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Learning analytics and its metrics – approaching an educational frame via a social semiotic pathway

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Learning Analytics und ihre Metriken – Annäherung an einen pädagogischen Rahmen über einen sozialsemiotischen Weg

Der Beitrag stellt sich die Aufgabe, Metriken auf Bildung anzuwenden und schlägt dazu vor, Lernanalytik und ihre metrischen Verfahren in ein sozialsemiotisches Konzept von Lernen als Entwicklung von Bedeutung einzuordnen. Solch ein sozialsemiotischen Rahmen definiert Metriken als eine qualitative und quantitative Modalität der Repräsentation von Lernpraxis, die empirische Belege von und für pädagogische Praxis bietet. Arbeiten aus den Bereichen der

Kulturwissenschaften und Medienwissenschaften der 1970er Jahren, die TV-vermittelte Massenkommunikation als Bedeutung konstituierende Praktiken definierte, dienen als Anregung, um Metriken als einen Repräsentationsmodus in und von Bildungsprozessen zu bestimmen. Dabei gilt es zu bedenken, dass Bildung zunehmend mit den Auswirkungen der Digitalisierung und mit der dazu gehörigen Automatisierung konfrontiert ist. Aufgabe von Pädagogik ist nun, Metriken sinnvoll für Lernen aufzubereiten, indem Metriken und Metrifizierung der Dynamik der persönlichen Entwicklung einer/s Lernenden sowie derer bzw. dessen Entwicklungskontext gerecht werden. Das ist vor allem eine pädagogische Aufgabe und keine, die sich auf Verwertbarkeit ausrichtet. Der Beitrag schlägt dazu vor, Metriken als einen Repräsentationsmodus von Lernprozessen und Lernergebnissen zu bestimmen. Hilfreich ist dabei, sich auf Narrative als einen Repräsentationsmodus von Lernprozessen und Lernergebnissen zu konzentrieren, nicht zuletzt, weil Narrative eine vertraute Form von Reflexivität bieten. Darüber hinaus schlägt der Beitrag vor, Lernpraktiken als eine Form von Context Awareness zu sehen, was mit Beispielen aus Grundschule und Universität veranschaulicht wird.

This paper explores the task of applying metrics to education and proposes a view of learning analytics as the semiotic work of meaning making. In this social semiotic frame, metrics are defined as a qualitative and quantitative modality of representation, offering evidence in and on practice. Work in the fields of cultural studies and media studies in the 1970s defining TV-mediated mass communication as signifying practices, are used as an example for the task of integrating metrics into education as a mode of representation and learning as meaning making. Education is increasingly

confronted with the impact of digitization and its framing by automation. Educators try to make metrics meaningful for learning by integrating metrification into the dynamic of a learner's development. However, the success of this is dependent upon its educational provenance, which means orientation to the learners' personal development and their context. A genuinely educational proposal for metrics refers to metrics as a mode of representation of learning processes and learning outcomes. We propose to concentrate here on narratives, which offer a familiar form of reflexivity. Furthermore the paper proposes practices of learning as context awareness which are illustrated through examples from primary school and university.

I. Introduction: Metrics as mode of signifying practices

This paper uses a historical reflection from cultural studies to propose the disconnection of learning analytics from a cybernetic understanding of its functions and methods. The historical reflection does not refer to the traditional formats of analyzing outcomes of learning in schools, but sees current metrics, as part of mass communication to which school contributes under conditions of the economically driven 'knowledge society'. Children grow up with a 'new' mass communication to which 'old' TV still belongs as a relevant part but which is integrated in social media as well as in cybernetic recommender systems. Structures and agency of the 'new' mass communication is characterized by individualization, mobility and systemic interdependences with a delimitated appearance of what media are about. The interrelation of TV, Internet, mobile apps with their 'active' and 'passive' offering is more and more driven by a diverse programme of metrics which is becoming normalized. In respect of mobile learning, learners exercise agency through user-generated contexts, which depend on mobile devices as a new mode of media. These user-generated contexts, definition see below, are individualized and provisional which lends itself towards the objectification of learning

processes and learning outcomes. Our proposal for objectifying learning processes and learning outcomes is to draw on narratives, as a deliberately considered alternative to a naïve calculation system of cybernetics. Not least, by approaching the idea of learning analytics through narration, this argumentation links to TV as, among other things, a narrative medium.

Looking back and comparing this with the TV mediated mass communication one sees TV emerging around the 1940s and getting the status as being amalgamated in everyday life at the end of the 1960s. From mid 1970s this amalgamation of TV and everyday life was framed by some in education as the Disappearence of Childhood (Postman 1982) or as TV-childhood with the connotation of a negative cultural development. That is, TV was seen as bringing dramatic change and the potential destruction of an adequate culture of children's growing up. Later on, education concentrated on media educational programmes with the key idea to enhance children's competence to deal critically with the TV offering or to become creative by producing their own media.

Simultaneously there was, in TV- and cultural studies, a discussion about modelling TV-driven mass communication. Initially, Harold D. Lasswell's statement from 1948 (37) became the leading idea to deal theoretically with the 'new' and TV-driven mass communication: "Who Says What In Which Channel To Whom With What Effect?" This social framing may justifiably be described as one influence on the development of cybernetics; that is, the intention to influence and orient people directly from a central point via TV. In Lasswell's publication "The Strategy of Soviet Propaganda" from 1951 and "The Analysis of Political Behavior" from 1947 the context of propaganda became overt. This historical situation has clear contemporary parallels, visible through the conjunction and coupling of the data mining company *Cambridge Analytica* with *Facebook* and the US president's election. Such phenomena have been the source of much recent discussion and debate with regards digital capitalism within globalisation. In education the context is predefined by the transformation of learning as an economic resource

within a knowledge society. Under the conditions of an economically driven knowledge society, datamining is not framed as a feedback system about learning as part of children and young people's personal development. Rather, it is a tool within a control and steering system, to adjust learners to defined outcomes. To understand metrics as an essential part of new mass communication we should begin with a similar discussion that Stuart Hall (1980) led on TV within cultural studies. His theoretical framing of TV production and reception as signifying practices within a specific organization differs definitively from the organization of school learning. But nowadays, formal learning organization in Moocs are closer to the TV organization than to the vis-à-vis interaction of learning in the school. Similarly, social semiotics especially that of Gunter Kress refers to learning as signifying practices of meaning making in multimodal environments (Kress/Bezemer, 2015; Kress 2010 and 2010a). These theoretical links between the cultural theory of mass communication and learning suggest, we argue, a redefinition of metrics within learning as follows:

Metrics within processes of learning analytics can be reframed and understood as a qualitative and quantitative modality of representation providing evidence in and on practice.

II. What we learned about Metrics from cultural studies and Stuart Hall

Defining metrics as a mode of representation embedded in signifying practices is like taking a loan from cultural studies and social semiotics for describing mass communication. This approach to framing metrics contextualizes it in a societal field which is in dramatic transformation. Mass communication, with its focus to provide an industrial way of representation via TV as cultural resources, is actually shifting from a sender-receiver model to a model of disparate, digital, individualized, convergent mass communication. Understanding these developments as new 'signifying practices' with recently emerged cultural products such as Internet based platforms or smartphone based and group related

communication tools like Whatsapp, offers new opportunities for much needed critical analysis. We are rather familiar with the old mass communication signifying practices of television, so we can draw on these practices to understand metrics within education. But how can we deal with the metrification of learning? Is metrics just an economic methodology developed for measuring the value of productivity which is conquering the field of formal education? From a mass communication perspective learning is conceived at least partly as both a mode of representation and communication. From the long history of transforming of communication into an industrialized mass communication we could find theoretical impulses for the categorisation of metrics as mode of representation.

All new media, begin as new cultural resources, that intrude at different rates into everyday life. This happened with photography, through the eighteenth, nineteenth and twentieth centuries, with film and TV, and recently, with computers, smartphones and tablets. The educational reaction to television as mass media was a 'critical media literacy'. In the German speaking context this was manifest as 'Medienkompetenz', and media education as a real branch of pedagogy was established. The normality of a width of forms of representation, from writing with characters to still images, videos, sound, spoken language etc. provoked cultural studies to interpret each kind of engagement with media as 'reading' (Fiske 1989, Hall 1997) and social semiotics to explain media reception as a mode meaning making (Hodge/Kress 1988, Kress/van Leeuwen 2001, Kress 2010, Kress/Bezemer 2015). To get closer to a theoretically informed discussion about metrics in mass communication and learning the concept of multimodality of representation (Kress 2010, Kress/Bezemer 2015) is adequate. Kress already connected 'multimodality of representation' in the processes of 'meaning making' to a theory of mass communication as well as to learning. This theoretical line of social semiotics supports the outline of this paper to get an introduction to metrics not primarily by looking to standardization of industrial production, as in Taylorization, but by mass communication and its on-going transformation.

The actual on-going societal and cultural transformation leads to a de-construction of the established understanding of what media are about and also what learning is about. In combination with the technology of the internet, communication services like Facebook are amalgamated into a delimitated media system. In the German context the delimitated media system is categorized as an information intermediary. Facebook and Twitter are examples of such intermediaries which produce new communication phenomena like echo chambers which lack any educational provenance. In contrast, the mass communication system of TV was based on the sender-receiver model and realized as the public broadcasting model of the BBC. Stuart Hall (1980) explained this BBC model with an active sender and a passive mass audience as interrelation of a "meaningful discourse" (Hall 1980: 130). That is, the media programme, and "meaning structures" of the programme producers and of the recipients with their respective "professional significations and their signifying agencies" (Hall 1980: 137) become signifying practices.

III. The cultural historic line of mass production and mass consumption

These 'old' signifying practices are becoming now just a part of a dispersed *digital, convergent* mass communication with individualized mass senders and individualized mass audience which is at the moment equipped with digital handhelds. Furthermore, this kind of mass communication transgressed the boundaries of entertainment, information, economy, education whilst also prolonging the historical line of mass production and mass consumption. The recent use of metrics with the representational modes of algorithms belong to the societal structure, agency and practices of mass production to which McDonald's delivered the model. Its historical predecessor was mass production especially that of the car. Also our actual forms of mass consumption by the Internet belongs to the developmental line of our culture from industrial mass production of standardized commodities to an individualized mass consumption. Undoubtedly, it is the cultural line from

Ford's car industry to McDonald's hamburgers. Fordian mass production was based on a standardizing algorithm under the heading of Taylorism[1]. Fredrick W. Taylor's "Principles of Scientific Management" (1911/2004) improved industrial efficiency, among others by "methods based on a scientific study of the tasks" as he wrote:

"And this one best method and best implement can only be discovered or developed through a scientific study and analysis of all of the methods and implements in use, together with accurate, minute, motion and time study. This involves the gradual substitution of science for rule of thumb throughout the mechanic arts." (Taylor 1911: 11)

Under today's conditions, the replacement of "mechanic arts" of workers in Taylor's statement, with the communicative and everyday mode of signifying practices of customers on Amazon's website, brings us very close to Amazon's marketing. For example, we may substitute Taylor's statement regarding "accurate, minute, motion and time study" for the signifying practices with the cultural resources of metrification and algorithms to reveal further links between Taylorism and contemporary online marketing strategies. Taylorism, with its replacement of craftmanship by mathematically-based engineering, replacing experience by standardization and linearity, led to the conveyer belt of mass production. In contrast to mass production, mass consumption is built on individualization. That is, one buys a Ford car by oneself and decides where to go and when to go, whilst also paying for it personally. This model of mass consumption was successfully established and exploited by McDonalds' fast-food. Ritzer (1993) summarized the *principles* of mass consumption under the heading of the "McDonaldization of Society" with the following characteristics:

"Efficiency" (pp. 35 ff): The optimal way to go from being hungry to be satisfied.

"Calculability" (pp. 62 ff.): The transformation of food, its production and its consumers into measurable units.

"Predictabity" (pp. 83 ff.): Predictable management of food units from production to consumption.

"Control" (pp. 100): People and consumers are subdued to these processes e.g. by pre-organised choice, through given channels.

"The Irrationality of the rationality" (pp. 121 ff) which includes among others the "demystification, deprofessionalisation, and assembly-line medicine" (pp. 139 ff.)

So what kind of cultural resources, modes of representation and signifying practices in education may be combined with the societal structures of mass consumption and are at risk of being offered up to McDonaldization? Education needs to ask what characteristics of mass production and consumption are already, and will be, transferred to learning.

Anna Wilson et al (2017) propose the following which is rather close to Ritzer's description of mass consumption:

"Real-time insight into the performance of learners".

"The widespread introduction of virtual learning environments (VLEs) – also known as learning management systems (LMSs) – such as *Blackboard* and *Moodle* has meant that educational institutions deal with increasingly large sets of data. Each day, their systems amass ever-increasing amounts of interaction data, personal data, systems information and academic information."

To realized learning analytics in the sense of the "Society for Learning Analytics Research (SoLAR): Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs."

This leads to "two assumptions: that learning analytics make use of pre-existing, machine-readable data, and that its techniques can be used to handle 'big data', large sets of data that would not be practicable to deal with manually."

Arguing with Giddens' (1984) widened Structuration model (Pachler et al 2010; Bachmair 2017), as educators we should ask how learning analytics, with its metric modes of representing, changes learners' agency. We should also ask if, and how, learning will become a form of work, as students may be transformed into learning workers, in the sense of Taylorism. There is, we argue, the risk that learners follow a McDonald's system of mass consumption in which student consumers queue in front of cash registers and sales kiosks to enjoy pre-organised and prefabricated knowledge which they self-select. Invisible data mining and learning analytics provide a feedback system. Is it such a far stretch of the imagination to conceive of *McDonald's knowledge consumption*, provided under the heading of Google, Apple or Amazon? There is no question that the structural driving power for such a model is well underway, although this may be uncomfortable for educationalists to acknowledge. McDonaldization is a strong historical and cultural line within our societies with orientation to mass consumption driving ahead 'digital' modes of learning and supported significantly by the business sectors of our societies. But, perhaps this technologically determinist picture we portray is not inevitable? Large and innovative companies are moving away from Taylorist models of management, efficiency, control and calculability (= McDonaldization) towards models based on the self-management of complexity. This enforces models of learning in line with Situated learning, investigative and self-organized learning, collaborative and peer-to-peer learning. To understand how learning analytics may be manifest in such models of learning we turn to the shift from "old" to "new" forms of metric representation in media.

IV. TV ratings: "Old" form of metric representation

The rational for audience research began with the sale of media items e.g. the book, the journal, the sold copies of newspaper. Television did not exist in different modes to the copy of a journal or as an item like a car because of its quality as an information stream. Furthermore, TV audiences remained hidden and anonymous in the private home. No

direct charge like in the cinema was feasible. Therefore, the *re-financing* of TV was established by way of a public service with a tax-like charge or in the tradition of the newspaper's advertising payed for by the buyer of an advertisement e.g. a brewery. By placing a TV advert the buyer's interest is to attract as many viewers of the anonymous TV audience as possible. Therefore, the price of a TV advert is calculated on the basis of 1.000 viewers' contact to a specific TV advert. The *1000 viewers' contact price* is measured by electronic measuring devices, in Germany, in a sample of 5000 TV- households on the basis of the daily television use of households of the TV research panel, which comprises persons living in the household including their viewing guests.

In generalizing this approach, the key categories of *reach* and *rating* were developed. *Ratings* in % inform about the proportion of the viewing audience to a particular TV programme unit in competition to other TV-broadcasters or other programmes units. *Reach* counts the numbers of viewers (heads, persons) of a TV-programme unit. These data for calculating range and reach were collected by a small electronic device on which a viewer has to click personally when he or she watched TV or went away from the screen. The data collection used a representative sample, but was fully real time processed immediately by a central computer.

The question is now what the *rating* and *reach* are representing? The signifying practice of the viewer was to stand in front of the TV screen and to click on the small electronic device, a rather simple practice of selection. This click also established the time of viewing TV. TV viewing is a reading practice of different programme elements and formats. The small electronic device, switched on by the viewer, recognized which programme offer the viewer is engaged in and sent it to a central computer. This recorded and objectified reading activity of a TV viewer is enormously reduced and merely a proxy of the viewer's engagement with the TV programme e.g. been bored or highly engaged. The click on the electronic tool box for 'I am watching' represents the click on the TV set for changing the programme to be viewed. The recorded and measured aspect of the signifying practices of reading TV is reduced to clicks. The TV

sender's cultural resource is a representative sample of viewers which was processed statistically by computer-based software. This software stored and analyzed the incoming viewer data together with the time of connecting with a broadcast programme unit. The result of all of this processing, lead and still leads to, among other aggregations, hitlists of watched TV programmes. A hitlist is a cultural product, which represents in the mode of a list and ranges, the reading preferences of the TV audience.

V. TV ratings in education

The question for education is if such rating data have an educational function? TV rating data are gathered and processed for the purpose of getting re-financed by advertising. These data quantify how many persons watched a programme in front of a TV screen at home. Education can interpret this data and its aggregation as a representation of the signifying process of selecting and reading TV. For example, the hit list of children aged 10 to 14 years does not differ much from the hitlist of the TV audience in the age category of youth (14 to 18 years of age). A plausible explanation of this result on comparing ratings could suggest that the children beyond primary school are on a trajectory to becoming young people, so their preferences reflect those of the adolescents who are their role models. The was a leading question for interpreting TV preferences as indicators for the appropriation of TV within the life-world of learners, in a socialization oriented educational project based on the TV ratings (Bachmair et al. 2005). Personally appropriated television may reveal a socialization function which co-structures subjectivity. The selected, read and appropriated TV programme interferes into a child's lifeworld e.g. the organization of everyday life and its social relations. Similarly, this TV programme influences interpretatively, the relation of a child to himself / herself and to the social, cultural and objective environment. The TV ratings are a partial representation of this process of appropriation and mediation.

VI. On the way to discover the communicative part of metrics

Our argumentative proposal to frame the view of metrics with the cultural theory of mass communication research, is helpful to reveal the communicative parts of metrics. Learning, as well as technologically mediated communication and metric modes of representation are based on *meaning making*; albeit meaning making in rather different social fields of cultural and signifying practices. Different also are the moulding structures and the agency of the actors within these fields and practices. One highly relevant structure is power and its relation to meaning making. In the case or TV ratings power comes into the influence of advertising on the broadcast programme.

In the argumentative line of the delimitation of the traditional media system we see and have to consider the widening of modes of representation within changing signifying practices. The new mode of representation is the metrification of a digital, convergent, individualized mass communication based on the Internet and digital data transfer. The assumption here is that producing and selling commodities is not separate from meaning making, which is communicative, but with different modes of representation. Of course, metrification does not follow any more the integrative 'reading activities' of the sender-recipient-model, e.g. reading a TV film. Actually, the delimitation of the BBC model of TV by mobile handhelds within the ubiquitous Internet and individualized programming and reception, has made this static methodology of TV metrics, invalid. The mode of metrification in the delimitated mediated mass communication system does not correspond well with the former TV reading audience and its aforementioned signifying practices. The new signifying practices of metrics belong now to a system of cultural resources which afford new representational modes of communication and vice versa. For example, metrification in the context of producing evidence of learning, works with the resources which are provided or will be provided by the Internet. The signifying practice of metrification does not belong any more to familiar cultural

structure of our society. Its development is driven by economy and power, encapsulated, for example in recommender systems designed to influence consumers choices through digital pushes or 'nudges', as we explore now.

VII. New forms of metrics: Recommender systems

As discussed, the reframed delimitation of the BBC model of TV prompted by mobile handhelds within the ubiquitous Internet and individualized programming plus reception made the static methodology of TV ratings metrics invalid. More recently, binge-watching has emerged as the cultural practice of watching television for a long time span, usually a single television show. In a survey conducted by Netflix in February 2014, 73% of people define binge-watching as "watching 6 episodes or more of the same TV show in one sitting" (West 2014). Binge-watching as an observed cultural practice has become popular with the rise of online media services such as Netflix, who have been credited with establishing the term and making it a word in the dictionary (Walters 2017). Netflix is spending billions to make bingeable content and some argue that this "seems to be paying off for Netflix" (ibid.). Specifically, the delimitation of the BBC has been challenged by streaming services like Netflix, given that Netflix members around the globe watched over 140 million hours of content per day on the streaming site (ibid.). This has prompted the BBC to enhance its iPlayer streaming service to include 'binge-worthy' box sets. These developments are driven by economy and power. Indeed, the running metrification driven by digitalization (e.g. binge watching) appears a new mode of cultural resource with specific modes of representation within signifying practices partly close to old forms of ratings communication (e.g. TV ratings).

Although metrics are not new, the point is how can we apply newly conceived metrics now in the context of learning? The signifying practice aspect of metrification (e.g. producing evidence of learning) do not belong any more just to the familiar cultural structures of our society like schools or higher education institutions. For example, take amongst other video

platforms, the Khan Academy. This is a "non-profit educational organization created in 2006 by educator Salman Khan with a goal of creating a set of online tools that help educate students" (Wikipedia 2018). The Khan Academy produces short tutorials in the form of YouTube videos. Its website also includes "supplementary practice exercises and materials for educators. All resources are available to users of the website. The website and its content are provided mainly in English, but are also available in other languages ... Khan Academy has delivered over one billion lessons worldwide. The platform is used by 40 million students and two million teachers every month" (ibid.). However, despite these impressive metrics, several criticisms of this approach include that lack of formal background in pedagogy or teaching of its creator, the fact that several videos have been questioned for their technical accuracy and the tendency towards a predominance of mathematics tutorials.

To provide an example to unpick the threads of our argument in the rest of this paper, we now briefly explore the notion of how recommender systems are potentially providing new modes of cultural resources; given that such systems are widely used by media platforms like YouTube and Netflix. A recommender system or a recommendation system "is a subclass of information filtering system that seeks to predict the "rating" or "preference" a user would give to an item. Recommender systems have become increasingly popular in recent years, and are utilized in a variety of areas including movies, music, news, books, research articles, search queries, social tags, and products in general. There are also recommender systems for experts, collaborators, jokes, restaurants, garments, financial services, life insurance, romantic partners (online dating), and Twitter pages" (Francesco/Lior/Bracha 2011).

Let us return to our example of Netflix. One of the key events that energized research in recommender systems was the Netflix Prize: "From 2006 to 2009, Netflix sponsored a competition, offering a grand prize of $1,000,000 to the team that could take an offered dataset of over 100 million movie ratings and return recommendations that were 10% more accurate than those offered by the company's existing recommender

system" (ibid.). This competition had the effect of energising the search for new and more accurate algorithms: "On 21 September 2009, the grand prize of US$1,000,000 was given to the BellKor's Pragmatic Chaos team using tiebreaking rules ... The most accurate algorithm in 2007 used an ensemble method of 107 different algorithmic approaches, blended into a single prediction" (Wikipedia 2018). Not only are the data sets used by such algorithms very large, the actual number of algorithms deployed to reach a decision for a recommendation can be very large and complex.

Amazon provides another significant example of how the dominant cultural resource of the recommender systems has affected signifying practices over the past two decades: "Each person who comes to Amazon.com sees it differently, because it's individually personalized based on their interests. It's as if you walked into a store and the shelves started rearranging themselves, with what you might want moving to the front, and what you're unlikely to be interested in shuffling further away. From a catalog of hundreds of millions of items, Amazon.com's recommendations pick a small number of items you might enjoy based on your current context and your past behavior. The algorithms aren't magic; they simply share with you what other people have already discovered" (Linden 2018). However, perhaps the biggest issue facing recommender systems is that they need a lot of data to effectively make recommendations. Companies like Google, Amazon and Netflix who are most identified with having excellent recommendations are also those with a lot of consumer user data. In an online learning management system large quantities of user data may be available, but how much of this pertains to learning? Indeed, taking recommender systems like those used in the commercial domain and using them for learning is not straight forward. For example, Manouselis et al. (2011) attempt to provide an introduction to recommender systems for Technology Enhanced Learning settings, as well as to highlighting their particularities compared to recommender systems for other application domains. Also, Seitlinger et al. (2013: 41) propose an approach that makes visible the assumptions upon which their recommender system is based and as such provides a welcome addition to the research literature: "Up to now, a cognitive

perspective also taking into account memory processes has been neglected. In this paper we therefore introduce a TRM [Tag Recommendation Mechanisms] that applies a formal theory of human memory to model a user's prototypical tag configurations. The algorithm underlying the TRM is supposed to recommend psychologically plausible tag combinations and to mediate social sensemaking".

For the purposes of this paper we conclude this section by highlighting that the signifying practice of using Amazon, YouTube or Netflix accesses the dominant cultural resources of algorithms, and that these algorithms draw on metrics that are not always obvious to the browsing person, who gets addressed by the narrative form of a competent, personal recommendation linked to other cultural resources which are claimed to be similar to the browsing one. In Netflix the system lines up and then auto loads the next episode in a series you are watching, thus facilitating binge-watching. Or Netflix makes available a recommendation that says: "Because you watched Marvel's Jessica Jones" and then give multiple images and the titles of the recommendations for you the viewer. This split form of representation hides the power and the driving dynamic underneath the visible communication which motivates the driving algorithms. An open question is therefore, given our concerns about educational provenance, how can the algorithms (e.g. recommender systems) be used to provide evidence in and on constructivist and agentive models of learning and teaching?

VIII. Proposal for hermeneutic development of learning metrics

Hermeneutics is seen as a contrast to the positivist and consumption interpretation of metrics, of which recommender systems are typical. The educational task is to establish critical distance to the culturally historic developmental lines of metrics and to lay bare new communicative options. Our leading consideration to access communicative options for education is to understand metrics within processes of learning analytics as a qualitative and quantitative modality of representation providing evidence in and on practice.

If metrics are to inform constructivist and agentive models of learning and teaching through their transformation into a usable modality that can be relied upon and read as signifying practices by teachers and learners – meaning making - then the limitations of isolated quantification need to be acknowledged and challenged. As Pachler and Turvey (2018) note, quantification alone has a tendency to merely raise 'more questions than it answers, without more detailed levels of granularity that complementary and concurrent qualitative data' can lend to signifying processes. Neff et al (2017: 94) suggest the capacity and speed of learning analytics to be simultaneously fed back into the ongoing pedagogical process bring new possibilities such as increasing the transparency of 'the assumptions and deliberations that go into choices' made by learners and teachers. Such transparency, however, is contingent on the recognition that:

"Stories occur before data production, during production, and are used in exchange to give data meaning across communities with different expertise, cultures, and practices." (Neff et al. 2017: 94).

In essence, here is the recognition of the irreducibility and dynamic nature of human experience and development. Weinstein and Colebrook (2017) assert, this is not about a particular theoretical turn, but a recognition that the various paradigms and methods to emerge from the sciences, humanities and social sciences throughout the modern era have reached the point where they cannot progress separately in any productive or sustainable form. The essential irreducibility of life modalities echoes the arguments of Bruner (1986) who saw narrative cognition and paradigmatic cognition as symbiotic modes of equal stature and significance in terms of human cognition and development. Indeed, Goodson (2013) argues more recently that narrative, as a significant mode of representation and cognition enables us to 'move beyond (or to the side) of the main paradigms of inquiry - with their numbers, their variables, their psychometrics, their psychologisms, their decontextualised theories' (2016: 89). Data have both political and intellectual ramifications, but representational innovation (e.g. narrative,

visual representation) provide what Eisner (1997) termed opportunities for 'productive ambiguity' (180). That is, such innovation in forms of representation lend themselves to the evocative, as well as the denotative leaving open the door to re-use, further interpretation, negotiation and co-construction of knowledge.

When education and pedagogy are framed as cultural ecology (Bachmair and Pachler 2014) in which structures, agency and cultural practices interact, modalities that yield rich and inclusive forms of representation offer the potential for sustainable and culturally responsive pedagogies (Ladson-Billings 1995; Paris 2012). Such a vision of learning analytics is in stark contrast to the McDonaldization and consumption models of education explored earlier in this paper. As such we argue that pluralistic modes of representation offer opportunities to emancipate the learning process from policies that merely treat 'policy subjects as objects of intervention needing remediation' (Gulson and Webb 2018: 286). Inherent within the notion of merely exploiting learning analytics to 'fix' learners (Ball 2013) according to normative educational goals and cultural practices is a high risk of alienation and exclusion as the education machine fails to respond to the 'linguistic, literate and cultural pluralism' that is central to the 'democratic project of schooling' (Paris 2012: 93). It is argued here that new pedagogical approaches that harness the plural modalities offered by new media technologies, and aggregate these within a model of learning as cultural ecology (Bachmair/Pachler 2014), lend themselves to the construction of knowledge ecologies (Turvey/ Hayler 2017) in which learners are engaged as active agents co-constructing knowledge. So what could this look like in practice?

VIII.I. Example 1: Learning as *becoming aware* - Semiotic work in primary school

In our times of delimitation learning is integrated in contexts which are generated by learning facilitators and learners. From a learning design point of view, holistic orientations like Situated Learning (Lave/Wenger 1991), and Wenger's communities of practice (Wenger 1998) are inspiring.

The hermeneutic interpretation of learning processes refers to a methodological innovation in theory in the 19th century, which understands science in its widest sense as a progressive and intersubjective consideration in a spiral-like reflection which is objectified and situated theory in reflexive progress as well as observing educational phenomena. In this hermeneutic line of reflection the first example is about awareness as part of learning and of evaluating learning. Awareness as consideration and reflection is embedded among others in everyday life. As a general dynamic of the cultural delimitation with the emphasis on individualization, all forms of reflexivity in the sense of consideration and reflection, are amalgamated with individual contexts e.g. of learning or other activities of meaning making. It includes reflexivity on different levels of complexity and consciousness. The concept of *awareness* is considered as part of literacy. In our times of learning analytics within big data *awareness* promises a communicative counter dynamic to the alienation of monitored learner and assessed learning outcomes. Accepted also, are simple forms of awareness such as dealing with images of compound nouns like "Feuerwehrzufahrt" (fire brigade access). In a project in a primary school, discussed below, boys reduce a triple compound noun to a double one. Girls split the same triple noun in a double and a single by following German grammar intuitively.

The following example refers to embedded language learning in a primary school. A child in the process of migration and a residential child were put in learning pairs and were of different ages. They investigated the language markers in the school's neighbourhood. The teacher provided the context for the "word treasure hunt" by offering tablets for each pair of learners. The children explored the school's neighbourhood and took photos of language markers like "Feuerwehrzufahrt" (fire brigade access). Back in school the pairs produced a book on their school tablet by using the app Book Creator. This book consisted of the photos to which the children added their written or drawn statements, and audio statements. Finally, the learning pairs presented their book to the class which discussed the results of the language investigation and book

writing. The teacher advised the learners that they should see that "mistakes are friends". Because the pupils were familiar with this procedure they listened to their classmate's critique and proposal for their further work on their book. "Mistakes are friends" enabled more judgement-free communication about the results of the photo investigation of embedded language which was oriented to formal learning as becoming aware.

This example of awareness refers to the compound noun "Feuerwehrzufahrt" (fire brigade access). In figure 1, two boys add in their digital books to the photo of their reduced and now more simple "Feuerzufahrt" (fire access). In addition they concentrate on a self-drawn smiley, which includes the message of something nice. This is a kind of qualification and emphasis of the message to get help at the 'notinsel' (help point). Also, they write the simple descriptive statement: "Das ist die notinsel" (This is the help point).

Figure 1: Extracts from Book Creator

In Figure 2, two girls explore the compound noun "Feuerwehrzufahrt" (fire brigade access) in a more complex way. They are beginning to deal with grammar**.** These two girls, a native German speaker and a migrant one, work on how to write German compound nouns, not by existing rules but by exploring and through investigation. From their photo of a language marker (the traffic sign with the word "Feuerwehrzufahrt" / fire brigade access) to their transcription with the app Book Creator the girls deal actively and creatively with the complicated German grammar issue of compound nouns. They split the photographed compound noun "Feuerwehrzufahrt" (fire brigade access) into two nouns "Feuerwehr" *(*fire brigade) and "Einfahrt" (driveway). Further, these two girls add a rather elaborate joke on a well known advert for sweets. They comment on the Haribo slogan by contrasting "Happy" with "fat": "Haribo makes children happy. No Haribo makes children fat". They are actively aware of the function of an advert by using the well know sentence from the advert with the contrast of "happy" and "fat".

Figure 2: Extracts from Book Creator

In Figure 3, another pair of girls writes a rather elaborate description which displays sweets as recommendation to buy them, remarking: "We saw delicious sweets so we just had to buy them immediately". The missing full stop / point between "sweets" and "so we" is irrelevant for the girl's statement. They deal with their statement as unit which is in contrast to the German grammar which asks to split the statement into two

sentences. But their intended meaning to express their view on advertised sweets is supported by the renounced full stop.

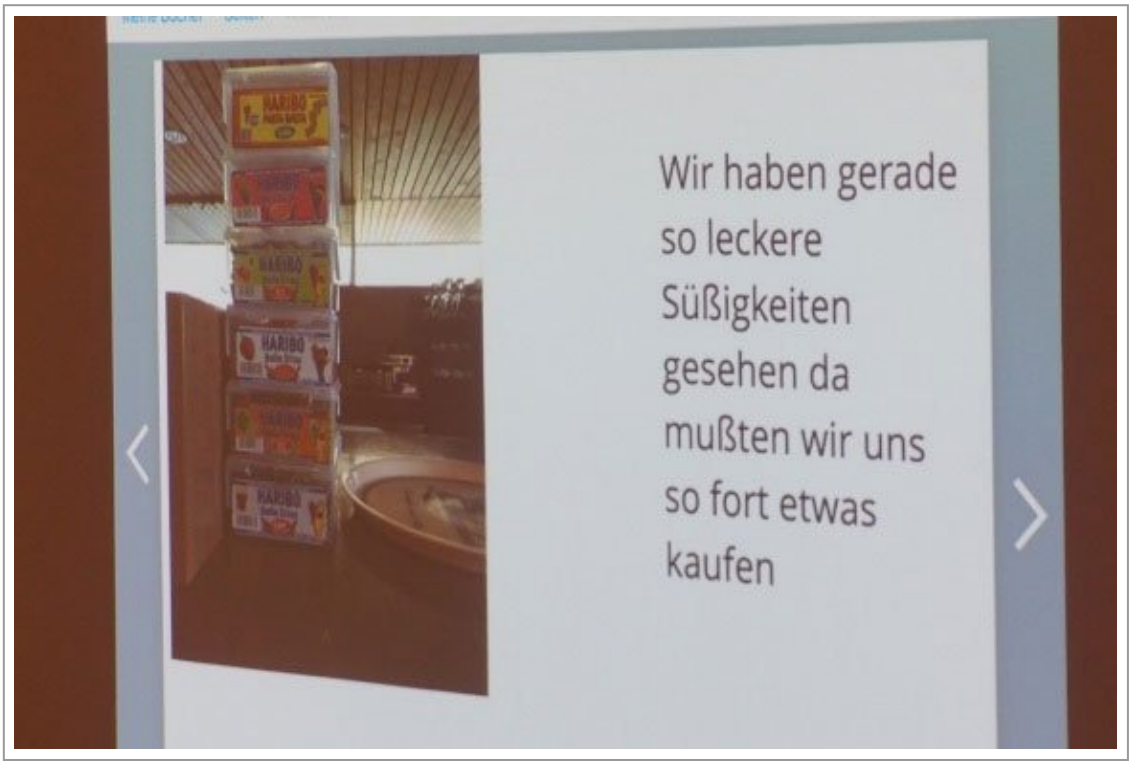


Figure 3: Extract from Book Creator

So what was the teacher's task on becoming aware of the learning process in these examples? At first, the teacher documented the learning process by taking photos in the sense of the teacher's photo portfolio. Secondly, it was to analyse as demonstrated above the objectified learning results and to give a simple *narrative* feedback to the pupils and the school community, that means, to teachers and parents.

Methodologically one can start with a quantitative evaluation of the digital books and list the acquired vocabulary. In the above case the pupils altogether dealt with 114 nouns, 30 verbs and 53 differentiating words to the 114 nouns. This analysis could be easily done by an additional app or plug-in of Book Creator. However, the qualitative analysis of the pupils' modes of language appropriation remains a task for experienced educationalists to be approached in an interpretative way (see Bachmair

2017; Bachmair/Hierdeis 2016). In summary, the appropriation of the photographed language markers clearly goes beyond mere reproductive copying. The pupils write their own statements, approach the meaning of the language markers, among others, and they explain their meaning. Pupils search for their own appropriate vocabulary and evaluate it. They use colloquial language, create writing contexts, integrate non-language symbols and drawings. The children also strive for correct spelling. This analysis of the appropriation modes is time-consuming and teacher intensive but it could be supported by an explorative 'learning analytic' app that supports the hermeneutic endeavour of the teacher.

VIII.II. Example 2: Learning as narrative interpretation; Professional development in higher education

By a narrative interpretation of learning or a narrative representation of learning contexts, we mean the schematic linking (Polkinghorne, 1988) of pedagogical actions and events within a meaningful, authentic and explanatory whole. Narrative as a process operates at different perceptual and representational levels, from the personal and biographical that is intrinsic to professional identity formation (Goodson 2013; Pachler/Daly 2009; Turvey 2013), to the more abstract but still grounded, explanatory narrative as analytical tool (Polkinghorne 1988; Pachler/Cook/Bradley 2009; Turvey/Hayler, 2013). As Pachler et al. state (2009: 81) explanatory narrative analysis is an "iterative and inductive approach in which the 'story' is allowed to emerge through systematic analysis and categorisation of available data'. Such an explanatory narrative interpretation and representation of the learning context combined with responsive and relevant analytics could be argued to challenge or disrupt the algorithmic automation of measurement and analysis that Perrotta and Williamson argue is being 'operationalised as objective ways of knowing, calculating about and intervening in educational practices and learning processes' (2018: 5).

Explanatory narrative analysis employed within a framework of learning analytics foregrounds live and reusable data as opposed to static 'learner

analytics' which we concur with Perrotta and Williamson, merely inscribe the 'logic of economic rationality and accountability that pervades governance cultures in education' (2018: 6). Indeed, we argue for a framing of the field of learning analytics, that foregrounds a narrative construction of learning as an alternative mode of representation to the process of abstraction associated with solely quantitative techniques of datafication and learner analytics. The narrative interpretation of learner and learner contexts challenges the notion of the learner or teacher as an individual, isolated 'data construct' (Perrotta/Williamson 2018). Qualitative narratives can have immediacy and lay bare their internal validity and authenticity in ways that are open to reuse by other learners and teachers as part of a wider knowledge ecology for as Cope and Kalantzis (2016: 8) suggest the 'social provenance of the student's thinking is traceable'. Furthermore, narrative is the explanatory vehicle for theory as 'the reality of big data, [however] is also likely to be one where theory is as important as ever and qualitative methods are needed beside quantitative' (Cope/ Kalantzis 2016: 11). The process of meaning making through narrative for example can be conceived as a process of qualitative aggregation towards theorization, meaning making, and the delineation of possible courses for further pedagogical action and intervention. Narrative representational forms accentuate human capriciousness and highlight the representational inadequacies and arbitrariness of decontextualised quantitative data points as the sole basis for further pedagogical action, as we use the following vignette to illustrate.

As part of a primary (5–11 years) postgraduate one-year teacher education course at a University in the South East of England, student teachers engage in a blended learning module in which they write a series of professional blog posts over three months. Their posts synthesize their school-based experiences, their responses to lectures and their reflections with regards to various theory and literature on a range of education themes. One such example of this is represented by Figure 4. This is an extract from a professional blog written by a deaf student teacher (Omar), in response to a lecture focusing on the theme of inclusion.

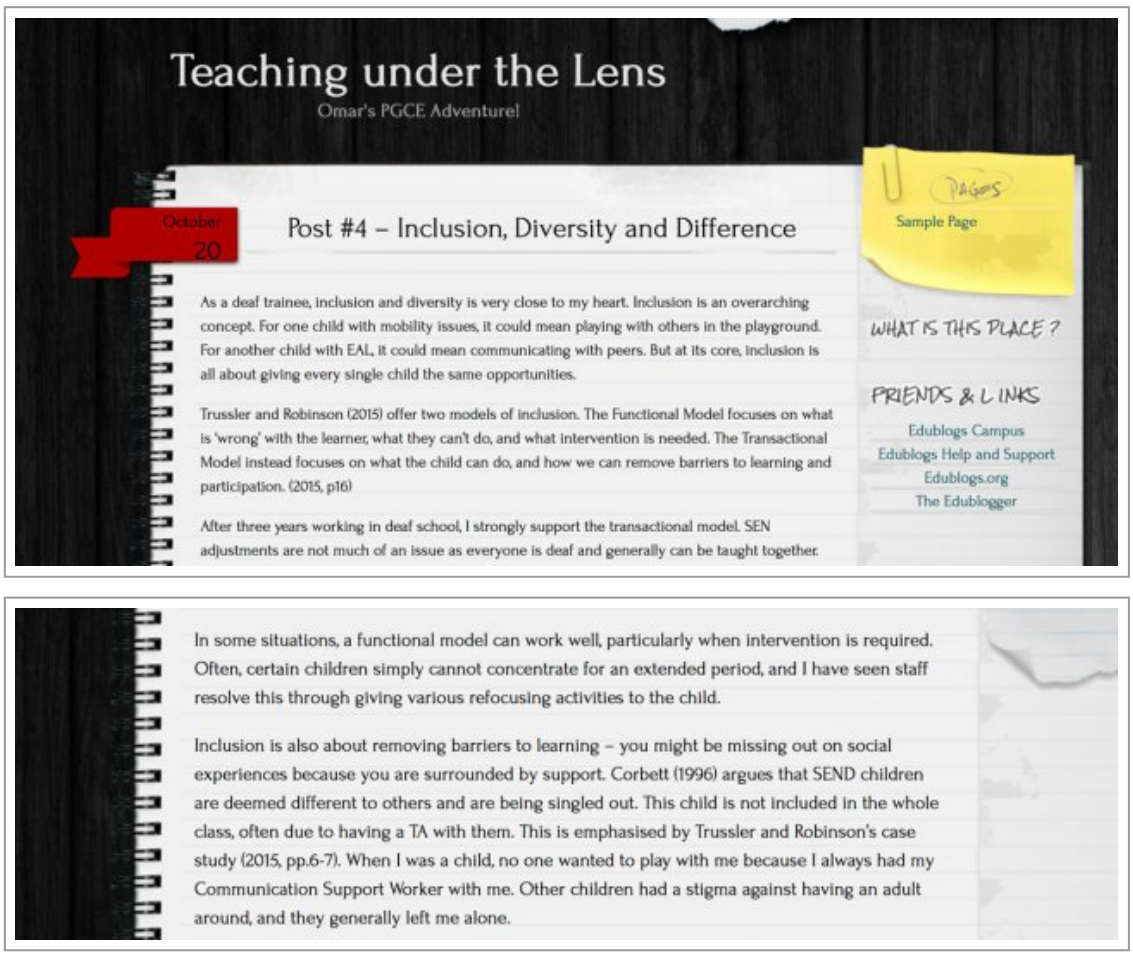
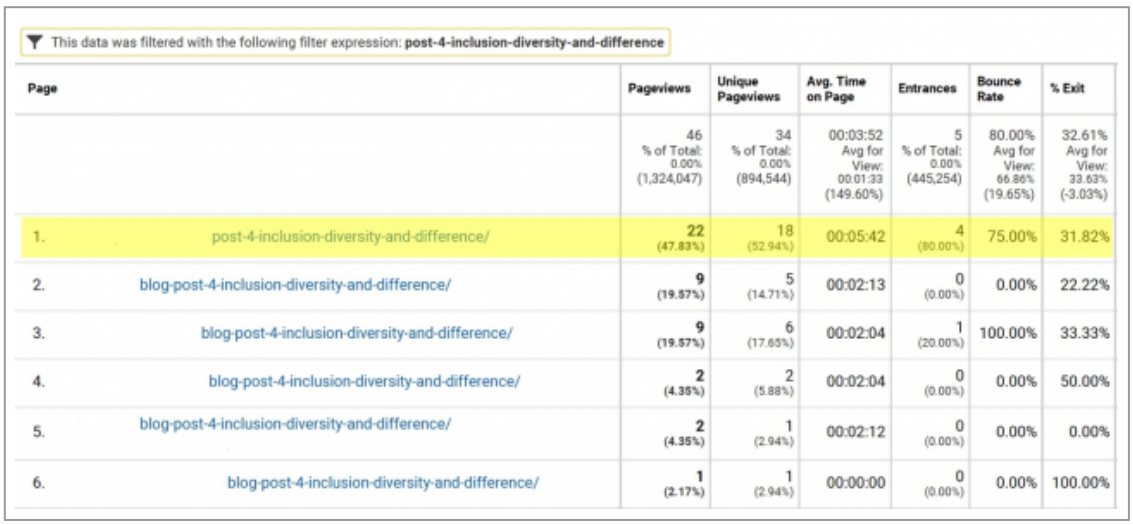


Figure 4 & 5: Two short extracts from a student teacher's longer blog post on inclusion

The immediacy and provenance is evident within these short extracts (Figure 4) from this student teacher's longer blog post. The student teacher is open about his own childhood experiences of isolation due to the way he was sometimes perceived by other children and also due to the way he was supported to participate in mainstream education. His thinking about these important experiences is traceable and therefore has provenance (Cope/Kalantzis 2016). The post offers fellow student teachers insights into the practical complexities of how different theoretical models of inclusion may be operationalized and perceived in practice. Recognising the provenance of this post, the university tutor

emailed the whole cohort to alert them to this insightful post, recommending that they read it.

A snapshot from Google analytics of this student teachers' blog post in comparison to some other student teachers' blog posts on the same topic, illustrates an above average time spent reading his post by viewers; 5 minutes 42 seconds. Similarly, this post had more views and more unique page views than others' posts (Figure 5).



This data was filtered with the following filter expression: **post-4-inclusion-diversity-and-difference**

Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit
	46 % of Total: 0.00% (1,324,047)	34 % of Total: 0.00% (894,544)	00:03:52 Avg for View: 00:01:33 (149.60%)	5 % of Total: 0.00% (445,254)	80.00% Avg for View: 66.86% (19.65%)	32.61% Avg for View: 33.63% (-3.03%)
1. post-4-inclusion-diversity-and-difference/	22 (47.83%)	18 (52.94%)	00:05:42	4 (80.00%)	75.00%	31.82%
2. blog-post-4-inclusion-diversity-and-difference/	9 (19.57%)	5 (14.71%)	00:02:13	0 (0.00%)	0.00%	22.22%
3. blog-post-4-inclusion-diversity-and-difference/	9 (19.57%)	6 (17.65%)	00:02:04	1 (20.00%)	100.00%	33.33%
4. blog-post-4-inclusion-diversity-and-difference/	2 (4.35%)	2 (5.88%)	00:02:04	0 (0.00%)	0.00%	50.00%
5. blog-post-4-inclusion-diversity-and-difference/	2 (4.35%)	1 (2.94%)	00:02:12	0 (0.00%)	0.00%	0.00%
6. blog-post-4-inclusion-diversity-and-difference/	1 (2.17%)	1 (2.94%)	00:00:00	0 (0.00%)	0.00%	100.00%

Figure 6: Google analytics data comparing analytical data from Omar's post on inclusion with other students posts on the same topic

So how can we interpret this? To some extent the analytics support the presence of a knowledge ecology, with learners making their own judgements about the veracity and usefulness of their peer's knowledge and experience through the narrative representation of knowledge blogs afford, choosing to spend longer reading this particular post. That is, the narrative representation of knowledge, allows for the qualitative aggregation of knowledge, in this case focusing on how theoretical models of inclusion may be manifest both positively and negatively in examples of personal and professional experience. But this interpretation is dependent not merely on the quantitative data analytics but on knowledge of the design of this module as a whole, and qualitative

interpretation of the content of the posts themselves. There is no way of disaggregating whether the higher than average time spent reading Omar's post was down to the *recommending* email given by the tutor or the provenance of this post. Whilst the recommendation may well have drawn further attention to the post, it seems likely that the provenance and openness of the post (Figure 4) is what sustained other student teachers' interest for them to spend more time reading the post. That is, without the qualitative data (e.g. extracts of the post), an interpretation of the quantitative data analytics alone is unlikely to provide a valid interpretation of this event.

This brief vignette highlights the pedagogical provenance that can be traced through the contextualized unity of the qualitative and quantitative. But it is also significant because it offers a glimpse of the risks ***to*** pedagogical provenance from decontextualised analytics; that is, the vulnerabilities inherent in constructing explanatory narratives based on partial and decontextualised evidence of the kind that tools such as Google analytics make readily available.

IX. Conclusion

Hall's interview *'The Narrative Construction of Reality'* in which he reflects on the media reporting of the Falklands war, might seem to belong to a different era in terms of the media technologies of the 1980s, but his observation that 'for the first time the journalists saw a reconstruction of their own construction of events' (Hall 1984: 3), is particularly pertinent we argue in contemporary societies, where the growth of digital data points enters into every aspect of people's lives. Indeed, in higher education in the UK, pedagogical provenance is becoming significantly eroded and *reconstructed* through the use of decontextualised and partial data. Educational provenance requires the task to contextualise the data in the sense of the learners' personal development within their personal and cultural contexts. But the data itself is already de-contextualised. For example, the UK government's introduction of the Teaching Excellence Framework in Higher Education reconstructs 'excellence' in 'teaching'

upon 6 core data points. All 6 are drawn from data points that are detached from the pedagogical context and its signifying practices. For example, 3 are students' self-reported 'satisfaction' with teaching, assessment and feedback, and academic support in general. Rienties' research on such 'satisfaction' data highlights the lack of pedagogical provenance stating that although important, students' self-reported satisfaction is 'unrelated to actual learning behaviour and academic performance' (Rienties, Inaugural lecture, 2018). In order to sustain and develop pedagogical provenance we have argued and illustrated that metrics within processes of learning analytics, need to be reframed and understood as a qualitative and quantitative modality of representation providing evidence in and on practice**.** We concur with Cope and Kalantzis (2016: 8) that:

"To teach and learn in such environments requires new professional and pedagogical sensibilities. Everyone becomes to some extent a data analyst - learners using analytics to become increasingly self-aware of their own learning and teachers as they acquire a level of data literacy required to interpret a student's progress and calibrate their instruction."

Such sensibilities cannot be built upon partial and decontextualised data. They will only emerge from activities that foreground professional and pedagogical provenance where data analytics is as a constituent element within a process of embedded meaning making built upon context awareness.

Endnote

[1] Available at https://en.wikipedia.org/wiki/Frederick_Winslow_Taylor#Biography (last access: 9 January 2018).

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