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Scientometric analysis in project virtual teams performance

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In a post-pandemic era, remote work has become part of the daily life of many people, and project management has not been immune to this phenomenon. For this reason, understanding how the study of performance in virtual project teams has evolved takes great importance in order to achieve the objectives of scope, time and cost in harmony with the personal and professional growth of the teams. The following paper shows a systematic literature review, to provide a status of the research dynamics on the performance of virtual project teams (VPT) based on the Scopus and Web of Science (WoS) databases in the last five years. The methodology implemented is the scientometric analysis of five steps (retrieval, migration, analysis, visualization, and interpretation). The study was based on 454 Q1 and Q2 papers, distributed in four clusters largely dominated by USA and Europe. The analysis allows us to identify key variables for high performance in VPTs, such as communication, leadership, and trust, as well as other relevant variables associated with technology and management. Additionally, it was possible to identify a few research developments in Spanish-speaking countries.

Keywords: Virtual Project Teams, Project Management, leadership, performance, communication.

I. Introduction

A. Context on virtual project teams

After the appearance of the COVID-19 pandemic, virtual Project Teams, hereinafter VPT, have shown considerable growth in number and size, creating new challenges for organizations and the people who lead them [1]. From this situation that humanity experienced, new activities arose to be carried out in teamwork, the adaptation of both old and new technologies was stimulated, and new ways of understanding performance emerged [2]. According with [3] need to have a look at innovation opportunities and new challenges raised, as well as a look at evolution and the challenges that are present [4].

As well as, among the most notorious characteristics of the VPT is the spatial and temporal dispersion, and stronger dependence on technologies without them fully solving the challenges of project teams that work virtually [5]. This type of characteristic confronts us with possible changes as a society [6] and these changes caused by new technologies are expected to lead to a positive transformation for humanity. Confidence is now given more importance since the stages of the teams are categorized and quick confidence and team confidence start to play a determining role [7]. Moreover, another alternative that has emerged is that of partially virtual teams, [8] which generates greater opportunities to solve the problems of fully virtual teams. However, alternatives for 100% virtual work are emerging, such [9]as stimulating reflection days, where the team can meet to think about the activities related to their work. Managers can set rewards and incentives for VPTs [10], help improve digital skills, [11], and foster the development of collective consciousness [12]. The need for organizations to establish new procedures accompanied by actions, processes, and tools that allow them to have more effective management of the VPT is observed [13]. It is necessary, also to expand the studies on VPT to understand their behavior, and understand the ways of work. And what of what they do leads to the appearance of certain patterns that facilitate the development of their work with higher levels of efficiency? [14]. In a study on VPT [15], it was possible to establish the relationship between challenges in generation Z with problems associated with coordination among its members, and difficulties on the part of organizations and leaders to keep them motivated.

In addition, performance and its relationship with satisfaction have been studied within the framework of face-to-face teams, but there is a need to expand the studies that detail the behavior of these factors within the framework of VPT, considering as a key point that the level of Team satisfaction can influence their performance [5]. VPT leaders must be more sensitive when identifying the personality composition of their team members, avoiding early dissatisfaction of their members and negative influences in the face of new challenges [15]. Some studies [16] show that to facilitate the work in the VPT, it is not enough just to choose a new digital platform, structural, cultural, and organizational changes and changes in the way of thinking must also be stimulated; all this with the acceptance by the members of their teams. Given this scenario, it is necessary to tend to improve the skills of leaders concerning the domain of virtual platforms, conflict management, communication, and the ability to stimulate the exchange of knowledge, thus stimulating a greater preference for VPT and pursuing better performance [15].

As a matter of fact, the main problems associated with VPTs studied [17] are related to the lack of fluidity of information, difficulties in having a common understanding of the objectives, lack of clarity in roles and responsibilities, lack of cohesion, mistrust, poor knowledge management, and

difficulties for effective feedback on performance. In the same way, studies [5] highlight some variables such as leadership, trust, communication, conflict, cultural intelligence, motivation, technical experience, and shared objectives; that affect the satisfaction of the VPT and indirectly in the performance. Likewise, the understanding of how the different types of trust are related to the performance of VPTs is still limited.

Furthermore, regarding performance, some studies [18] suggest that leaders include the provision of periodic virtual meetings in the schedule to improve collaboration between team members and improve their effectiveness. In another study [19], some steps are proposed to improve the performance of the teams, which include the contextualization of reality, the generation of organizational culture, having updated and quality technical tools, promoting the culture of articulated or shared work, and establishing audits. to measure the level of ownership of employees with the organizational culture. Likewise, [20], past performance can influence confidence and future performance. The nature of the tasks, added to the dispersion and size of the team generate a strong impact on performance [21] and other factors can influence the performance of VPTs [22] such as relationship building, cohesion, trust, communication and trust. coordination.

Besides, from the point of view of cohesion, [23] recognizes the importance of cohesion but warns of the need to consider factors such as the size and permanence of the team. Autonomy and cohesion show a positive impact on team performance, unlike factors such as individual work and team tensions [24]. VPT workers need to perceive honesty and transparency from leaders to resolve conflicts [25]. At the communication level, [26] higher levels of performance are perceived when better and more varied communication tools are used. For his part [27], he recognizes that achieving good communication in the VPT requires trust, clarity in tasks, reliability, and permanent feedback. In the same way [28], it is recognized that trust plays a determining role not only in the performance of the VPT but also influences the strengthening of team communication.

B. Scientometric Analysis in Research

Scientometrics has become a valuable mechanism for the analysis of scientific papers from the appearance of new analytical techniques and access technologies, likewise, it has helped to reduce time and costs, in the same way, it has been possible to reduce the workload to achieve broader data analysis, reliably and efficiently [29]. In itself, scientometrics is described as a tool that facilitates the emergence of scientific policies from the quantitative analysis of scientific papers [29].

C. Purpose and Research Questions

In summary, this paper aims to socialize the behavior of studies related to virtual project teams based on the scientometric analysis that emerges from the Scopus and Web of Science databases from 2017 to 2022 and is analyzed with two computer tools. (VOSviewer and Biblioshiny). In this way, the research question is answered: What is the academic context related to the study on virtual project teams? In the same way, we tried to answer the following important questions:

1) In which countries is there greater production over VPT?
2) Which are the countries that are most closely related to VPT research?
3) Who are the most cited authors regarding VPT?
4) What are the journals that publish the most papers related to VPT?
5) What are the variables or concepts that are most related to VPT and what is their behavior?
6) What is the relationship between scientific journals, the most relevant variables and the countries?

Finally, the following structure is used for the presentation of this paper and the results of the scientometric analysis. In the first part (I) the context of the VPT and the problems related to these work groups were presented, as well as the delimitation of the scientometric analysis and the questions to be addressed in the study. In the second section (II) the methodology and methodological design that allowed reaching the results of the investigation are socialized. In the third section (III) the results of the study are presented. Subsequently, in the fourth (IV) and last section, the conclusions are shared and the paper is finally closed with the references.

II. METHODOLOGY

The methodology used to carry out the scientometric analysis in this paper was adjusted to the methodological steps proposed in the study of scientometrics for medical sciences [29]. This methodology contemplates the development of five phases (recovery, migration, analysis, visualization, and interpretation) that give scientific rigor to the research and allows more reliable results to be obtained from a sequential process, as shown in Fig. 1.

Fig. 1 Methodology adapted to carry out the scientometric analysis.

A. Recovery:

From this phase, the aim is to achieve a choice of databases and a search strategy that allows obtaining adequate information, with the operators, terms, and criteria that facilitate the selection of the appropriate papers [29].

B. Migration:

This phase consists of the extraction of metadata, the steps to transfer and load the information, articulated the cleaning of the data through its normalization and purification [29].

C. Analysis:

In this phase, the quantitative processing of the papers is carried out, some software applications are used, bibliometric indicators are achieved, statistical methods are applied and answers are given to the research questions from the study [29].

D. Display:

It consists of the presentation of Fig.s or graphs that facilitate the visualization of the results of the analysis. It is characterized by being presented in such a way that the degree of relevance is observed and that its understanding is facilitated [29].

E. Interpretation:

This phase is based on analysis and visualization to facilitate the identification of research trends, highlight the interactions that arise around the topic, as well as socialize the influence and comparison of the different groups that are formed around the topic [29].

III. RESULTS

For the presentation of the results, the four phases socialized in the methodology are developed, rigorously following each of the data. The results corresponding to the phases of analysis, visualization, and interpretation are presented jointly, given the interrelation of these three phases.

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A. Recovery:

The information that was selected to carry out the elaboration of this paper was obtained systematically, considering appropriate search criteria and quality criteria that guarantee the rigor of the study. Next, Table I is presented, where the steps to arrive at the choice of the papers analyzed are listed in detail.

TABLE I
STEPS FOR PAPER SELECTION

Search equation ("virtual teams" OR "remote teams" OR "distributed teams" AND projects)		
search criteria	Databases _	
	No Scopus Papers	No WOS Items
Search initial	296	158
last five (5) years	68	85
Only papers	64	70
Subtotal Items	134	
Papers repeated	17	
total items	117	
The search equation was carried out by means of an advanced search, adding in the restrictive criteria (AND) only the ISSNs of Engineering and Administration journals Q1 and Q2.		

In any case, the search criteria were oriented around the study question: What is the academic context related to the study on virtual project teams?

B. Migration:

To achieve the extraction, transfer, loading, and cleaning of data, the procedure presented in Table II was carried out.

TABLE II
DATA MIGRATION PROCEDURE

Extraction	The papers selected after applying the steps in Table 1 are downloaded from the Scopus and Wos databases, in a bib.tex format file.
transfer and cleaning	The two files in bib.tex format were uploaded to Rstudio.
	Using Rstudio, the papers from Scopus and Wos, initially loaded in bib.tex, are unified and repeated papers are purged.
	A single file is downloaded in xlsx format with all the items from the selection.
	The file in xlsx format is uploaded to the Biblioshiny tool, to perform the analyses.
	The xlsx file is converted to TXT format.
	The TXT format is uploaded to the VOSviewer tool to perform the analyses.

In this way, it was possible to carry out the phases of analysis, visualization, and interpretation on the 117 scientific papers Q1 and Q2 product of the search, extraction, transfer, and detailed methodical cleaning.

C. Analysis, visualization and interpretation:

In this phase, the results of the analysis are presented together with the graphs generated through Biblioshiny and VOSviewer tools in the order of the research questions with

their corresponding interpretation and sequentially according to the phases proposed by the methodology.

1) In which countries is there greater production over VPT?

According to Fig. 2, it can be seen that in recent years, the countries that have been leading research on VPTs are the USA with 51 published papers, followed by Australia with 14 publications, Germany with 10, the United Kingdom, India, and France, each with 8 publications.

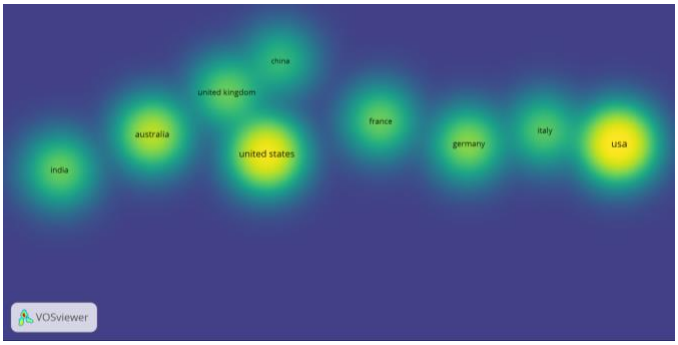

Fig. 2. Production intensity by country

The number of published papers is represented in Fig. 2, with the intensity of heat surrounding each of the related countries.

2) Which are the countries that are most closely related to VPT research?

At the level of the relationship between countries in Fig. 3, it was possible to identify 4 well-defined clusters. The first cluster is largely dominated by the US, a country that has managed to focus VPT research with Germany, France, Ireland, South Africa, Portugal, Canada, Israel, China, Finland, and Italy. Likewise, a second cluster can be seen articulated between the Netherlands, Denmark, and Norway, a third cluster made up of the European Union, Australia, and Iran and a fourth cluster made up of Malaysia and Spain.

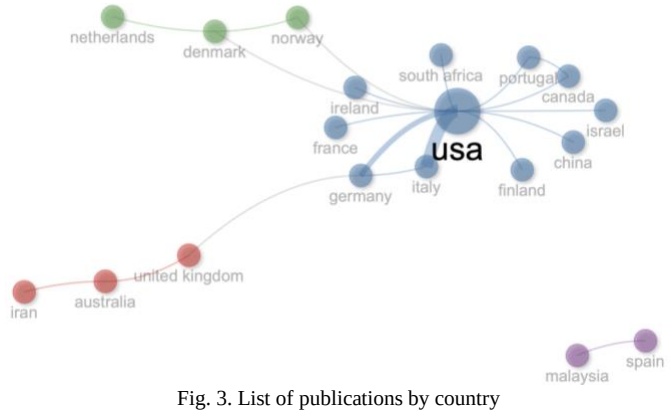

Fig. 3. List of publications by country

To logically understand the relationship in publications on VPT, it is necessary to identify, according to Fig. 3, that in the first cluster dominated by the US, there is a strong articulation in terms of publications between Portugal and Canada, that the second and third cluster also is related to the first and that in the fourth cluster, production has been generated on the VPT in an isolated way.

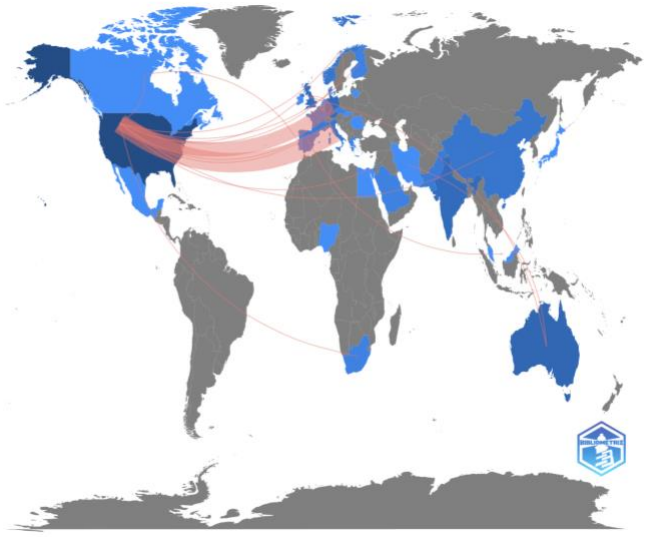

Fig. 4 Map of the relationship of publications between countries

3) Who are the most cited authors regarding VPT?

Responding to this question, Fig. 5 is presented, where the authors are related to a sequence by year, considering the following criteria: The largest circle is assigned to the greatest number of papers and the strongest intensity of the color of the circle is assigns the largest number of citations per year. Thus, Table III is presented the number of citations by authors per year.

TABLE III
CITATION OF AUTHORS PER YEAR

Years	Hosseini M	Taras V	Maynard M.	Gilson L.
2018	twenty	0	0	0
2019	91	37	37	37
2020	0	0	0	0
2021	3	2	4	4
2022	0	5	0	0
Total	114	44	41	41

In the same way, Fig. 5 is illustrated below, detailing the author's publications by year with their respective citation intensity.

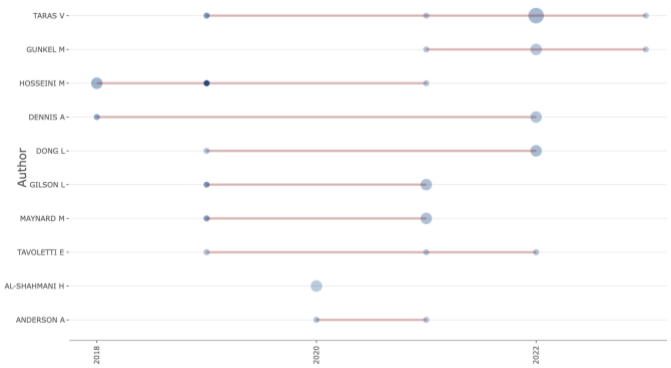

Fig. 5 Citation of authors by year

The relationships that arise between the different authors who present production and citations in the last 5 years can be observed in Fig 6, where 6 clusters of interaction between the different authors are detailed, finding that Hosseini M. has articulated his academic efforts with Chileshe, Arashpour, Martek, and Edwards. In the same way, it is seen that the cluster led by Taras is made up of Jimenez, Dong, Tavoletti, Stephens, Gunkel, and Veglio. On the other hand, it generates curiosity about Gilson and Maynard, who despite being two of the most cited authors, only relate to each other.

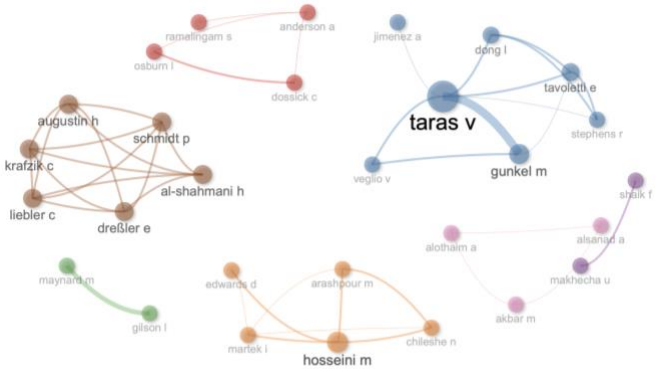

Fig. 6 Network Collaboration

4) What are the journals that publish the most papers related to VPT?

It was possible to identify two magazines that stand out in the publication of these papers: "Team Performance Management" with 41 publications in the last five years and "Organizational Dynamics" with 29 publications.

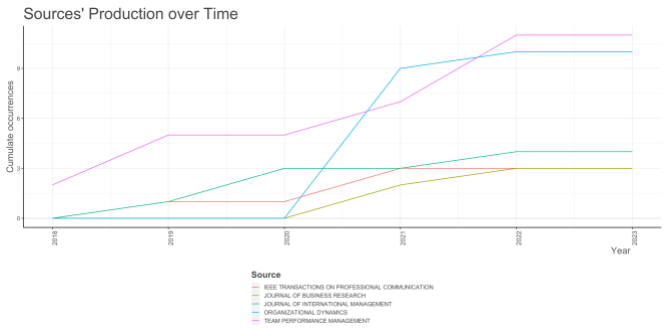

Fig. 7. Publication by scientific journals

Fig 7 allows us to conclude that although the magazine that registers the most publications on VPT is Team Performance Management, it only began to publish this type of paper in 2020 and since then it has managed to sustain itself constantly.

5) What are the variables or concepts that are most related to VPT and what is their behavior?

In the case of the most relevant research variables, Fig. 8 allows a clear interpretation of their degree of relationship and the impact they generate in virtual teams. VPTs are influenced by trust, communication, and leadership. In turn, these three variables directly affect performance. Information, together with collaboration, knowledge, management, and technology generate a high impact on these teams. Finally, project management, human talent management, and software design are linked in the same VPT cluster, considering that they are decisive for its proper functioning.

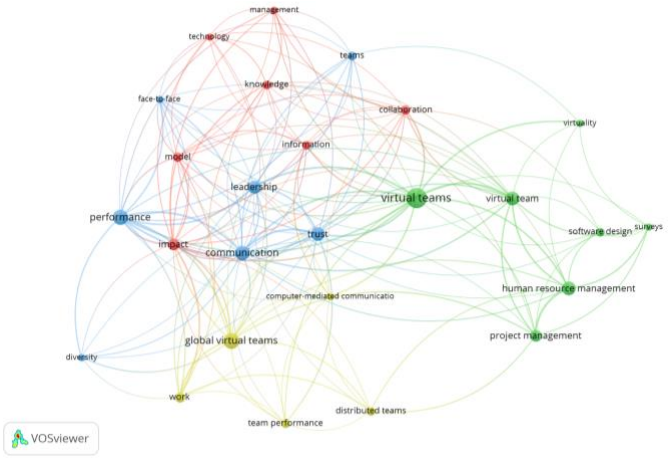

Fig. 8 Co-occurrence of terms

Fig. 9 Key variables

Making an analysis of the degree of development and the degree of relevance, Fig 10 is presented.

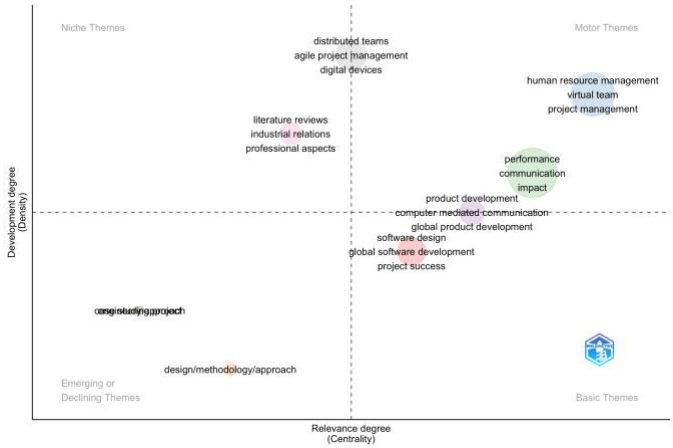

Fig. 10 Development and relevance of the variables

Fig. 10 shows that the management of human talent, articulated with project management and virtual teams, are the clusters that present the highest degree of development and relevance, but it was possible to identify that performance and communication are the variables that present the greatest score individually “18 and 16”.

6) What is the relationship between scientific journals, the most relevant variables and the countries?

As illustrated below, in Fig. 11 the magazine "Team Performance Management" presents an association with papers related to variables such as performance, impact and communication of the VPT, the only magazine that is not related to the variable of communication in the VPT is the "IEEE Transactions on Professional Communication", although performance ends up being a very representative variable, it is only referenced in a scientific journal.

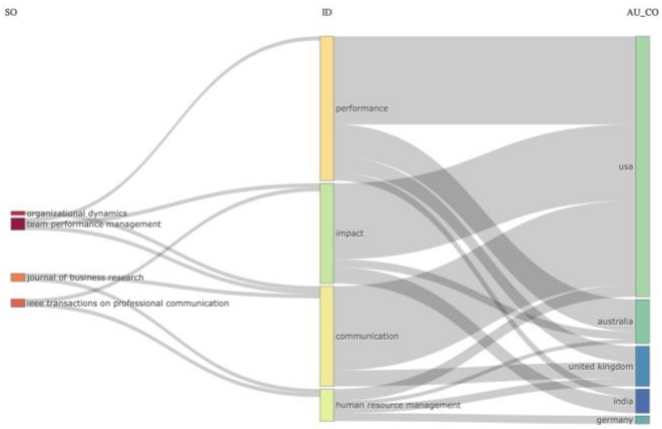

Fig. 11 List of journals, variables and countries

The only countries that generate production related to the three most relevant variables are the US and the European Union, with a notable difference from the first about VPT.

IV. CONCLUSIONS

This paper focused on answering the research questions raised by a scientometric analysis of the literature, using two data analysis tools such as Biblioshiny and VOSviewer. It was possible to obtain the results of the research questions by applying the rigor of the methodology, which allowed for finding relevant information for future research on the VPT. The US is the country with the most publications related to the subject (51), followed by Australia (14), Germany (10), the United Kingdom, India, and France, the latter 3 with 8 publications each. The relationship between the countries is divided into 4 clusters, the first led by the US and made up of Germany, France, Ireland, South Africa, Portugal, Canada, Israel, China, Finland, and Italy. In the second cluster are the Netherlands, Denmark, and Norway. The third cluster to the European Union, Australia, and Iran; and a fourth cluster is made up of Malaysia, and Spain, the latter has been working in isolation from the other clusters.

The most referenced authors concerning publications on VPT are Hosseini M (144), Taras V (44), Maynard M (41), and Gilson L (41). About the journals with the highest number of papers published on VPT, "Team Performance Management" stands out with 41 publications, and "Organizational Dynamics" with 29 publications. The co-occurrence analysis made it possible to identify determinant variables for VPT such as communication, leadership, and trust, these three variables presenting a high level of relationship with performance. Thus, important variables such as information, collaboration, knowledge, management, technology, project management, human talent management, and software design were identified. It is evident that the US and the European Union are the only countries that relate their research to the four most determining variables of the VPT (Performance, impact, communication,

and human resources management) and that the only journal that associates their studies with performance in this field is "Team Performance Management".

Finally, it is possible conclude that the academic context related to the VPT has been generating important studies, with relationships between countries and authors growing each year and with a greater number of scientific journals interested in endorsing publications related to a topic that each day it becomes more relevant due to its growth as the VPT.

RECOGNITION

This section is addressed to the EAN University, which with its wonderful faculty and management allows articulated work based on the professional and human development of its students.

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