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THE USE OF COMPUTER SCIENCE AS STRATEGY TO FACILITATE THE LEARNING IN THE DIFFERENTIAL AND INTEGRAL COURSE

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ABSTRACT
A lot of research in Education presents strategies for teaching Calculus in Universities, because this field of study leads to a large number of students failures This article seeks to show the results of using the software Graph 4.3 to plot graphs of functions during a course of Calculus at Fatec Itapetininga. We interviewed all the academic students during a semester, at two different times, and raised data to see how this method can contribute to this area of Mathematics learning and thereby decrease the number of failures. The final results indicated that most students of Technology Analysis, Systems Development and Technology in Agribusiness approved the teaching methodology and the use of the software.

Keywords: Calculus. Teach. Learning. Educational Software. GRAPH.

1.Introduction

Scenario of Differential and Integral Calculus course

Difficulties in learning the concepts of Differential and Integral Calculus are verified in most Universities and Academic Centers in the world. The common sense among educators is that the Calculus represents an obstacle in advancing academic curriculum of students of higher education courses. Countless discussion groups exist in the field of mathematics education that specifically seek to identify the main causes of the difficulty in understanding calculus and find solutions that solve or mitigate this scenario.

The Differential Calculus arose in the History of Science to solve problems facing humanity and that barred its technological and scientific development. The historical moment of the eighteenth century presented an European society in technological development, and the patterns of cause and effect to be passed to important advances in the technologies. Thus, mathematical tools were necessary, within a natural Philosophy that dealt with Continuous as opposed to Discrete and Countable of earlier centuries.

Soon after the presentation of the Differential and Integral Calculus with Newton in England and Leibniz in France and Germany, the general scientific community took to accept the new mathematical techniques. Previously, algebraic mathematics and statics, allowed data to be found correctly, without resorting to continuous partitions, dynamic and infinite, as says Bardi (2008). With Calculus the world of knowledge changes and the transformations of Scientific Academy didn't follow the same speed, this fact was caused by delays in paradigms. Some renowned researchers, at the time, denied the statements obtained from the calculus for more than ten years after its discovery.

But if even renowned scientists took time to accept the epistemological tools of Differential Calculus, what can one say about our students? If Mathematics needed, since its early records with Euclides in 400 BC, about 2100 years to accept and explain Calculus thought by Archimedes a little earlier, how can one ask to our students, that also, use the static algebra of school mathematics from Elementary and High School, if they can understand, in a short time, this new dynamic Mathematics that Calculus attempts to present? If in the History of Science, Calculus took a long time to break some paradigms, in Education the learning of student also needs time to allow a conceptual change.

In higher education, according to Lopes (1999), Differential and Integral Calculus operates in different areas, such as: Engineering, Chemistry, Physics, Biology, Economics, Computer Science, Social Sciences, Earth Sciences and Business Administration. It allows the systematic analysis of models that lead to decision to provide, calculate, optimize measure, analyze the performance, estimate and develop efficiency standards that benefit the social, economical, technological and humanistic development in several countries.

It is observed that most students of Higher Education, although they originate from a High School, where the Mathematical knowledge is offered in a ready and finished way, they also use in their daily life, Computer science tools. And do through a tacit knowledge, acquired through trial and mistakes, in which the computing experience does not necessarily lead to the same negative effects of bad grades that lead to low self-esteem. Presenting a wrong answer on a Math test puts the students in embarrassment, facing the classroom and society. It makes them to internalize the concept of failure, taking months to try to recover their grades in the next evaluation and bearing with an emotional anxiety. On the other hand, in Computer Science, on daily basis, for example, making mistakes entering an address on a website of searching does not show the same result in their overwhelming emotions, and can be corrected just retyping it, in a few second.

Therefore, our students are accustomed to the cause and effect phenomenon, to continuous and immediate phenomenon and infinite and partitions phenomenon. In other words, our students have all the necessary concepts to understand the Differential Calculus, but they are not in Math School, they are, everyday, on dynamics speed of Computer Science, as a way to operate a computer and obtain, with pleasure, what they search for. The students don't think anymore that, pressing a mouse button on letter X, an application closes on the monitor, making another that was open to appear. This process does not cause any conceptual discomfort, but, also, they don't understand how can give a number to the variable X of a function and have another number to return as an answer. The students open many pages at the same time when they are searching, and make selections and centralize what they want on Internet, but can't search roots of graphics functions, making partitions and finding zeros. The students at home open a search page in an election site and see that their candidate presents a graph with stronger growth than the opponent who will overcome, but they can't understand what the derivate means as rate of growth or decreasing functions.

According to Guimarães (2002), using computer simulation approximates the mathematical reality, showing in the classroom, that the examples are less artificial. In addition, the focus of Education is on modeling and not on algebra, because the computer provides easy geometry viewing for decision making, integrating geometric and numerical part of the discipline.

The use of software for teaching graphics function, according to Barbosa (2012), coupled with the teacher's role, not as a mere transmitter of knowledge, but as a motivator and mentor, should lead to a better learning performance. The authors developed a research, and submitted groups to the same Math content, another one to computational environment to build graphics and other in the traditional model, with notebook. In applying similar evaluations for these groups, they obtained better results than the same number of students, who manipulated software during the classes and have noticed this methodology as a facilitator of learning.

In this case, this article aims of analyzing a teaching methodology of Differential and Integral Calculus, using the computer softwares in order to facilitate the visualization and understanding by students about the concepts and tools that employ this knowledge area.

2. METHODOLOGY

With the aim of analyzing the possibilities and advantages (or not) about the use of Computer Science for learning Calculus, this study sought to evaluate some classes from this area, using computers and verifying the students behavior . With the quantitative character, a questionnaire was made at the beginning of Lab classes and, a second questionnaire, at the end of the last class, trying to verify, through the simple statement of students, if there was greater motivation and understanding of the phenomenon of Calculus that occurred when analyzed graphs of functions.

For this, the subjects of this research were the students of Calculus from second semester of Analysis and Development System Technology Course (ADS) and from the first semester of Agribusiness Technology Course (AGRO) from FATEC of Itapetininga, from evening and morning period, in a total of 133 students. This corresponds, practically, to the total population enrolled in this curricular grade and this doesn't necessarily intended to be a representative sample of all Technology courses in the country, but a picture of the local situation and the current of what is happening in the discipline of Calculus. The generalization of the results to other higher courses and the application of similar methodologies for teaching Calculus are up to the reader.

The materials used were software open source called GRAPH, which was presented on the version 4.3, computers from Informatic Lab of FATEC of Itapetininga and Calculus Exercises list.

3. RESULTS

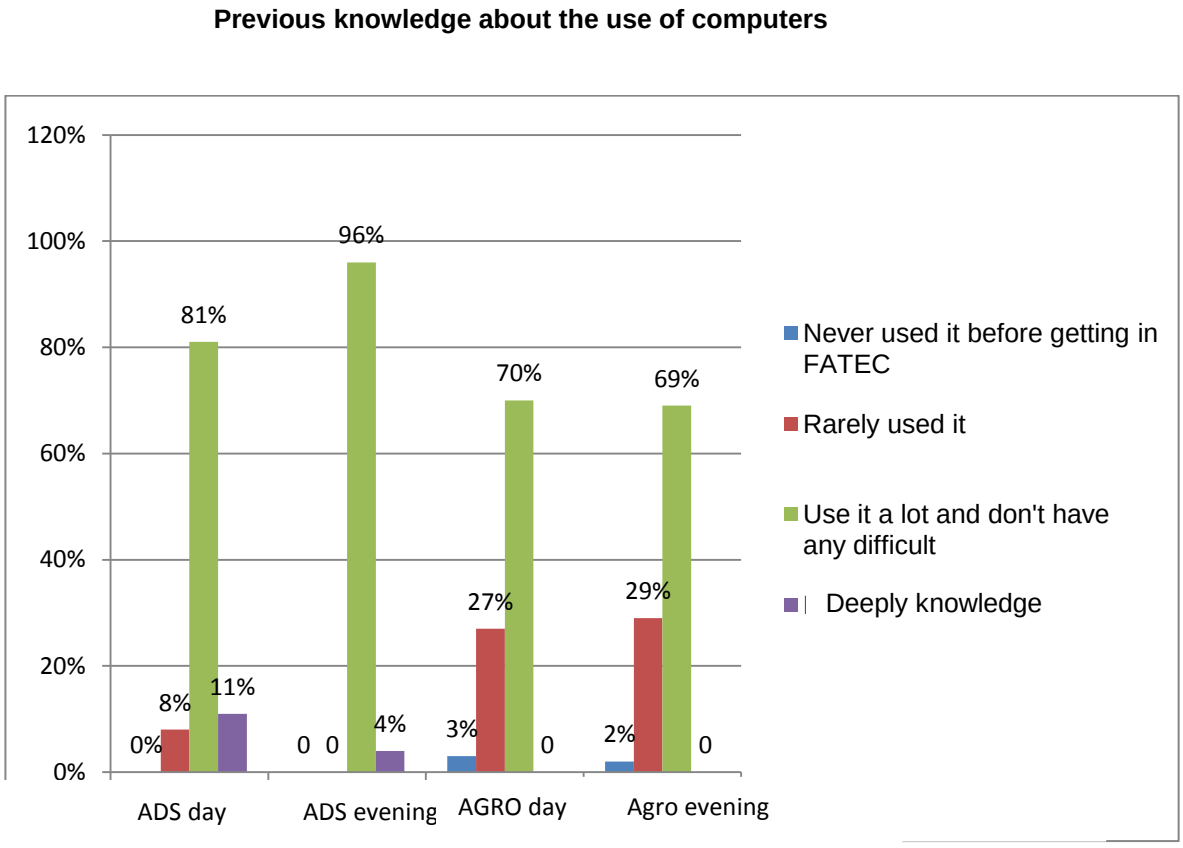
With the Calculus classes in the Lab, the students were invited to learn the working of software GRAPH 4.3. It has several tools to plot graphs of functions for modeling curves from a chart of data.

During the first class, the students were invited to plot functions from models, provided by professor, and from the graph produced by software, to adjust the coordinate axes, to put or take off crates, change labels and parameters, to find roots of functions, maximum and minimum, tangent, derivates, etc.

After the first class, a questionnaire was applied to the students to identify them and verify some relevant points as the importance or not of Computer Science as a tool of supporting the Calculus Course.

When we verify the previous using of computers at home, we obtained the presented answers on chart 1, which shows the common differences between the groups from Agribusiness, morning and evening period, and Analysis and Development System, also in the both times.

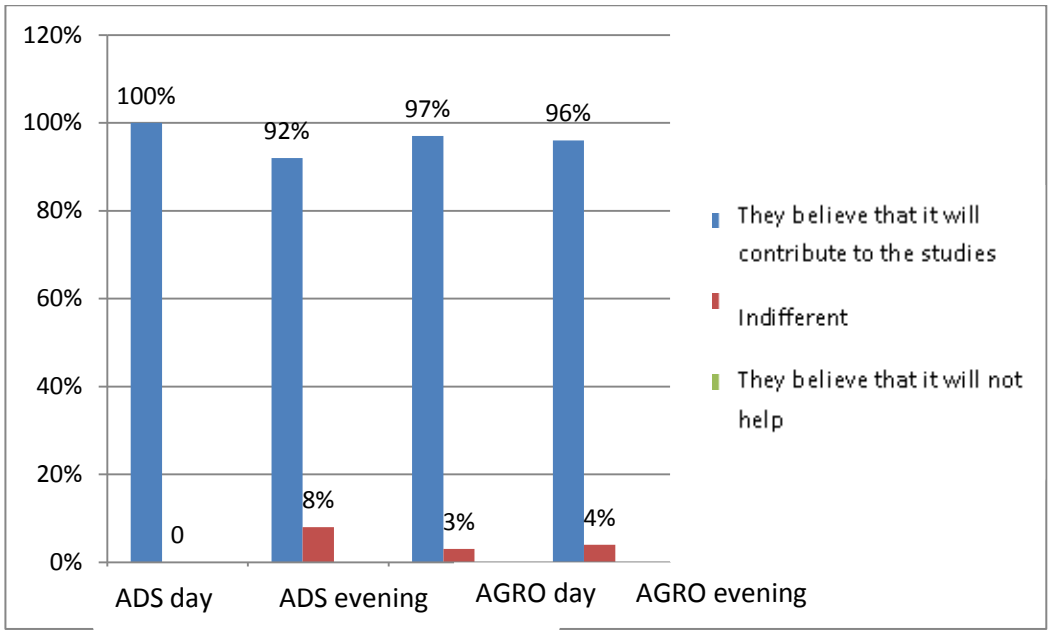
Chart 1 - Number of answers obtained by the students of 1st semester of Agribusiness and 2nd semester of Analysis and Development System from FATEC to the question about what are their previous knowledge about using computers (Source: VILLAÇA, 2011).



Even if the expectation would lead us to recognize that students who chose to study Analysis and Development System (ADS), already have contact with computers, it is surprising that in the course of Agribusiness, 3% of students that study in the morning and 2% of students from evening period never had contact with the computer before entering the FATEC. This is, somehow, a barrier to the use of software in Graph Calculus course, despite being a small number of percentage.

Soon, after using the software of Calculus in the Lab, at the end of the 1st class, the students expressed a positive opinion about the value of it. The same students had already done manually the graphs in their notebooks the month before, in a common process of drawing up graphs by junctions with coordinate axes and point their maximum and minimum locals. But, the display of graphs on the monitor, by the program, seems to have surprised positively the students, as shown on chart 2.

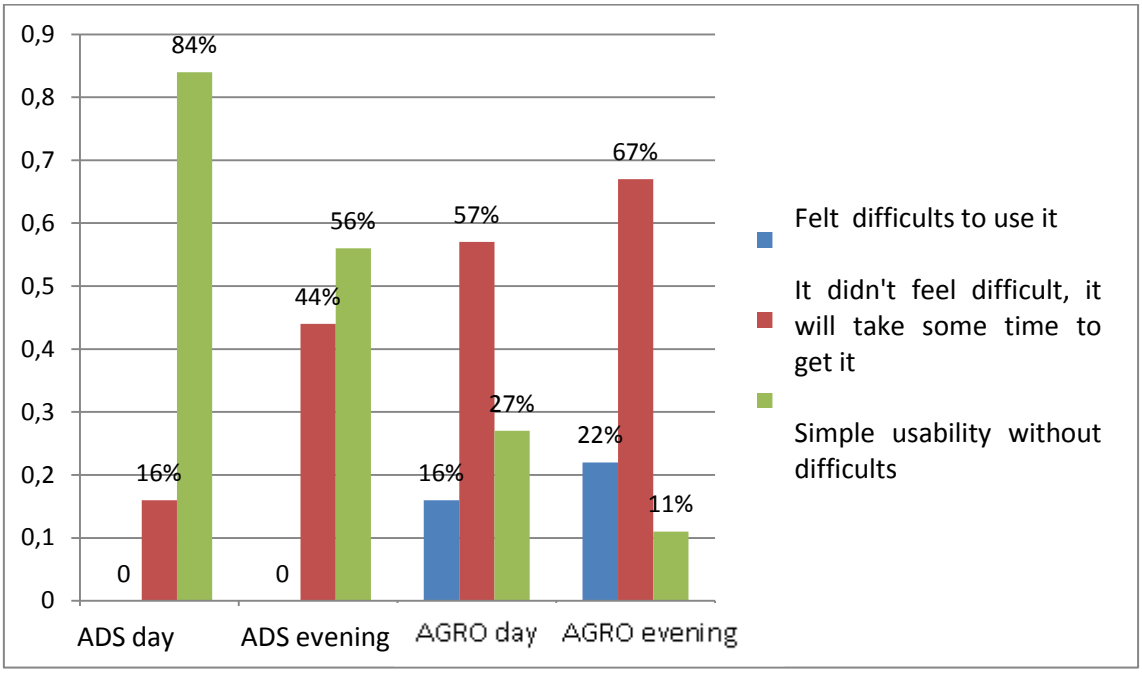
Chart 2 – Number of answers obtained through students from 1st semester of Agribusiness and 2nd semester of Analysis and Development System from FATEC in the question: " What was your opinion about the software Graph?" (Source: VILLAÇA, 2011).



The answers to this question on chart 2, show that, although few students believe the use of this software for learning of Calculus to be indifferent, none of them believed that its use would be confusing or mix up the learning, and most of students believe that the software can contribute with their learning.

But, when they were asked about how easy it was to use the software, the opinions were not unanimous. The results on chart 1 show that there were many students who rarely used the computer at home or even didn't use it. Therefore, it is possible to confirm the answers on how difficult or not the use of software Graph is, as shown on chart 3.

Chart 3 – Number of answers obtained through students from 1st semester of Agribusiness and 2nd semester of Analysis and Development System from FATEC in the question about their opinion on using Graph. (Source: VILLAÇA, 2011).

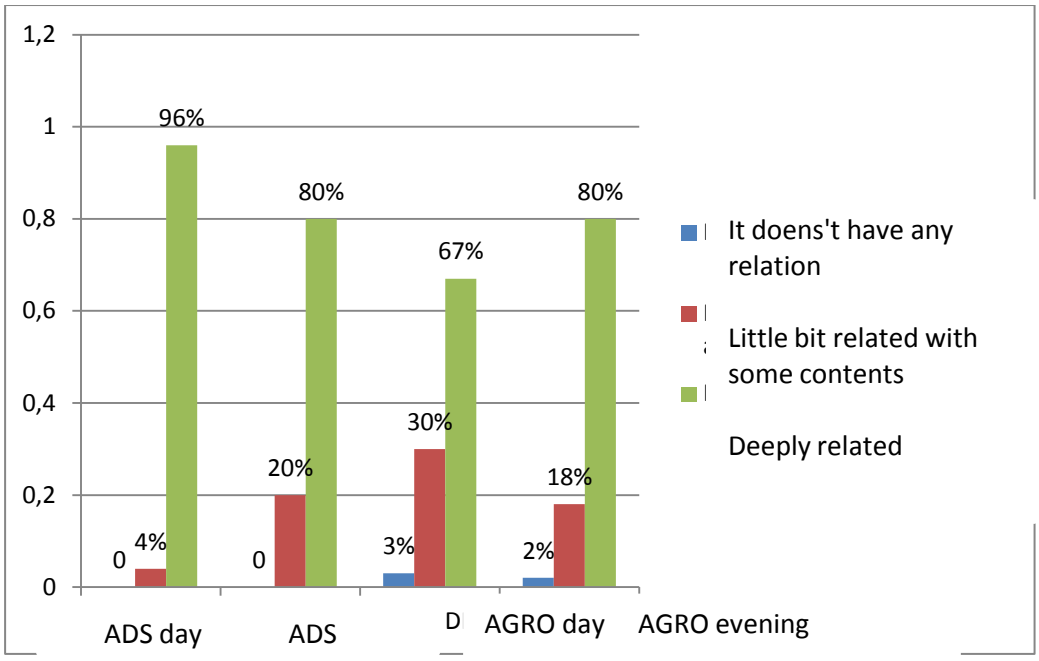


Some students of Agribusiness felt difficulties in using the Graph, as shown on chart 3, and no one of Analysis and Development System course pronounced the same. We can note, however, that most students said that they haven't felt difficulties or safely declared that the software is friendly, with a simple usability.

Also, it was important to investigate whether the students recognized on software Graph, and its relation with the course of Differential and Integral Calculus as a useful tool in analyzing problems and applicability. (Chart 4).

Chart 4 - Number of answers obtained through students from 1st semester of Agribusiness and 2nd semester of Analysis and Development System from FATEC about the relation of Graph with contents from calculus classes. (Source: VILLAÇA, 2011).

Relation of GRAPH with contents from calculus classes



Some students said that the Lab class didn't have any relation with the contents from classroom, but the percentages of 3% of students from Agribusiness daytime and 2% of students from evening time represent just one student in each classroom. It's a small number if compared to the universe studied, but, it is worrying from the didactic teaching standpoint, since the plotted graphs made on the first day of school were given to the students, few weeks before. The mismatch may mean that the student didn't understand about function graphs even with a method (classic, in classroom) and even with another one (use of the software), which requires another specific study of case, with qualitative method for these two individuals, and this was not the objective of this article.

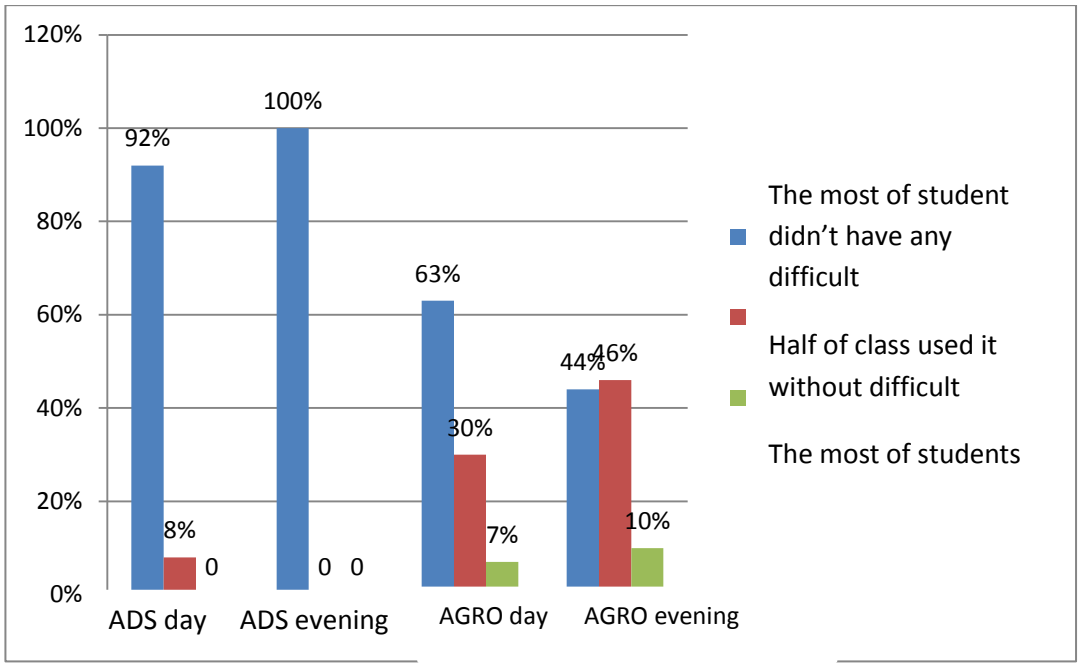
However, it is important to note that most students realized in the software an essential tool for understanding Calculus classes, observing the behavior of graphs when its parameters vary and visually recognizing the existence of maximum and minimum locals, that are essentials to take decisions within their respective work area.

During the second class in the Lab, using the software Graph in the course of Calculus, occurred few days after the first class. The professor resumed the construction of graphs through linear, polynomial, logarithmic, exponential and trigonometric functions. Moreover, a slope of the tangent was presented as a value of the derivate in some specific points and the maximum or minimum values as well. Finally, a points chart was used (fictitious data of temperature variation in a processor for ADS students, and a temperature of variation to manufacture the long-life milk for Agribusiness students. And it plotted in the Cartesian plan. Then, how it is possible to proceed to the curves adjustment through linear regression was showed, polynomial, exponential or logarithmic and to find out the correlation of coefficients.

The goal was to show the applicability of mathematical models in the respective courses and, next, how the Calculus tools allow decision making.

The students' perception about the learning of their classmates was observed. It was asked: In your opinion, do you believe that the classmates are facing difficulties in using the software Graph?", and we obtained the result shown on chart 5.

Chart 5 - Analysis of answers about students' perceptions about the difficulty of their classmates. (Source: VILLAÇA, 2011)



Finding any difficult of someone else can represent a way to express their own deficiency in Computer Science or a vision of that, often, the professor, when taking the position of knowledge, can not do it. This graph shows a result for students from ADS, but it shows an alarming fact that up to 10% of a class from Agribusiness has the perception that their classmates didn't understand the use of the software.

4. FINAL CONSIDERATIONS

As we can verify, the use of the software in the classes of Calculus represents an advancing in the teaching-learning process, but this educational methodology requires a planning for the use of appropriate operational procedures, that allows students to transpose barriers of Math and don't create other in the area of Computer Science.

Therefore, for the appropriate implement of software in the Calculus course, it is necessary that the professor, at the moment of his/her didactic planning, take into

consideration, the large number of users with heterogeneous characteristics, within the same group thus comparatively between different groups.

The usual methodology for teaching Calculus brings a historical baggage that doesn't refer to the use of softwares, it represents an educational barrier to the professor that needs to promote a cultural change among the students from the Institution. This process faces even in the complexity of evaluations process that attends the teaching technology and contemplates the classical concepts of Differential and Integral Calculus as the study of dynamic and continuous processes.

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