The approach of andragogy in a mechanical engineering course

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ABSTRACT

For adult students of Engineering courses, one of the greatest challenges is, through their successes and setbacks, creating a critical awareness through their experiences and continuing to seek more assertive conduct in the face of technical and human procedures in everyday life. Studies of this nature with the aim of understanding teaching and learning processes based on Andragogy, can contribute to the technical and human development of these adults during their academic training, but the studies limited, proving the need for further development in technological education. The strategy with a focus on Andragogy taken in a restricted universe, through descriptive methods of a qualitative and exploratory nature, through documentary analysis with bibliographic review. The use of a questionnaire with a target audience of adults between 18 and 30 years old, 51 students from odd-numbered semesters (1st to 9th) of the Mechanical Engineering course at the Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul – IFRS, Campus Ibirubá – RS, allowed an analysis of the profile of students and conceptions on the subject. In this direction of structures of thought and in search of answers and reflections, the data obtained were due to the possibility of structuring educational strategies based on Andragogy. Proposing a new teaching-learning relationships using active methodologies for adults in a meaningful way.

Keywords: Andragogy, Science, Education, Teaching, Learning.

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INTRODUCTION

While we live in the search for innovation, in order to aim for excellence that guarantees the quality of our educational actions, associating issues of planning, strategy and didactic organization within technological education becomes paramount. These issues facilitate the teaching and learning relationship of adult students, because from active methodologies with concepts based on Andragogy can be a way to add value to educational development and independence.

The major issue surrounding these educational practices is the fact that the target audience of this study is exclusively adult students aged between 18 and 30 years and, therefore, have considerable life experience. In other words, these adults have different experiences, with their successes and setbacks, which shape their perception of life resolution. In this way, they possess knowledge, which has been aggregated during their lives. In this way, they seek new experiences and new knowledge at school, building a critical and more assertive awareness of their actions in the face of everyday events (De AQUINO, 2007).

The trait that compares the development that matures the adult and the consequent autonomy guaranteed by him/her by his/her acts, derives from the actions taken according to the scale of the knowledge acquired and the knowledge aggregated in his/her cognitive structure. These define the best strategies to solve the problems that are pertinent to their daily lives. Human beings, in general, are led to develop social survival strategies, as well as to dignify proactive actions that solve their problems in order to keep under control what has been directed from their life learning. In the relationship between teachers and students, each of these actors presents a certain level of involvement, considering their responsibilities that are intrinsic to their personality. Andragogy refers precisely to acting at the center of this pre-established relationship, with a directional focus on learning between these parts.

The practice of andragogical teaching methodologies, which privileges the increasing level of learning desired among teachers and students, tends to generate greater cognitive viability in the relationship between the parties involved. With the expansion of the use of active methodologies from Andragogy, it is possible to generate an adequacy of learning styles among the group of students that will certainly promote new relationships in the learning processes. . Same

According to the propositions of Aquino (2007) and the andragogical considerations defined by the theoretical model of Knowles (1980), it is possible to assess that the following reflections are developed in these relations of the teaching-learning precepts between teachers and students: how do these adults develop to manage their actions within society? How, in fact, do the students' independence and direction apply to the activities carried out within the course developed? How is it possible to notice the conceptual correlation of the acquired knowledge? The answers to these questions will provide proposals for the use of educational practices between the teaching-learning

relationship, in which the personal and professional development of these adults will be created, which this study proposes to discuss.

The proposal, from a constructivist and andragogical perspective, aims, in a coherent way, to contribute to teachers and students dignifying their new ideas and experiences, in order to stimulate the development of their creativity, proactivity and dynamics. With these practices, in view of the presentation of the use of active methodologies for problem solving, the development of their autonomy and the strengthening of their respective human capital are prioritized.

It should be noted that the general objective of the study is to carry out a research referenced in the methodology in the respective target audience, which indicates the necessary actions to direct the proposals for the use of active methodologies to be applied, based on the Andragogy approach. Regarding the specific objective, it follows the tabulation of the research data applied with the use of questionnaires and, in this way, provide alternatives for the development of teaching, research and extension actions on campus. Finally, following the proposed objectives, it seeks to disseminate the andragogical culture within the academic community.

THEORETICAL FRAMEWORK

Andragogy, in its conception of meaning, was first used in Germany in 1833, by Professor Alexander Kapp, and described teaching in the education of adults. In 1921, still in Germany, Professor Eugene Rosenstock used the same term and arguments when teaching his adult students. The term became familiar in the United States with the thoughts of Eduard Lindeman and, around the 1960s, other countries began to refer to the significance of Andragogy, among them: France, the former Yugoslavia, and the Netherlands (BEZERRA, 2021).

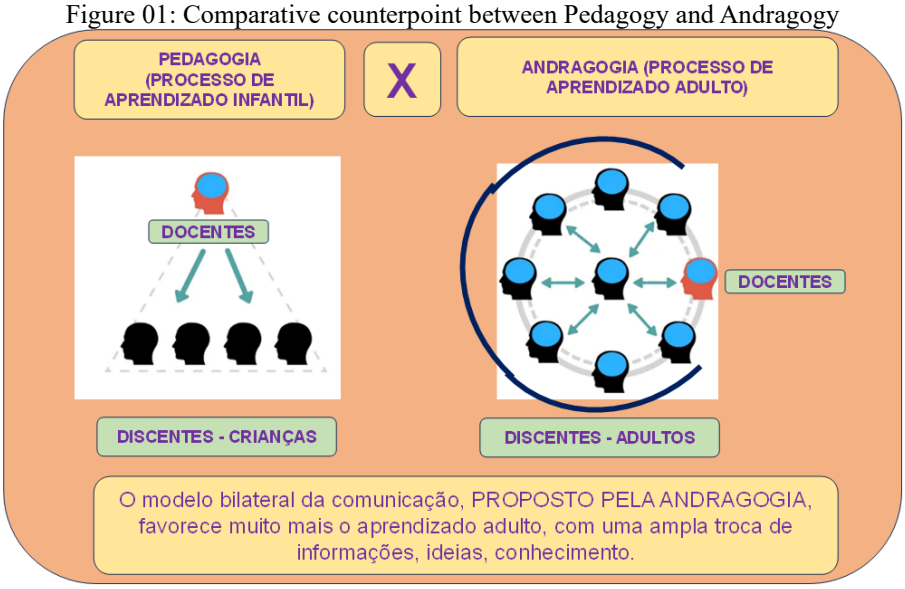
The term gained popularity as a theory from 1970, based on several works published by the American educator Malcolm Knowles, influenced by Lindeman's studies on adult learning. He introduced and defined a meaning for Andragogy, as being the art and science of guiding adults to learn. Because of this, he came to be considered by many the "father of Andragogy", as he is still one of the main references on the subject. (VOGT & ALVES, 2005).

In recent decades, the relationship between the world of work and professional education and schooling has undergone numerous changes. Because of this, the adult student needs a professional education that enables the development and adaptation to new technologies. Professional and technological education (EPT) is considered an educational modality provided for in the Law of Guidelines and Bases of National Education (LDB) and aims to prepare students for the "exercise of professions", contributing to the student's insertion in life in society and in the world of work (EPT, 2023).

Educational methods based on the theory of Andragogy can be an alternative in order to develop in the adult student the appropriation of knowledge, incorporating new knowledge to their life experience, and they will act in a significant way in their area of training. In order for the issue of adult learning to become significant, in addition to students having a predisposition in relation to technical education, an educational environment that fosters this frank development is essential.

The use of the andragogical model is in line with valuing the relationships between educator and learner. Thus, the details of the relationships between these parts are privileged within teaching-learning, which refer to the construction of knowledge based on new knowledge. What illustrates this difference in applicability to the pedagogical model is shown in figure 01:

Figure 01: Comparative counterpoint between Pedagogy and Andragogy



Source: AUTHORS, 2023.

With this horizontal orientation, the andragogical proposal revolves around the fact that the adult himself is, in fact, his only root structure in the significant construction of his knowledge and acquired knowledge.

For Bezerra (2021, p.18), "adults, in a crescent in their lives, accumulate experience, which is an important factor for the development of their learning. For this reason, in educating adult learners, a principle of valuing the learner's autonomy is created." These factors derive from their daily experiences, which in no way can be disregarded in the teaching-learning relationship that is predisposed between teachers and students.

In contrast to the pedagogical application, Andragogy is much more related to the daily life of the adult human being than to the essence itself, by virtue of taking advantage of its life passages for the creation of its knowledge (NOGUEIRA, 2004).

In fact, there is still a lack of studies that dignify the application of Andragogy in EFA that can consistently offer a broader scientific basis on the subject. However, it is possible to be guided by the

historical precepts that come from Aristotle, Plato, Ancient Greece and Confucius in China, illustrious didactics who were "teachers of adult people". Notable teachers mentioned above came to develop in a dominant way, as can be seen in the process of formal education, the application of their concepts in a different way in the teaching-learning relationships between teachers and students (KNOWLES, HOLTON, SWANSON, 2009).

In the current contemporary context, the andragogical approach is recognized as essential for the permanent development of the adult, because in EFA it makes the adult learner more participative in society, raises their self-esteem, transfers scientific and technological knowledge, identifies themselves as a social being (ARAÚJO et al, 2015).

The adult learner in andragogical education will need to realize how his/her learning objectives, as well as the teacher, should involve them in a mutual process of construction and interaction in which educational needs are both respected and considered.

It is believed that one of the relevant challenges of the teaching practice regarding the development of the teaching-learning relationship is the planning of active educational strategies that promote the learning of new knowledge and knowledge in a simple, direct and objective way. Considering the great diversity of the adult spectrum contained in the classroom in terms of personal characteristics, such as age, life goals, different professions, knowledge and, above all, maturity. According to Filatro (2015, p. 35), maturity in the adult learner is defined as being:

> [...] The adult learner is fundamentally characterized by self-direction resulting from an organic and psychological maturity. In other words, in order to be an adult, the individual has reached a stage of physical maturation (readiness), which gives him the ability to reproduce, as well as a stage of psychological maturation, which enables him to assume responsibilities for his own life, in the social, professional and family spheres (FILATRO, 2015).

In this sense, the study reveals that didactics and its application in the education of adult students, through various proposals of methods with active teaching actions, should and can be used by the teacher in the place of learning, so that the contents from the abstract to the concrete can be manipulated. In fact, an active method in the application of Andragogy becomes aimed at the participation of the majority of students, which will corroborate the fulfillment of the pressing and specific needs of each adult learner at this time. The teacher, due to his own and dignified horizontal position with the students, understands the other adult, in his cognitive construction, demonstrating the application of Andragogy, because he acts in this stage as a facilitator figure through dialogue, mutual respect between individuals and stimulates the collaboration and trust of all within this teaching-learning process.

Thus, active methodologies are presented as an alternative in the teaching-learning relationship. The students, with their autonomy, develop in a participatory way the resolution of real

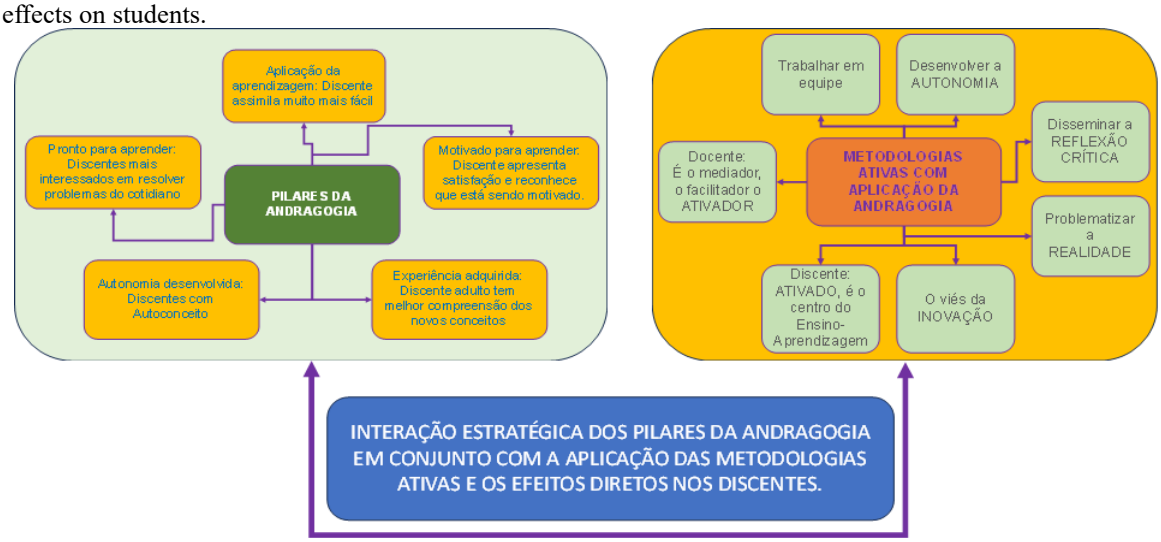
problems of their daily lives and present, then, a relationship of connectivity in a realistic way in their contemporaneity.

Following this idea, we can rely on the basic principles of Andragogy to facilitate the teaching and learning process of adults, which according to Bezerra (2021, p. 33),

> The need to know, where the adult needs to know because they must learn something before they can actually start learning. The learner's self-concept, where the adult is responsible for his own decisions and for his life, therefore the learner depends on himself. The learner experience, where the learner's previous experiences provide a wealth of resources for learning. The readiness of the learner, where the adult is willing to learn, when the occasion requires some type of learning related to situations in their daily lives. The orientation to learning, where the adult has his temporal perspective focused on the immediate application of knowledge and, in this way, his orientation to learn is focused on real-life situations, and his daily life. And finally, motivation, where the motivation for adult learning is more internal than external (BEZERRA, 2021, p. 33, emphasis added).

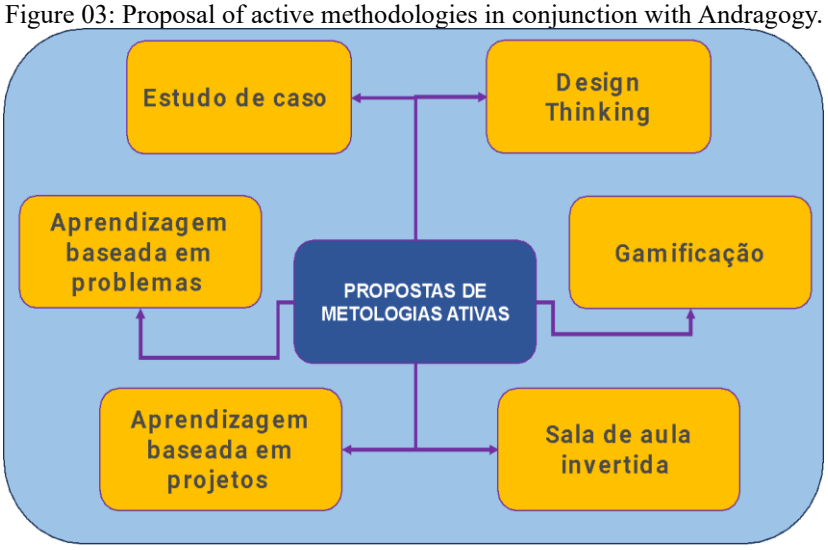
With this, the applicability of these active methodologies is the benefits of a more critical and developed formation of students in order to work collaboratively as a team, in addition to respecting all the individualities conceived in the life of each adult. In a way, we summarize in figures 02 and 03, the active methodologies that can be applied together with the principles of Andragogy.

Figure 02: Strategic interaction of the pillars of andragogy together with the application of active methodologies and the direct effects on students.



Source: AUTHORS, 2023.

Figure 03: Proposal of active methodologies in conjunction with Andragogy.



Source: AUTHORS, 2023.

METHODOLOGY

In order to understand the answers obtained through the questionnaire, a structured theoretical basis is relevant. For this, we consider Gil (2008, p. 178), since "the researcher needs to go beyond the reading of the data, with a view to integrating them into a broader universe in which they may have some meaning". In this way, it is in line with the theoretical knowledge built in the course of this research, and the data obtained are related to the application of the questionnaire and the theory that studies adult learning, in order to obtain analyses in a more reliable way.

This study is configured with descriptive methods with a qualitative and exploratory approach, in addition to the search to demonstrate the educational area that aims to understand the learning process of the adult student. To promote reflections that allow a more accurate look at the psychological, biological and social aspects of Andragogy within technological education. Such studies are appropriate when we consider the teachings of Eduard Lindeman and John Dewey (1926), as they argued that a committed school is one in which the teacher's performance provides the connection of school subjects with the students' interest, in which practice and theory would lead the student to the development of scientific thinking.

The strategy adopted employed the literature review method, in addition to the use of the questionnaire technique with 51 students from the odd-numbered semesters (1st, 3rd, 5th, 7th and 9th) of the Mechanical Engineering course at the Federal Institute of Education, Science and Technology of Rio Grande do Sul – IFRS, from May 16 to July 17, 2023, at the educational unit of Ibirubá – RS. The data collection instrument used the operational procedure of the questionnaire-type research technique, which fulfilled two basic objectives, according to Richardson (1999), namely the description of the characteristics of the investigated group and the degree of perception of the group in relation to the theme studied.

The data collected during the implementation were analyzed and interpreted using qualitative analysis techniques. Aspects such as students' involvement with study techniques, familiarization of the term Andragogy in higher education and students' conception of engineering training were evaluated. The results are arranged in two distinct sections, the first being aimed at the students' informational data and the second using the semi-structured questionnaire to assess the students' perceptions in relation to the research theme.

In this stage of the field survey, open and closed questions were applied to the students participating in the study in order to ascertain the previous conceptions, in addition to considering the importance of respecting the experiences and knowledge lived by the students (FREIRE, 2015). With the data collected, the analysis procedures were carried out with a broad analytical strategy, establishing priority factors of what to analyze. The qualitative research studies by Miles and Huberman (1994 apud GIL, 2008, p. 175) "present three steps that are generally followed in data analysis: reduction, display, and conclusion/verification" to contemplate the proposed objective.

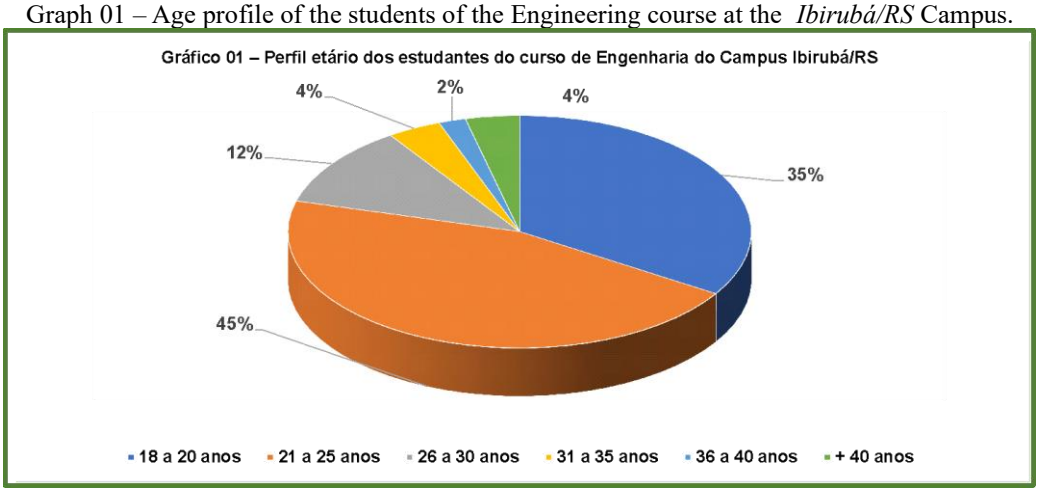
RESULTS AND DISCUSSIONS

We considered observing the informational data because they are pertinent to the research, highlighting a look at the characterization of the age profile of the interviewees and their percentages that represent unique aspects of the student body. When analyzing the students who are studying Mechanical Engineering at the Federal Institute, Ibirubá campus and who participated in the research, an age profile between young people and adults is noted. The importance of didactics in Andragogy is justified, since the teacher facilitator needs to be attentive to connect as a member of the group and never as an authority. You must demonstrate that you are open to joint participation with the students and take the opportunity to understand the best educational resources, in order to facilitate the teaching and learning process of the group. Graph 01 shows the age profile of the students involved in this study.

INFORMATIONAL DATA

When analyzing the data in the context of technological education, it is verified that it represents 47.06% (24 students) aged between 21 and 25 years; 35.29% (18 students) between 18 and 20 years old and 11.76% (06 students) between 26 and 30 years old. This shows that these are young/adult students and workers, as they chose training in the scientific and technological area during the night period, indicating that, possibly, they already work in their respective areas of knowledge. Therefore, they possess and bring their own experiences and knowledge of reality into the academic environment.

Graph 01 – Age profile of the students of the Engineering course at the *Ibirubá/RS* Campus.



Source: AUTHORS, 2023.

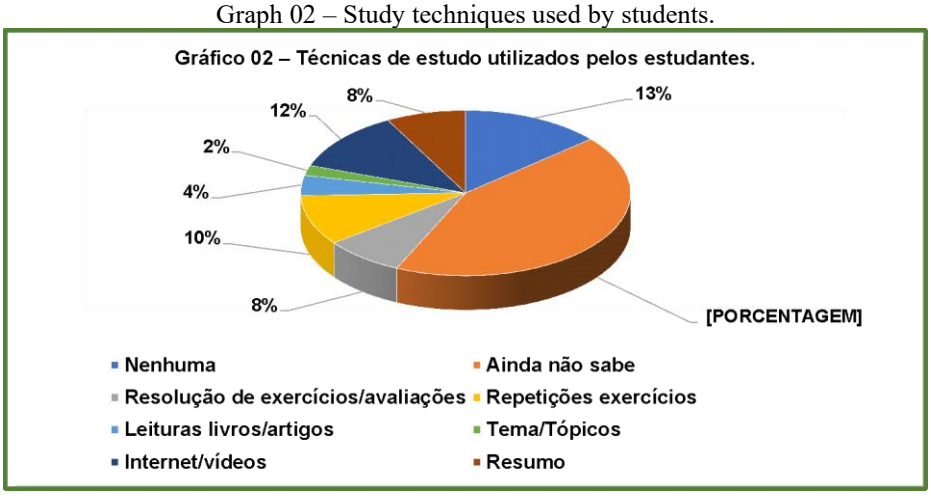
They correspond to young/adult student-workers who learn from their own mistakes and successes, realize when they don't know and are aware of how much the lack of knowledge harms them. In this sense, the school curriculum must be aligned according to the needs of adult students, as they are independent and self-directed individuals, and the form of teaching and learning based on Andragogy can contribute to human development, in the personal, professional and social dimensions during their academic training.

QUESTIONNAIRE DATA

With the help of a questionnaire, we tried to understand the students' conceptions in relation to the proposed theme, enabling the student to understand the relevance of the adult student's learning process. In order to verify the relationship that the students establish with their own studies, the questionnaire addressed the following question: *"Your choice was for training in the scientific and technological area. What study technique do you use to study Mechanical Engineering?"* This theme is pertinent to the subject, because in the andragogical model the responsibility for the construction of knowledge is shared. This perspective can be analyzed as a teaching and learning method that seeks a sum of exchanges of experiences between the facilitator teacher and the adult student.

The question seeks to understand the contact scenario of Mechanical Engineering students in relation to their own learning process, their approach from the perspective of using study techniques during their academic training. Graph 02 shows that they are not familiar with the terms of the question or that they were unable to identify the techniques they use for their own technical and scientific studies, representing 43.13% of the participants.

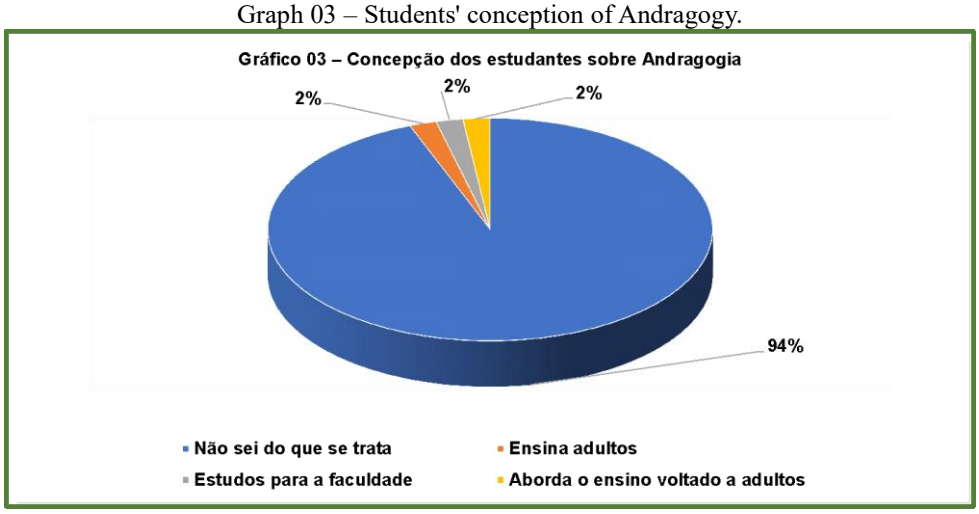
Graph 02 – Study techniques used by students.



Source: AUTHORS, 2023.

These data obtained from Mechanical Engineering students reflect a worrying information and indicate an urgent need for educational approaches focused on techniques. It is believed that it is the study techniques that will make it possible for Engineering students to reach other levels of thinking and acting within the technological area. To identify the students' conceptions of the term Andragogy, the following question was asked: *"Do you know or have you heard of Andragogy or the Andragogic approach? If the answer is YES, what do you mean by Andragogy?"* Both data make up Graph 03.

Graph 03 – Students' conception of Andragogy.

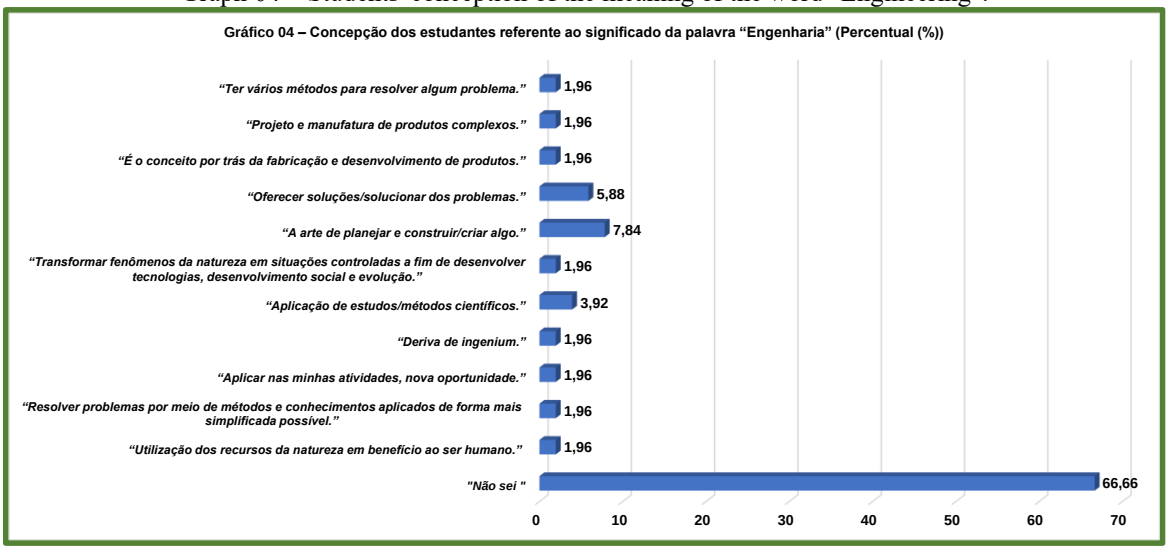


Source: AUTHORS, 2023.

It is evident in the conceptions of the students 94.11% (48 students), the lack of knowledge of the term and the lack of access to these concepts during their academic training, demonstrating a minimal view of the process of teaching and learning of adults. This data emphasizes that, even with the great expansion of digital communication technology, subjects such as Andragogy in scientific technical education will be an obstacle to be overcome by professionals of technological education

These are issues that do not allow these Mechanical Engineering students to direct a look to the autonomous search for knowledge. In view of these notes and in search of the students' conception in relation to the training in Engineering, in the questionnaire we propose the question: . *"Your choice was for the training in Engineering. What is the origin or meaning of the word Engineering?",* and the information mentioned is important for the scope of the research, as we believe in Andragogy as an educational path that seeks to understand the adult student. In order to better understand the students' position in relation to the question, a space was created in an open and descriptive format. Both data make up Graph 04.

Graph 04 – Students' conception of the meaning of the word "Engineering".



Source: AUTHORS, 2023.

The majority of those surveyed, which reflect 66.66% (34 students), affirm that they do not have a direct conception of the theme of their own higher education. This demonstrates superficialities in the foundations of this great area of knowledge, which attests to the need to expand these concepts during academic training. Based on this principle, adult students can relate their life experience to the proposed educational model, considering that, in Andragogy, the responsibility of learning to learn is shared among the actors involved. The other answers obtained and mentioned by the students present more similarities than differences in relation to the role of Engineering in the sense of the engineering profession. These results are shared and published in the *Revista de Ensino de Engenharia*, (nº 17, jun. 1997, p. 11-18 by the author José Roberto G. da Silva), who cites:

> Engineering is the professional art of organizing and directing the work of man by applying scientific knowledge and using, sparingly, the materials and energies of nature to economically produce goods and services of interest and need of society within safety parameters. (SILVA, 1997).

To broaden the data analysis, it is pertinent to reflect: what are the methods, practices, tools, resources and andragogical strategies to train technical and human skills in Engineering students? It is important to highlight that, in this study, the insertion of the Andragogy methodology is defended as one of the elements for the construction of these competencies.

In this same direction of thought structures and in search of answers to the reflections, the relevance of the data obtained in the study is due to the possibility of structuring educational strategies based on Andragogy. Through this, to relate the forms of teaching-learning for adults, aiming to occupy spaces in the student's agenda in a significant way, so that information is assimilated and transformed into knowledge. It is understood that it is necessary to debate within the educational institution, as it enhances environments and ways of thinking, in addition to creating active methodological possibilities applied to Andragogy for a technological and human training aimed at IFRS Mechanical Engineering students.

FINAL THOUGHTS

The increase in educational complexity in both new and old curricula, as well as the increasing pressure caused by digital technology, leads to an increased need for increasingly multidisciplinary professionals in technical and social skills. The rapid technological evolution requires an education professional with a highly specialized, up-to-date and comprehensive technical knowledge, with an emphasis on the knowledge derived from Andragogy. This approach helps to prepare the use of techniques that place your students at the center of teaching as an aggregating part of knowledge. In an andragogical environment, the students' experiences are of paramount importance to adopt a teaching methodology that is useful to all involved.

This brings the need for greater effort, sensitization and training of education professionals to work in the area of technological education and in other areas directly or indirectly linked to adult education. For these reasons, it is essential to improve the interactions between teacher and student, teaching strategies, motivation for learning and the didactic format of learning experiences. There is, however, a discrepancy between appropriations, contents and certifications on Andragogy, which requires a review of the educational procedures involved in the training of adult students. This includes the development of teaching, research and extension actions on campus, in order to seek a greater dissemination of the andragogical culture within the academic community.

The analysis of the data allowed us to verify the importance of Andragogy for technological education and for society as a whole, as it is a learning process focused on the technical education of adult students. One of the biggest challenges for teachers of technical courses is to promote the learning of specific knowledge in a practical way and to provide students with knowledge in the fields of activity in a simple and objective way. Future professionals have the need to appropriate

knowledge in such a way that they are able to seek solutions to the problems they may encounter in the work environment, which imply economic, social and environmental actions.

It is necessary to preserve open and uninterrupted the studies and research that address the theories and approaches of Andragogy in technological education, with a view to models, strategies and tools that involve the art and science of guiding adults to learn. At the end of this study, new questions about Andragogy are presented: how to offer learning based on Andragogy aimed at adult students of the Mechanical Engineering course? What is the role of Andragogy in Technological Education? What are the challenges of Andragogy posed by digital technology? It is expected that this study will contribute to the critical reflection on the curricular area that aims to understand the adult learning process, in addition to considering the psychological, biological and social aspects, through specific principles with technological education. It is believed that it is in this path that technological education and andragogical thinking meet, in an attempt to balance a society permeated by Science and Technology.

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