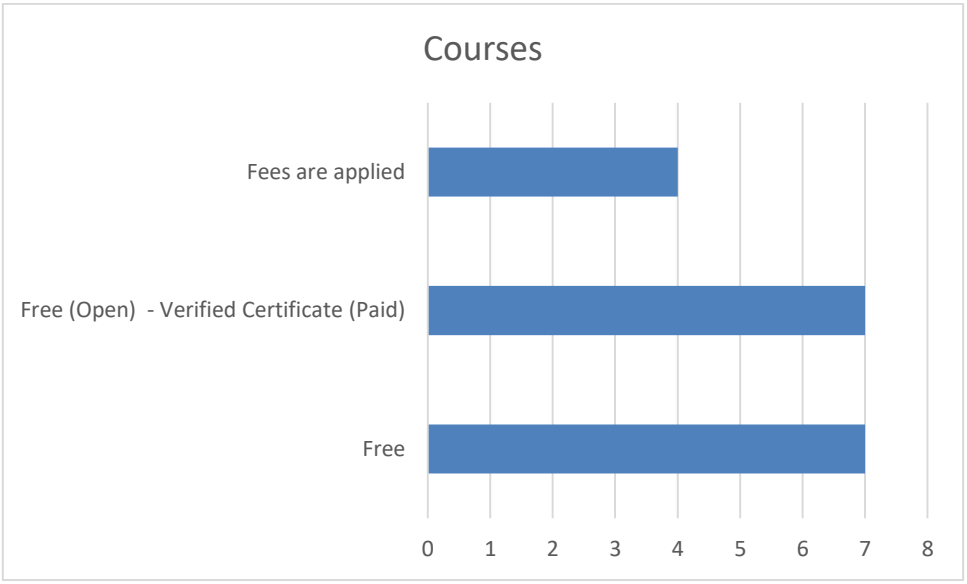

Figure B.3. *Cost*

Addressing Question 1: *What are the main Learning Objectives that are identified in the selected courses?*

Appendix B gathers the Learning Objectives that are identified in the selected courses (as reported in their Syllabi).

Addressing Question 2: *What are the Competences related to these Learning Objectives?*

Learning objectives of the selected courses are grouped and reveal the related Competences.

Addressing Question 3: *What are the main Dimensions of Competences that we can identify in these courses?*

Competences are grouped in 11 Dimensions of Competences as shown in Table B.4.

Table B.4. Competences identified from Learning Objectives

Competences	Courses
D1. Educational Data collection: D1.a Recognise different types of educational data. D1.b Identify educational data sources. D1.c Be able to apply Data Limitations and Quality Measures.	[1], [8], [9], [10], [14], [15], [16], [17]
D2. Data management: D2.a Apply Data Processing methods (Data Cleaning, Wrangling, Tidying). D2.b Apply Data Organization methods. D2.c Apply Data Preservation methods.	[1], [3], [8], [10], [14], [15]
D3. Data analysis: D3.a Data Analysis (educational data mining). D3.b Data visualization.	[2], [3], [4], [6], [8], [11], [14], [15], [16], [17]
D4. Data comprehension & interpretation: D4.a Data properties, data errors, data discrepancies. D4.b Statistics interpretation. D4.c Insights interpretation from data analysis. D4.d Interpret implications to instruction.	[10], [11], [14], [17]
D5. Data application: D5.a Evaluate and revise instruction. D5.b Support Data-Driven Decision making. D5.c Support Personalized learning.	[1], [2], [4], [5], [6], [7], [9], [10], [14], [15], [16], [17], [18]
D6. Data Ethics: D6.a Informed consent. D6.b Data privacy and security.	[3], [11], [12], [15], [16], [17],

D6.c Authorship, ownership.	
D7. Data literacy	[1], [2], [7], [8], [9]
D8. Learning Analytics D8.a Descriptive LA D8.b Predictive LA D8.c Prescriptive LA	[2], [3], [5], [6], [11], [12], [13], [15], [16], [18]
D9. Frameworks: D9.a SHEILA Framework.	[12]
D10. Tools: D10.a R in RStudio/ Tableau D10.b Jupiter Notebooks. D10.c Rapidminer. D10.d Gephi (for visualization). D10.e LightSIDE (for text analysis).	[3], [4], [5], [8], [15], [16],
D11. Platforms: D11.a Moodle D11.b Canvas	[14]

REFERENCES

Carlson, J., & Stowell Bracke, M. (2015). Planting the Seeds for Data Literacy: Lessons Learned from a Student-Centered Education Program. International Journal of Digital Curation, 10(1).

Chaudhry, A., Crowcroft, J. A., Howard, H., Madhavapeddy, A. V., Mortier, R. M., Haddadi, H., & McAuley, D. Personal Data: Thinking Inside the Box. Critical Alternatives, 1 (1) https://doi.org/10.7146/aahcc.v1i1.21312

Clark, K. Duckham, M. Guillemin, M. Hunter, A. McVernon, J. O'Keefe, C. Pitkin, C. Prawer, S. Sinnott, R. Warr, D. Waycott, J. (2015) Guidelines for the Ethical use of Digital Data in Human Research, The University of Melbourne, Melbourne.

Data Quality Campaign. (2014). Teacher Data Literacy: It's About Time.

Demchenko, I., & Belloum, A. (2017). EDISON: Discussion Document: Part 1. Data Science Competence Framework (CF-DS) release 2, (July), 1–59. http://doi.org/10.5281/ZENODO.1044346

Hamilton, L., Halverson, R., Jackson, S., Mandinach, E., Supovitz, J., & Wayman, J. (2009). Using student achievement data to support instructional decision making (NCEE 2009–4067). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/publications/practice/guides/

Hon Matt Hancock (2018) Data Ethics Framework, UK Ministerial Foreword

Ikemoto, G. S., & Marsh, J. A. (2007). Cutting through the data decision mantra: Different conception of data-driven decision making. In P. A. Moss (Ed.), Evidence and decision making (pp. 105–131). Malden, MA: Blackwell

Knapp, M. S., Swinnerton, J. A., Copland, M. A., & Monpas-Huber, J. (2006). Data-informed leadership in education. Seattle: University of Washington, Center for the Study of Teaching and Policy.

Lai M., Schildkamp K. (2013) Data-based Decision Making: An Overview. In: Schildkamp K., Lai M., Earl L. (eds) Data-based Decision Making in Education. Studies in Educational Leadership, vol 17. Springer, Dordrecht

Love, N. (2012). Data literacy for teachers. Hawker Brownlow Education.

Mandinach, E. B. (2012). A Perfect Time for Data Use: Using Data-Driven Decision Making to Inform Practice. Educational Psychologist, 47(2), 71–85. http://doi.org/10.1080/00461520.2012.667064

Mandinach, E. B., & Gummer, E. S. (2012). Navigating the landscape of data literacy: It IS complex. Washington, DC/Portland, OR: WestEd/Education Northwest.

Mandinach, E. B., & Gummer, E. S. (2013). A Systemic View of Implementing Data Literacy in Educator Preparation. Educational Researcher, 42(1), 30–37. http://doi.org/10.3102/0013189X12459803

Mandinach, E. B., & Gummer, E. S. (2016). What does it mean for teachers to be data literate: Laying out the skills, knowledge, and dispositions. Teaching and Teacher Education, 60, 366–376. http://doi.org/10.1016/j.tate.2016.07.011

Marsh, J. A. (2012). Interventions promoting educators' use of data: Research insights and gaps. Teachers College Record, 114(11), 1–48.

Marsh, J. A., & Farrell, C. C. (2015). How leaders can support teachers with data-driven decision making: A framework for understanding capacity building. Educational Management Administration & Leadership, 43(2), 269–289. http://doi.org/10.1177/1741143214537229

Means, B., Chen, E., DeBarger, A., & Padilla, C. (2011). Teachers' Ability to Use Data to Inform Instruction: Challenges and Supports. Office of Planning, Evaluation and Policy Development, U. S. Department of Education.

Means, B., Chen, E., DeBarger, A., and Padilla, C. (2011). Teachers' Ability to Use Data to Inform Instruction: Challenges and Supports, Office of Planning, Evaluation and Policy Development, U. S. Department of Education.

North Carolina Department of Public Instruction. (2013). Data Literacy. Retrieved from http://ites.ncdpi.wikispaces.net/Data+Literacy

Prado, C. J., & Marzal, A. M. (2013). Incorporating Data Literacy into Information Literacy Programs: Core Competencies and Contents. Libri, 63(2), 123–134. http://doi.org/10.1515/libri-2013-0010

Ridsdale, C., Rothwell, J., Smit, M., Ali-Hassan, H., Bliemel, M., Irvine, D., … Wuetherick, B. (2015). Strategies and Best Practices for Data Literacy Education. Dalhousie University.

Sampson, D., & Fytros, D. (2008a). Competence Models in Technology-enhanced Competence-based Learning. In Adelsberger, H. H., Kinshuk, Pawlowski, J. M. & Sampson, D. G. (Eds.), International Handbook on Information Technologies for Education and Training (2nd Ed.), Berlin: Springer, 155-177

Schildkamp, K., & Kuiper, W. (2010). Data-informed curriculum reform: Which data, what purposes, and promoting and hindering factors. Teaching and Teacher Education, 26(3), 482–496. http://doi.org/10.1016/j.tate.2009.06.007

The Information Accountability Foundation (IAF). (2014). A Unified Ethical Frame for Big Data Analysis - Big Data Ethics Initiative, http://informationaccountability.org/wp-content/uploads/IAFBig-Data-Ethics-Initiative-Draft-Part-B-Final-03-03-2015.pdf

The Open Data Institute. (2017). The Data Ethics Canvas

Vahey, P., Rafanan, K., Patton, C., Swan, K., van't Hooft, M., Kratcoski, A., & Stanford, T. (2012). Across-disciplinary approach to teaching data literacy and proportionality. Educ Stud Math, 81, 179- 205. doi: 10.1007/s10649-012-9392-z

Vahey, P., Yarnall, L., Patton, C., Zalles, D., & Swan, K. (2006). Mathematizing middle school: Results from a cross-disciplinary study of data literacy. In Annual Meeting of the American Educational Research Association, San Francisco, CA.

Wolff, A., Gooch, D., Montaner, C., Rashid, J. J., Kortuem, U., Wolff, A., … Kortuem, G. (2016). Creating an Understanding of Data Literacy for a Data-driven Society. The Journal of Community Informatics, 12(3), 9–26. Retrieved from www.ci-journal.net/index.php/ciej/article/view/1286.

Zook M, Barocas S, boyd d, Crawford K, Keller E, Gangadharan SP, et al. (2017) Ten simple rules for responsible big data research. PLoS Comput Biol 13(3): e1005399. https://doi.org/10.1371/journal.pcbi.1005399

APPENDIX A: THE GENERIC COMPETENCE DIMENSIONS AND COMPETENCE STATEMENTS OF EXISTING EDUCATIONAL DATA LITERACY COMPETENCE FRAMEWORKS

EF1: Data Science Competence Framework (CF-DS) (Demchenko & Belloum, 2017)

Table AA.1. Data-Related Competence statements of the EF1

EF1-Demchenko & Belloum (2017) **Competence statements** **5**
Develop and implement data management strategy for data collection, storage, preservation, and availability for further processing.
Develop and manage/supervise policies on data protection, privacy, IPR and ethical issues in data management
Implement data protection, backup, privacy, mechanisms/ services, comply with IPR, ethics and responsible data use
Ethics and responsible use of data and insight delivered, awareness of dependability (data scientist is a feedback loop in data driven companies)
Adhere to high ethical and professional norms, responsible use of power data driven technologies, avoid and disregard un-ethical use of technologies and biased data collection and presentation

EF2: Ten simple rules for responsible big data research (Zook et al. 2017)

Table AA.2. Data-Related Competence statements of the EF2

EF2-Zook et al. (2017) **Competence statements** **10**
Acknowledge that data are people and can do harm
Recognize that privacy is more than a binary value
Guard against the reidentification of your data
Practice ethical data sharing
Consider the strengths and limitations of your data; big does not automatically mean better
Debate the tough, ethical choices
Develop a code of conduct for your organization, research community, or industry
Design your data and systems for auditability
Engage with the broader consequences of data and analysis practices
Know when to break these rules

EF3: Guidelines for the Ethical use of Digital Data in Human Research (Clark et al. 2015)

Table AA.3. Data-Related Competence statements of the EF3

EF3-Clark et al. (2015) **Competence statements** **12**
Consent (*gaining informed consent to collect personal data and material posted on social media, including social networking sites, audio-, photo- and video-sharing sites, blogs and microblogs, wikis, chat rooms, and virtual worlds as sources of research data*) - data can only be used if they are de-identified, that is, anonymised.
Notice and transparency *(Individuals must be made aware of when personal information about them is collected, by whom, and for what purpose*).
Re-negotiate consent if data are to be used by someone other than whom who collected it, or are to be re-purposed in another context than the one it was collected in use of digital data only with explicit permission

Authentication of subjects (*Issues of consent, duty of care and harm in relation to participants may be compounded by a lack of knowledge about who participants really are (digital identities)*)
Consent and use limitation (*An individual's consent is required in order to collect personal information about them; Personal information can only be collected for specified purposes, and the subsequent use of that information is limited to those purposes*)
Protecting privacy and confidentiality (*define mechanisms, regulatory frameworks, or administrative structures to protect the individual's privacy and confidentiality in relation to the project*)
Access and participation (*Individuals have the right to access personal data that refers to them. In case that stored data contains any inaccuracies, individuals may also require that errors be corrected*)
Integrity and security (*Collectors of personal information must make reasonable efforts to ensure data is accurate and up-to-date; also protect against unauthorized access, disclosure, or use*)
Enforcement and accountability (*The collectors of personal information must be accountable for any failures to comply with the previous principles*)
Authorship and ownership of digital data (*Clarify information ownership, who is in control of access, who is charged with managing the data, who may be considered responsible for the data, who has long-term responsibility for the quality of the data, the protection of sensitive material and the long-term maintenance of the data*)
Data governance and custodianship (*Clarify who is responsible for storage, management and access to data - establish good data governance practices in order to ensure data security and thus protect participants' privacy and confidentiality*)
Data-sharing (*clarify where data re-use must be approved or justified under the same framework as the original use of the data - reduce unnecessary duplication and competition*)

EF4: Data Ethics Framework (Hancock, 2018)

Table AA.4. Data-Related Competence statements of the EF4

EF4-Hancock (2018) **Competence statements** **7**
Start with clear user need and public benefit (*Description of the user need with supporting evidence*)
Be aware of relevant legislation and codes of practice (*List the pieces of legislation, codes of practice and guidance that apply to your project.*)
Use data that is proportionate to the user need (*Describe how the data being used is proportional to the user need*)
Understand the limitations of the data (*Identify the potential limitations of the data source(s) and how they are being mitigated*)
Use robust practices and work within your skillset (*Explain the relevant expertise and approaches that are being employed to maximise the efficacy of the project*)
Make your work transparent and be accountable (*Describe how you have considered making your work transparent and accountable*)
Embed data use responsibly (*Describe the steps taken to ensure any new model, policy or service is managed responsibly*)

EF5: A Unified Ethical Frame for Big Data Analysis - Big Data Ethics Initiative (IAF, 2014)

Table AA.5. Data-Related Competence statements of the EF5

EF5-IAF (2014) **Competence statements** **5**
Ethical data use should be done with an expectation of tangible benefit - define the usefulness or merit that comes from solving the problem
If the anticipated improvements can be achieved in a less data-intensive manner, then less intensive

processing should be pursued
Big data insights, when placed into production, should provide value that is sustainable over a reasonable time frame (Data Sustainability, Algorithmic Sustainability, Device and/or Manufacturer-Based Sustainability)
Respect the individuals to whom the data pertains, organizations that originate the data, organizations that aggregate the data and those that might regulate the data.
Conduct analysis of fairness needs to look not only at protecting against unseemly or risky actions but also at enhancing beneficial opportunities

EF6: The Data Ethics Canvas (ODI, 2017)

Table AA.6. Data-Related Competence statements of the EF6

EF6-ODI (2017) **Competence statements** **15**
Name and describe key data sources used in your project, whether you're collecting them yourself or getting access from third parties.
Identify Limitations in your data sources (e.g., biases, sensitivity)
If sharing data with other organisations, define with who and under which conditions
Consider data protection legislation, IP and database rights legislation, anti-discrimination laws, sector-specific data sharing policies/regulation (eg health, employment, taxation), sector-specific ethics legislation
Determine the rights over data sources
Cite existing ethical frameworks that are relevant to your project
Justify your reason for using this data (primary purpose, benefits)
Communicating your purpose of using data with the people whom the data come from
Explain what are the positive effects on people
Explain what are the negative effects on people
Explain actions take to minimising negative impact
Engaging with people (*how and to what degree they can appeal or request changes to the service*)
Communicate potential risks and issues to people who the data come from
Reviews and iterations (*explain how will ongoing issues related to data ethics be monitored and discussed*)
Determine the actions taken

APPENDICES B: EDUCATIONAL DATA LITERACY PROFESSIONAL DEVELOPMENT AND UNIVERSITY COURCES

Appendix B.1 – Courses' Overview

1.

Title of the Course	**Data Literacy 01 (http://artofeducating.com/online-courses/)**
Type of Course	Professional Development
Targeted Audience	Practicing school administrators and teachers from kindergarten to high school in any subject area
Offered by	Art of Educating (Jennifer L. Morrison)
Means of Delivery	Blended
Cost	Fees are Applied
Duration	15 Weeks
Expected Workload to Study the Course	At minimum three or more hours per week listening, participating, and completing the course activities.
Learning objectives	• Define reliability and validity in classroom terms. • Define data literacy and explain why educators need to be data literate • Give good reasons why educators don't necessarily jump up and down with excitement about data and assessment. • Know what you can do to own and spread the data literacy story in your context. • Recognize that data are more than standardized test scores. • Gather four types of data in your own context. • Reinforce and support your learning and data literacy development. • Define classroom research and how it might improve learning in your classroom and/or school. • Generate and share potential research questions. • Identify appropriate data sources for conducting your research.
Link with Existing EDL Competence Framework	--
Structure	• Unit 1 – Understanding the Role of Data • Unit 2 – Creating Reliable Classroom Assessments • Unit 3 – Harnessing Classroom Research to Improve Student Learning • Course Wrap-Up
Method of Assessment	Assignments (At the end of each lesson students will be asked to complete an activity and share it with other members of their classthrough lesson-specific discussion forums).
Your comment why this is a useful course to include	This course will ground us in her eight principles of

in the review	data literacy, with the goal of empowering us to collect and use them more effectively,

2.

Title of the Course	**Analytics for the Classroom Teacher (https://www.edx.org/course/analytics-for-the-classroom-teacher)**
Type of Course	University Course
Targeted Audience	Teachers, Instructional Designers
Offered by	Curtin University via edX
Means of Delivery	MOOC
Cost	Free (Open) - Verified Certificate (Paid)
Duration	6 weeks
Expected Workload to Study the Course	3 to 4 hours per week
Learning objectives	• How educational data analytics can improve classroom teaching and learning, as well as supporting data-driven decision making at various levels of school operations • An understanding of the current state-of-the-art in teaching and learning analytics tools and methods • How teaching analytics can be used to analyse your lesson plans • How learning analytics can be used to analyse the classroom delivery of your lesson plan and reveal more about your students' learning • How you can reflect on your teaching practice by combining insights from both teaching and learning analytics
Link with Existing EDL Competence Framework	
Structure	• Module 1 -Introduction to educational data for supporting data-driven decision making in school education • Module 2 -Teaching analytics: Analyse your lesson plans to improve them • Module 3 -Learning analytics: Analyse the classroom delivery of your lesson plans and discover more about your students • Module 4 -Teaching and learning analytics to support teacher inquiry • Module 5 –Conclusion
Method of Assessment	Online Quiz
Your comment why this is a useful course to include in the review	This course will teach us how teachers, curriculum developers and policy makers are collecting and analyzing data from the classroom to help guide

	decisions at all levels. We will get a deeper understanding of how data analytics can help us to make improvements in students' learning.

3.

Title of the Course	**Learning Analytics Fundamentals (https://www.edx.org/course/learning-analytics-fundamentals-utarlingtonx-link-la-fundx)**
Type of Course	University Course
Targeted Audience	Those who have a bachelor's degree and are interested in developing learning and data science skills for employment in education, corporate, non-profit, and military sectors
Offered by	University of Texas at Arlington via edX
Means of Delivery	MOOC
Cost	Free (Open) - Verified Certificate (Paid)
Duration	4 Weeks
Expected Workload to Study the Course	5-7 hours per week
Learning objectives	• The field of learning analytics and explore how data and information are used • Common learning analytics methods and approaches, such as data wrangling and cleaning, structure discovery, and basic prediction modelling • How to conduct basic data wrangling and analyses • Ethics and privacy considerations • Working in a collaborative, cross-disciplinary setting • Common toolsets used in the UTArlingtonX Learning Analytics courses (R in RStudio and Jupiter Notebooks)
Link with Existing EDL Competence Framework	
Structure	• Instructor Lecture Videos • Guest Lecture and Interview Videos • Supplemental Reading • Discussion Forums • Working with Learning Data in R, R Studio, Swirl, and Jupyter Notebooks • Ethics Scenario Assignment
Method of Assessment	• Assignments in R (30% of total grade) • Ethics Scenario (20% of total grade) • Participation (50% of total grade)

Your comment why this is a useful course to include in the review	After completing this course we will have a better understanding of the field of learning analytics and be able to apply skills to any occupation that utilizes educational data

4.

Title of the Course	**Big Data and Education (https://www.edx.org/course/big-data-education-pennx-bde1x-0)**
Type of Course	University Course
Targeted Audience	Teachers, Instructional Designers
Offered by	University of Pennsylvania via edX
Means of Delivery	MOOC
Cost	Free (Open) - Verified Certificate (Paid)
Duration	8 weeks
Expected Workload to Study the Course	6-12 hours per week
Learning objectives	• Key methods for educational data mining • How to apply methods using standard tools such as RapidMiner • How to use methods to answer practical educational questions
Link with Existing EDL Competence Framework	
Structure	• Week 1: Prediction • Week 2: Diagnostic Metrics and Cross-Validation • Week 3: Feature Engineering and Behavior Detection • Week 4: Knowledge Inference and Knowledge Structures • Week 5: Relationship Mining • Week 6: Visualization • Week 7: Structure Discovery • Week 8: Discovery with Models • Wrapping Up
Method of Assessment	Assignments
Your comment why this is a useful course to include in the review	Methods for mining and modeling the increasing amounts of fine-grained data about learners are being developed; in this class, we will learn about these methods, and their strengths and weaknesses for different applications. Thus we will be able to use each method to answer education research questions and to drive intervention and improvement in

	educational software and systems.

5.

Title of the Course	**Data, Analytics and Learning (https://www.edx.org/course/data-analytics-learning-utarlingtonx-link5-10x)**
Type of Course	University Course
Targeted Audience	Teachers, Instructional Designers
Offered by	University of Texas at Arlington via edX
Means of Delivery	MOOC
Cost	Free (Open)
Duration	9 weeks
Expected Workload to Study the Course	5 hours/week
Learning objectives	• How to identify trade-offs between proprietary and open source tools commonly used in learning analytics • The learning analytics data cycle • How to perform social network analysis, interpret the analysis for the study of networked learning, and visualize the analysis results in Gephi • Training and evaluating classifiers that use clickstream data, with a focus on how to engineer features and training labels • Evaluation issues, key diagnostic metrics and their uses, and validity issues • How to approach a problem in the area of text mining using LightSIDE, how to engineer features for text classification, how to use LightSIDE for automated collaborative learning process analysis • How trained models can be used in service of learning research
Link with Existing EDL Competence Framework	If any, which one
Structure	**Week 1:** Introduction to Learning Analytics (LA) **Week 2:** Starting With Data **Week 3:** Basics of Social Network Analysis **Week 4:** Sensemaking of Social Network Analysis for Learning **Week 5:** Prediction Modeling **Week 6:** Behavior Detection and Model Assessment **Week 7:** Text Mining Introduction **Week 8:** Text Mining Nuts and Bolts **Week 9:** Wrapping Up
Method of Assessment	Weekly assignments
Your comment why this is a useful course to include	It is a great introduction to the logic and methods of

in the review	analysis of data to improve teaching and learning.

6.

Title of the Course	**Practical Learning Analytics (https://www.edx.org/course/practical-learning-analytics-michiganx-plax)**
Type of Course	University Course
Targeted Audience	Post-secondary students, faculty, and staff, along with those outside the academy who are interested in understanding it – people in foundations, the educational technology industry, or the government.
Offered by	University of Michigan via edX
Means of Delivery	MOOC
Cost	Free (Open)
Duration	4 Weeks
Expected Workload to Study the Course	2-8 hours per week
Learning objectives	• About the landscape of learning analytics in higher education • How to bring in data of your own for analysis and visualization • About performance prediction in a course: up to and including grade penalties, placement analyses, performance disparities and their correlates, course-to-course correlation • How institutions are creating early warning systems and personalized communication • How to apply learning analytics to observe differences and probe impact, capturing more and better information
Link with Existing EDL Competence Framework	-
Structure	• Setting the table • Five courses – each with an overview, data, tools, and a creative extension competition • Clearing up
Method of Assessment	• One group of users will be expected to participate only in the core material of each week, perhaps 4-8 hours total of watching, reading, and responding. Each week's core material will include short quizzes on core content, along with discussion prompts for use in the forums. • A second group will go slightly deeper, visiting some of the five courses, selecting the small plates • The hungry diners: The third group will complete at least some of the full courses, adapting the code which is provided of developing their own R code to determine things about the data which instructors' examples don't support.

Your comment why this is a useful course to include in the review	I believe that after completing this course we should emerge with a deeper appreciation for what we might learn from data we already have, with knowledge of either the general nature or the gory details of some specific applications, and with excitement about the possibilities afforded by the richer data which is coming soon

7.

Title of the Course	**Data Literacy for School Teachers - EDPZ6012 (https://sydney.edu.au/courses/units-of-study/2018/edpz/edpz6012.html)** https://sydney.edu.au/courses/units-of-study/2019/edpz/edpz6012.html
Type of Course	University Course (Unit of study)
Targeted Audience	Teachers, Instructional Designers
Offered by	University of Sydney
Means of Delivery	Blended
Cost	Fee are Applied
Duration	2hrs x13wks
Expected Workload to Study the Course	Not mentioned
Learning objectives	• to understand and use data effectively • to inform teaching and learning decisions
Link with Existing EDL Competence Framework	--
Structure	List of Topics in bullets
Method of Assessment	Formative assessment and engagement 1000wds (20%) and major project with 3 assignments 5500 wds (80%)
Your comment why this is a useful course to include in the review	It is completely focused on EDL

8.

Title of the Course	**Advancing computational and data literacy skills schools for life scientists** (http://www.nhm.ac.uk/our-science/courses-and-students/advancing-computational-and-data-literacy-for-life-scientists.html)

Type of Course	Professional Development
Targeted Audience	PhD students and early career researchers in the field of computational and data literacy teaching
Offered by	Berkeley Institute for Data Science (Dr Karthik Ram) Natural History Museum (Dr Natalie Cooper) Denison University (Dr Sarah Supp)
Means of Delivery	Blended
Cost	Fee are Applied
Duration	5Days
Expected Workload to Study the Course	--
Learning objectives	• Train participants in data literacy skills • efficient collection of data and metadata for future analyses • data wrangling, tidying, and organisation in R • data visualisation and analysis in R • Teach participants basic tools for reproducible science reproducible report creation version control • Introduce participants to Open Science principles and procedures • data archiving options and best practice • code sharing options and best practice • Introduce participants to the fundamentals of programming basics in R and • the principles of tidy code and code review • create a community of data literate scientists
Link with Existing EDL Competence Framework	
Structure	• short lectures • computer practicals • putting skills into practice using data gathered in the Museum's "behind the scenes" collections. • optional evening activities where participants can network with each other, and with members of London's data science community.
Method of Assessment	Not mentioned
Your comment why this is a useful course to include in the review	This course has been designed by professionals in the field of EDL. Thus it seems to be really practical and interactive.

9.

Title of the Course	**Introduction to Data Wise: A Collaborative Process to Improve Learning & Teaching**

	(https://www.edx.org/course/introduction-to-data-wise-a-collaborative-process-to-improve-learning-teaching?source=aw&awc=6798_1528751625_af527528449614f1594dcc5313473d52&utm_source=aw&utm_medium=affiliate_partner&utm_content=text-link&utm_term=301045_https%3A%2F%2Fwww.class-central.com%2F)
Type of Course	University Course
Targeted Audience	Teachers, Instructional Designers
Offered by	Harvard University via edX
Means of Delivery	Online
Cost	Free (Open) - Verified Certificate (Paid)
Duration	2 weeks
Expected Workload to Study the Course	4-6 hours a week
Learning objectives	• Understand what the Data Wise Improvement Process is and how it can help you improve teaching and learning. • Build skills in looking at a wide range of data sources, including test scores, student work, and teaching practice. • Identify next steps in supporting a culture of collaborative data inquiry in your setting. • As a bonus, this course provides a complete video case study introducing the Universal Data Wise Improvement Process and showing how it can be used at a system level.
Link with Existing EDL Competence Framework	
Structure	• Step 1 - Organize for Collaborative Work • Step 2 - Build Assessment Literacy • Step 3 - Create Data Overview • Step 4 - Dig into Student Data • Step 5 - Examine Instruction • Step 6 - Develop Action Plan • Step 7 - Plan to Assess Progress • Step 8 - Act and Assess
Method of Assessment	Self-assessment
Your comment why this is a useful course to include in the review	It seems that upon completion of this module, we will be able to pursue opportunities for continuing to learn and apply the Data Wise Improvement Process.

10.

Title of the Course	**Using Data to Provide Personalized Student Support** (https://www.edx.org/course/using-data-provide-personalized-student-utarlingtonx-link-la-ssax)
Type of Course	University Course
Targeted Audience	Educational designers, learning technology managers, and academics
Offered by	University of Texas Arlington via edX
Means of Delivery	MOOC
Cost	Free (Open) - Verified Certificate (Paid)
Duration	3 weeks
Expected Workload to Study the Course	5-7 hours per week
Learning objectives	• How data sets are captured in learning experiences • What basic procedures to use to manipulate these data sets • The use of statistical models to predict student behavior • The deployment of personalized support actions for the students
Link with Existing EDL Competence Framework	--
Structure	Week 1: Computer Logs Week 2: From logs to indicators Week 3: Combining data sources and deploying student support actions
Method of Assessment	Not Mentioned
Your comment why this is a useful course to include in the review	This course will guide us on how can data be translated into actionable knowledge and how can data help improve the overall quality of a learning experience.

11.

Title of the Course	**Trusted Learning Analytics** (https://ou.edia.nl/courses/course-v1:OUNL+TLA2019+2019_1/about)
Type of Course	University course
Targeted Audience	Not mentioned
Offered by	Open Universiteit (***OUNL***, The Netherlands) via OpenEdX

Means of Delivery	MOOC
Cost	Free
Duration	4 weeks
Expected Workload to Study the Course	4-5 hours per week
Learning objectives	This course aims at framing learning analytics and its most important dimensions. It will demonstrate why learning analytics has the power to be a real game-changer for educational research by enhancing the e-learning experiences and creating more effective e-learning environments.
Link with Existing EDL Competence Framework	--
Structure	**Welcome** • Course introduction • Make your own plan **Week 1: Grounding: LA in a Nutshell** • Intro + Grounding video • Definition and dimensions of LA • References • Assignment: Getting started with LA **Week 2: Digging: LA Implementation Challenges** • Intro + Digging video • Ethics and Privacy • LA for Learning Design • Evaluating LA • References • Assignment: Quiz **Week 3: Peeling: Learning Analytics Dashboards** • Intro + Peeling video • Dashboard design • Dashboard interpretation • LA Case Studies • References • Assignment: Evaluating a LA Dashboard **Week 4: Shining: Create Your Own LA** • Intro + Shining video • Final Assignment: Design your own Learning Analytics
Method of Assessment	Peer assessment + Online Quiz

Your comment why this is a useful course to include in the review	The course has an interesting part of planning own study. Planning reminders are set according to this plan. The course has interesting peer assessing assignments. After submitting an assignment, participants are required to evaluate the

	answers submitted by two of their peers.

12.

Title of the Course	**Learning Analytics in Higher Education** (https://www.edx.org/course/moving-towards-systematic-adoption-of-learning-analytics-in-higher-education)
Type of Course	University course
Targeted Audience	Not mentioned
Offered by	Universidad Carlos III de Madrid via EdX • Dragan Gašević, Professor of Learning Analytics. Monash University. • Carlos Delgado Kloos, Full Professor. Universidad Carlos III de Madrid. • Pedro J. Muñoz-Merino, Associate Professor. Universidad Carlos III de Madrid. • Maren Scheffel, Assistant Professor. Open University of the Netherlands. • Hendrik Drachsler, Professor. University of Frankfurt & German Leibniz Institute of Education (DIPF). • Kairit Tammets, Senior Researcher. Tallinn University. • Yi-Shan Tsai, Research Associate. University of Edinburgh. • Anaïs Gourdin, Project Manager. European Association for Quality Assurance in Higher Education (ENQA). • Rasmus Benke-Åberg, Director. Erasmus Student Network (ESN).
Means of Delivery	MOOC
Cost	Free Course Auditing - Verified Certificate (Paid)
Duration	3 weeks
Expected Workload to Study the Course	3-5 hours per week
Learning objectives	What you'll learn • Describe and critically discuss the current state of learning analytics in higher education. • Outline and analyze the adoption of learning analytics in an international landscape. • Explain and appraise key drivers, challenges, and relevant policies. • Apply the SHEILA framework for learning analytics strategy formation. • Apply the SHEILA framework for learning analytics policy formation. • Address and manage different expectations and concerns among stakeholders.
Link with Existing EDL Competence Framework	--
Structure	Week 1: Learning Analytics in Higher Education: Overview a. The rise of learning analytics in higher education

	b. The global landscape of adoption c. Success and challenges in the adoption of learning analytics in higher education d. Ethics and privacy issues e. Learning analytics Policies f. Using learning analytics for quality assurance Week 2: Enabling systematic adoption using SHEILA framework a. SHEILA framework - Steps and Tools b. Key actions towards a systematic adoption c. Key challenges to address d. Key questions to answer when developing an institutional policy or strategy e. Using SHEILA framework - Case Studies Week 3: Adopting learning analytics in a complex educational system a. Cultural differences in stakeholder expectations b. Managing multi-stakeholder expectations c. Working together with different stakeholders d. A systematic adoption of learning analytics in higher education
Method of Assessment	The evaluation is based on two tests in weeks 1 and 2 (they are graded with a 35% each) about the contents and one activity in week 3 (graded with a 30%). To pass the course it will be necessary to obtain the 60% of the final grade.
Your comment why this is a useful course to include in the review	This course gives an overview of learning analytics in higher education and introduces the SHEILA framework that can be used to support strategy and policy formation in addition to readiness assessment.

13.

Title of the Course	**Learning Analytics Unraveled** (https://www.maastrichtuniversity.nl/learning-analytics-unraveled)
Type of Course	University course
Targeted Audience	N/A
Offered by	Maastricht University, Next Learning Valley and The Learning Hub • Simon Beausaert, Associate professor in Workplace Learning at Maastricht University • Melvyn Hamstra, Assistant Professor in Organizational Behavior at Maastricht University • Simeon De Simon, The Learning Hub • Francois Walgering, Next Learning Valley
Means of Delivery	MOOC
Cost	Free

Duration	4 weeks
Expected Workload to Study the Course	4 hours per week
Learning objectives	N/A
Link with Existing EDL Competence Framework	--
Structure	**Week 1:** introduction on 'What is Learning Analytics' and how could it be applied in different organisations. **Week 2:** why we should be interested in Learning Analytics and for which kind of purposes it can be used. **Week 3:** different ways of applying Learning Analytics **Week 4:** pitfalls when doing learning analytics
Method of Assessment	N/A
Your comment why this is a useful course to include in the review	MOOC on Learning Analytics Unraveled aims to help us to understand what Learning Analytics is all about, why we should use it and how. After the completion of the course we will know about all the LA ins and outs and have a better understanding of implementing it in an organisation.

14.

Title of the Course	**ANALYTICS IN COURSE DESIGN: LEVERAGING CANVAS DATA (HE)** (https://www.canvas.net/browse/dartmouth/courses/analytics-in-course-design)
Type of Course	Professional Development
Targeted Audience	Faculty and instructional designers of Dartmouth College
Offered by	Dartmouth College via Canvas **Jing Qi, EdD,** LMS and Learning Analytic Specialist at Dartmouth College, NH. **Brian Reid, PhD,** Associate Director of Information Technology at Geisel School of Medicine at Dartmouth
Means of Delivery	Online course
Cost	Free
Duration	6 hours
Expected Workload to Study the Course	6 hours in total

Learning objectives	Upon completing this course, participants should be able to: • install an userscript that gathers the access report data for an entire course • understand the common fields included in the the Access Report raw data • load the data to an app that analyzes the access report data • understand content usage in a course, and apply the results to improve course design that better facilitates student engagements • understand Canvas course design strategy categories • install an userscript that evaluates the design strategies being applied in a course • deploy a mixed course design strategy to facilitate greater engagement and better learning • install an userscript that gathers quiz submission data in a course • understand the common fields that are included in the quiz submission raw data • analyze the quiz submission data to address the questions which are not answered in the Canvas built-in quiz statistics. • install an userscript that gathers discussion data for an entire course • understand the common fields included in the discussion raw data • create an edge list that includes from (reply_author) and to (initial_thread_author) fields, and load the discussion data to a discussion analytical app • use the diagrams to inform student discussion participation and facilitate greater discussion engagement
Link with Existing EDL Competence Framework	--
Structure	This course contains four modules that each applies different aspects of Canvas Data to Canvas course design. They include: 1. **Course Engagements:** Leverage the student Access Report to analyze course content engagements. 2. **Course Content Design:** Explore the usage of Canvas course features and the organization of course navigation items to categorize Canvas course design strategies. 3. **Assignment Submissions:** Examine assignment and quiz submission data using an analytical approach. 4. **Discussion Interactions:** Analyze student participation using Canvas discussion data to help faculty understand how students interacted with their peers in Canvas discussion forums and whether they were actively engaged in discussions.
Method of Assessment	N/A
Your comment why this is a useful course to include in the review	This course is useful for leveraging Canvas Data and visualization techniques to make informed decisions about Canvas course design.

15.

Title of the Course	**NOC:Introduction To Learning Analytics** (https://nptel.ac.in/courses/127/101/127101012/)
Type of Course	University course
Targeted Audience	University students
Offered by	IIT Bombay via NPTEL
Means of Delivery	Online course (video lectures only)
Cost	Free Course Auditing
Duration	4 weeks
Expected Workload to Study the Course	40 min per week
Learning objectives	N/A
Link with Existing EDL Competence Framework	--
Structure	Week 1 : What is LA • Definition • Relation with Academic Analytics • Relation with Education Data Mining • LA - Big-Picture • Relation with Machine Learning, EDM • Four Levels of Learning Analytics • Overview I • Overview -II Week 2 : Data Collection • How Big is Education data • Data Collection from Learning Environments • Pre-Processing Ethics in Learning Analytics • Student Privacy Week 3 : Descriptive Analytics • Data Visualization Example Dashboard Analytics Week 4 : Predictive Analytics • Linear Regression Analytics Tools • Demo of Weka/Rapidminer • Demo of Linear Regression using Weka
Method of Assessment	Exams
Your comment why this is a useful course to include in the review	This course is useful as a LA course example from a non-western country

16.

Title of the Course	**Learning Analytics and Knowledge LAK13** (https://learn.canvas.net/courses/33)
Type of Course	Professional development
Targeted Audience	This course will be of interest to individuals across the full learning spectrum: K-12, higher education, corporate learning and informal/life long learning. Leaders, educators, and even students will benefit from the topics explored and the related implementation issues (in particular, privacy and ethics of analytics).
Offered by	Canvas Taught by: • Simon Buckingham Shum (Open University UK) • Shane Dawson (University of South Australia) • Erik Duval (Katholieke Universiteit Leuven) • Dragan Gašević (Athabasca University) • George Siemens (Athabasca University)
Means of Delivery	MOOC
Cost	Free
Duration	8 weeks
Expected Workload to Study the Course	5-10 hours per week
Learning objectives	At the conclusion of this course, participants will be able to: 1. Describe learning analytics and how it differs from related concepts such as educational datamining and academic analytics. 2. Analyze, plan, and deploy a small learning analytics pilot, including the intent of LA and tools needed to address analytics goals. 3. Develop a matrix of prominent learning analytics tools and the particular analytics strategies each tool addresses. 4. Evaluate current state of learning analytics technologies and describe the benefits and drawbacks to open source and proprietary tool sets. 5. Evaluate and describe the role of semantic web and linked data in next generation educational content. 6. Conduct basic analytics activities (such as importing and visualizing data) through in open source tools (R) and commercial tools (Tableau Software).
Link with Existing EDL Competence Framework	--
Structure	**Week 1:** Trends and Context: Why Learning Analytics? **Week 2:** Cases and examples of implementation of learning analytics **Week 3:** Tools, methods, and levels of learning analytics **Week 4:** Predictive models & Assessment **Week 5:** Smarter curriculum: semantic web, linked data, and adaptive content

	Week 6: Epistemology, Pedagogy, Assessment and Learning Analytics **Week 7:** Privacy and ethics: principles for governing LA use and implementation **Week 8:** Learning analytics: where is it headed? How to get involved (SoLAR, IEDMS, academic programs)
Method of Assessment	Not Mentioned
Your comment why this is a useful course to include in the review	This course will provide an (generally non-technical) introduction to learning analytics and how they are being deployed in various contexts in the education field. Additionally, the tools and methods, ethics and privacy, and the systemic impact of analytics will be explored, presenting a broad overview of the current state and possible future directions of the field.

17.

Title of the Course	**Using Data to Improve Student Outcomes (not available)** (https://www.futurelearn.com/courses/data-student-outcomes)
Type of Course	Professional Development
Targeted Audience	This course is designed for professional educators, as well as those working in other professional services like health, who wish to use data science to improve outcomes.
Offered by	American Association of Colleges for Teacher Education (AACTE) via FutureLearn
Means of Delivery	MOOC
Cost	Free Course Auditing Verified Certificate (Paid)
Duration	3 weeks
Expected Workload to Study the Course	3 hours per week
Learning objectives	By the end of the course, you'll be able to... • Identify data sources and recognise different types of data. • Recognise and discuss different methods for improvement initiatives. • Interpret case studies and discuss improvement processes within your ow context and professional experience. • Explain the relationship between data, findings and actions required in orc to achieve continuous improvement. • Describe the difference between data and findings. • Produce findings from a sample set of data. • Evaluate and discuss the different approaches taken in example data dashboards. • Identify and select the most appropriate indicators for measuring

	improvement.
Link with Existing EDL Competence Framework	--
Structure	Week 1 – Improvement Science • Identifying different sources and types of data • Ways to improve student outcomes • Improvement processes in your own context and professional experience • Real-world examples of improving student outcomes Week 2 – Findings • How to present and evaluate data effectively • The difference between data and findings • The role of ethics in data handling and sharing • The relationship required between data, findings and actions, to achieve continuous improvement Week 3 – Actions • Different indicators for measuring improvement • How to collect sample data and select the appropriate indicator • How to present indicators and actions to students
Method of Assessment	Not Mentioned
Your comment why this is a useful course to include in the review	This free online course from AACTE American Association of Colleges for Teacher Education (a national alliance of educator preparation dedicated to offering high-quality, evidence-based programs) claims that it will help us to use data science to deliver better outcomes for our students.

18.

Title of the Course	**Learning analytics: process and theory (ended Sept 2018)** (https://online.education.ed.ac.uk/course/learning-analytics-process-and-theory)
Type of Course	University course
Targeted Audience	University students
Offered by	The University of Edinburgh Course leader: Professor Dragan Gasevic
Means of Delivery	Online course
Cost	Fees are applied
Duration	Not mentioned

Expected Workload to Study the Course	Not mentioned
Learning objectives	On completion of the course you will be able to: • describe and critically analyse learning analytics process and theory; • review, integrate and critically assess emerging trends in learning analytics literature; • develop a proposal for a piece of research or application using learning analytics in an educational setting, based in a critical understanding of the literature • develop a detailed plan for the learning analytics application or research proposed, and critically assess its main elements.
Link with Existing EDL Competence Framework	--
Structure	The course is structured around a number of activities. Each week will have a set of readings introducing the topics of learning analytics covered by the course. The topics will be adjusted each to acknowledge the rapid development of the field of learning analytics and its theory and processes. Each of these readings will be accompanied by a series of tutor-provided questions that will help scaffold participants' posts to asynchronous online discussion posts. The purpose of these discussions is to create a space for the participants to engage with social knowledge construction activities, negotiate the meaning of the topics studied with their peers, and get to appreciate and critical discuss different viewpoints to learning analytics. Each summative assessment will be accompanied with formative feedback to inform and guide later assessments in the course. The three main assessments guide the participants through a process of the development of their ideas – from early literature review to project proposal to project execution, and reporting and presentation of the findings. To increase the flexibility necessary to a globally-distributed cohort, online activities are mainly asynchronous. To increase access to the tutor, the course will feature weekly synchronous discussion session with the instructor and scheduled weekly online chats.
Method of Assessment	Assignments are designed to be cumulative while remaining distinct. **Assignment 1:** Critical literature review paper (35% of your final mark). **Assignment 2:** Collaborative formulation of application or research proposal (20% of your final mark). **Assignment 3:** Learning analytics planning paper (40% of your final mark).
Your comment why this is a useful course to include in the review	This course provides a framework for understanding and critically discussing the emerging field of learning analytics. Students will learn about the distinction between learning analytics, educational data mining, and big data, and the relationship of learning analytics and existing fields. Perspectives on what learning analytics should be will be connected to philosophy and theory on the nature of design and inquiry. We will consider what it means for a learning

	analytics analysis or model to be valid, and the key challenges to the effective and appropriate use of learning analytics.

Appendix B2 – Learning objectives and syllabus per course mapped to the identified dimensions.

Learning Objectives as reported in syllabus	Courses
• Define reliability and validity in classroom terms. **[D.1c]** • Define data literacy and explain why educators need to be data literate **[D7]** • Give good reasons why educators don't necessarily jump up and down with excitement about data and assessment. **[D2]** • Know what you can do to own and spread the data literacy story in your context. **[D7]** • Recognize that data are more than standardized test scores **[D1.a].** • Gather **[D1.b]** four types of data in your own context. • Reinforce and support your learning and data literacy development. **[D7]** • Define classroom research and how it might improve learning in your classroom and/or school. **[D5.a]** • Generate and share potential research questions. **[D5.a]** • Identify appropriate data sources for conducting your research. **[D1.b]**	[1] Data Literacy 01
• How educational data analytics can improve classroom teaching and learning, as well as supporting data-driven decision making at various levels of school operations **[D5.b]** • An understanding of the current state-of-the-art in teaching and learning analytics tools and methods **[D8]** • How teaching analytics can be used to analyse your lesson plans **[D3.a]** • How learning analytics can be used to analyse the classroom delivery of your lesson plan and reveal more about your students' learning **[D3.a]** • How you can reflect on your teaching practice by combining insights from both teaching and learning analytics **[D5.a]**	[2] Analytics for the Classroom Teacher
• The field of learning analytics and explore how data and information are used **[D8]** • Common learning analytics methods and approaches, such as data wrangling and cleaning **[D2.a],** structure discovery, and basic prediction modelling **[D3.a]** • How to conduct basic data wrangling **[D2.a],** and analyses **[D3.a]** • Ethics and privacy considerations **[D6.b]** • Working in a collaborative, cross-disciplinary setting • Common toolsets used in the UTArlingtonX Learning Analytics courses (R in RStudio and Jupiter Notebooks) **[D10.a]**	[3] Learning Analytics Fundamentals
• Key methods for educational data mining **[D3.a]** • How to apply methods using standard tools such as RapidMiner **[D10.c]** • How to use methods to answer practical educational questions [D5.b]	[4] Big Data and Education
• How to identify trade-offs between proprietary and open	[5] Data, Analytics and

source tools commonly used in learning analytics **[D10]** • The learning analytics data cycle **[D8]** • How to perform social network analysis, interpret the analysis for the study of networked learning, and visualize the analysis results in **Gephi [D10.d]** • Training and evaluating classifiers that use clickstream data, with a focus on how to engineer features and training labels • Evaluation issues, key diagnostic metrics and their uses, and validity issues **[D5.a]** • How to approach a problem in the area of text mining using **LightSIDE**, how to engineer features for text classification, how to use **LightSIDE** for automated collaborative learning process analysis **[D10.e]** • How trained models can be used in service of learning research **[D5.b]**	Learning
• About the landscape of learning analytics in higher education **[D8]** • How to bring in data of your own for analysis and visualization **[D3.a, D3.b]** • About performance prediction in a course: up to and including grade penalties, placement analyses, performance disparities and their correlates, course-to-course correlation **[D5.a]** • How institutions are creating early warning systems and personalized communication **[D5.c]** • How to apply learning analytics to observe differences and probe impact, capturing more and better information **[D5.a]**	[6] Practical Learning Analytics
• to understand and use data effectively **[D7]** • to inform teaching and learning decisions **[D5.b]**	[7] Data Literacy for School Teachers - EDPZ6012
• Train participants in data literacy skills **[D7]** • efficient collection of data and metadata for future analyses **[D1]** • data wrangling, tidying, and organisation in **R [D2.a, D10.a]** • data visualisation and analysis in **R [D3.a, D3.b D10.a]** • Teach participants basic tools for reproducible science reproducible report creation version control **[D10]** • Introduce participants to Open Science principles and procedures • data archiving options and best practice **[D2.c]** • code sharing options and best practice • Introduce participants to the fundamentals of programming basics in R **[D10.a]** • the principles of tidy code and code review • create a community of data literate scientists **[D7]**	[8] Advancing computational and data literacy skills schools for life scientists
• Understand what the Data Wise Improvement Process is and how it can help you improve teaching and learning. **[D7]** • Build skills in looking at a wide range of data sources, including test scores, student work, and teaching practice. **[D1.a, D1.b]** • Identify next steps in supporting a culture of collaborative data inquiry in your setting. **[D5.b]**	[9] Introduction to Data Wise: A Collaborative Process to Improve Learning & Teaching

• As a bonus, this course provides a complete video case study introducing the Universal Data Wise Improvement Process and showing how it can be used at a system level.	
• How data sets are captured in learning experiences [D1] • What basic procedures to use to manipulate these data sets **[D2]** • The use of statistical models to predict student behavior **[D4.b]** • The deployment of personalized support actions for the students **[D5.c]**	[10] Using Data to Provide Personalized Student Support
This course aims at framing learning analytics and its most important dimensions. It will demonstrate why learning analytics has the power to be a real game-changer for educational research by enhancing the e-learning experiences and creating more effective e-learning environments. **[D8]** **Welcome** • Course introduction • Make your own plan **Week 1: Grounding: LA in a Nutshell** • Intro + Grounding video • Definition and dimensions of LA • References • Assignment: Getting started with LA **Week 2: Digging: LA Implementation Challenges** • Intro + Digging video • Ethics and Privacy **[D6.b]** • LA for Learning Design • Evaluating LA • References • Assignment: Quiz **Week 3: Peeling: Learning Analytics Dashboards** • Intro + Peeling video • Dashboard design **[D3.b]** • Dashboard interpretation **[D4]** • LA Case Studies • References • Assignment: Evaluating a LA Dashboard **Week 4: Shining: Create Your Own LA** • Intro + Shining video Final Assignment: Design your own Learning Analytics	[11] Trusted Learning Analytics
• Describe and critically discuss the current state of learning analytics in higher education. **[D8]** • Outline and analyze the adoption of learning analytics in an international landscape. **[D8]** • Explain and appraise key drivers, challenges, and relevant policies. • Apply the **SHEILA** framework for learning analytics strategy formation. **[D9.a]** • Apply the **SHEILA** framework for learning analytics policy formation. **[D9.a]** • Address and manage different expectations and concerns	[12] Learning Analytics in Higher Education

among stakeholders. Week 1: Learning Analytics in Higher Education: Overview a. The rise of learning analytics in higher education b. The global landscape of adoption c. Success and challenges in the adoption of learning analytics in higher education d. Ethics and privacy issues **[D6.b]** e. Learning analytics Policies f. Using learning analytics for quality assurance Week 2: Enabling systematic adoption using SHEILA framework a. SHEILA framework - Steps and Tools **[D9.a]** b. Key actions towards a systematic adoption c. Key challenges to address d. Key questions to answer when developing an institutional policy or strategy e. Using SHEILA framework - Case Studies Week 3: Adopting learning analytics in a complex educational system a. Cultural differences in stakeholder expectations b. Managing multi-stakeholder expectations c. Working together with different stakeholders d. A systematic adoption of learning analytics in higher education	
MOOC on Learning Analytics Unraveled aims to help us to understand what Learning Analytics is all about, why we should use it and how. After the completion of the course we will know about all the LA ins and outs and have a better understanding of implementing it in an organisation. **[D8]** **Week 1:** introduction on 'What is Learning Analytics' and how could it be applied in different organisations. **Week 2:** why we should be interested in Learning Analytics and for which kind of purposes it can be used. **Week 3:** different ways of applying Learning Analytics **Week 4:** pitfalls when doing learning analytics	[13] Learning Analytics Unraveled
• install an userscript that gathers the **access report** data for an entire course **[D1.a, D1.b]** • understand the common fields included in the the **Access Report** raw data **[D2]** • load the data to an app that analyzes the **access report** data **[D3]** • understand content usage in a course **[D4]**, and apply the results to improve course design that better facilitates student engagements **[D5]** • understand **Canvas** course design strategy categories **[D11.b]** • install an userscript that evaluates the design strategies being applied in a course **[D5.a]** • deploy a mixed course design strategy to facilitate greater engagement and better learning **[D5.a]** • install an userscript that gathers quiz submission data in a	[14] Analytics in Course Design: Leveraging Canvas Data (HE)

course **[D1.b]** • understand the common fields that are included in the **quiz submission** raw data **[D2]** • analyze the **quiz submission** data to address the questions which are not answered in the Canvas built-in quiz statistics. **[D3.a]** • install an userscript that gathers discussion data for an entire course **[D1.b]** • understand the common fields included in the **discussion** raw data **[D2]** • create an edge list that includes from (reply_author) and to (initial_thread_author) fields, and load the **discussion** data to a discussion analytical app **[D3.a]** • use the diagrams **[D3.b]** to inform student discussion participation **[D4.c]** and facilitate greater discussion engagement **[D5.a]**	
COURSE PLAN : Week 1 : **[D8]** • What is LA • Definition • Relation with Academic Analytics • Relation with Education Data Mining • Learning LA - Big-Picture • Relation with Machine Learning, EDM • Four Levels of Learning Analytics • Overview I • Overview -II Week 2 : **[D1], [D2], [D6]** • Data Collection • How Big is Education data • Data Collection from Learning Environments • Pre-Processing • Ethics in Learning Analytics • Student Privacy Week 3 : **[D3]** • Descriptive Analytics • Data Visualization Example • Dashboard Analytics Week 4 : **[D5], [D10]** • Predictive Analytics • Linear Regression • Analytics Tools • Demo of Weka/Rapidminer • Demo of Linear Regression using Weka	[15] NOC:Introduction To Learning Analytics
At the conclusion of this course, participants will be able to: 1. Describe learning analytics and how it differs from related concepts such as educational datamining and academic analytics. **[D8]** 2. Analyze, plan, and deploy a small learning analytics pilot, including the intent of LA and tools needed to address analytics	[16] Learning Analytics and Knowledge LAK13

goals. **[D5]** 3. Develop a matrix of prominent learning analytics tools and the particular analytics strategies each tool addresses. 4. Evaluate current state of learning analytics technologies and describe the benefits and drawbacks to open source and proprietary tool sets. 5. Evaluate and describe the role of semantic web and linked data in next generation educational content. 6. Conduct basic analytics activities (such as importing and visualizing data) through in open source tools (R) and commercial tools (Tableau Software). **[D1.a,D1.b,D1.c, D3.b, D10.a]** **Week 1:** Trends and Context: Why Learning Analytics? **Week 2:** Cases and examples of implementation of learning analytics **[D8]** **Week 3:** Tools, methods, and levels of learning analytics **Week 4:** Predictive models & Assessment **Week 5:** Smarter curriculum: semantic web, linked data, and adaptive content **Week 6:** Epistemology, Pedagogy, Assessment and Learning Analytics **Week 7:** Privacy and ethics: principles for governing LA use and implementation **[D6.b]** **Week 8:** Learning analytics: where is it headed? How to get involved (SoLAR, IEDMS, academic programs)	
• Identify data sources and recognise different types of data. **[D1]** • Recognise and discuss different methods for improvement initiatives. **[D5]** • Interpret case studies and discuss improvement processes within your own context and professional experience. **[D4]** • Explain the relationship between data, findings and actions required in order to achieve continuous improvement. **[D5]** • Describe the difference between data and findings. • Produce findings from a sample set of data. **[D3]** • Evaluate and discuss the different approaches taken in example data dashboards. **[D4]** • Identify and select the most appropriate indicators for measuring improvement. **[D5]** Week 1 – Improvement Science • Identifying different sources and types of data **[D1]** • Ways to improve student outcomes • Improvement processes in your own context and professional experience • Real-world examples of improving student outcomes Week 2 – Findings • How to present and evaluate data effectively **[D3]** • The difference between data and findings **[D3]** • The role of ethics in data handling and sharing **[D6]** • The relationship required between data, findings and actions, to achieve continuous improvement	[17] Using Data to Improve Student Outcomes (not available anymore)

Week 3 – Actions • Different indicators for measuring improvement **[D5]** • How to collect sample data and select the appropriate indicator **[D1]** How to present indicators and actions to students	
• describe and critically analyse learning analytics process and theory; **[D8]** • review, integrate and critically assess emerging trends in learning analytics literature; **[D8]** • develop a proposal for a piece of research or application using learning analytics in an educational setting, based in a critical understanding of the literature **[D8]** • develop a detailed plan for the learning analytics application or research proposed, and critically assess its main elements. **[D5]**	[18] Learning analytics: process and theory (ended Sept 2018)