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Technological tools for virtual teaching and their effect on the satisfaction of online learning

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ABSTRACT

The objective of the research is to analyze the satisfaction of the online learning of the applied electricity subject, when implementing technological tools for virtual teaching. The development of the research determines a high level of student satisfaction, finding the perception of reliability with 93.05%, that of security with 93.2%, that of answer's capacity with 90.73% and empathy with 82.87%. Satisfaction with the technological tools of virtual teaching is related to the adequate and accessible use of simulation software during online learning, which allowed compliance with the syllable. In addition to the security and confidence when the teacher is willing to help him in the use of the simulation software, responding to it appropriately and quickly. Satisfaction of online learning of the applied electricity subject using virtual teaching tools is related to the teacher's sample of concern towards students regarding their academic needs and their expressed interests.

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1. INTRODUCTION

The degree of satisfaction in the university student environment is an indicator that is considered as a measure of control of the quality of the teaching-learning processes [1]-[3]. In recent years, quality has become a priority for all companies, however, its application also has a great interest on the part of Universities, since quality also plays an important role so that functions, services and the university educational process is optimal [4], [5]. The assessment of university student satisfaction allows identifying aspects that are part of the educational service process that require restructuring or improvement, which is why there is justification to be measured permanently [6]-[8]. Students, as main members of education, are the ones who can best express their opinion of the educational service received, their assessment is a good reference, since they are the reason for the existence of university institutions [9], [10].

To satisfy the student, one must be efficient in academic quality, this condition of satisfaction improves academic performance, and allows students to acquire the competencies established in the subjects of the study plan [11]-[14]. Teaching at the university level aims to achieve academic excellence, so that those who design and implement courses and programs have high expectations about the quality of training [15], [16]. An important factor for improving satisfaction is the teacher's performance in carrying out the

learning sessions and how he uses teaching strategies to make the student meet the expectations set in the subject [17].

In the context of the health emergency caused by COVID-19, universities went from offering a face-to-face educational service to a virtual one, relying on virtual tools and platforms for the development of teacher teaching strategies [18]-[21]. Teaching strategies through virtual environments must be supported by a planning whose structure is oriented to the principles that guide teaching effectively, considering that each subject in the curriculum is different [22]. It is important to bear in mind that, under the context of distance education, in order for students to achieve the skills and abilities of each subject, the teacher must design teaching strategies based on virtual platforms and tools [23]. For what has been described, it is important to partially improve the learning conditions, in this scenario in which virtual education has become the modality that guarantees the continuity of the educational service, hence the prevailing need that the teacher it must innovate learning strategies in a continuous way, relying on virtual tools [24]-[26].

In this sense, the objective of this article is to analyze the satisfaction of online learning of the applied electricity subject, when implementing virtual teaching technological tools, for which initially the description of the results will be made, and then determine the percentage association of indicators of satisfaction by means of crossed tables.

2. METHOD

2.1. Design and research level

For this research, the non-experimental design was used, since the analysis of the study population was carried out without exerting any type of manipulation on them, that is, in a natural state. The research level is descriptive, because it is intended to analyze the satisfaction of the students with the online learning of the applied electricity subject, by implementing technological teaching tools, also by means of the SPSS software used the statistical cross tables, the association of the indicators of the only variable under study will be determined as a percentage.

In Figure 1, the indicators that are associated with the satisfaction of the students are outlined, during the online learning of the applied electricity subject, when implementing technological tools of virtual teaching. It should be noted that the research was carried out during the 2020 academic year, to a total of 108 students belonging to the professional career of chemical engineering.

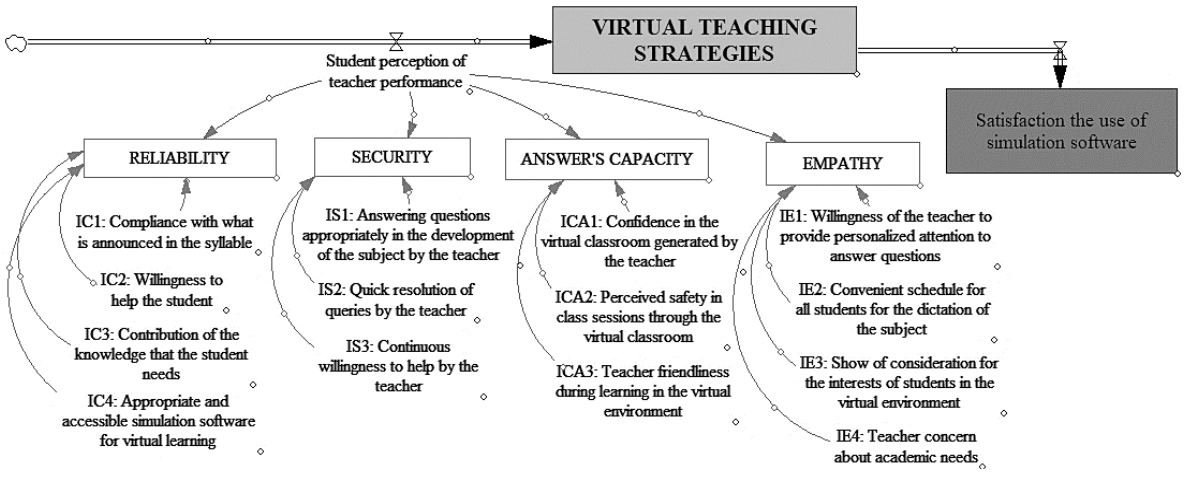

Figure 1. Indicators that measure satisfaction with online learning and the use of simulation software

2.2. Validation of the data collection instrument

The instrument used for data collection is a questionnaire based on the service quality (SERQUAL) model, which was applied at the end of each academic semester of 2020 (2020-I and 2020-II), the content of the instrument was validated through [26]. The instrument is divided into four dimensions, which encompasses student satisfaction during online learning of the applied electricity subject, these indicators are reliability, safety, responsiveness and empathy, which in turn are directly related to the implementation of the technological tools of virtual teaching.

The responses were categorized on the likert scale. Likewise, the validation of the collected data was carried out using the cronbach's alpha statistic, using the SPSS v25 software, the result of which shows that there is a high reliability of 0.960, determined this, the results of the investigation are shown.

2.3. Description of the teaching strategy under analysis

In the applied electricity subject, the contents are developed based on a planning through a syllable based on competences (understanding, logical thinking and decisive thinking), which is divided into four units, these units being: current analysis alternating electricity, conversion of alternating current to DC, industrial electricity and programmable logic controllers. In the context of virtual education, the use of the professional simulation software Proteus V8, CadeSimu V3 and Logo soft confort V8 was used as a technological tool. In Figure 2, the architecture of the virtual teaching strategy is observed, highlighting the elements that intervene in each sub-process and how these are cohesive or linked to obtain learning. It is important to highlight that in this architecture the student starts with a previous knowledge base, which he acquires autonomously, on conceptual aspects, said contents are previously loaded in the virtual platform, created through moodle.

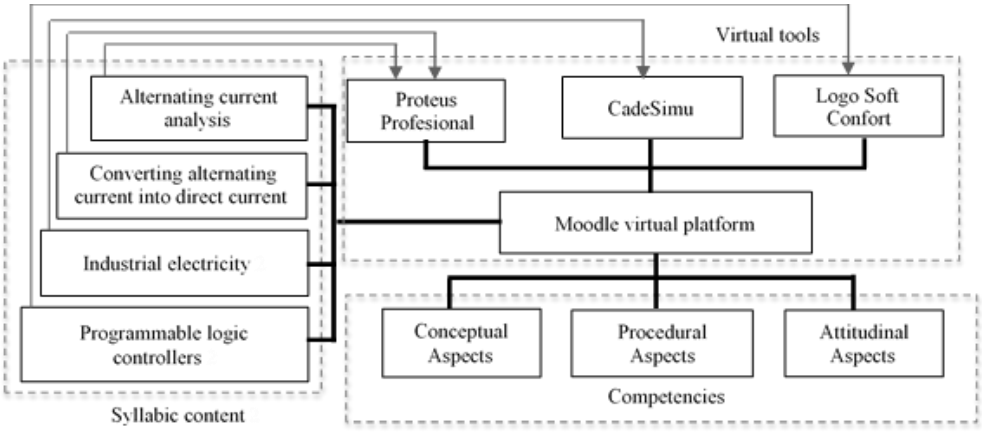

Figure 2. Architecture of the virtual teaching strategy

Then proceed to develop procedural aspects using simulation software; students design and simulate their own circuits that are part of the solution to a proposed problem. It should be noted that the simulation software allows identifying errors or flaws in the design. This allows the student to locate where they made a mistake and what they must correct. Finally, the solution proposals of a group of students are randomly selected and the knowledge feedback is carried out.

3. RESULTS AND DISCUSSION

3.1. Results

In Figure 3, the results of satisfaction regarding the reliability indicator with the virtual teaching technological tools are shown during the online learning of the applied electricity subject. From Figure 3, it can be indicated that 93.05% of the students are satisfied with the perceived reliability in the implementation of virtual teaching technology tools.

Regarding the IC1 indicator, 64.8% of students fully agree that the teacher of the applied electricity course complied with what was announced in the syllabus and 61.1% fully agree that technological tools were used (simulation software) appropriate and accessible for learning in the virtual environment (IC4). Likewise, 46.3% agree that through simulation software the teacher provided the knowledge they needed (IC3). However, 9.3% consider that teachers can improve their willingness to help them with educational problems (IC2). In Figure 4, the satisfaction results with respect to the security indicator with the technological tools of virtual teaching are shown during the online learning of the applied electricity subject.

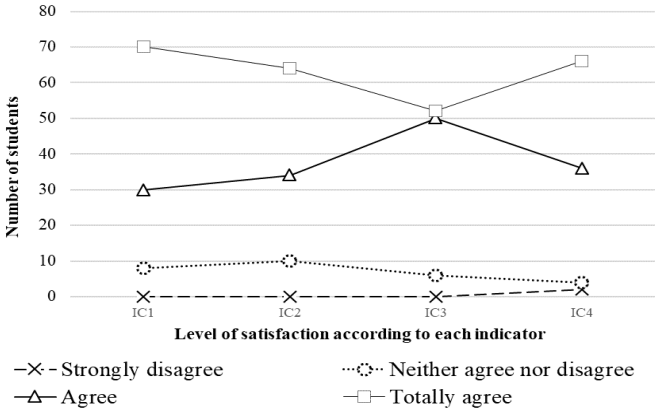

Figure 3. Reliability with the technological tools of virtual teaching

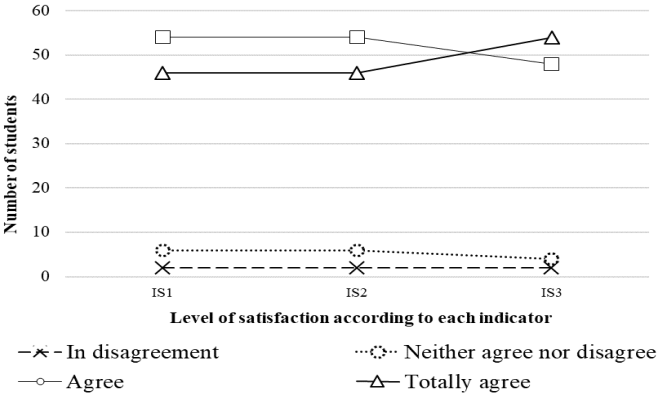

Figure 4. Security with the technological tools of virtual teaching

From Figure 4, it can be indicated that 93.2% of the students are satisfied with the perceived security in the implementation of virtual teaching technology tools. Regarding the IS3 indicator, 50% of students fully agree that the teacher of the applied electricity course was willing to help them in relation to the use of simulation software. Likewise, 50% of the students agree that when an observation was presented in the development of the subject, the teacher responded to it adequately and quickly (IS1 and IS2). In Figure 5, the results of satisfaction regarding the indicator answer's capacity with the technological tools of virtual teaching are shown during the online learning of the applied electricity subject.

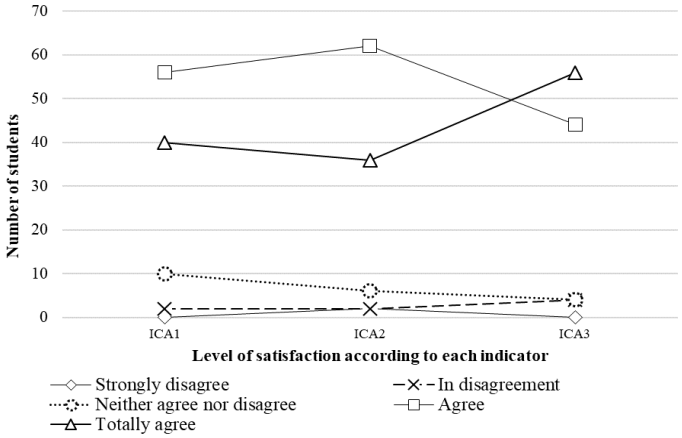

Figure 5. Answer's capacity with the technological tools of virtual teaching

From Figure 5, it can be indicated that 90.73% of the students feel satisfied with the perceived answer's capacity in the implementation of virtual teaching technology tools. Regarding the ICA3 indicator, 51.9% of students fully agree that the teacher of the electricity course applied during online learning has treated them with kindness. Likewise, 57.4% of the students agree that they felt safe with the class sessions of the subject making use of the virtual classroom. However, 9.3% state that the teacher can improve in terms of the confidence they generate in teaching through the virtual classroom. In Figure 6, the results of satisfaction regarding the empathy indicator with the technological tools of virtual teaching are shown during the online learning of the applied electricity subject.

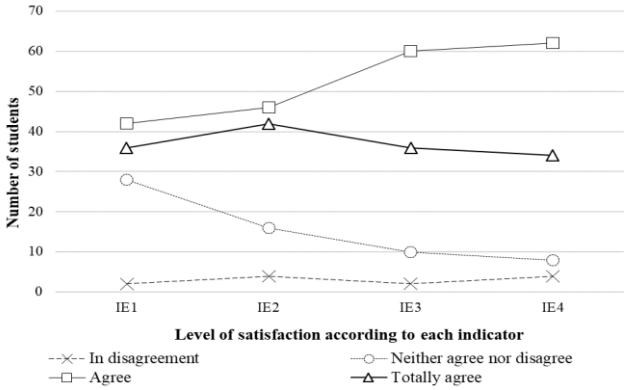

Figure 6. Empathy with the technological tools of virtual teaching

From Figure 6, it can be indicated that 82.87% of the students feel satisfied with the perceived empathy in the implementation of virtual teaching technology tools. Regarding the IE2 indicator, 38.9% of the students fully agree that the schedule in which the applied electricity course was taught was convenient for all students. Likewise, 57.4% of the students agree that, in the development of the subject during online learning, the teacher conveyed that he was concerned about their academic needs (IE4) and 55.6% agree that in virtual teaching the teacher took into consideration their expressed interests (IE5). However, 25.9% consider that the teacher must improve their willingness to provide personalized attention to the doubts or observations presented during virtual learning (IE1).

In order to determine the percentage association of the indicators that measure student satisfaction with the implementation of virtual teaching technology tools, by means of crossed tables. Initially, the normality test in Table 1 is performed to determine the correlation statistic to be used. For this, the Kolmogorov-Smirnov test will be used, since the sample is greater than 50. As can be seen in Table 1, the significance (sig.) of the indicators of the satisfaction variable is less than $\alpha = 0.05$, for this reason it can be noted that there is no normality of the data, for which the test is used nonparametric correlation, Spearman's Rho. In Table 2, the results are shown.

Table 1. Normality test

	Statistical	gl	Sig.
Reliability	0.240	108	0.000
Security	0.188	108	0.000
Answer's capacity	0.228	108	0.000
Empathy	0.153	108	0.003

Table 2. Spearman's RHO correlation

	N= 108	Reliability	Security	Answer's capacity	Empathy
Reliability	Correlation coefficient	1.000	0.722	0.679	0.554
	Sig. (bilateral)		0.000	0.000	0.000
Security	Correlation coefficient	0.722	1.000	0.894	0.694
	Sig. (bilateral)	0.000		0.000	0.000
Answer's capacity	Correlation coefficient	0.679	0.894	1.000	0.781
	Sig. (bilateral)	0.000	0.000		0.000
Empathy	Correlation coefficient	0.554	0.694	0.781	1.000
	Sig. (bilateral)	0.000	0.000	0.000	

As can be seen in Table 2, all the indicators are related to each other, because the significance (sig.) is less than 0.05. Although all the indicators are related, the answer's capacity (ICA) and security indicators (IS) are the ones with a higher degree or level of relationship of 0.894. For this reason, the association analysis by crossed tables will be carried out using only these two indicators. Table 3 shows the percentage association between the IS1 and ICA1 indicators.

Table 3. Cross table between IS1 and ICA1

	ICA1	In disagreement	Neither agree nor disagree	Agree	Totally agree	Total
IS1	In disagreement	0.0%	100%	0.0%	0.0%	100%
	Neither agree nor disagree	33.3%	66.7%	0.0%	0.0%	100%
	Agree	0.0%	7.4%	77.8%	14.8%	100%
	Totally agree	0.0%	0.0%	30.4%	69.6%	100%
	Total	1.9%	9.3%	51.9%	37%	100%

In Table 3, the association between satisfaction when the teacher responds adequately to some observation in the development of the electricity subject applied during online learning can be evidenced (IS1) and the confidence generated by the teacher in the virtual classroom of the developed subject (ICA1). As shown, 1.9% of the students who disagree with the ICA1 indicator state that they neither disagree nor agree with the IS1 indicator. Likewise, of the 37% of those who indicated that they fully agree with the ICA1 indicator, 14.8% agree with IS1 and 69.6% agree that they fully agree with IS1. Similarly, of the 51.9% of those who indicated that they agree with the ICA1 indicator, 30.4% fully agree with IS1 and 77.8% agree with IS1. While of the 9.3% who state that they neither agree nor disagree with ICA1, 7.4% agree with IS1, 66.7% agree that they neither agree nor disagree with IS1 and 100% disagree with IS1. Table 4 shows the percentage association between the IS2 and ICA2 indicators.

Table 4. Cross table between IS2 and ICA2

	ICA2	Strongly disagree	In disagreement	Neither agree nor disagree	Agree	Totally agree	Total
IS2	In disagreement	100%	0.0%	100%	0.0%	0.0%	100%
	Neither agree nor disagree	0.0%	33.3%	66.7%	0.0%	0.0%	100%
	Agree	0.0%	0.0%	3.7%	88.9%	7.4%	100%
	Totally agree	0.0%	0.0%	0.0%	30.4%	69.6%	100%
	Total	1.9%	1.9%	5.6%	57.4%	33.3%	100%

In Table 4, the association between satisfaction when the teacher quickly absolved before any question or concern about the electricity subject applied during online learning (IS2) and security with the class sessions of the developed subject can be evidenced (ICA2). As shown, 1.9% of students who strongly disagree with the ICA2 indicator disagree with the IS2 indicator. Likewise, of the 33.3% of those who indicated that they fully agree with the ICA2 indicator, 7.4% agree with IS2 and 69.6% agree that they fully agree with IS2. Similarly, of the 57.4% of those who indicated that they agree with the ICA2 indicator, 30.4% fully agree with IS2 and 88.9% agree with IS2. While of the 5.6% who state that they neither agree nor disagree with ICA2, 3.7% agree with IS2 and 66.7% agree that they neither agree nor disagree with IS2. Furthermore, 1.9% who disagree with ICA2 state that they neither agree nor disagree with IS2. Table 5 shows the percentage association between the IS3 and ICA3 indicators.

Table 5. Cross table between IS3 and ICA3

	ICA3	In disagreement	Neither agree nor disagree	Agree	Totally agree	Total
IS3	In disagreement	100%	0.0%	0.0%	0.0%	100%
	Neither agree nor disagree	0.0%	100%	0.0%	0.0%	100%
	Agree	4.2%	0.0%	79.2%	16.7%	100%
	Totally agree	0.0%	0.0%	11.1%	88.9%	100%
	Total	3.7%	3.7%	50.7%	51.9%	100%

In Table 5, the association between the satisfaction of the help provision by the teacher during the online learning of the applied electricity subject (IS3) and the kindness transmitted by the teacher during the online learning can be evidenced (ICA3). As shown, of the 3.7% of the students who indicated they disagree with ICA3, 100% disagree with IS3 and 4.2% agree with IS3. Likewise, of the 51.9% of those who indicated that they fully agree with the ICA3 indicator, 16.7% agree with IS3 and 88.9% agree that they fully agree

with IS3. Similarly, of the 50.7% of those who indicated that they agree with the ICA3 indicator, 11.1% fully agree with IS3 and 79.2% agree with IS3. While of the 3.7% who state that they neither agree nor disagree with ICA3, 100% agree that they neither agree nor disagree with IS3.

3.2. Discussion

The results show a high level of student satisfaction with the implementation of the virtual teaching technology tools during the online learning of the applied electricity subject, finding the perception of reliability with 93.05%, that of security with 93.2%, that of answer's capacity with 90.73% and empathy with 82.87%. Satisfaction with the implementation of virtual teaching technology tools is related to the adequate and accessible use of simulation software during online learning, which allowed compliance with the syllable. At the same time, the students feel a great satisfaction of security and trust when the teacher is willing to help them in the use of the simulation software, responding to it appropriately and quickly. Likewise, satisfaction is related to the teacher's sample of concern towards students regarding their academic needs and their interests expressed during the online learning of the applied electricity course.

In accordance with the aforementioned, in [27], [28] it is specified that it is preponderant and relevant for teachers to develop skills with respect to the use of digital tools, they point out that these skills must be linked to the so-called soft skills since these directly influence satsifaction of the student in virtual teaching and learning environments. Thus, my findings also coincide with those indicated in [29], since it establishes that the perception of students, although it is true, has not been diminished by the use of technological tools for the learning process, however both students and teachers, they have evolved significantly in developing their skills and abilities in the use of technological tools; and here I highlight that in the near future it would imply under this domain of virtual teaching tools to move to a hybrid-type teaching learning model.

As indicated in [30], the ability to transmit security in the face of the knowledge acquired through strategies and didactic tools incorporated in the teaching process is of great relevance to increase the level of student satisfaction by 50.6%, because these indicators directly affect the development and comprehensive training of the student in 25.8%. The analysis shows that the aspects of training or integral development, values and skills enrich the academic or professional trajectory of the students, being the use and management of technology an important factor in the perception of the student, since this reflects the academic quality of University. It is pointed out that e-learning technologies offer students control over content, learning pace, learning sequence, media and time so that they can personalize their experiences to achieve their personal learning objectives, being the fundamental interface design to enhance learning experiences and influence user perception of a complete learning process, complementary virtual tools create communication such as online discussion and interaction between teachers and students during teaching activities and learning, as well as among students, these activities being meaningful and interesting [31]. In this regard, in [32], it is specified that there is a self-sufficiency of students for the management of technological learning tools, whose scenario makes them feel capable of solving any problem during the teaching-learning process; however, the opinion of the students is that the mastery of the teachers with respect to these virtual tools, as well as the platforms offered by the university insights, are preponderant for the improvement of virtual learning.

The positive influence of strategies in virtual teaching is expressed in [33], [34] where it is concluded that the performance of students and the achievement of their cognitive skills at the level of application thinking has improved by at least 30%-40%. Due to the method of teaching through technological tools, which not only increases the understanding of the subject, but also encourages the creativity of students and improves their computational skills. Regarding the integration of technology in learning, in [35] it is indicated that it was achieved that students work independently and positively that guarantee success in teaching learning.

4. CONCLUSION

Educational systems must respond to the multiple challenges that the information society throws at them, always in function of a continuous enrichment of knowledge adapted to the demands of this new virtual context. The strategies and technologies that appear should be considered as additional tools, whose purpose is to improve, enhance, stimulate, motivate and favor the online teaching-learning process. In this regard, one of the permanent challenges for the teacher is knowing how to integrate technological tools in curricular planning and in the virtual classroom. We know that it is not an easy task and that it also has an added value, to properly select the material and didactic resources for the specific development of each subject. The results obtained support the didactic proposal made.

Since, more than 82% of the students are satisfied with the indicators of reliability, security, answer's capacity and empathy in the use of the technological tools of virtual teaching in the learning of the subject of applied electricity. Satisfaction is related to compliance with the syllable, to the accessibility of the simulation software, to the concern shown by the teacher regarding the academic needs of the students. Regarding the empathy indicator, 25.9% of the students indicate that the teacher's disposition should be improved to provide personalized attention to any query presented during the development of the subject. Given these results, it is necessary to establish the appropriate corrective measures, as well as a constant update of the methodology used.

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