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TECHNOLOGICAL TOOLS IN THE ELECTRICAL ENGINEERING TO APPROACH STUDENTS TO PROFESSIONAL ROUTINE

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Abstract
This work aims to define and demonstrate the importance of technological tools in the teaching of subjects in the Electrical Engineering graduate course. A parallel between the theoretical contents and their practical applications will be done taking into account a curricular grid of the mentioned course, since some of the assignments of the engineer is to have skills and abilities to apply mathematical, scientific, technological and instrumental knowledge to the engineering. In the text will be addressed 3 tools that have various professional and didactic applications: MATLAB, Arduino and Lumine, as well as the importance of teaching these tools and the benefits acquired by the student when entering the increasingly competitive labor market. In addition, a survey was conducted to evaluate the students' opinions on the subjects of this work.

Keywords: Technological tools, MATLAB, Arduino, Lumine, Electrical Engineering.

INTRODUCTION

The economic development of a given country is directly related to the Engineering area. There is a significant relationship between the percentages of GDP verified for the sub-sectors of the economy and the offer of Engineering courses in each region of Brazil, as noted by Pereira et al. (2012) and can conclude that Engineering is one of the main factors of country's development and the Engineer is certainly an agent that fosters economic growth. This factor is decisive in the production of great added value goods or technological innovations, and weighs favorably in the trade's balance of any nation (Lobo & Silva Filho, 2012). However, the teaching in the undergraduate courses does not always follow market trends or the speed with which new technologies are created.

Universities and university centers must meet the demands of the national market. In order for the country to reduce regional discrepancies, it is necessary to invest mainly in the training of more and better engineers, always innovating and investing in order to provide the best training experience for the student. The student, in turn, must do his part too, always taking full advantage of the opportunities that are given to him. In the same way that technological innovations improve the production of a certain product or the accomplishment of a certain service, they can be used to improve the student's experience, bringing him closer to the professional environment and, in turn, stimulating him to use the new technologies and to act in the development of other advances. According to W. Brian Arthur, in "The Nature of Technology", "...new technologies appear by combining existing technologies and therefore could be said that existing technologies generate new technologies..." (Arthur, 2009).

An undergraduate course in the Engineering area needs to be constantly updating, seeking revisions in its curricular bases in order to integrate scientific and technological knowledge with economic and market knowledge. One way to achieve this integration is through technologies and tools that are used in practice and which, too, have great didactic value. To prove the above statement, this text will approach two computational tools and a device that assist in the course of graduation in Electrical Engineering, as well as its relationship with the course subjects, in a generic way. The choice of the Electrical area was given because it is an intrinsic part of the country infrastructure.

Matlab

During graduation, the student is introduced to a series of books to complement the learning process. Some are used by teachers as the course basic bibliography. Others are used as complements. However, a trend can be observed in the Engineering books: the addition of chapters and sections referring to the use of MATLAB.

MATLAB™ is a high-performance matrixing software (MATrix LABoratory). It is a set of tools developed to solve mathematical problems. It contains several specialized toolboxes, which are made by contributions from the developers of their manufacturer, Mathworks™, enabling the software to solve various functions and problems in different and specific areas of engineering (Duarte Filho, 2010). The MATLAB commands are closer to how we write algebraic expressions, making it easy to use. Currently, MATLAB is defined as an interactive system and a programming language for technical and scientific computing in general, integrating the ability to perform calculations, graphical visualization and programming (Tonini & Couto, 1999). This software is extremely important for the analysis of control systems, dynamic system modeling and process automation (Duarte Filho et al., 2013).

In the course of Electrical Engineering, which is the object of this study, several disciplines that deal with the analysis of electrical circuits use MATLAB for more efficient resolutions, calculations of demand and installed load, as well as the matrices that represent the electric flow during distribution and transmission of energy.

Arduino

Arduino is a set of electronic prototyping open source tools that simplifies the creation of electronic devices (McRoberts, 2011). Besides the controller card, it also has a development environment, so it is considered a platform and not simply hardware (https://www.arduino.cc/en/Guide/HomePage). To write Arduino codes in the software development environment (using the C/C++ language) we need just connect the card to the computer. The purpose of Arduino is the exchange of information, which leads to the improvement of existing technologies and the creation of new ones. With countless accessories and gadgets (sensors, meters and actuators), Arduino applications are virtually endless. The use of it is of extreme importance for the understanding of processes and operations, being an excellent approximation of what we see in real environment. Often, the Arduino is the student first practical contact, moving from basic projects and evolving to the complex ones. In addition, the cost of purchasing the platform and its components is relatively low.

Currently, several companies have their versions of Arduino due to the fact that the platform is open source. The principle of operation and purpose are the same, and some of them have software compatibility and it is possible to use the same program in different models. The subjects related to digital control, system modeling, robotics, digital electronics, embedded systems, among many others, require a practical element, something where theory is applied to obtain and analyze results. A great difficulty that can be observed in students is the visualization of results, understanding how an operation or process can interfere and change the final result and, in certain cases, how to prevent an unwanted change from occurring. In this sense, the Arduino presents itself with a strong alternative, because through its components students can experience in practice how such a procedure occurs.

Lumine

The development of electrical projects requires the experience and agility of the designer to make the same applicable. In order to improve the design of these systems, Lumine software, manufactured by AltoQi[1], assists in the development of the design as a whole, besides automating several stages of the electrical design, by means of generated reports that together form the descriptive memorial of the project, including the calculation of demand sizing, as well as several lists of materials, legends and single-line diagrams that support the execution of the project installation (Wolf & Stefenon, 2016).

In summary, the student of electrical engineering can emphasize the technical situations presented by the software, guiding the applicability of the technical norms, making a data approach. The project comprises the installation of lighting, power distribution, connection of electrically controlled and trigged elements and all other services necessary to the installations. He can apply what he has learned about the main elements and steps for designing it and some basic symbology concepts usually used in the projects, all in accordance with the requirements of NBR 5410-2004 (Brazilian Standard for Low Voltage Electrical Installations) (ABNT, 2017a) and IEC 60417 (Brazilian Standard for Graphic Symbols for building electrical installations) (ABNT, 2017b).

After finalizing the electrical project, Lumine shows a practical study for the planning of the operation of electrical systems that are demonstrated through illustrations of the main screens of the program and the results based on simulations realized through the tools available by the software. Thus the software can aid in the development of electrical projects, with which students of electrical engineering face specific disciplines and in practice, making the design and scaling of the project simpler and faster.

METHODOLOGY

In order to demonstrate the importance that MATLAB, Arduino and Lumine have for the undergraduate course in Electrical Engineering, a survey was done with 57 undergraduates from different periods. For the questions related to MATLAB and Arduino, 27 students were divided into two groups: the first group with 10 students from the first to fifth period, and the second group with 17 students from the sixth to the tenth period. For questions related to Lumine, 30 students who are in the middle of the course until the last period were surveyed. The research consisted of nine questions that were thought to check three main points: how much the graduate knows about the subjects and their willingness to know, for those who do not know; how was the experience using the tools and what is the importance, in the opinion of undergraduates, of teaching MATLAB, Arduino and Lumine in the graduation in Electrical Engineering.

These are the questions applied to the students as well as the answer options:

Do you know a tool called "MATLAB"?

YES ( ) NO ( )

1) If yes, rate how this tool has met your needs:

Very well: ( ) Well: ( ) I don't know: ( ) Bad: ( ) Very bad: ( )

[1] <http://www.altoqi.com.br/institucional>

2) If not, rate your interest in learning how to use it:
High interest: ( ) Some interest: ( ) I do not know: ( ) Low interest: ( ) No interest at all
3) Now, regardless of the answer to the first question, classify the importance of teaching this tool for the graduation in Electrical Engineering:
( ) Very important: ( ) Some importance: ( ) I don't know: ( ) Little importance: ( ) Not important at all: ( )

Do you know the "Arduino"?
YES ( ) NO ( )
1) If yes, rate how this tool has met your needs:
Very well: ( ) Well: ( ) I don't know: ( ) Bad: ( ) Very bad: ( )
2) If not, rate your interest in learning how to use it:
Much interest: ( ) Any interest: ( ) I don't know: ( ) Little interest: ( ) No interest at all
3) Now, regardless of the answer to the first question, classify the importance of teaching this tool for the graduation in Electrical Engineering:
( ) Very important: ( ) Some importance: ( ) I don't know: ( ) Little importance: ( ) Not important at all: ( )

Do you know a tool called "Lumine"?
YES ( ) NO ( )
1) If yes, rate how this tool has met your needs:
Very well: ( ) Well: ( ) I don't know: ( ) Bad: ( ) Very bad: ( )
2) If not, rate your interest in learning how to use it:
Much interest: ( ) Any interest: ( ) I don't know: ( ) Little interest: ( ) No interest at all
3) Now, regardless of the answer to the first question, classify the importance of teaching this tool for the graduation in Electrical Engineering:
( ) Very important: ( ) Some importance: ( ) I don't know: ( ) Little importance: ( ) Not important at all: ( )

RESULTS AND DISCUSSION

It is worth noting that in addition to the topics covered in this text, other tools are also available. However, during the analyzes made for this study, the selected items were the ones that were most relevant in their respective areas, taking into account the ease access to acquiring the tool, the robustness of their system and the integration with the curricular matrix of the undergraduate course in Electrical Engineering. When students have access to the aforementioned tools, improvement in performance is noticeable, showing that technology can be allied with education at all levels. We can observe this importance in the research's results. Graphs assembled from the answers obtained will be discussed below. It begins with the number of students who are aware of the topics covered in this study (figures 1, 2 and 3):

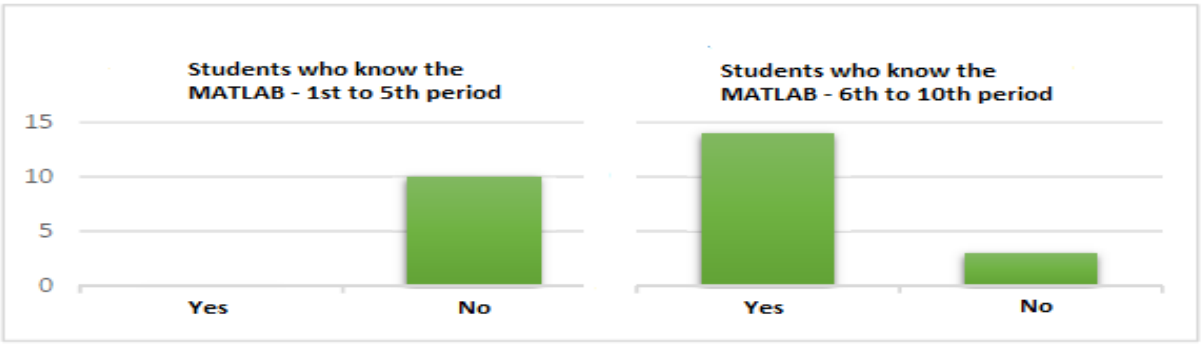

Figure 1: Graphic for questions related to MATLAB

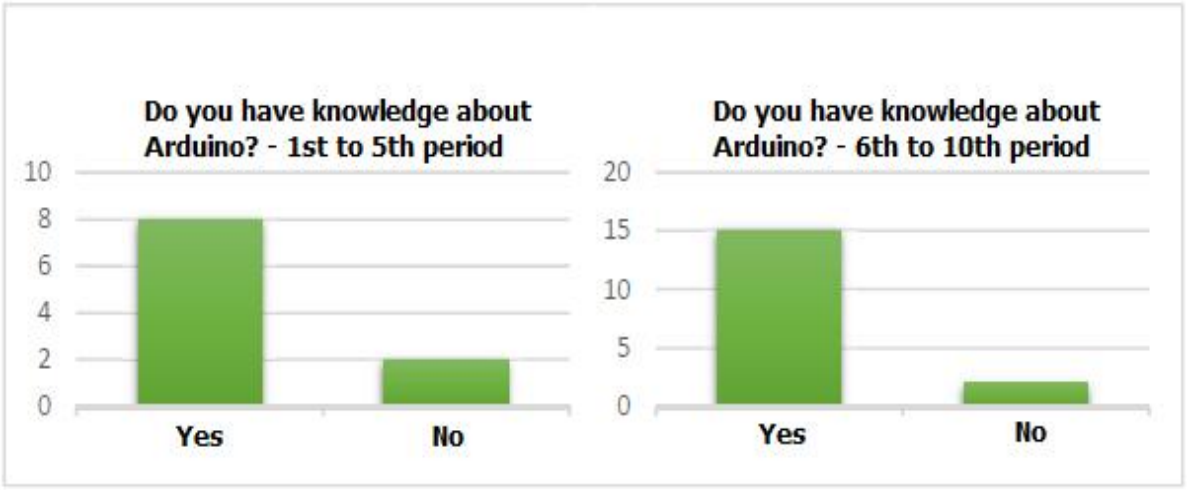

Figure 2: Graphic for questions related to Arduino

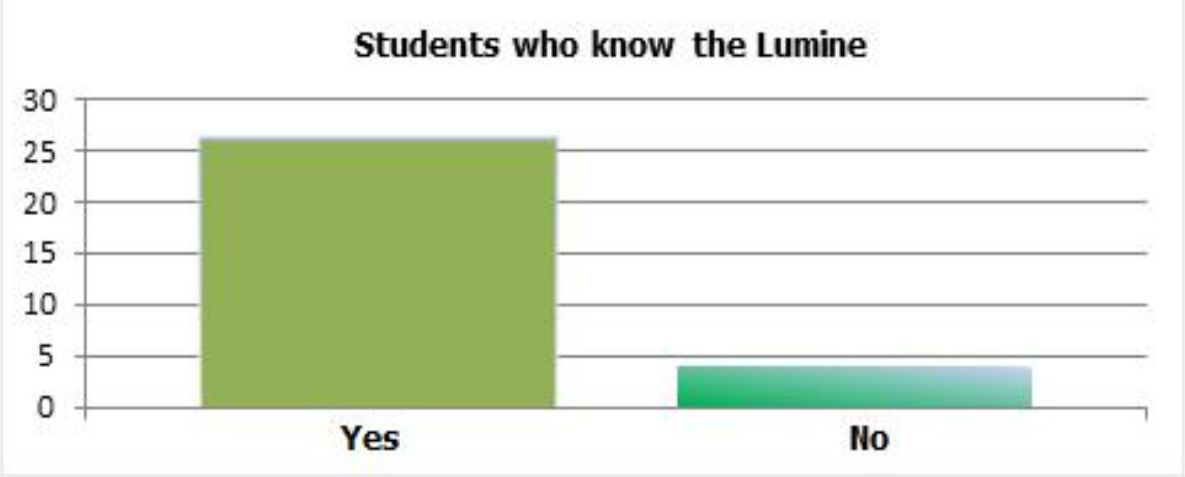

Figure 3: Graphic for question related to Lumine

With these graphs, two important trends were observed. First, students, even though they do not have a specific MATLAB class, get to know it during the course of the disciplines, especially when they enter the cycle of specific disciplines of the course, which shows that this tool is already incorporated into teaching and makes even more essential its mastery. Second, due to the fact that Arduino and Lumine are more focused on the practice and elaboration of projects, many students who have other previous training (a technical course, for example) already arrive at the graduation with knowledge about it.

Another relevant factor is the fact that the students who reported that they did not know or could not form an opinion about the subjects, expressed an interest in learning more about them, as can be seen in Figure 4. These students showed interest in learning, in order to get experience using the programs and the device. It was also observed that this trend occurred in students who are more advanced in the course, who understand that they will use these tools in their professional field (we did not observe the same effect in the students of the first periods).

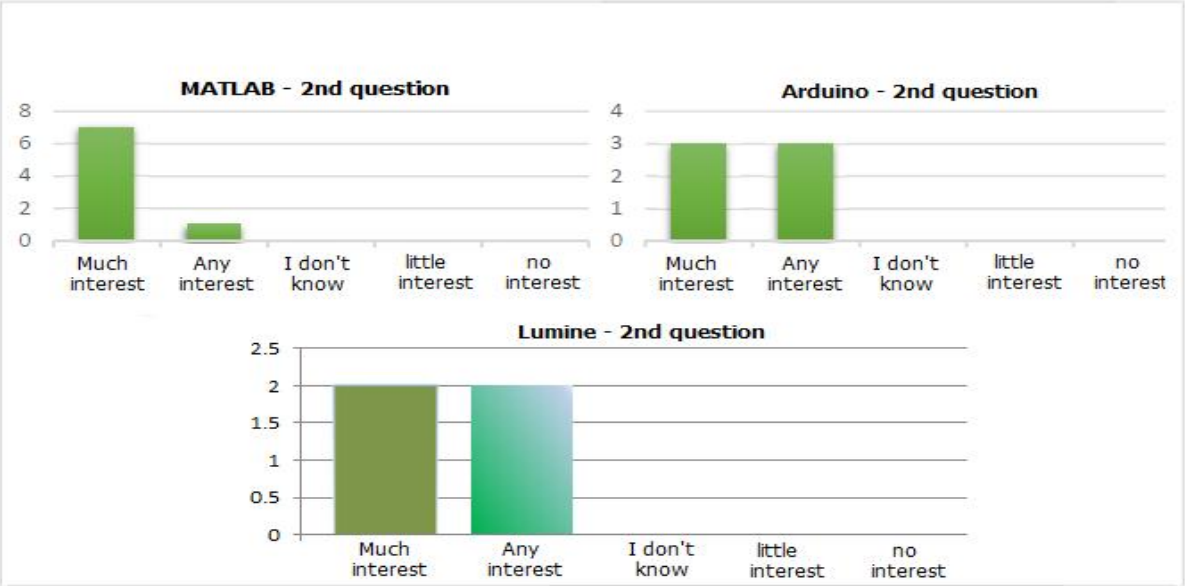

Figure 4: Graphic related to the second research question

To finalize this discussion, it can be observed from the analysis of the graphs of figures 5, 6 and 7 that there is a strong interest in learning about MATLAB, Arduino and Lumine, considering that these subjects are presented to students at all times. The students of the initial periods, which have not yet been presented in the specific bibliographies, still present some doubts regarding the importance of the themes (which can be seen in the left side of the graphs of figures 5 and 6).

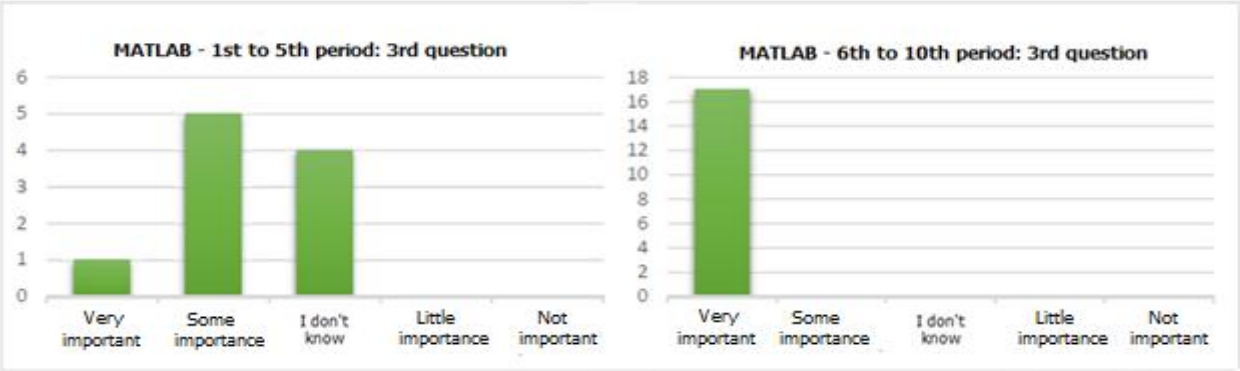

Figure 5: Graphic related to the third research question for MATLAB

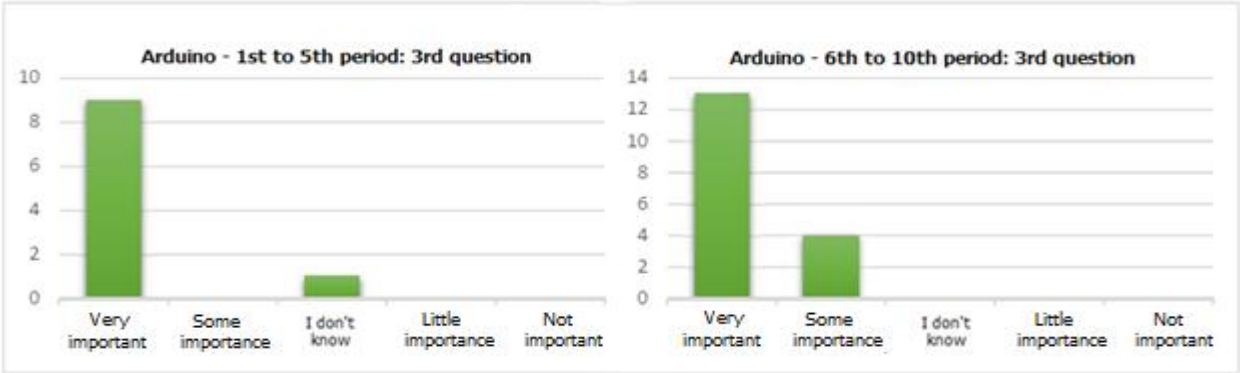

Figure 6: Graphic related to the third research question for Arduino

However, the way the more advanced periods students' responses are presented (which can be seen in the right part of the graphs of figures 5 and 6 and in the graph of figure 7) shows a change of thought, since part of the bibliography of specific disciplines introduces, for example, solved exercises and experiments for execution in MATLAB.

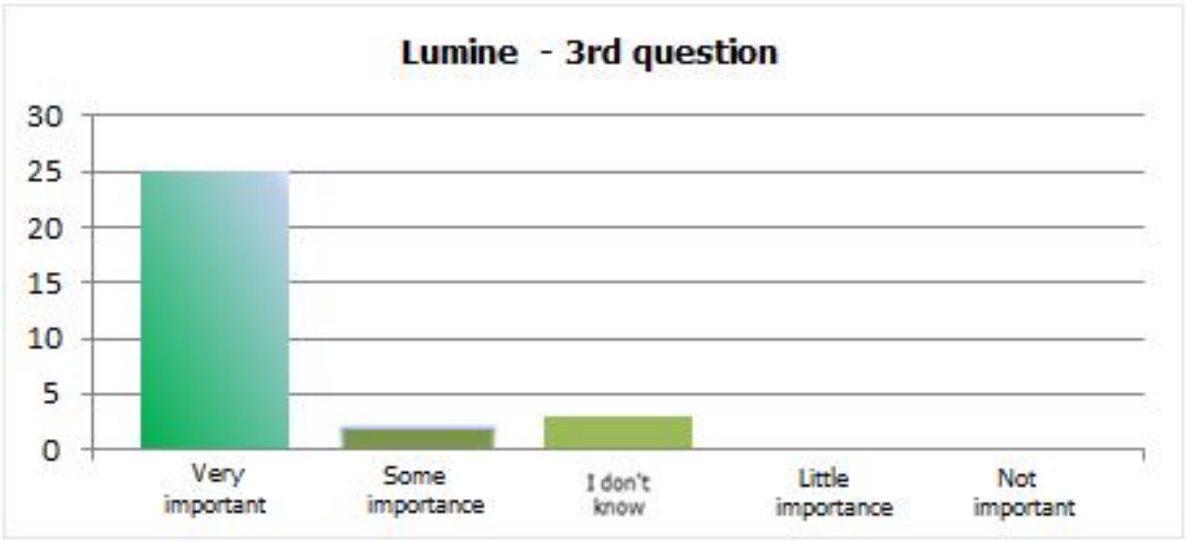

Figure 7: Graphic related to the third research question for Lumine

CONCLUSION

Unlike basic education, in higher education the proximity to the labor market is a fundamental factor because it can define how the student will be inserted in it after graduating, and helps even in the decision to continue in the professional field for the rest of his life. The university offers the student the tools to facilitate this insertion and helps in his professional growth.

This growth, which is also personal, can be observed in the way the graduate looks at the importance of using computational tools and devices that can add much to their training. Among these tools, those that have been detailed through the research shown in this work help to foster their intellectual growth to what will be required in the job market. It was evident that the students interviewed in the Electrical Engineering course understand that it is necessary to have the knowledge and know how to use MATLAB, Arduino and Lumine. This knowledge helps the student to choose which electrical area he or she will improve from among the many existing divisions.

In any case, bringing the student closer to the job market is a necessity nowadays, applying scientific and technological knowledge to engineering, teaching him to design and conduct experiments and interpret results, and to design and execute systems, products and processes; and any tool, be it MATLAB, Arduino, Lumine or other that helps in this process is of great value.

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