MENDIVE
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Review article

Theoretical assessments on the concept of learning analytics

Valoraciones teóricas sobre el concepto de analítica del aprendizaje

Avaliações teóricas sobre o conceito de análise de aprendizagem

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ABSTRACT
Learning analytics is the subject of multiple interpretations and weightings, depending on the analysis and use given to it by each scientific area. The objective of the work is to evaluate different concepts of learning analytics, formulated by various authors to provide an inclusive definition with those components that are required to be present in said concept. The research is based on a qualitative approach. It is classified as exploratory. It uses heuristic, historical-logical, analytical-synthetic, inductive-deductive methods, internal criticism, document analysis, triangulation and modeling from praxis. The results allow us to affirm that the different meanings of the concept given by the various authors, for the most part, unload their weight on the techno-pedagogical element, understood as Big Data, without sufficiently taking into account the other components that intervene in the teaching processes. educational and teaching-learning, in which the true act of learning of the student as a psycho-biological-social being occurs. It is concluded that learning analytics is essential for better management of educational institutions and, in particular, for achieving greater progress in the teaching-learning process, given that it must be complemented with qualitative data.

Keywords: learning analytics; didactics; Teaching learning process.

RESUMEN
La analítica del aprendizaje es objeto de múltiples interpretaciones y ponderaciones, en dependencia del análisis y empleo dado a la misma por cada área científica. El objetivo del trabajo es valorar diferentes conceptos de analítica del aprendizaje, formulados por diversos autores para proporcionar una definición incluyente con aquellos componentes de obligada presencia en dicho concepto. La

investigación se sostiene en un enfoque cualitativo. Se clasifica como exploratoria. Emplea los métodos heurísticos, histórico-lógico, analítico-sintético, inductivo-deductivo, la crítica interna, el análisis de documentos, la triangulación y la modelación desde la praxis. Los resultados permiten afirmar que las diferentes acepciones del concepto entregadas por los diversos autores, en su mayoría, descargan su peso en el elemento tecno pedagógico, entiéndase Big Data, sin tomar en cuenta de manera suficiente los demás componentes que intervienen en los procesos docente-educativo y de enseñanza-aprendizaje, en los cuales ocurre el verdadero acto de aprendizaje del alumno como ser psico-biológico-social. Se concluye que la analítica del aprendizaje resulta imprescindible para un mejor manejo de las instituciones educativas y, en particular, para el logro de superiores avances en el proceso de enseñanza-aprendizaje, habida cuenta de que esta debe complementarse con datos de índole cualitativa.

Palabras clave: analítica del aprendizaje; didáctica; proceso enseñanza-aprendizaje.

RESUMO
A análise da aprendizagem é objeto de múltiplas interpretações e ponderações, dependendo da análise e utilização que lhe é dada por cada área científica. O objetivo do trabalho é avaliar diferentes conceitos de análise de aprendizagem, formulados por diversos autores para fornecer uma definição inclusiva dos componentes que devem estar presentes nesse conceito. A pesquisa baseia-se em uma abordagem qualitativa. É classificado como exploratório. Utiliza métodos heurísticos, histórico-lógicos, analítico-sintéticos, indutivo-dedutivos, crítica interna, análise documental, triangulação e modelagem a partir da práxis. Os resultados permitem-nos afirmar que os diferentes sentidos do conceito dados pelos vários autores, na sua maioria, descarregam o seu peso no elemento técnico-pedagógico, entendido como Big Data, sem ter suficientemente em conta as outras componentes que

intervêm no os processos de ensino, educativo e ensino-aprendizagem, nos quais ocorre o verdadeiro ato de aprendizagem do aluno como ser psicobiológico-social. Conclui-se que a análise da aprendizagem é essencial para uma melhor gestão das instituições de ensino e, em particular, para alcançar maiores avanços no processo de ensino-aprendizagem, visto que deve ser complementada com dados qualitativos.

Palavras-chave: análise de aprendizagem; didática; Processo de ensino-aprendizagem.

INTRODUCTION

The use of data obtained in classrooms by teachers, based on the improvement of their students' learning, is not something new. For years, in a more or less empirical, more or less scientific way, most of the time anonymously and routinely, teachers have been collecting quantitative data, and also of course qualitative data, about their students, in order to carry out the more diverse analyses, in order to perfect the teaching-learning process (Ortega Bastidas, *et al.*, 2018).

Into the last two decades of the last century, when such data collections became excessively voluminous, with the support of ICT, their processing or analysis began using said technologies. (Arriaga, 2015); (Villacres Arias, *et al.,* (2020)**.** The term Big Data then emerged, which will be given due attention later.

Big Data brought the so-called learning analytics. The concept encompasses the process of collecting, analyzing, and using data on student performance and progress to improve education. The concept of learning analytics emerged in the 1990s, with the increase in data availability and computing technology. (Soler Mc-Cook, *et al.,* (2022). From then to date its development has been constant and

progressive, evolving from the collection and analysis of basic data to the use of advanced technologies, along with concern for privacy and the security of said data.

In the early years of its development, learning analytics focused primarily on the collection and analysis of data on students' academic performance: grades, standardized test results, among others. Educators and administrators of the educational system used this information to evaluate their academic performance and to make decisions about how to improve the various processes of education, particularly teaching-learning.

As technology has advanced, learning analytics has become increasingly sophisticated and begun to include a previously unthinkable variety of data, such as data relating to educational technology use, online interactions, and machine learning logs. . At the same time, new tools and techniques have been developed to analyze that data and provide a deeper understanding of how students learn and how to improve teaching.

This last aspect is where the difference between learning analytics and educational data mining is evident, because the former involves understanding how students learn and the strategies to design to achieve this improvement in education. By requiring human judgment, it makes the difference with the cold statistical processing generated by data mining.

In the last few years, learning analytics has conceptually evolved to include the use of advanced technologies, such as machine learning and artificial intelligence, which allows the educational experience to be personalized and improved. At the same time, more attention has been paid to data privacy and security, and work has been done to ensure ethical use of data.

The aforementioned has resulted in the study of such reality from various perspectives. One of them is the philosophy of education, this time with a "last name": analytical philosophy of education.

The point to which these analyzes have reached has made it inevitable that:

> "…the role of analytical philosophy of education would undergo careful examination." In this sense, it is worth taking into account the criteria of Joao Oscar Picardo, who states that the trend of a large part of the discussions held on the matter for decades "is summarized in an article written by the philosopher Abraham Edel, republished in a collection of essays in 1973." (Picardo, 2005, p. 115).

The objective of this work is to evaluate different concepts of learning analytics, formulated by various authors to provide an inclusive definition with those components that are required to be present in said concept.

The research was based on a qualitative approach. It is classified as exploratory. For its development, heuristic, historical-logical methods were used for the analysis of learning analytics over time, where the background of different concepts of learning analytics, formulated by various authors, analytical-synthetic, for the analysis of the information related to learning analytics and in the synthesis of the most relevant aspects that were the object of the study, inductive-deductive, for the exploration of the aspects that allowed analyzing and making evaluations on the subject in different areas, internal criticism, document analysis and modeling from praxis, for data collection, understanding practical behavior and real context conditions. In addition, information was obtained on the basis of which criteria were developed and generalities were identified to limit the criteria on the topic.

Specifically for data analysis, techniques such as content analysis and grounded theory were used, which allowed the authors to confront their own influence in the research process. The validation of the results was carried out through data triangulation, maintaining the standards of ethical practices in the research process.

DEVELOPMENT

Regarding the inclusion or not of values when talking about and practicing learning analytics, Picardo himself stated:

> "...of course, philosophers of education are not generalists and do not feel inclined to give orders to teachers; certainly, value neutrality constitutes a very important principle in the analytical creed. But discontent (...) does not "It can be eliminated so easily. For even those who practice the philosophy of analytic education have begun to raise the question of whether it is adequate to fulfill its promise." (Picardo, 2005, p. 115).

Decades later, according to Jiménez (2002); Authors such as Söderbaum (1999) and Kaufmann (1999), in clear contradiction with the criteria collected by Picardo in his article about the "principle of value neutrality" in learning analytics, stated: "On the other hand, in the practical field "Not only does this separation not occur, but there is empirical evidence that shows that the neutrality of values demanded by the traditional school is an unrealistic hypothesis." (Jiménez, 2002, p. 32).

As can be seen, some authors flatly accept the "neutrality of values" when it comes to learning analytics. Others deny it. Faced with such opposite positions, it is worth asking: how valid can one or the other approach be?

A universally accepted assessment from didactics assumes content as the indissoluble integration of knowledge, skills and values. In line with this, for the authors of this article it is impossible to carry out any analysis about the teaching-educational and teaching-learning processes, without taking values and training in values as a basis.

Regarding the results of education, worldwide, these reveal shortcomings and limitations of educational systems that affect the quality of the process; This has been demonstrated in international tests carried out to determine the effectiveness of these systems. (Correa-Reynaga & Morán-Franco, 2022)

From what has been seen so far, understanding "learning analytics" requires dismembering the concept, the whole, into its parts, in this case two: analytics and learning. It is necessary, at the outset, to assess what learning is and what elements characterize it and intervene in its formation. For one of the authors of this work, "learning occurs when there is prior knowledge, which serves as integrative support for the new, and which only occurs within the framework of social interactions with the other, in which the subject who learns is guided by another human being." (López Fernández, 2021, p. 543).

Learning, whether formalized in school, the social institution in charge of it, or as part of the process of daily life in its most general and informal sense, is necessarily linked to the processes of formation and development of personality. The aforementioned Picardo (2005); exposes some elements necessary for its achievement. See these:

1. "Learning Styles are the cognitive, affective and physiological traits that serve as relatively stable indicators of how learners perceive,

interact and respond to their learning environments."

2. Paulo Freire went beyond what you pointed out. In addition to locating dialogue as an expression for the generation of learning, he stated that professionals have the obligation to evaluate their speech, because it is clear that learning is the result of a communicative act,
3. Consider the interest,
4. Social dynamics and its variables as a substantive resource,
5. It is a form of behavior modification,
6. Level of importance that translates into internalizations for the student,
7. Learning by doing or learning by action *(learning by doing)* .

A parenthesis regarding this last point, learning by doing, also known as active or experiential learning, is a pedagogical approach based on an idea: "the best way to learn is through experience and practice" (Salica, 2021, p. 271). In this case, learning analytics can be used to measure student performance in an active learning environment and to identify areas for improvement in instructional design. Consequently, learning analytics and active learning are two complementary elements capable of being worked together to improve teaching.

The previous evaluations confirm the multiple number of variables issued on the concept of learning. Of course, there are not only those mentioned. Others are added, which exposes the difficulties to face when modeling said concept, in the act of the teaching-learning process. This turns such a task into a true holon of didactics.

It is also necessary to attend to the first part of the binomial under examination "learning analytics", that is, "analytics". It is necessary to investigate the also varied meanings of the use of this concept. The analytical-obvious, derived from analysis-, in this case, implies attention to the realization of a process. This, in turn, channels a later one: that of synthesis, with which the development of the usual

combination of two scientific methods occurs, from which the analytical-synthetic method results.

The so-called "mother of all sciences", philosophy, from its etymological and scientific roots, defines analysis - a concept originating from the Greek, *analysis* , from *analyo*, to untie, as the decomposition of an object or a phenomenon into its simple constituent elements. As the culmination of scientific logic, coupled with the analysis process, the aforementioned process of synthesis is carried out - a concept also coming from the Greek: *synthesis* , composition. This consists of the meeting of the component parts of an object or a phenomenon into a whole. The analytical, therefore, the authors of this work assume as the result of the examination of the object in its unity, which results in synthesis.

As can be seen, the phenomenon is complex. It goes beyond a simple grammatical structure. It entails the chaining of two processes into one , from the interaction of a dialectical pair, from the development of two methods: the realization in unison, in practice, of analysis and synthesis.

As noted before, the analysis of educational data is not new. The term "academic analytics" - in English, *academic analytics* ; hereinafter AA-, coined by Goldstein and Katz (2005), cited by Gómez-Aguilar, García-Peñalvo, & Therón (2014); who defined it as the application of business intelligence tools for the learning area. The main application of AA is to go beyond simple reporting of information and suggest decisions. Given the above, note what concerns learning analytics. The first mention of the term "learning analysis" noted by the authors of this work is related to business intelligence on *e-learning products and services* (Mitchell and Costello , 2000, as cited in Salica, 2021). Unlike ML, where captured data is used to make decisions at the institution level, the goal of "learning analytics " *analytics* ; hereinafter LA-, is the use of these data and any other additional observations from

which information can be obtained, to have a direct impact on students, teachers and the learning process (Gómez-Aguilar, García-Peñalvo , & Therón, 2014). For its part, "visual analytics" - *visual analytics* ; hereinafter VA-, is understood as the emerging area of research and its practice. Its objective is to support analytical reasoning through interactive visual interfaces (Thomas & Cook, 2006). Observation of the previous definitions allows us to detect a descending logical cycle that goes from the macro to the meso, and then to the micro, understood from the entire institution, to its management and coordination, to the teacher and the students.

However, very often the volume of data collected and compiled by teachers and institutions is extremely voluminous. In others not. For the first case, what is included in the aforementioned term Big Data is used. This term is synonymous with the attention paid to a large volume of data, structured or not, which organizations make use of in order to analyze it, orient themselves and define ideas that allow them to assume certain positions and make better decisions strategically.

Regarding the possibilities opened by Big Data, there are two positions. A maximalist position, which leads to the attempt to measure and count any activity directly or indirectly connected with learning, versus one that takes into account the effective practices of the subjects and relies on evaluative and explanatory schemes (Domínguez, et al., *2016*) . For the authors of this work, it is essential to propose their rejection of the "versus" of one with the other, and to position themselves in the consideration of what is necessary that, in the case of the teaching-learning process, since the object of analysis are the subjects themselves, do not ignore the combination of both.

The *Society for Learning Analytics Research,* when defining the role of Big Data in the complex world of education, considers it a field of study which

encompasses "the measurement, collection, analysis and presentation of data about students and their contexts, with the purpose of understanding and optimizing learning and the environments in which it occurs" (Long & Siemens 2011; cited in Sánchez-Poveda, 2017, p. 34). It is worth highlighting this as the most complete and widespread concept today about what Big Data is.

However, a correct analysis of educational reality entails not only the use of technology. It goes much further than what the teacher normally uses in the day-to-day life of his class, when the objective of his fundamental and daily analysis is to identify the behavior of the students through their extraverbal communication, which transmits possible data of used by the teacher based on the growth of the student individually and of the students seen collectively. In light of the latter, Social Learning Analytics (hereinafter SLA) is added to the previous concepts . Social Learning can be considered a derivation, a scope of learning analytics, characterized by a single attribute: the evidence that new skills and ideas, although manifest individually, are not exclusively particular to each person, but are manifested as individual achievements and behaviors developed and transmitted through interaction and collaboration among all.

In particular, when considering the issue of language, Onrubia (2005) and Wells and Claxton, (2002), cited by Zapata-Ros (2013) consider that:

> "The socio-cultural and socio-constructivist lines of educational research show how language is in itself one of the main tools through which students construct meanings and their use, that of language, is influenced by objectives, feelings and the relationships between the interlocutors, which change depending on the context." (Zapata-Ros, 2013, p.94)

However, when analyzing the studies and works regarding the link between cognition and language, a certain tendency is observed to examine them independently of each other. This, despite the existence of an extensive theoretical literature that points out the interdependence between cognition and language, and indicates the study of both processes in an integrated manner (Cáceres- Reche, *et al*., 2020). In this sense, these last authors maintain that in both processes, sociocultural factors should be considered with extreme care. For example, gender and its possible impact on these skills must be taken into account. In this way, delving into this perspective in an integrated manner will provide a better understanding of how students learn differentially and how educational strategies should be implemented according to their characteristics (Mac Cann, *et al.,* 2022).

The above reaffirms the need to attend to the effective practices of the subjects, which, as already noted, goes beyond the simple or complex measurement and accounting of data, given that if learning analytics is reduced to what concerns technological and not to the integrality of everything that composes or constitutes the didactic, there is a risk of turning students into products that become machines that are unable to carry out the analysis of the learning to which they aspire.

In another line of research, Zapata-Ros himself (2013); citing Gee (1997); Wertsch (1991) and Reigeluth (2012) emphasize that:

> "…learning cannot be understood by focusing solely on the cognition, abilities or behavior of individual learners, nor can it be understood without reference to their situated nature. Thus the success of learning activities in the context of a group is related to a combination of knowledge, individual skills, environment, use of tools and the ability to work as a team. Thus, understanding achieving quality learning in these environments requires paying attention to group processes and their influence. in the construction of individual knowledge. Attention must therefore focus not only on the students, but also on their tools and contexts." (Zapata-Ros, 2013 , p. 94)

When referring to the field of learning analytics (LA), many authors recall its roots: the appropriation of business intelligence concepts, which can barely cover the world of education and that of educational institutions.

In this sense, the authors of this article consider it "obligatory" to refer above all to "academic analysis", based on an analytical action referred to:

> "...it already captures reports built with data from educational administrators, which satisfy the need for comparative evaluation to increase the effectiveness of institutions dedicated to training. But exclusively in a descriptive or, at most, diagnostic way." (Zapata-Ros, 2013, p. 94).

Element to distinguish within the evaluation is proposed by Duan & Wu (2023); citing Admiraal et al. (2015): "It has been suggested that self-assessment should be used as an assessment for learning rather than an assessment of learning" (Duan & Wu, 2023, p. 9),

In the field of what is properly defined as "learning analytics" several reports and works, among which in Sabulsky (2019), are mentioned: the Horizon Reports , in which Learning Analytics are taken into account exclusively; as well as the works of

Johnson et al. (2010; 2011; 2012) and Ferguson & Buckingham (2012); which, in their opinion, go beyond collecting and interpreting student data by institutions, in order to inform organizational objectives, to provide new tools to the students themselves and teachers. In this case, and taking advantage of the knowledge accumulated by the learning sciences, its objective is to understand and optimize not only learning but also the environments in which it develops. (Zapata-Ros, 2013).

The field of "learning analytics" is expanded by Jiménez (2002), who considers that to confront and solve any of the multiple problems that teachers face in the classroom, it is not enough to apply an exclusively theoretical prism, or to show off from an objectivist perspective (myopia of classical rationality), which would mean applying a common analytical procedure, capable of determining, "coldly", the "optimal solution to a highly structured problem" (Jiménez, 2002, p. 56). Far from it, in the opinion of this author:

> "The multi-criteria tool must be used from a practical perspective, that is, following a broader, more flexible and realistic paradigm of rationality than the traditional one, where the incorporation of the human factor (integration of the tangible and the intangible) is allowed in the search. of the best solution to the problem." (Jiménez, 2002, p. 56)

As can be seen, for the aforementioned authors, "learning analytics" implies complementing the data obtained from the students with those referring to the contexts, which results in a more finished "product", since the analysis incorporates the sciences of the learning, educational research and the use of computational techniques. Such triad guarantees or tends to guarantee superior achievements or learning results, which is ultimately the goal of any educational process focused on the growth of knowledge.

In various works, learning analytics is defined as a series of techniques to collect, analyze and provide actionable data generated by students with the aim of developing appropriate strategies to improve learning processes, student performance or the of the institution itself (Cáceres- Reche, *et al.,* 2020). For their part, Long & Siemens (2011); cited by Sánchez-Poveda (2017); define learning analytics as "the use of intelligent data, learner-produced data, and analysis models to discover information and social connections originating in a digital environment to predict and assess people's learning. " (Sánchez-Poveda, 2017, p. 35).

Meanwhile, other authors consider that learning analytics are based on the interpretation of a wide range of data produced and collected about students to guide their academic progression, predict future actions and identify problematic elements. The objective of collecting, recording, analyzing and presenting this data is to enable teachers to quickly and effectively adapt educational strategies to the level of need and ability of each student. Still, in its early stages of development, learning analytics respond to the need to monitor and control activity on campus for making strategic decisions. On the other hand, they aim to take advantage of a large amount of data produced by students in academic activities (Sabulsky, 2019).

The bibliographic review carried out by Cáceres- Reche , *et al.,* (2020); allowed the identification of authors such as Siemens and Gaševiæ (2012); Amo and Santiago (2017), who define learning analytics as the measurement, collection, analysis and presentation of data about students, their contexts and the interactions that are generated.

For its part, in Salica (2021); it is reported that Suthers and Verbert (2013); define learning analytics as the coalescence of intermediate fields between the learning

sciences, educational research and the use of computational techniques to obtain and analyze data. Salica himself (2021); It is responsible for noting that the interaction of these fields of knowledge allows for tracking the digital trail left by the student body and intervening in their academic production by addressing the challenges that emerge during the learning process in virtual environments. One of the types of data analysis that can be carried out and that is the object of study of this research focuses on micro analysis in a certain course or virtual classroom.

The above allows us to analyze and understand the learning process based on the participation of the students and the exchange produced between them and the teachers (Valencia, 2021). This type of techniques based on data mining in digital environments becomes vitally relevant to evaluate the effects of learning in the context of isolation and social distancing, given that ICT is essential to support and enhance the evaluation of training processes. (Pozo-Sánchez, *et al.,* 2020).

Although one of the challenges in understanding instructional processes in virtual environments is linked to their own dynamic nature, learning analytics makes it possible to collect large amounts of data and information and in this way it is possible to describe said dynamics.

The researcher Salica (2021); seems to agree with (Galaige & Torrisi -Steele, 2019) regarding criticizing learning analytics for its poorly pedagogical use; It also agrees with Gaševiæ *et al.,* (2015); by saying that learning analytics must focus on the study of the instructional design itself, on the content of the course and on the epistemic beliefs promoted in the participants.

A key milestone in the formation of a field of research and production on the topic was the holding of the 1st International Conference on Learning *Analytics & Knowledge* , held in 2011, which managed to formalize the academic community on the topic. At that conference, learning analytics was defined as: the measurement, collection, analysis and reporting of data about students and their contexts, with the purpose of understanding and optimizing learning and the environments in which it occurs (Ferguson & Buckingham, 2012; as cited in Sabulsky, 2019, p. 14). And also, how the use of this data and any other additional observation from which information can be obtained, to have a direct impact on students, teachers and the learning process (Long & Siemens, 2011; cited by Sánchez-Poveda, 2017); (Sabulsky, 2019).

It is worth noting that the application of learning analytics is assumed to different degrees in the Latin American academic context. Its use stands out, in particular, in Argentina. The meager development of learning analytics in this context is due to lack of knowledge of the technical devices for its application and its theoretical production of English origin (Sabulsky, 2019). Specifically in the educational context of secondary school, there are some incipient applications to evaluate b-learning learning systems, and as a technique to provide possible solutions to the problem of pedagogical continuity (Salica, 2021).

CONCLUSIONS

Firstly, the authors of this article do not conceive of the possibility of carrying out any examination of learning analytics without taking values and values training as a basis.

Secondly, in the opinion of those who subscribe to this work, the multiplicity of criteria issued by the aforementioned researchers reaffirm, on the one hand, the usefulness and need to address learning analytics as an essential technique today for better management of educational institutions. and, in particular, to achieve greater progress in the teaching-learning process.

Thirdly, the essentiality of learning analytics is corroborated, while attending to what is not quantifiable in the activity of teaching subjects, students and managers, due to force majeure of the circumstances and the context of the teaching-educational process, with measurement and accounting alone it is incomplete. It necessarily requires not only interpretation, but must be complemented with qualitative data.

Finally, nourished by what the authors found throughout this bibliographic study, and based on the systematization of the multiple definitions appreciated, it is possible to define learning analytics as that eclectic procedure aimed at measuring, accounting, processing, analyze, synthesize and interpret data and data sets, of greater or lesser complexity, either through the most diverse techno-pedagogical resources, methods and techniques of research methodology, and the qualitative, individual and collective examination of the educational community, or of certain groups or individuals that configure it in a particular way, in order to, based on this, offer answers to questions, form others, identify problems, deliver new ideas and seek transformative guidelines for a superior functioning of the different elements. that make up the systematic interactive process of the practices of the subjects involved in the teaching-learning process, of the so-called academic parameters and, last but not least, of the non-academic parameters.

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