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# VIDEOMINING FOR THE ASSESSMENT OF TEACHER SKILLS IN HIGHER EDUCATION

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## Summary

Recently, learning analytics and the use of big data to help teaching practices has increased. However, despite there is an easy access to teachers' big data regarding internet, MOOCs, VLEs and other logs; data from onsite teacher classroom activity is also needed, both to evaluate teacher skills both in face-to-face courses, and also in order to triangularize data to help having a complete view of the teacher competencies in blended learning contexts. With the implementation of videomining in onsite contexts, qualitative data from the teacher activity in class can turn into quantitative logs that are useful for real-time assessment and also as part of a bigger learning analytics processes. This study proposes a new methodology, based on the integration of video analysis data mining (videomining), for measuring teacher skills in the classroom. As a first step in the implementation of videomining for the assessment of teacher skills, we explain the process of a video analysis system, MED1A software, an evolution from the existing SME instrument named MED1C; observations conducted in classroom, and the later big data preparation description. This video analysis tool can manage big data from logs and catalogue teacher actions in real-time, multi-observer sources. In particular, we will show the example of teacher Digital Competence (DC) case. Conclusions show that videomining could help retrieving real-time, quantitative and qualitative data from teacher activity without having to spend hours of post-visioning and cataloguing data. This will help researchers, institutions and teachers to retrieve, analyse and later evaluate teacher's skills and guide them to a real reflection and better practice of their profession.

MED1C (Call: H2020-SMEINST-1-2014_24-09-2014 Funding scheme: SME instrument phase. Proposal number: 663957. Proposal acronym: MED1C. Duration (months): 4. Proposal title: Video Management in Medical Practice Activity: ICT-37-2014-1);

## Introduction

In the last years, big data has landed in teaching and learning processes. In particular, the use of data in MOOCs and web videomining (Othman, Abdelali, & Jaber, 2016) have been studied in online learning contexts. However, a high percentage of Higher Education learning activities are still using blended or face to face methodologies. In Spain, in 2017, around 92% of highschool students are still enrolled in onsite education (Ministerio de Educación, Cultura y Deporte, 2017), an 82% of students are enrolled in onsite universities, and a 74% in Master degrees (GAD3, 2017). In these contexts, we believe that datamining in general, and the use of big data from video analysis (videomining) in particular, could be useful for studying classroom activity of both teachers and learners.

Focusing on teacher activity, research on videomining is scarce; however, video analysis has been a key aspect for the reflection and assessment of teacher skills, as stated by Major and Watson (2018) in their systematic review of 23 video usage studies. These authors believe that video technology in general and video analysis in particular can be an opportunity to support in-service teacher training and development, as it can capture the complexity of teaching in classroom (Borko, Whitcomb, & Liston, 2009). Furthermore, and compared to classic observation, video analysis of teachers gives a greater access to classroom events (Ball & Cohen, 1999), without compromising authenticity (Sherin, 2004). Finally, the spread use of mobile devices can also be a help to the expert or researcher observation by real-time categorization of teacher activity, without the need of a big technological implementation that could hamper classroom normal activity (Aubusson, Schuck, & Burden, 2009).

This paper describes the implementation of a digital video analysis tool that records and categorizes teacher activity in educational face to face contexts. This tool allows the assessment of teacher skills and reflection of practitioners and researchers, based on existing skill evaluation rubrics; and could be a first step for designing future teacher's skills evaluation and training programs. In particular ,we have focused on a case of teachers Digital Competence (DC) in order to better show the results of the rubrics and taxonomy that can be implemented in the tool, and the videomining process outcomings. A complete detail of the process has been described and will be the theoretical base to implement this video analysis tool in further practical studies in different contexts in Higher Education.

The main aim is to set the basis for the implementation of a reliable and valid video analysis procedure to retrieve and evaluate teacher skills in the classroom. Based on the literature review, we ask the followings:

- How can we set up, measure and assess teacher skills with the use of a digital video analysis tool?
- Which are the principal phases and outcomes of the process (in particular, in the case of evaluating teacher DC)?

## Teacher skills

Generic skills are defined as those competences that are common to the majority of professions. They are related to the integrated application of aptitudes, personality features, educational background and also other values (UNESCO, 2004; Wilson et al., 2011). These skills are usually learnt in work-related environments (both in real and simulated scenarios). With this assumption, training transversal competencies becomes of great complexity and demands the change of educational methodologies and the inclusion and support of new tools to facilitate these processes. In this direction, real-time video analysis techniques that help to reflect on particular situations could improve the teaching and learning process in general, and teaching skills in particular (Star, Lynch, & Perova, 2011).


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Focusing on teacher activity in the classroom, it has been related to teaching, research and management skills. In particular, the two latter are specific for teachers in Higher Education. It must be taken into account that competences related to management are responsibilities that are subject to the personal commitment of the teacher. We must remember that these skills are not part of the essential teaching profession (Mas, 2012). The most important component in maximizing outcomes for learners leaving school is teachers and the quality of their teaching (Darling-Hammond & Youngs, 2002). Furthermore, one of the most important responsibilities that a teacher must assume in the design of a learning process is incorporating the Digital Competency (DC) training of his students in the activities that he must develop with them in the classroom (Gutiérrez, 2012; Tondeur, van Braak, & Valcke, 2007). This guides our first step for video analysis in the classroom: we focus on the analysis and evaluation of teaching skills, and in particular, on the teacher Digital Competence (DC). In particular, to be in line with the European Recommendation, we adopt the term proposed by Larraz (2013): Digital Competence requires the presence of four literacies: (a) information literacy, for managing digital information; (b) computer literacy, for treating data in different formats; (c) media literacy, for analysing and creating multimedia messages; and (d) communication literacy, for participating in a safe, ethical and civic manner from a digital identity.

Teacher DC proficiency implies naturally incorporating technologies to the teaching and learning activity, carrying out processes of innovation, transformation and change (Gisbert & Esteve, 2011, Lázaro, 2015, Schalk, 2010). Following Koehler and Mishra (2008) teachers should have technological, disciplinary and pedagogical knowledge (TPACK model). In summary, the competent teacher in a digital world is in constant development, he is able to strengthen his critical capacity to incorporate technology in classroom, "developing his technical skills guided by his own good judgment" (Castañeda, Esteve, & Adell, 2018; p.14). Regarding video analysis and teacher competences, there is a variety of teacher preparation programs that use video as an effective methodology for developing teachers' noticing skills (Roller, 2016). From Tripp and Rich (2012) study, it emerges that, in video analysis, teachers use codes or checklists to help facilitate their video reflections, usually tagging the number of times certain behaviours occur (e.g. the number of positive and negative feedback statements and questions that they used during their lesson). These authors state that the use of checklists help teachers to notice specific behaviours and to gain insights into their own teaching.

## Assessment of teacher skills

Skill assessment is a complex process that should not be left to the subjective evaluator. It is therefore advisable to use some instruments that would not only discriminate competence indicators, but also provide a more objective and triangulated evaluation process. Cano (2008) explains that skill assessment requires using a variety of instruments and the involvement of different actors. The instruments must respond to a strategy of systematic information gathering. These tools can be closed (checklists, scales, rubrics, etc.) or open records, and can be used by one or several evaluators (360 model).


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A difficulty is added when assessing in-service teacher skills. Most of the time, teacher competencies in classroom are not directly observable; these must be inferred by performance or specific behaviours. De Miguel (2007) notes that skills require new criteria and instruments to be used in the assessment procedures. Qualitative analysis has classically studied teachers while lecturing; both participant and non-participant observation are used in teacher skills evaluation. Regan-Smith, Hirschmann, and Lobst (2007) found that medicine teachers' skills improved over time after feedback was provided and repeat observations occurred. In particular, observed faculty receiving feedback improved their ranking, compared with non-observed teachers. Furthermore, we believe that with the implementation of cameras and mobile devices in the classroom there are new possibilities that bring researchers into the field of video analysis (Aubusson, Schuck, & Burden, 2009).

In the particular case of teacher DC (Gisbert, González, & Esteve, 2016), there are different tools to measure the skill level. As reviewed in Esteve (2015), it is necessary to define teacher DC together with the strategy to develop and evaluate it. We will therefore focus on the self-evaluation rubric consisting of 22 items (COMDID) designed and evaluated by Gisbert and colleagues (2018). COMDID groups teacher DC in four dimensions; each descriptor defined with four levels of development. (a) Didactic, curricular and methodological; (b) Planning, organization and management of digital technological spaces and resources; (c) Relational, ethical and security; (d) Personal and professional. Levels of development are based on Krumsvik (2009): Beginner, Medium, Expert and Transformative.

According to the cited studies, our aim is not to expand the range of skill measuring tools, but to accommodate each skill for assessment. Therefore, there is a need for a complete tool that allows researchers to implement theoretical categories of skills such as COMDID, and more important, a video analysis system that can transform this items into indicators observed and recorded during teacher activity. Video gives greater access to classroom events than classic observation (Ball & Cohen, 1999), without compromising authenticity (Sherin, 2004). It also has the capability to provoke cognitive, emotional and motivational processes (Seidel, Stürmer, Blomberg, Kobarg, & Schwindt, 2011). Video tools develop further as technology advances, and add both new and beneficial dimensions to teacher professional learning (Aubusson, Schuck, & Burden, 2009). Furthermore, as stated by Rich and Hannafin (2008), video annotation tools could help increasing teacher self-reflection, overcoming the limitations of video-captured episodes (or videoclips) that can only review teaching activity. Furthermore, tools such as MED1A implement a third dimension to video recording and video annotation: videomining.

## Videomining to assess teacher skills: The case of MED1A

Othman, Abdelali, and Jaber (2016) studied web data mining in MOOCs, they stated that educational data mining is the emerging topic for research, and defined two approaches for web videomining: the use of traditional image processing and the metadata based approach. Their methodology has been used for mining MOOC videos using metadata. As mentioned in the introduction, the use of videomining in face to face teaching is scarce, however, a research


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field in video analysis and video annotation tools has evolved the last decades. Institutions across the world are developing video analysis tools that make the process of viewing, analysing, and sharing videos easier. In a review of the use of video for teacher training worldwide, Brouwer (2011) identified three domains of application for video analysis: orientation, support, and assessment. Tochon (2008) explains that, this procedures are now practiced worldwide, using video as a valid method for teacher improvement. More, this practice is changing to a more global video-reflection, wherein teachers view videos of their own practice and think about the effects of particular actions within a situated environment (Tripp & Rich, 2012). Technological advances are pushing the use of video even further: it has enabled teacher administrators to recognize important patterns in teachers' practice (Rich & Hannafin, 2009).

Based on the existing research, we focused on the aspects that Tripp and Rich (2012) highlight in their complete review: teachers report that the use of a guiding framework (e.g., rubric, checklist, teaching principles) helps to focus their reflection. These authors show that some teachers prefer to choose their own focus. Thus, in our proposal, we looked for a balance between the use of a predetermined category framework (COMDID rubric) but also teacher choice of focus within that framework, that is also the reason why the phases proposed (Figure 2) have an iterative component.

Our approach focuses on the patterns mentioned by Rich and Hannafin, and introduces two different aspects of videomining in a single framework:

1. The use of categorized video episodes as big data (turning qualitative videos into time and category quantitative data logs that can be used for big data analysis).
2. The use of the categorized video episodes directly with the teachers in order to help in-time reflection of their teaching skills.

These two aspects are complementary and help building the whole picture of teacher skills in the classroom. In particular, we will explain the case of the implementation of teacher DC framework based on COMDID in the videomining tool chosen for our research: MED1A.

MED1C, a SME instrument founded by the European Commission Horizon 2020. MED1C software solution has a solid foundation, since it was launched 7 years ago by the SME 1d3a to cope with similar needs within the sector of Elite competition in sports. Some of their main customers are FC Barcelona, Aspire (QA), CSKA (RU) and FIBA. In particular, the evolution of MED1C into MED1A (Figure 1) is part of a research project involving different universities and companies around Europe. MED1A main features include a user friendly interface, fixing the complexity of having many video formats, allowing to tag and categorize actions during a classroom, reducing reports and video storage solely to relevant parts, allowing videomining across data bases, and offering a collaborative interface that can be used in mobile devices, helping observers and teachers in the process of skills evaluation. Following Suthers and Rosen (2011), an integrated analytics system would allow data and analytics layering: using


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multiple data sets and analytics techniques in a single interface for visualizing and presenting data to practitioners. Thus, we believe that the choice of MED1A is appropriate for our aim.


Figure 1. Screenshots of MED1A, a video analysis and annotation tool for teaching and learning evaluation processes

## *Methodology*

As a first step in the implementation of a video analysis tool in teacher skill evaluation in classroom, researchers worked together with the design team of MED1A and focused on the case of teacher DC and using the COMDID rubric, we define the following phases:

Phase 1 was devoted to choose the indicators for each of the 4 dimensions of the TDC. The research group worked as experts to implement at least 4 indicators for each dimension, according to the items in the questionnaire, and implement them in the buttons of the software tool (see Figure 3). In this phase it is very important to set the goal of the implementation: teacher skills evaluation, feedback to the teacher of one or more dimensions, data for triangularization of a blended learning environment, etc. Based on Esteve (2015) and Krumsvik (2009) we propose the following dimensions and levels of teacher DC: (a) Didactic, curricular and methodological. (b) Planning, organization and management of digital technological spaces and resources. (c) Relational, ethical and security. (d) Personal and professional. We propose the following levels for each skill, implemented as Likert scale variables with the following labels: Beginner, Medium, Expert and Transformative (see Evaluation Buttons in Figure 3). For each dimension, items were selected based on the 22 items of the rubric, and focusing on those items related to classroom actions (e.g. "use of ICT tool in the classroom").

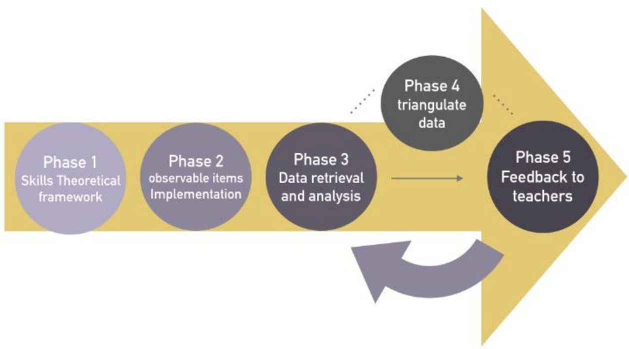



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Figure 2. Phases of the videomining process

Phase 2 consisted of the implementation of this items in the tool, the selection of the scales for each item, and also the implementation of other buttons useful for the observer and data retrieval, that would help teacher self-reflection when reviewing the videos. In this phase we believe that Likert scales can be useful for some indicators, also dichotomous variables such as "the teacher uses the digital board (Y/N)". Finally, a time-counter for each item was enabled, that can be very useful for retrieving actions such as "time spent answering student questions".

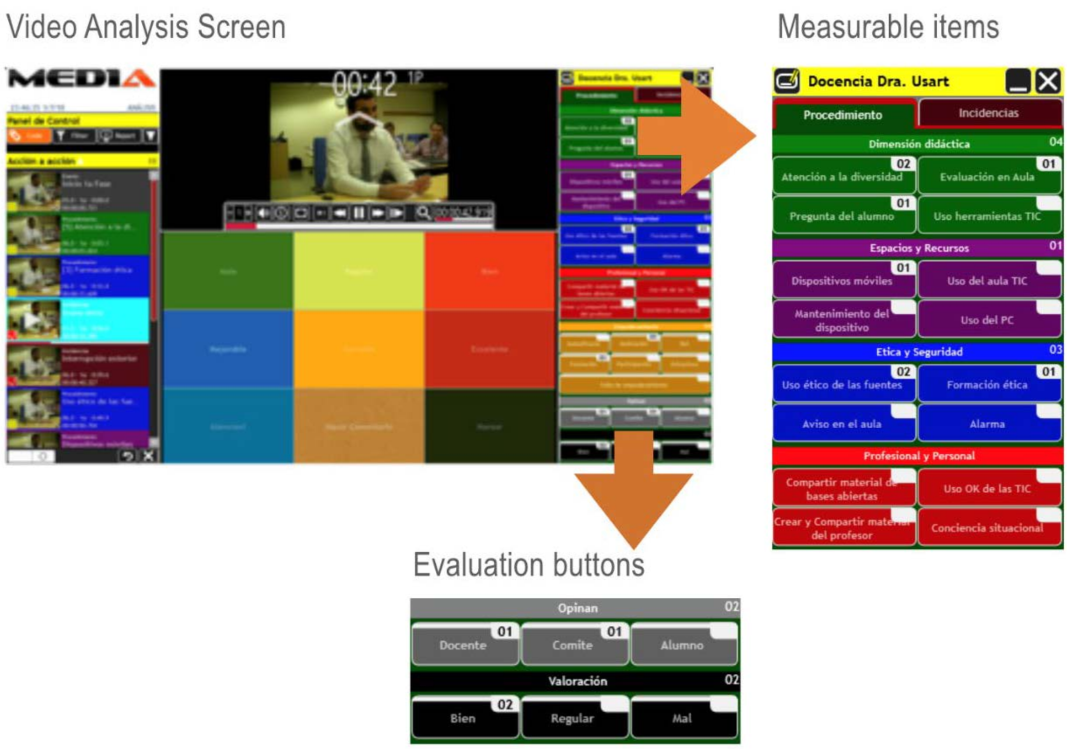


Figure 3. Screenshot of a teacher video analysis in MED1A

Phase 3 is focused on the observation process of the teacher in the classroom, MED1A has an app that helps non-intrusive observation and allows more than one observer to synchronous note each item during the lecture.

Furthermore, there is the possibility to implement more than one camera to the analysis, and also other data sources, such as a biodata measurements of the teacher. Video episodes are categorized and saved in the tool, and can be seen in the right side of the screen (Figure 3). Once again, setting the objective will help researchers and teachers design this phase.

Phase 4 is mostly for blended-learning and biodata evaluation processes, if we want to measure teacher DC not only in classroom but also in a Moodle context, we can to triangulate data with Moodle logs from teacher. All this data leads to a xml or csv file with all the logs from videos, both dichotomous, Likert, and time-logs, and helps the implementation of this big data source into a learning analytics software (see Figure 4).


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Phase 5 implies teacher seeing the videos categorized and reflecting on the real action. It can be done just after the class has ended, as it does not need time to calculate or retrieve, it can also be accessed without internet, and from a mobile device, and as video categories are not really cut nor edited, teachers and researchers can contextualize each item observed in order to improve the reflection and evaluation of the whole process in context.


Figure 4. Screenshot of videomining screens in MED1A

## Discussion, conclusions and further research

As mentioned in Siemens (2012), there is a gap between researchers and practitioners in education that ends up in a lack of communication between empirical research and educational practice. A methodology based on videomining could allow the measure of different competences in general, and teacher DC in particular. Furthermore, recent developments in video annotation tools make video reflection more viable and accessible: these tools make possible the process of teacher self-analysis using verifiable evidence (Bryan & Recesso, 2006). In particular, videomining offers the potential to support both reflection and analysis of one’s own teaching and to link it to big data from different scenarios where teachers act. These tools, as Siemens states, should be intuitive and easy-to-use, in order to help more practitioners to use them and understand the results without the necessity of permanently working with a researcher.

Within this framework, the main aim of our study was to set the basis for the implementation of a reliable and valid measure and assessment for teacher skills in classroom activity. The two research questions have been answered with the particular case of teacher DC, as one of the key competences for practitioners in the ICT society. The first goal was to understand how to set up, measure and assess teacher skills with the use of a digital video analysis tool. According to Brouwer (2011), we design our methodology in the three domains of application for video-analysis: orientation, support, and assessment. We proposed and tested the implementation of the COMDID rubric in MED1A, a videomining tool with a solid background that allowed us to test the possibilities of the user-friendly interface and ease of use of the screens, buttons and scale types.

Following Krumsvik (2008) the basic use of ICT by a teacher does not warranty a skilled professional. We must link this use with the context and the pedagogical criteria of the practitioner. One of the goals of our implementation is to allow teachers reflect in a complete


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and real scenario, making self-reflection more significant than only using a questionnaire or evaluation rubric. Using a tool such as MED1A helps saving time through real-time categorization from mobile devices, avoiding high review times. More, availability of the revised report and the need to provide immediate feedback so that processing changes is faster for teachers. The TPACK model (Koehler & Mishra, 2008) states that teachers will only be competent if they can activate disciplinar, pedagogy and technology skills. In this sense, we believe that future experiences of videomining in educational context must observe teachers in other contexts and focus on different skills. Another research topic is related to memory and MED1A immediate feedback for teachers.

Concerning the second goal: phases and outcomes of the process (in particular, in the case of teacher DC); we designed the main phases of the model. However, more research will be conducted in order to quantitatively test the phases proposed and analyse the data from videos, also triangulate it with data from online activity of teachers. The ease of use of MED1A when implementing and changing buttons and video sources can help teachers and non-technical profiles when implementing this video analysis tools. It also helps reflecting on the items and rubrics chosen for the observation, as seen in Figure 2, it can lead to DBR processes (Design-Based Research Collective, 2003) and help in the Iteration process of both the items and the observations in order to create a solid rubric. According to Tripp and Rich (2012), teachers report that the use of a guiding framework (e.g., rubric) helps to focus their reflection. However, some teachers prefer to choose their own focus. According to this real needs, we looked for a balance between the use of a predetermined category framework (COMDID rubric) but also teacher choice of focus within that framework, that is why the phases proposed have an iterative component.

In summary, we believe that the use of videomining tools such as MED1A can help in the measure and evaluation of teacher skills. The methodology presented is a first step that aims to show how to implement a taxonomy for video analysis, as in teacher DC, focus on the fact that usually video analysis was used for teachers and researchers to reflect on the activity. Existing linear video practices provide holistic snapshots but are difficult to systematically observe, analyse, or reflect on individual teaching practices (Hewitt, Pendretti, Bencze, Vaillancourt, & Yoon, 2003). We give a step forward with the implementation of an evaluation rubric such as COMDID, that will give a solid based on theory guide to evaluate and further reflection and design, together with institutions and other researchers, more significant evaluation and training programs for teachers. This programs could use videos and real-time analysis, immediate post-classroom reflection with other teachers and researchers. A second phase of triangularization of data to help deeper reflection and improving the rubrics that measure the different competences in all the contexts where teaching takes part.

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