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Identification of factors that influence student satisfaction from the analysis of voice messaging from WhatsApp: a case study

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ABSTRACT

In these times when there is talk of a return to a new normality in education after what happened due to the pandemic, it is necessary to permanently evaluate the perception of student satisfaction, contributing to the results obtained through traditional methods such as the survey, with methods in which open opinions can be analyzed as in the case of voice analysis. In this sense, this article describes a case study, which aims to identify the factors that influence student satisfaction with respect to teaching performance, based on the analysis of WhatsApp voice messaging. The study has a qualitative approach, exploratory level and non-experimental design. It was possible to identify various factors grouped into five categories: i) planning; ii) didactic strategies; iii) communication; iv) administration of the class session; and v) professional and personal characteristics of the teacher. Therefore, it is concluded that it is possible to close the gaps between the factors that are sensitive and relevant for the university, when a questionnaire with delimited questions is applied to observe only some factors of student satisfaction, with respect to those sensitive factors and relevant to students, by analyzing their comments from the use of voice messaging from mobile applications.

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1. INTRODUCTION

Worldwide, higher education institutions establish that educational quality is a relevant dimension to achieve student satisfaction [1]–[4]. Therefore, it is necessary to innovate in the different processes immersed in the educational system, particularly those aimed at monitoring the level of student satisfaction [5], [6]. With the declaration of a health emergency due to the appearance of COVID-19, many educational institutions saw their face-to-face teaching system interrupted, so as part of their adaptation they opened the doors to virtuality, generating a great impact on educational quality [7], [8]. Even before the declaration of the state of emergency due to the pandemic, many higher education institutions already had deficiencies in

terms of their technological infrastructure [9]. Therefore, in these scenarios it becomes relevant to identify university student satisfaction [10], [11], since by identifying satisfaction, it will allow diagnosing the state of the quality of the services offered, being valid information to make adjustments and improvements [12]–[14].

Thus, it is also important to take into account that the quality conditions that govern university programs are caused by multiple factors [15], [16], within which one of the most important is teacher performance [17]–[20]. In these times, the influence of technology in education has increased exponentially, requiring greater training and commitment from educators to be able to adjust and apply it to their class sessions [21], [22], and it is that the evaluation of student satisfaction regarding teaching performance will allow feedback on the achievements and difficulties linked to the teaching process [23], [24]. Influencing student satisfaction regarding teaching performance has a positive impact on aspects related to academic performance [25], and on reducing the dropout rate by detecting the needs and barriers they face students [26]. Currently, one of the techniques used to identify student satisfaction with respect to the different services offered by an educational institution is sentiment analysis or also called opinion analysis [27]. This technique is part of one of the areas of artificial intelligence linked to natural language processing (NLP), which allows analyzing opinions, evaluations and emotions regarding a certain service or product [28]. However, many times the data is generated in voice format, so for its processing and analysis it must be converted to text, through the NLP through Python, with the purpose of identifying the sentiment contained in each data [29]–[31]. Sentiment analysis is closely linked to social networks or mobile voice messaging applications, since they represent a potentially data source to be analyzed and extract information [32]–[34]. Therefore, nowadays it represents a very useful tool to identify the emotions of the students manifested during the class sessions [35], [36], which contributes with the feedback of the teacher's teaching strategies, methods, and techniques [37], [38].

In a digital environment, the trend is social relationships, whether professional or personal, to find a way of multiple expression in technology, with permanent opinions exchange [39]–[41], and communication in education is a main axis through which students and even teachers are integrated [42]–[44]. One of these instant messaging applications is WhatsApp, which allows synchronous or asynchronous communication between users and facilitates the acquisition of any type of information instantly [45]–[50]. WhatsApp in the educational field represents a space for communication and collaboration, in which students freely express their opinions regarding their satisfaction with the service received at the university [51]–[54]. Through this instant messaging application, opinions can be exchanged in various formats, ranging from texts, images, video, and voice [55]–[59].

In relation to the explanation, this research aims to identify the factors that influence student satisfaction regarding teacher performance, based on the analysis of voice messaging from WhatsApp. Therefore, a case study will be developed, taking as study population, students of the professional school of mechanical and electrical engineering of the National Technological University of Lima Sur. The approach to be used is qualitative, with an exploratory scope and transactional non-experimental design. This article is made up of a literature review section, in which previous studies carried out on the subject of study are highlighted. In addition, the methodological aspects that led to the development of the case study are detailed. The identified results are also detailed in a single section, as well as their discussion, considering the findings and results obtained in other investigations. Finally, the conclusions section is specified, which also details the limitations of the study and future work.

2. LITERATURE REVIEW

Regarding research that considers the WhatsApp messaging application as a means to express opinions and comments, regarding their satisfaction with teaching performance at the university level, there is what was developed by Valerio [60], who describes the experience of using the WhatsApp as a mediation and support tool in the teaching and learning processes, in which he states that the students highlighted the importance of immediacy in receiving communications about the course and the ease it represents for them to exchange opinions through this application. In addition, it is that they frequently review and are even more aware of this medium than of the official email and the virtual classroom of the University. Likewise, Ningtyas *et al.* [61] develop research in the context of virtual education on the appearance of COVID-19, in which focuses on teaching performance through the WhatsApp instant messaging application. In this same line of research, Berg and Mudau [62] develop a work based on the identification of the perception of students regarding the use of WhatsApp and how this application contributes to the improvement of learning processes, in the context of COVID-19. In the same period of the study, Enyama *et al.* [63] developed a research paper in which WhatsApp was used to assess student satisfaction regarding the implementation of online teaching and how the teacher and students interacted with it. Lantarón *et al.* [64] used WhatsApp as a means to interact with the student, seeking to assess their satisfaction with the tutoring and follow-up activities that the teacher carried out with the students. Likewise, Tagoe and Cole [65] point out that the use

of WhatsApp contributes to the teaching-learning process since it allows greater interaction between students and teachers. Abdullah [66] developed an investigation that sought to identify the factors that predict the quality of online education in the context of COVID-19, this through the use of a WhatsApp group, making its application viable for this purpose. In addition, Sason and Kellerman [67] identified that when analyzing opinions regarding the identification of teacher-student interaction factors in the context of COVID-19, they were able to identify that student would have preferred to express their comments through WhatsApp messaging than through email. Iranmanesh *et al.* [68] investigated the factors of student satisfaction, considering WhatsApp not only as a tool for social interaction between students and teachers, but also as an alternative for the teacher's didactic strategy.

3. METHOD

3.1. Focus, level and research design

In the present investigation, the qualitative approach was used, with the purpose of carrying out an analysis of the content of the audio messages of the students with the purpose of identifying the factors that influence student satisfaction regarding teaching performance. In this regard, Johnson-Mardones [69] point out that a qualitative approach collects and analyzes non-numerical data such as interviews, observations and documents to understand and explore the complexity of social and human phenomena. The research carried out is of an exploratory level to the extent that it is intended to know and identify, based on the content analysis of the WhatsApp audio messages, the factors that influence their satisfaction with respect to teaching performance, in the context of the progressive return to face-to-face class teaching sessions. In this regard, Ramos-Galarza [70], points out that exploratory level research gives us a first approach to the aspects associated with a phenomenon or situation under study. Likewise, the research design used is non-experimental, transactional, because the data was collected in a single period, corresponding to the last week of class of the automatic process control subject of the 2022-II academic semester. This case study applies WhatsApp messaging so that the student can express himself freely, and is not framed in categories that restrict the identification of sensitive and relevant factors for the student.

3.2. Data processing

Figure 1 shows the method used for data processing, which begins with the data collection phase through the WhatsApp instant messaging mobile application. These data were stored through voice messages for each student; however, each student was able to express more than one message, thus obtaining a total of 155 audio messages. Then these messages were pre-processed through voice recognition libraries of the Python software, with which it was possible to transform a message from audio format to text format. Finally, the data in text format was processed with the Atlas Ti software, in which it was possible to use a hermeneutic unit, which contained all the textual messages, to facilitate content analysis; assigning codes that allow categorizing each opinion within a context in which it is intended to evaluate satisfaction with respect to teaching performance. For this reason, we sought to represent a semantic map in which the factors and their relationship of influence with student satisfaction are shown.

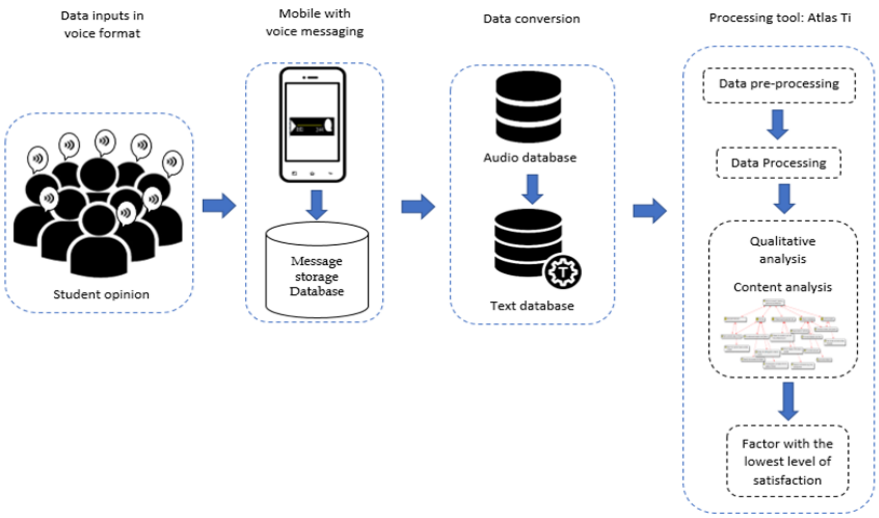

Figure 1. Research method used to obtain results

4. RESULTS AND DISCUSSION

From the content analysis of the 155 audio messages generated by the students in WhatsApp, a first set of factors was identified, which were categorized as "planning" factors, because they referred to the fact that the teacher: "starts and ends your class on time", "introduces and explains the syllabus", "specifies the purpose and topic", "discloses the bibliographic material", and "evaluation matches the topics of the syllabus". In this regard, Salas [71] point out that it is important that the teacher, when carrying out his didactic planning, identify what he is going to do to teach and what the student is going to do to learn, relying on instructional methods and group techniques, taking take into account the contents, resources, times and the context where the teaching practice takes place. Likewise, Mejía [72] considers that as part of the planning of the class session, the teacher must provide students with bibliographic materials in advance to help them acquire prior knowledge. From what is extracted from the students' responses and from what is indicated by the cited bibliographical references, it is essential that the teacher, from the beginning of the academic semester, describe the thematic contents, the competences that he intends to develop in the students and present class materials. that will serve as support for each class session, this in order for the student to guide their efforts towards a defined purpose, such as the specific competencies to be achieved per session or class unit, as well as to identify the tools they have to achieve such objective. Figure 2 shows the percentage distribution of the factors categorized as "planning"; this according to the number of times that said factor has been repeated in the total comments extracted from the WhatsApp messaging application. In this case, it was possible to identify that the factor that has been mentioned to a greater extent and for which reason it is considered relevant in this category is related to student satisfaction regarding the teacher's punctuality, that is, if he starts and ends his session class at the allotted time.

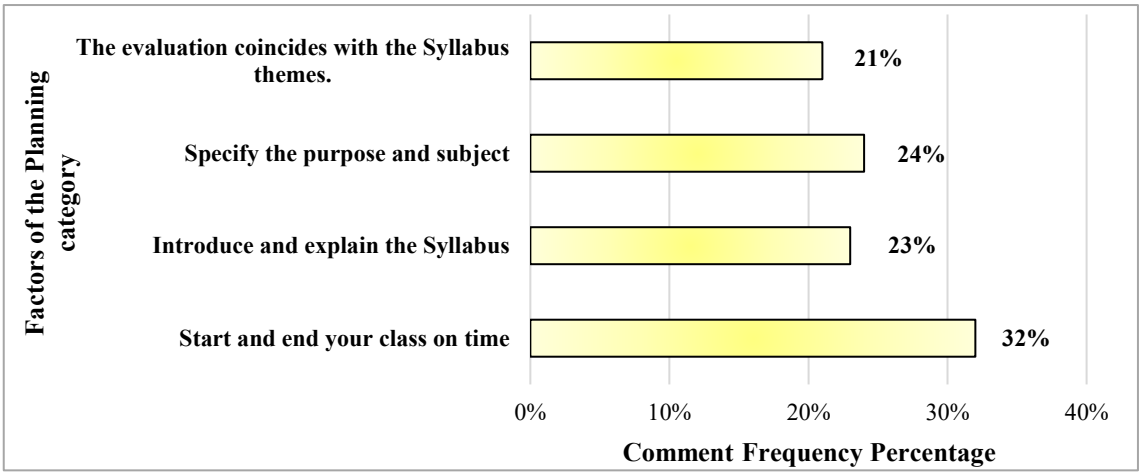

Figure 2. Percentage distribution of factors categorized as–planning

A second set of factors were identified, which were categorized as "didactic strategies" because they referred to the fact that the teacher "applies didactic methods", "promotes feedback activities", "promotes teamwork", "promotes research", and "promotes student participation". In this regard, Alarcón *et al.* [73] points out that didactic strategies are very important in teaching performance, since they help students understand and reflect on any type of information, favoring the reading process, creativity, comprehension, and decision-making. Likewise, Rivera [74] indicates that didactic strategies continually seek new approaches that allow acting and enriching theoretical approaches, models and educational practices that improve the learning experience of students, influencing their satisfaction. Figure 3 shows the percentage distribution of the factors categorized as "didactic strategies", in this case, it was possible to identify that the factor that has been mentioned to a greater extent is related to student satisfaction with respect to the fact that the teacher promoted the student research.

A third set of factors were identified, which were categorized as "communication" factors, because they referred to the fact that the teacher "promotes student participation" and "uses correct oral and written language". In this regard, Soto-Córdova [75] points out that the teacher's communication plays an important role in student learning, since through it is possible to maintain a fluid and constant information channel that allows both agents to sustain teaching processes and effective learning, even in contexts of social distancing. In addition, Capa [76] affirms that teacher performance must not only encompass their ability to transmit

their knowledge, but must also make correct use of oral and written language to transmit confidence and promote the participation of the students Figure 4 shows the percentage distribution of the factors categorized as "communication", in this case it was possible to identify that the factor that has been mentioned to a greater extent is regarding the correct use of oral and written language; gaining greater notoriety because some class sessions are developed virtually, so if the communication is not optimal, the message will not be correctly assimilated by the student.

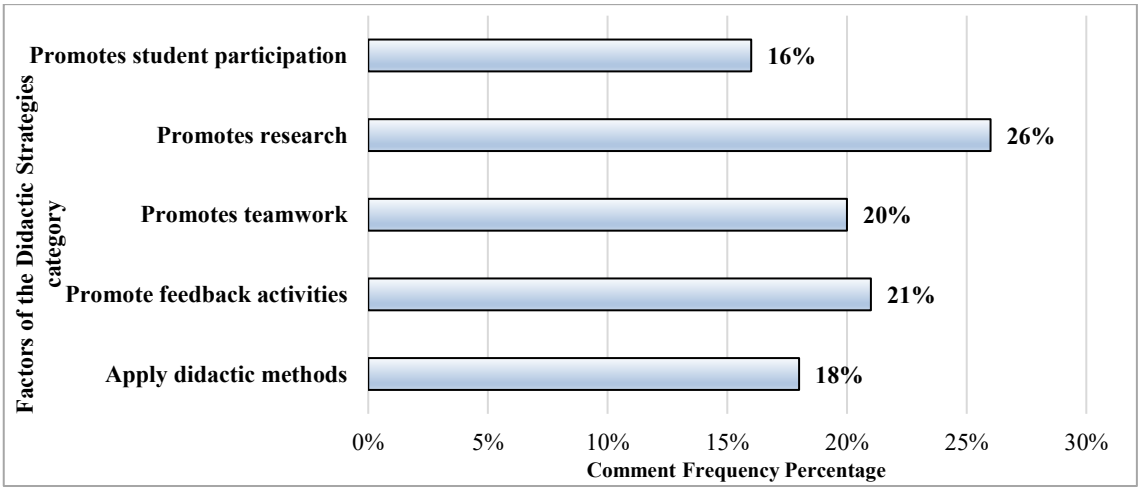

Figure 3. Percentage distribution of factors categorized as-didactic strategies

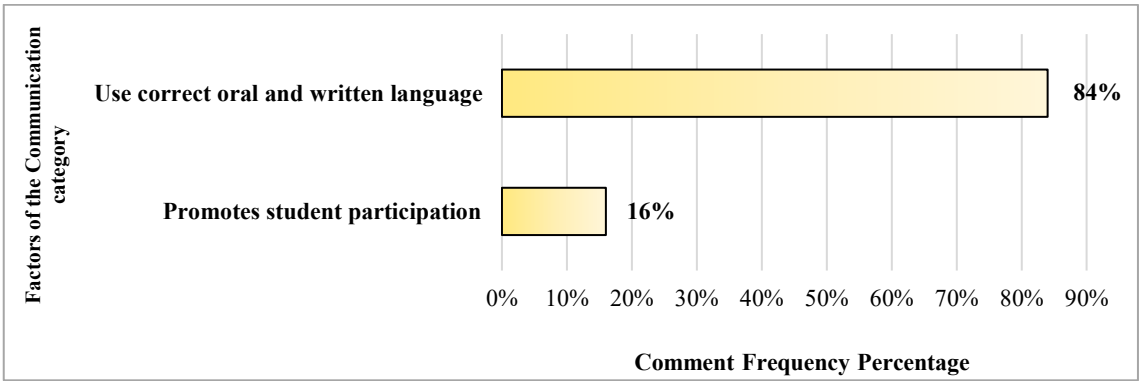

Figure 4. Percentage distribution of factors categorized as-communication

A fourth set of factors were identified, which were categorized as "class session management" factors, because they referred to the fact that the teacher: "starts and ends class on time" and "does not mention foreign topics in the class". In this regard, Martínez-Salas [77] points out that a relevant aspect of teaching performance in the context of virtual teaching is how to best invest the time taught in class sessions, specifying that the activities must be developed in a dynamic and motivating way, achieving effective student learning. Bastardo [78] points out that the degree of non-compliance with institutional regulations related to the achievement of learning goals and objectives due to the lack of planning and class session administration significantly affects the quality of the educational service and obtaining satisfactory academic performance. Figure 5 shows the percentage distribution of the factors categorized as "class session administration", in this case it was achieved to identify that the factor that has been mentioned to a greater extent is related to student satisfaction regarding the fact that the teacher did not develop topics unrelated to what was established in the study plan or that had nothing to do with the class session.

Finally, a fifth set of factors were identified, which were categorized as "professional and personal characteristics of the teacher" because they referred to whether the teacher: "relates the academic part with the professional part", "shows mastery of the topics covered", and "shows a positive attitude during the development of the class". In this sense Colomo and Gabarda [79], point out that there is a type of teacher

who prioritizes how their students feel and the human factor over other issues of an academic nature, in this way, emotional competence becomes a key trait for the development of teaching activity. Likewise, Guadalupe *et al.* [80] in their research work regarding the teacher's personality, established that the trait commitment to work as one of the main factors associated with teaching activity. Figure 6 shows the percentage distribution of the factors categorized as "professional and personal characteristics of the teacher", in this case, it was possible to identify that the factor that has been mentioned to a greater extent is that the teacher showed mastery of the topic developed in class sessions.

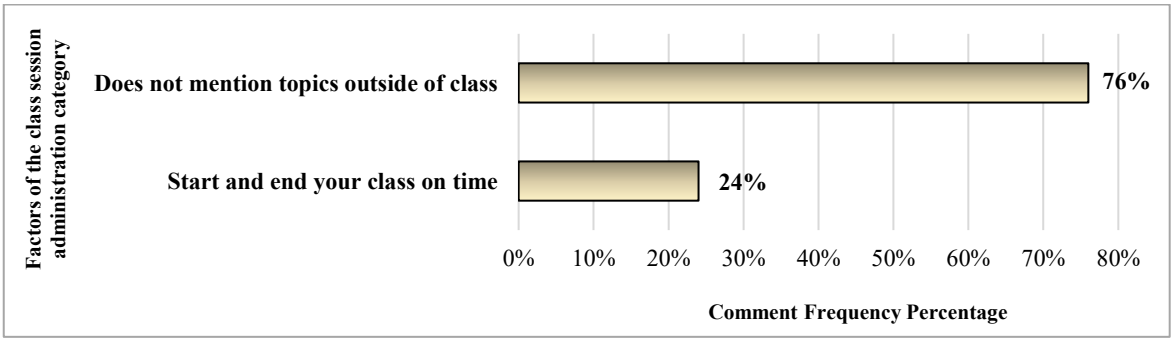

Figure 5. Percentage distribution factors categorized as-administration of the class session

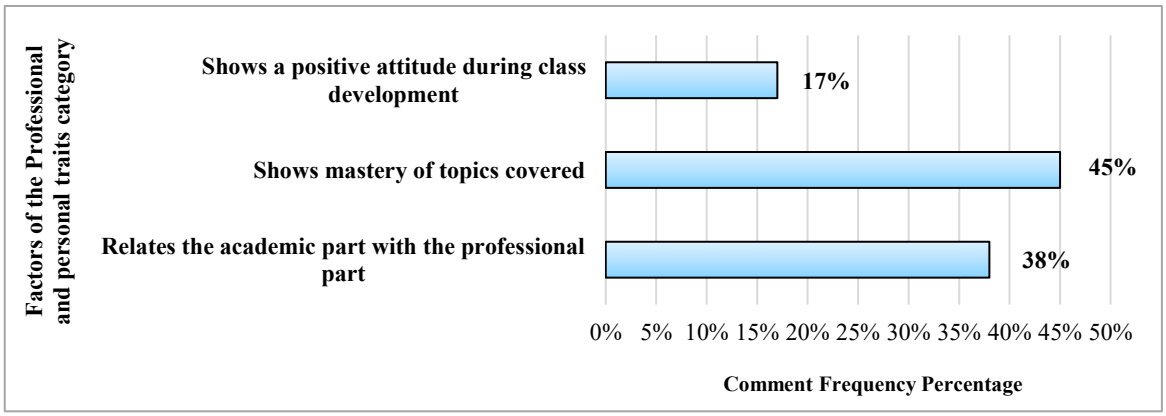

Figure 6. Percentage distribution of factors categorized as-professional and personal characteristics of the teacher

In this way, after analyzing the comments, it was possible to generate a semantic network using Atlas Ti, which shows the factors that influence student satisfaction with respect to teaching performance. This network also shows the categorizations made to each of the factors identified in the students' audio messages, in such a way that it allows not only to visualize the factor-category relationships in a structured way, but also the multiple relationships with other categories. In this case study, for example, it was identified that the factor "start and end class on time" is related to both the "planning" category as well as the "class administration" category student participation", is related to both the category "communication" and the category "didactic strategies". Figure 7 shows the semantic network obtained from the Atlas Ti software.

Regarding the content analysis regarding the factors that influence student satisfaction with teaching performance, Martínez-Chairez *et al.* [81] on the qualitative analysis of educational quality, concludes that among the factors that influence teacher performance are the planning in the development of their class sessions, in order to make the necessary recommendations or prevent the practice from being carried out with improvisation without meeting the needs of the students. In addition to being attentive to the minimum traits of normality, through punctuality and responsibility, as well as a positive or motivating attitude of the teacher. In this sense, there are coincidences in the results obtained in this research with the cited research, although not in all the factors, however those mentioned in the cited research are contained in the factors that were obtained as a result. Likewise, Stein and Wei [23] conclude as part of their research regarding the analysis of student comments on teacher performance based on various dimensions that the ones that have

been most demanded by students are those linked if establishes connections with the contents of other subjects, presents examples applied to professional life and daily life, as well as intervention strategies such as tutorials and didactic training courses, both linked to both pedagogical factors and the implementation and monitoring of the progress of the curricular contents. In addition, there are also coincidences with the results obtained, again not in all the factors that influence student satisfaction on teaching performance, but in what is defined in this research, such as the planning dimensions, didactic strategies, and the administration dimension of the class session.

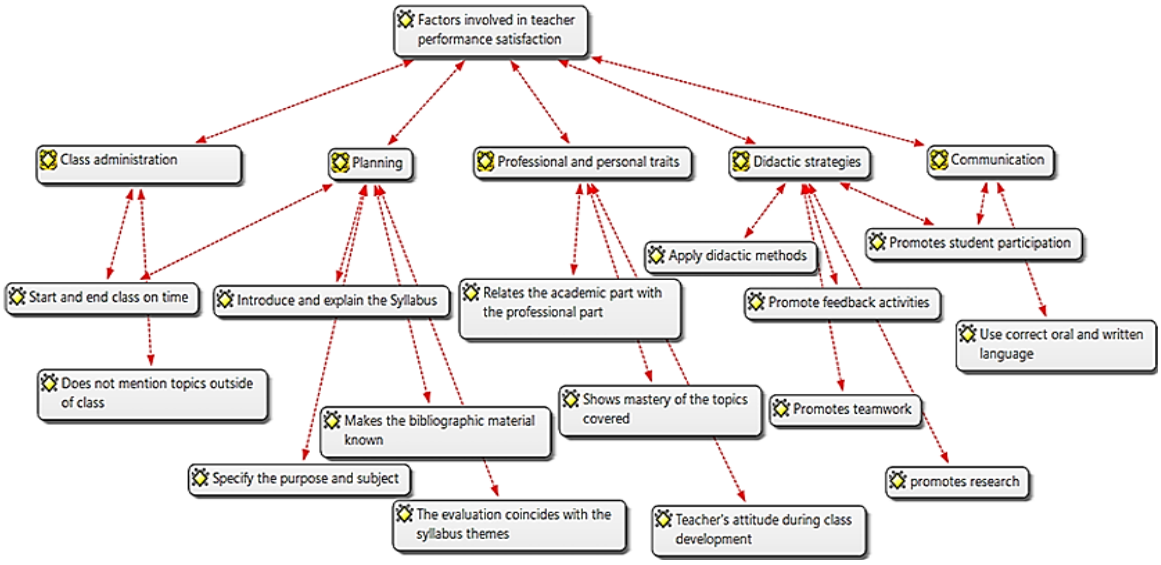

Figure 7. Semantic network that shows the factors that influence student satisfaction regarding teacher performance

5. CONCLUSION

According to the objective proposed in the research, regarding identifying the factors that influence student satisfaction regarding teaching performance, based on the analysis of voice messaging from WhatsApp, it was determined that these factors are categorized into five groups, these being: “planning”, “didactic strategies”, “communication”, “administration of the class session”, and “professional and personal traits of the teacher”. With which it is concluded that through voice analytics applied to messages generated from mobile applications, they represent a tool that allows extracting relevant information that goes beyond the limits presented by a questionnaire with closed questions and that are generally used in university institutions to assess student satisfaction. Thus, through this case study, it is possible to show that it is possible to close a gap between the factors that are sensitive and relevant to the university (when a questionnaire with delimited questions is applied to some dimensions pre-defined by the educational institution) with regarding the factors that are sensitive and relevant to students (when analyzing their free comments from the use of voice messaging from mobile applications). Also, it is that in these times when there is much talk of a return to a new normality in education, it is necessary to apply tools that allow us to transcend between a purely quantitative analysis and a qualitative analysis based on a content analysis, which broadens the range of factors that from the perspective of the university it is enough to observe and measure them, but that from the student’s position it is not enough.

This case study focused on a population made up of 33 students of the automatic process control subject, from the school of mechanical and electrical engineering. Therefore, based on the knowledge obtained, future studies could expand the scope of this same line of research. In such a way that a greater number of factors can be identified, and that they can serve as information for the authorities to redesign their evaluation instruments of student satisfaction on teacher performance, taking into account this context of return to a new normality of the education.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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Lilly Moreno-Chinchay	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	
Yurfa Medina-Bedón	✓			✓		✓	✓	✓		✓		✓	✓	
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Susan Gonzales-Saldaña	✓		✓	✓		✓	✓			✓	✓		✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [OCA]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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