

# Educational Data Literacy for the School Teacher of Blended Learning Courses

D. Vinatsella<sup>1</sup>, S. Mougiakou<sup>2</sup>, D. Sampson<sup>3</sup>

<sup>1</sup>Directorate of Secondary Education of Piraeus & University of Piraeus, Greece

[vinatsella@sch.gr](mailto:vinatsella@sch.gr)

<sup>2</sup>Ionidios Model High School of Piraeus & University of Piraeus, Greece

[mougiakou@sch.gr](mailto:mougiakou@sch.gr)

<sup>3</sup>Department of Digital Systems, University of Piraeus, Greece

[sampson@unipi.gr](mailto:sampson@unipi.gr)

## Abstract

Educational Data Literacy (EDL) is globally recognized as a key competence for educators, since it is essential for supporting data-driven reflective teaching practice. This is particularly important because of the increased adoption of blended teaching and learning strategies, such as the flipped classroom - where rich educational data are generated and collected by the use of course management systems, like the Moodle, calling for transforming educational data into actionable pedagogical knowledge. Despite this fact, there are limited opportunities targeting the development of EDL competences on methods and tools used to support educational data analytics for school teachers. Designing such teachers' professional development programs require a better understanding on how educational data analytics can be used in real school and classroom settings to support teaching and learning. To this end, this paper presents a thorough use-case for the school teacher of blended learning courses in the K-12 education context, linked to the Learn2Analyze Educational Data Literacy Competence Profile Framework. This use-case aims to provide insights about how educational data literacy competences can be integrated into real work-oriented tasks, through the exploitation of innovative educational data analytics tools, offered by the Moodle.

**Keywords:** educational data literacy, educational data analytics, blended learning, flipped classroom, K-12, Moodle.

## 1. Introduction

Educational Data Analytics (EDA) is identified as a key enabler for driving changes in both School (Mandinach, 2012) and Higher (Lang et al., 2017) Education. As a result Educational Data Literacy (EDL) is recognized as a core competence for all professionals in Education. In particular for school teachers, EDL is essential for supporting data-driven pedagogical decision making and reflective teaching practice and thus, it needs to be part of both School Teachers Pre-Service Education and In-Service Professional Development.

Designing competence-based EDL professional development programs for School Teachers requires professional competence frameworks specifically developed to meet the needs of EDL. To this end, the Learn2Analyze (L2A) initiative, a Knowledge Alliance of Academia and Digital Learning Industry co-funded by the European Commission through the Erasmus+ Program of the European Union, has developed a comprehensive proposal for an Educational Data Literacy Competence Profile (L2A EDL-CP) for Education Professionals, including school teachers of blended learning courses (Sampson et al., 2020).

Furthermore, designing competence-based EDL professional development programs for School Teachers requires a better understanding on how educational data analytics can be used in real school and classroom settings to support teaching and learning. To this end, this paper presents a thorough use-case for the school teacher of blended learning courses in the K-12 education context, linked to the dimensions of the L2A EDL-CP. This use-case aims to provide insights about how educational data literacy competences can be integrated into real work-oriented tasks, through the exploitation of innovative educational data analytics tools, offered by the Moodle (<https://moodle.org>).

## ***2. Educational Data Literacy for School Teachers***

Given the growing interest in Educational Data Literacy, multiple definitions have been proposed in literature. The Data Quality Campaign (2014), taking under consideration the ethical aspects, defines EDL as “[the capacity to] *continuously, effectively, and ethically access, interpret, act on, and communicate multiple types of data from state, local, classroom, and other sources in order to improve outcomes for students in a manner appropriate to their professional roles and responsibilities*” (p. 1). Mandinach and Gummer (2016) proposed a more elaborated definition about 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).

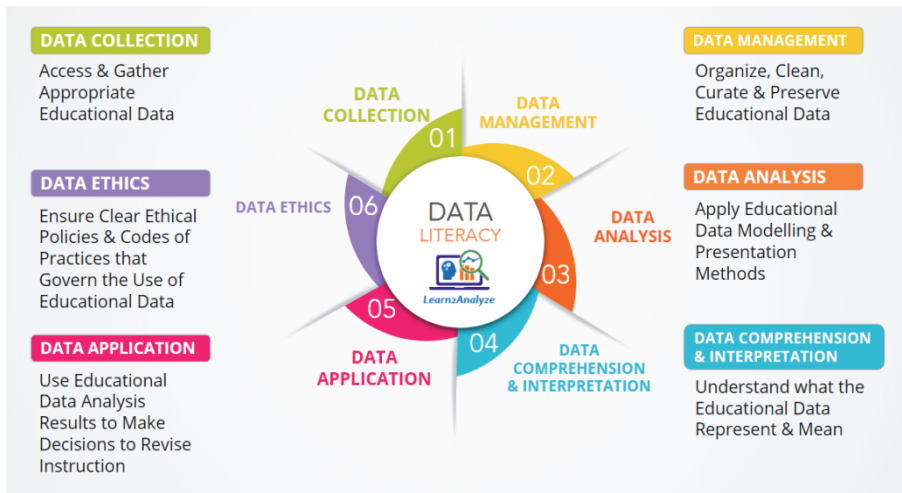
Educational Data Literacy is considered as a core competence for School Teachers and it is expected to be an essential component of School Teachers Pre-Service Education and In-Service Professional Development. This is highlighted by multiple directions: i) national policies and requirements for external accountability brought to the forefront the importance for teachers to ground decisions based on data and evidence, aiming to boost the effectiveness and the efficiency of the education systems (Mandinach & Gummer, 2016), ii) teachers’ pre-service education and

licensure standards, such as the USA's CAEP Accreditation Standards (CAEP, 2013), as well as teachers' continuing professional development standards, such as the European Framework for the Digital Competence of Educators (Redecker, 2017) and the USA's InTASC Model Core Teaching Standards (CCSSO, 2013), where the skill to “*use of data to support learning*” is highlighted as a key cross-cutting theme, iii) personalized learning repeatedly appears to be one of the major educational challenges, as per Horizon Report (Freeman et al., 2017), and effective data use is needed to tailor instruction to meet the needs of the increasingly diverse student cohort, iv) the exponential growth of the educational data from a variety of rich data sources in diverse formats (Lang et al., 2017) that go far beyond assessment data, v) the emerging advancements in innovative Teaching and Learning Analytics methods and tools empowering teachers to reveal useful insights (Lang et al., 2017; Sergis & Sampson, 2017), vi) the rich body of literature which advocates for educational data literacy capacity such as a series of research studies, based on large-scale projects, which demonstrate growing evidence that educational data literacy can enhance students' achievements (Schildkamp et al., 2013). As argued, the key reason is that both teachers and school leaders engage in a continuous “cycle of reflective inquiry” for self-evaluation and improvement based on educational data analysis. Finally, according to OECD International Survey (OECD, 2019), teachers have self-reported as a main training need the exploitation of data to make informed decisions.

### ***3. The Learn2Analyze EDL Competence Profile***

Although Educational Data Literacy is recognized as a core competence for all education professionals, including school teachers, instructional designed and tutors of online and blended learning course, as well as educational institutions' leaders, nevertheless, most existing professional competence frameworks for educators pay a narrow attention to EDL, missing out the potential of using emerging EDL methods and tools in online and blended teaching and learning.

The Learn2Analyze (L2A) initiative is an Academia-Industry Knowledge Alliance for enhancing Education Professionals' Competences in Educational Data Literacy, co-funded by the European Commission through the Erasmus+ Program of the European Union. A key outcome of the Learn2Analyze initiative is the development and validation of a comprehensive proposal for an Educational Data Literacy Competence Profile (L2A EDL-CP) for education professionals, including school teachers of blended learning courses (Sampson et al., 2020). The EDL-CP framework consists of 6 competence dimensions and 17 competence statements which aim to describe the dimensions. Figure 1 summarizes the dimensions and the statements of the L2A EDL-CP.



*Figure 1. The Educational Data Literacy Competence Profile (L2A EDL-CP) (Sampson et al., 2020)*

#### **4. Applying Educational Data Literacy in Blended Learning Courses of K-12 Education**

The Flipped Classroom (FC) is a blended learning strategy which is widely adopted in school education targeting to use classroom time and space for meaningful interactive learning activities which are customized to individual and group students’ needs, rather than lecturing (DeLozier & Rhodes, 2016). There are several empirical studies in literature presenting strong evidences on the FC's benefits in student's learning, engagement and motivation as a result of the efficient use of classroom time for personalized feedback and guidance (Giannakos, Krogstie, & Sampson, 2017).

Typically, the flipped classroom implementation is supported by course management systems that are used to facilitate the classroom-based activities with pre-class and post-class online learning activities. This generates a wide variety of data that can be useful for designing better informed classroom-based teaching and learning activities (van Leeuwen, 2018). Thus, teaching and learning analytics (TLA) can support the flipped classroom teachers in exploring the student-generated data to assess learning progress, to identify learning difficulties, to predict learning performance and to act upon the findings. Moreover, TLA can reveal insights about the course design and the teaching practice that teachers might not recognize otherwise (Sergis & Sampson, 2017). As a result, teachers can reflect on their lesson plans and adjust or redesign part of it to offer better learning experiences to their students.

In order to better understand these opportunities which are offered by applying educational data analytics in the flipped classroom teaching, it is essential for

educators to possess the necessary EDL competences and feel confident that they can use them in practice. Next, we present a thorough use-case for a school teacher in K-12 education linked to the dimensions and statements of the L2A EDL-CP framework. The use-case aims to provide insights about how the respective EDL competences may be integrated into real work-oriented tasks in the K-12 school context, by putting theory into practice through the use of existing educational data analytics tools offered by the Moodle, an open-source Course Management System (CMS) that is widely used to support the flipped classroom in school education.

### ***5. Use-case of Applying EDL Competences by the School Teacher of Blended Learning Courses***

Alice is an enthusiastic English Language teacher who has just been appointed in an Experimental High School, in Athens. She will be responsible for the English Language Course of the 9th Grade (14 to 15 years students). Alice is very excited about her new role. Nevertheless, the school's principal, Alex, is concerned about the relatively low performance of last year's 8th graders, compared to other schools in the region. Alex encourages Alice to use student data to gain insights and plan her teaching activities accordingly, so as to improve this year's Grade 9 students' academic performance. The principal also informs Alice about the Course Management System (Moodle) used by the school to facilitate teaching and learning. Alice decides to apply the flipped classroom strategy to her new students using the school's CMS. For this, she develops online teaching resources where student enrol and study the lecture material at home (prior to classroom meeting). The material is in the form of videos, small activities with automatic feedback (online quizzes), and forum discussions. During the classroom sessions, students perform more complex activities, typically in small groups, with the benefit of Alice's scaffolding, guidance and feedback. Then, they can undertake some additional homework online to further check their understanding and extend their learning. Alice is confident with the flipped classroom approach, as she has used it before with great results.

Alice starts posing questions to identify and *collect* the appropriate educational data. She decides to *gather* a variety of students' data, including demographics, perception data, last year's academic performance and the regional performance data over the past 5 years. Thus, she has to access both school's internal data sources (e.g. Student Information System) and external data sources. [L2A EDL-CP Dimension: 1. Data Collection]

Next, Alice contacts the colleague, appointed as school's Data Protection Officer (DPO), so as to sign the required data protection consent form and secure all necessary approvals. She then imports all retrieved datasets into her spreadsheet software to process them. She also requests the CMS administrator, to grant her access to the platform. In the CMS "User agreements page" she confirms that *signed*

*informed consent* has been given for all students. Moving further, Alice gets informed by the DPO on school's policy and measures to protect students' *data privacy, confidentiality, integrity and security* and about the school's *CMS General Data Protection Regulation (GDPR) compliance* functionality, designed to assist teachers in ensuring that the online course is fully compliant with the GDPR. Alice gets familiar with key legal concepts: *authorship, ownership, data access, re-negotiation and data-sharing*. Alice is now ready to proceed further with her flipped classroom strategy, making it a success story for her students. [L2A EDL-CP Dimension: 6. Data Ethics]

After running the online course for three weeks, Alice checks the data about students' activity, tracked by the learning environment. Thus, she also *collects* data related to students' engagement and performance within the CMS, e.g. time spent on the platform, videos watched, downloaded files, online quiz scores, participation in the forum and interaction between peers. Before proceeding, Alice needs to verify the collected data against different *quality measures* (relevancy, reliability and validity). Alice pays attention to avoid biases. [L2A EDL-CP Dimension: 1. Data Collection]

Alice studies the performance of her students based on all the data collected so far. She soon realizes that since the data comes from various sources in diverse formats, are quite messy, containing missing values and duplicate instances. To obtain a concrete database, she applies *data cleaning and organizing*, under the guidance of school's technical team. In the produced structured dataset, she also applies *descriptive, administrative and structural metadata*. Once done, it's time for Alice to apply the needed *curation processes to ensure that data is reliably retrievable for future reuse*, always with the support of the technical team. Thus, she addresses the DPO to define a *data preservation plan* so that the performance data are transferred every semester to the school database for permanent storage, while the tracking data remains at the CMS till students' graduation. [L2A EDL-CP Dimension: 2. Data Management]

Now that the data is ready to yield powerful insights, Alice proceeds with analysis and modelling methods. Initially, she applies *descriptive statistics* for the last year's 8th graders. Alice calculates the *total mean, median and standard deviation* of her students' last year's final scores, so as to get a measure of their general performance. She is also interested in learning whether there is a correlation between time spent on the CMS and student's performance on quizzes (*inferential statistics*). To gain a better understanding of the data on hand, Alice proceeds with its *pictorial visualization*. This will assist her for the upcoming meeting with the school's principal to show her findings. Firstly, she plots a *histogram* to present the last year's overall students' performance and to ascertain the number of students who are performing to a particular standard. Based on the gathered CMS data, Alice also produces a *scatter plot* that shows the relationship between students' activity time in

the CMS and their performance on quizzes. [L2A EDL-CP Dimension: 3. Data Analysis]

Following data analysis, Alice is keen to comprehend the story that the collected data reveals. She starts by interpreting *data properties*, including *measurement errors*, *discrepancies* and *data dependencies*. For last year's academic performance, Alice *appreciates the impact of extreme scores on the mean*. The *median* may be more helpful than the mean depending on *outliers*. With regards to the scatter plot, it seems that it reveals four 'unique' data points: Two students Ann and David appeared to be quite active in the course but did not do as well as the rest of the class. One student, John, was not so active but did reasonably well, whereas Peter spent the least amount, however, he excelled on quiz assignments. Alice understands that she needs to drill into the CMS activities for these students. She learns that her school's CMS (Moodle) provides a number of useful Learning Analytics tools. She decides to leverage them and implement more complex analyses and statistical models. Alice implements *Descriptive Learning Analytics* by using the "*Learning Analytics Enriched Rubric*" tool, an advanced grading method used for assessment based on specific criteria. Grading levels are associated to data from the analysis of learners' interaction and learning behaviour within the online elements of her course, such as the number of post messages, times of accessing learning material, assignments' grades and so on. She also decides to use "*Inspire Analytics*", a tool for *Predictive Learning Analytics*, which provides feedback about student's progress against a range of indicators and activities identified to have an impact on student success in the online course. In order for Alice to examine further the quizzes' results, she generates a respective "*Quiz Statistics Report*". She focuses on two of her students, Ann and David, who do not perform well. For these 2 students, she also retrieves a "*Complete Report*" that displays a detailed view of the progress of the individual learner throughout the course. She confirms that Ann and David struggle with content comprehension. Using learning analytics, Alice is self-reflecting to improve the design and the delivery of her course. She uses Learning Analytics to monitor their learning process, to discover patterns, to find indicators for success and indicators for poor marks or drop-out. Using *Prescriptive Learning Analytics*, Alice applies the "*Analytics and Recommendations*" tool, so as to get a visual color-coded presentation of the student's participation in each online course activity, as well as some initial recommendations about what activities students could work to improve their final grade. She realizes that some students like John do not participate in the forums at all. This behaviour reflects his low interaction in class activities, as well. And then, there is Peter whose performance is remarkable though he does not seem interested in the online activities, as he goes right from the homepage of the online course to assignments/quizzes. [L2A EDL-CP Dimension: 4. Data Comprehension & Interpretation]

Based on the results of her data analysis, Alice decides to *revise* the course's online learning activities and educational resources. She uses the course level "*Activity*

*report*” to investigate how her students engaged with the elements of the course and which activities were most appealing. To support students who are struggling, like Ann and David, Alice decides to include “*Lesson Activities*” to incorporate conditional branching and create differentiated learning paths. Moreover, she includes *graded discussion forums* to facilitate a higher participation and support further the students when they study on their own. To drive motivation for students like Peter, she also assigns optional challenging activities. To further increase students’ engagement, she adds “*Level up!-Gamification*”, an easy way to gamify students’ learning experience by motivating them to progress towards the next level of the course. Finally, Alice designs an *evaluation plan* for her course. She uses indicators to ensure that the flipped classroom initiative is on track for reaching the long-term goal of improving students’ academic performance to reach the regional standards. Her data literacy awareness and competences, including the use of available tools, have helped her collect useful evidence (based on data analysis) for herself, her principal, her students and the parents. [L2A EDL-CP Dimension: 5. Data Application]

## **6. Conclusions**

Given the emerging importance of Educational Data Literacy for teachers, this paper presents a use case, linked to the L2A EDL-CP framework, which describes in detail how school teachers can integrate such competences into their daily practice, enabling them to improve their teaching and learning. Nevertheless, for a school-wide adoption of educational data analytics based decision making, major organisational changes would be needed, including updating the teachers’ workload and improve both pre-service teacher education curricula and in-service teachers’ professional development programs. A key requirement is the support of the school community, prioritizing a common data-based culture among students, parents, teachers and school leaders. To further promote this agenda, our future work will concentrate on the design and the development of a competence-based Professional Development MOOC for cultivating EDL competences.

## **7. Acknowledgement**

This work has been partially funded by (a) the European Commission in the context of the Learn2Analyze project (Grant Agreement no. 2017-2733 / 001-001, Project No 588067-EPP-1-2017-1-EL-EPPKA2-KA) under the Erasmus+ Program of the European Union (Cooperation for innovation and the exchange of good practices – Knowledge Alliances) and (b) the Greek General Secretariat for Research and Technology, under the Matching Funds 2014-2016 for the EU project “Inspiring Science: Large Scale Experimentation Scenarios to Mainstream eLearning in Science, Mathematics and Technology in Primary and Secondary Schools” (Project Number:



325123). This document does not represent the opinion of neither the European Commission nor the Greek General Secretariat for Research and Technology, and the European Commission and the Greek General Secretariat for Research and Technology are not responsible for any use that might be made of its content.

## **References**

CCSSO. (2013). *Interstate Teacher Assessment and Support Consortium InTASC Model Core Teaching Standards and Learning Progressions for Teachers 1.0: A Resource for Ongoing Teacher Development*. Washington, DC: CCSSO.

Council of Accreditation of Educator Preparation. (2013). *CAEP Accreditation Standards*. Retrieved from <http://caepnet.org/~media/Files/caep/standards/caep-standards-one-pager-0219.pdf?la=en>

Data Quality Campaign. (2014). *Teacher Data Literacy: It's About Time. A Brief for State Policymakers*. Retrieved from <https://dataqualitycampaign.org/resource/teacher-data-literacy-time/>

DeLozier, S. J., & Rhodes, M. G. (2016). Flipped Classrooms: a Review of Key Ideas and Recommendations for Practice. *Educational Psychology Review*, 1-11.

Freeman, A., Adams Becker, S., Cummins, M., Davis, A., & Hall Giesinger, C. (2017). *NMC/CoSN Horizon Report: 2017 K-12 Edition*. Austin, Texas: The New Media Consortium.

Giannakos, M., Krogstie, J., & Sampson, D. (2018). Putting Flipped Classroom into Practice: a Comprehensive Review of Empirical Research. In D. Sampson, D. Ifenthaler, J. M. Spector, and P. Isaias (Eds.), *Digital Technologies: Sustainable Innovations for improving Teaching and Learning*. Springer, Charm.

Lang, C., Siemens, G., Wise, A., & Gasevic, D. (Eds.) (2017). *Handbook of Learning Analytics*. Beaumont, AB, Canada: SoLAR. doi:10.18608/hla17

Mandinach, E. B. (2012). A Perfect Time for Data Use: Using Data-Driven Decision Making to Inform Practice. *Educational Psychologist*, 47(2), 71-85.

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.

OECD. (2019). A Teachers' Guide to TALIS 2018. Retrieved from: <http://www.oecd.org/education/talis/talis-2018-results-volume-i-1d0bc92a-en.htm>

Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu* (Y. Punie, Ed., JRC Science for Policy Report No. JRC107466). Luxembourg: Publications Office of the European Union. doi:10.2760/159770

Sampson, D., Papamitsiou, Z., Ifenthaler, D., & Giannakos, M. (2020). *Educational Data Analytics Literacy*. Springer Brief Monograph for the Series Educational Communications and Technology: Issues and Innovations Series.

Schildkamp, K., Lai, M. K., & Earl, L. (Eds.). (2013). *Data-based decision making in education: Challenges and opportunities*. Dordrecht: Springer.

Sergis, S., & Sampson, D. (2017). Teaching and Learning Analytics to support Teacher Inquiry: a Systematic Literature Review. In A. Peña-Ayala (Ed.), *Learning analytics: Fundamentals, applications, and trends* (pp. 25-63). Berlin: Springer.

van Leeuwen, A. (2018). Teachers' perceptions of the usability of learning analytics reports in a flipped university course: when and how does information become actionable knowledge?. *Educational Technology Research and Development*. doi:10.1007/s11423-018-09639-y

## Περίληψη

Οι ικανότητες της αναλυτικής εκπαιδευτικών δεδομένων θεωρούνται πλέον εξαιρετικά σημαντικές για τους εκπαιδευτικούς. Σε αυτό συνηγορεί και η αυξημένη υιοθέτηση στρατηγικών διδασκαλίας που χρησιμοποιούν μοντέλα μικτής μάθησης, όπως η ανεστραμμένη τάξη, όπου πληθώρα εκπαιδευτικών δεδομένων συλλέγεται μέσα από τη χρήση συστημάτων διαχείρισης ψηφιακών μαθημάτων, όπως το Moodle. Παρά ταύτα, υπάρχουν διεθνώς ελάχιστα προγράμματα επαγγελματικής κατάρτισης που στοχεύουν στην ανάπτυξη αυτών των ικανοτήτων. Η σχεδίαση τέτοιων προγραμμάτων απαιτεί βαθύτερη κατανόηση της αξιοποίησης μεθόδων και εργαλείων ανάλυσης εκπαιδευτικών δεδομένων στη διδακτική πράξη. Η παρούσα εργασία παρουσιάζει μια πλήρη μελέτη περίπτωσης για τη υποστήριξη της διδασκαλίας μαθημάτων που συνδυάζουν το μοντέλο της ανεστραμμένης τάξης και την ανάλυση εκπαιδευτικών δεδομένων με αναφορά στο πλαίσιο ικανοτήτων αναλυτικής εκπαιδευτικών δεδομένων που ανέπτυξε το Ευρωπαϊκό Πρόγραμμα Learn2Analyze.

**Λέξεις κλειδιά:** αλφαριθμητισμός αναλυτικής εκπαιδευτικών δεδομένων, μικτή μάθηση, ανεστραμμένη τάξη, Moodle