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PERCEPTIONS OF UNIVERSITY TEACHERS FOR THE APPLICABILITY OF LEARNING ANALYTICS IN ONLINE ENVIRONMENTS IN THE UNIVERSITY CONTEXT

William Rodrigo Avendaño Castro,

Facultad Ciencias Empresariales, Universidad Francisco de Paula Santander

E-mail: williamavendano@ufps.edu.co, Orcid: https://orcid.org/0000-0002-7510-8222

Audin Aloiso Gamboa Suárez,

Facultad de Educación, Artes y Humanidades, Universidad Francisco de Paula Santander

E-mail: audingamboa@ufps.edu.co. Orcid: https://orcid.org/0000-0001-9755-6408

Raúl Prada Núñez,

Facultad de Educación, Artes y Humanidades, Universidad Francisco de Paula Santander

E-mail: raulprada@ufps.edu.co. Orcid: https://orcid.org/0000-0001-6145-1786

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ABSTRACT

The objective was to provide an analytical overview of the perceptions of educators from a public university in northeastern Colombia on the applicability of learning analytics in online environments in the university context. Methodologically, it was qualitative, under an interpretative paradigm and phenomenological perspective, the study took 5 teachers from that university as key informants. A semi-structured interview was used to collect the information. The results revealed that learning analytics offers an interpretative framework that ensures applicability in appropriate pedagogical aspects according to indicators based on the evidence of the data analyzed. It was concluded that, through the analysis of student patterns, it is possible to compare and analyze learning contents, learning organization and learning patterns, and based on these data, to derive the direction of improvement of the teaching method by monitoring learning progress.

Keywords: Data Analysis, Learning Analytics, Online Environments.

INTRODUCTION

In the face of the sudden outbreak of COVID-19, hundreds of teachers and millions of students have conducted remote and online education on a large scale. From the initial stage of the epidemic, ICT provided teachers with multiple options to continue their educational work during the social distancing (Rueda *et al*., 2021) and gradually moved toward a response to mobilize a large amount of human, material and financial resources in a very short time, where not only the infrastructure of educational informatization and information literacy of teachers and students was put to the test, but also the modernization capacity of the educational system and the adaptation of teachers to use ICT to teach in this context (Avendaño *et al*., 2021; Prada *et al*., 2022; Torres *et al*., 2022).

On the other hand, with such popularization of large-scale education and the gradual maturity of big data educational technology, learning analytics technology has received more attention and its application scenarios have been continuously enriched (Ortiz-Arismendy *et al*., 2019), since, learning analytics according to Siemens et al. (2011) can meet the needs of different stakeholders (students, educators, and administrators, among others) through processes, algorithms and technologies, as the data include, attendance, participation in activities, academic performance, behaviors, subject numbers, dropout, assessment results and even data on standardized test results (Aristizábal, 2016), which represents a shift towards new models in online or distance learning supported by virtuality.

According to Chen & Poquet (2022), the first learning analytics applications focused on deriving metrics to characterize learner learning, as well as to facilitate real-time practical feedback, analytical, computational and representational support for the analysis of teaching and learning, among others. On the other hand, in the words of Contreras *et al*., (2021) research on learning analytics in higher education and fields of study are oriented to the "application of online learning with LMS platforms (E-Learning), learning through mobile devices (M-Learning), learning through games (G-Learning) and Bimodal learning or B-Learning" (p. 160).

Analytically, analytics offers a set of methods for deriving network metrics useful for characterizing learner learning (Ferguson *et al*., 2016). Computationally, contemporary analytics software packages offer tools that handle large volumes of data generated by communicating through virtual environments (Sabulsky, 2019). The myriad ways in which analytics can be leveraged to examine learning have made it a popular topic in learning analytics, in representing visualizations of patterns about relationships and interactions, like who is talking, and whom they are talking to (Gómez, 2015).

Therefore, this article offers a breakthrough in the scientific field concerning learning analytics in online environments in the university context, it is considered that good data management could infer processes for learning analytics, whether descriptive (performance in activities), diagnostic by analyzing past information and predictive to anticipate behaviors among variables (Contreras et al., 2021). In particular, to lay the foundations of transversal factors to implement learning analytics applications that facilitate the orderly interpretability of data for those users who have limited competencies in data analysis (Ruipérez-Valiente, 2020).

On the practical side, to know the perceptions of teachers in the university context about the applicability that learning analytics has and its use in the Teaching Support Platform (hereinafter PLAD), dedicated to the university community, where teachers and students can use the educational tools for learning, communication and evaluation, provided by Moodle technology (Rodríguez, 2018; Prada *et al*., 2019; Contreras-Colmenares & Jiménez-Villamrín, 2020; Adoumieh, 2021), since it is important for current and data-driven education to monitor student activity and thus predict academic outcomes (Domínguez *et al*., 2020). Therefore, the study aims to provide an analytical overview of the perceptions of educators belonging to the Universidad Francisco de Paula Santander (UFPS) on the applicability of learning analytics in online environments in the university context.

Learning analytics and its applicability in online environments in the university context

Learning analytics emerged, according to Stewart (2017), from the need to inform the use of educational management systems and virtual learning environments, since in such systems and environments both learning and teaching processes generate data. Data refers to a variety of information and knowledge resources used by teachers, educational institutions and their leaders, about students and their teachers, evaluations, tests generated, teaching practices, activities, and tasks, among others.

As for the applicability from the context of the teacher, analytical literacy is related to the necessary knowledge of these and the three major components when incorporating ICT in the teaching-learning processes: disciplinary, pedagogical and technological (Cabero & Marín, 2014). Hence, teachers' data analysis literacy, specifically includes three specific areas: data for teaching, disciplinary knowledge (content) and teaching content knowledge.

In other words, the applicability of data analysis is an integral field closely related to the knowledge proposed by the TPACK (Technological Pedagogical Content Knowledge) model. In terms of practical ability, identifying, discovering, and applying data to uncover teaching problems lays the foundation for a new vision of educational data. The ability to use data is the starting point for teachers to use antecedents to improve their teaching praxis, and to use data for objective, rational, and development-oriented decision-making in teaching.

Similarly, León et al. (2017) argue that learning analytics provides information for the use of social network visualization techniques to represent the relationships established among participants when they approach a topic, as well as, adjust the educational intervention guided by theories of personalized learning by pedagogical and instructional design techniques. Macfadyen et al. (2020) argue that learning analytics can assist in design principles by providing the necessary indicators for evidence-based learning design decisions (including interventions during course runtime), as well as an interpretive pedagogical framework to guide learning analytics, application and data collection, ensuring that learning analytics is appropriate and relevant in a given learning context.

Whereas, applicability to the learning subject, learning analytics is defined by Siemens & Baker (2012) as the technology and method for measuring, collecting, analyzing, and reporting data about learners, and their learning contexts to understand and optimize learning in learning contexts. Sanz (2018) distinguishes from this definition at least the following phases: 1) measurement, referring to setting objectives, 2) data collection, 3) data analysis and visualization, and 4) concluding and acting accordingly.

From there, teaching professionals can obtain various types of data through the platform in the teaching and learning processes, including implicit information such as student behavior, learning preferences, and cognitive patterns. Current learning in an online education environment with an integration of technology and teaching is multiplatform and multi-scenario.

Aristizábal (2016) refers to the mechanism to create a culture that gives value to data where attention is paid to teamwork and teacher training in data analysis from the proposed Harvard Datawise Process, which highlights three categories in eight stages, namely: a) the first category is preparing, which refers to two stages: 1) organize for collaborative work, and 2) know the literature in evaluation. The second category is inquiring. It refers to stage 3) creating a general outline of data, and 4) the third category is acting, which is composed of steps 5) examining teaching, 6) developing a plan of action, and 7) planning for evaluating the advances; finally is 8) acting and evaluating.

Thus, the collection and analysis of learning data can comprehensively understand educational stakeholders, provide learning suggestions according to the different characteristics of learners, and promote appropriate resources to promote personalized learning and accurate teaching management.

Regarding technology, Ferguson *et al*. (2016) mention that the types of learning analytics tools are targeted according to the following categories: tools for schools, for higher education, for the work environment, and those that can be used in multiple contexts and have various purposes in education. All of them can be integrated into virtual learning environments to: (a) alert teachers and learners about performance and identify learners in need of feedback and support, (b) predict learners' future

performance and their chances of success, (c) recommendations on resources or activities, (d) to adapt course materials to the level of understanding of individual learners (personalized learning), that is, to establish adaptive learning, (e) oriented to the design, planning of educational interventions and evaluation, (f) presenting data on students through visualizations, or summarizing and describing the data of work that has been done, among others.

Specifically, decision-making based on a data management system according to Aristizábal (2016) addresses the administrative as well as the pedagogical dimension. The first one evaluates the academic needs of the institution that aims to improve learning in areas identified as low performance and teacher training based on pedagogical needs, while the second one is aligned to teaching and assessment results, identifying learning styles, strengths and weaknesses of students, as well as adjusting curricular needs and content to learning styles.

On the other hand, Llanos & Bucheli (2021) refer that the most used information analysis methods are: (a) Naive Bayes, which predicts which students are at risk, leadership competencies, identifies the flow of interactions in social networks, as well as emotions such as joy, surprise and recall; (b) decision trees, is an algorithm that includes student participation, preparation and evaluation; (c) support vector machines, a method for predicting academic performance, dropout and student risk, identifies learning patterns in the development of questionnaires and teacher feedback in the LMS; (d) Gaussian process. This method focuses on identifying at-risk students and chat conversations from discussion threads; and e) nearest neighbors, which describes the analysis of content reviewed by students via their cell phones.

However, for some learning analytics is unwelcome. According to Selwyn (2019), it is an emerging area of data science that only recently started to find its way and these neutral tools can be used well or poorly depending on who is involved. But, learning analytics is undoubtedly a key element of contemporary education, moreover, from a socio-technical perspective, they can influence the way people do things, while at the same time being deeply shaped by those who design, develop, implement and use them.

In this sense, each technology is intertwined with a variety of social, cultural, political, and economic factors that play an important role in its design and adoption (Hernández *et al*., 2019). Thus, as the scope and nature of data available to teachers grows at an ever-increasing rate, data literacy as the new literacy of the next generation of teacher education graduates.

METHOD

The research is framed under the qualitative approach since it is "systematically oriented to the in-depth understanding of educational and social phenomena, to the transformation of socio-educational practices and scenarios" (Sandín, 2003, p. 123), under an interpretative paradigm and phenomenological perspective. Therefore, descriptive language was used to make human experience evident through reflection and thus discover the genuine and true forms of one's thoughts (Rodriguez et al., 1999).

In turn, the phenomenological method captures what is essentially human in social reality, establishing the meaning and understanding within people according to their immediate experiences. Hence, the method proposed by Martínez (2007) was followed for an interpretative understanding, by applying various thought processes and according to the objectives of each stage. First, approaching the previous stage with theoretical and conceptual foundations for the understanding of the phenomenon. Next, the study phenomenon is described, therefore, the aforementioned author highlights the choice of the technique or procedure for the collection of information and the application of the selected processes.

Then, in the subsequent stage, which is reflective, the meaning or essence of the phenomenon is carefully examined for the previously selected descriptions, hence, reading the descriptions of each protocol, delimiting the thematic units, then defining the themes in each thematic unit and interpreting each theme, to descriptively structure the identification of the phenomenon and distinguish it from the others to be able to move on to the final interview with the subjects under study. The subsequent stage,

the construction of texts, integrates the facts collected, which is why this method requires interpretative and argumentative ingenuity for a coherent narration that meshes the visions, conceptions, and experiences of the subjects studied.

The research scenario corresponds to the UFPS and for the approach to this reality, 5 key informants who teach at that institution were selected. Semi-structured interviews were used to collect information from the subjects. Triangulation was used as a validation strategy.

Then this accumulation of information was organized and the units of analysis were defined. Through the units of analysis, emerging categories were generated, following the three-phase procedure: open coding, axial coding and selective coding proposed by Strauss & Corbin (2002).

Finally, the theorization process integrated a coherent and logical whole of the research results, in which the aim was to examine various processes for Learning Analytics, according to the online learning behavior and the possibilities of Learning Analytics applied to PLADs.

INTERPRETATION OF INFORMATION AND DISCUSSION

Teaching Support Platform and Learning Analytics Capabilities

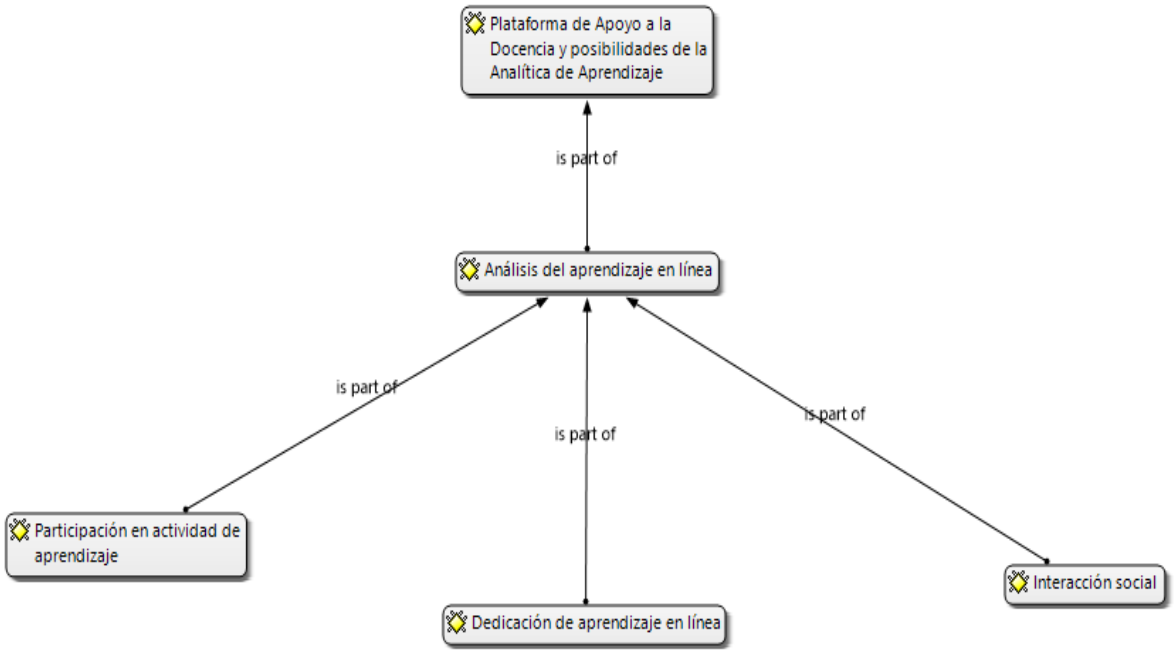

Figure 1. Teaching support platform and learning analytics capabilities.

A learning management system (LMS) is a platform that supports the entire learning process, including planning, execution and student interventions in the learning process, as well as curriculum management. Learning analytics states that learning experiences and analytics use smart data, student-generated data to discover information and social communication to predict and advise student learning. In addition, learning analytics in LMSs extrapolate past events to predict better future events, and lead to better actions based on learning analytics, behavioral analytics, as well as learning activities.

Online Learning Analytics

Learning analytics responds to a need and transformations in the way technologies are built to collect data, convert data into knowledge and finally into determined actions that generate results. The

transformations reveal that university institutions can analyze data about student success from activities, time, and observations and use them to interact with students and improve performance indexes.

According to individual characteristics and their behaviors in the LMS learning process, not only can online learning outcomes be effectively predicted, but the dynamics of data and information accumulated in the teaching support platform are indisputable and lay the foundations for learning analysis, where predictors and indicators are highlighted. For the informants, these events are manifested as follows:

> *The platform allowed to continue working both in pandemic and post-pandemic time, I wonder if students and colleagues (myself included...) have become accustomed to reviewing student entries every day in the online environment. [S1]*

> *... On the platform board it is observed that students had done the proposed activities. [S3]*

From what has been expressed, the analysis focuses on understanding the past (what happened and why it happened), although analytics is oriented towards why this happened and what will happen next. In other words, it is predictive. Thus, it uses behavioral data to understand how learners work and change the way practices are managed for learning.

Also in Online Learning Analytics, participation in the learning activity is used to measure the degree of student involvement in learning, for the informants, these aspects inherent to each subject are expressed as follows:

> *My students usually participate in the activities... [S2].*

> *... When I notice that there are students who are missing activities, I communicate with them through instant messaging so that they can catch up [S5]*

Meaningful participation depends on people being willing and able to engage in online activities. The higher the log-in value of students to the platform, the higher the enthusiasm of teachers, and vice versa. Thus, the frequency with which both teachers and students log in to the platform are recorded and the total of such data are collected are metrics to characterize learning (Chen & Poquet, 2022), which are cross-referenced with the type of activity or actions they perform in the PLAD.

Therefore, information is collected regarding the motivation of participants according to the learning cycle between the week of records and participation in online learning. This would allow a comparative analysis of detailed data of active learning time and active participation, as well as analyze data from the learning activity with the characteristics of change of active learning time, that is, how active participation is in online learning in their time. Which leads to learning engagement.

Likewise, in the learning analysis, the online learning engagement comes to show the time that teachers and students provide on the platform, to obtain the characteristics of active time. Information on learners' commitment to the tasks is collected and examined. The subjects can condition the dedication from the desire/knowledge of the learner, since they are in charge of structuring such practice in the PLAD, which allows likes, resistances, practices and habits directed by the interests among subjects.

This direct dedication is expressed as follows:

> *… I am one of those teachers who, as I watch the students carry out their learning activities, I record their interventions. ... It is rewarding. [S4].*

> *It is noticeable in the teaching support platform. ... In fact, it is part of the student's profile. The student's dedication is recorded and observed on the platform. [S5]*

> *I think we are all dedicated to it... I think that the PLAD again and I repeat that it does not work as one would wish neither on the part of the students nor of the professors... The platform shows several applications, but it is not used properly, but it could be very broad for many other things such as learning analytics and analyzing the dedication of the students [S2]*

In the informants' conception, learning analytics is a possibility of applicability in the platform for learning analytics, it is situated in the tools that could be presented in any modality such as E-Learning, learning through mobile devices (M-Learning), learning through games (G-Learning) and Bimodal learning or B-Learning (Contreras et al., 2021). Moreover, these reporting tools can help not only to show a participant's engagement but their progress and interactions to improve their learning outcomes. Siemens & Baker (2012) state that learner-oriented dashboards encourage reflection and self-regulated and collaborative learning.

Therefore, learning analytics has an intersection between data science, theory and design, as it provides computational methods and techniques for the collection, preprocessing, analysis and presentation of data, not only from the participation and engagement in learning as already mentioned but also in online duration and social interaction with other subjects including teachers.

Regarding social interaction, in the social sciences, it is not knowing who is talking to whom and with what, it is defining the online social presence. García *et al*. (2008) emphasize that participants project personal characteristics by appearing to others as real people. Similarly, they argue that, when analyzing interaction patterns, participants include General course exploration (viewing the course, messages, activities, etc.) and task orientations (viewing the forum, replies to the forums, viewing the chat, etc.).

Thus, social and analytical learning interaction involves tracking how students develop and informants detail it as follows:

Interaction in forums equals large amount of information to be read from students' knowledge. More conversation in forums, ...translates into more data to consider [S2].

The teacher examines and evaluates the input given by students. ...Everything becomes information and this has an impact on education [S2].

...socially the interactions have a great value, ...some are very active in their contribution, but others are not, even when they still manage to give their participation [S4].

From what has been expressed, a person becomes a social subject and occurs in an interactive process. In this, people not only develop communication but establish the forms of expression and the construction of information while creating social contacts and networks, resulting in certain social behaviors that are stored with information, which coincides with Sabulsky (2019) who argues that through communication in virtual environments a large volume of data that can be collected by exchanging interactions are produced.

In that sense, metrics, in this case, could be applied to reach the data thrown after activity in the forum and the visualizations of relationships that are established (León et al., 2017), as well as, to analyze the cooperation and competencies achieved during the various social interactions of the participants, all of this helping in the learning design. Learning analytics offers an interpretative framework that ensures applicability in appropriate pedagogical aspects according to indicators based on evidence from the analyzed data. All of the above details that, depending on the objective or method, learning analytics varies in several aspects, as well as the chosen perspective (descriptive, diagnostic, predictive or prescriptive).

CONCLUSIONS

Without pretending that learning analytics is the solution to the teaching and learning processes in the online environment teaching support platform, this educational trend offers certain advantages mainly to educational actors on educational management and students' online learning. What is certain is that it promotes the adoption of learning analytics by showing the progress of activities at the individual and group level, enables the exchange of information to detect problems related to learning outcomes, and by extension the development, implementation and evaluation of strategies and methods that promote their achievement, although it reveals gaps in perception among teachers for decision making according to the predictors to be analyzed.

In other words, it provides an easy-to-understand visualization of registration data for individual users or groups through data generated by digital content, as well as learning activities applied in PLAD and student connections during student or instructor profiling.

Thus, it is concluded that through the analysis of student patterns, it is possible to compare and analyze learning content, learning organization and learning patterns, and based on these data, it is possible to derive the direction of improvement of the teaching method, since by monitoring the learning progress, it is possible to adapt to the needs of the student group and determine whether the teacher has intervened at the right time, and in turn, provide personalized answers and advice to individual students. Therefore, the data obtained, such as the frequency of content exposure, learner participation rate and learner attitudes, can provide the design of better learning experiences and resources based on facts.

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