A New Didactic-Andragogical Tool to Consolidate Knowledge Applied to the Active Methodology PBL

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Abstract
Literature and teaching experience show the need to reflect upon teaching-learning strategies that take advantage of students' prior knowledge and that promote opportunities to develop autonomy, especially when teaching adults. This work aims to present the strategy named Circle of Knowledge (CK) and contextualizes it in the light of andragogy by demonstrating two practical applications in the Phonographic Production course at FATEC Tatuí, a Public Technology College in Brazil. The study comprises of a bibliographic review on teaching-learning theory, andragogy, and didactic tools. Furthermore, the dynamics of CKs involving two project-based learning (PBL) groups, the Plug-ins League and the Events League, are described and discussed. The CKs were carried out after the projects were accomplished in order to register the learning obtained as well as to deepen the discussions. Two behaviors were observed among the students - free speech and active participation (at a high level) in the discussion with the guests, and silence. Those who remained silent reported that they were able to follow and understand everything that was being discussed despite the high level of the discussion specially for a topic that had been far beyond their level of knowledge before their participation in the PBL which gave them a great sense of satisfaction. This promoted transdisciplinarity and was efficient in reinforcing learning by allowing more space for speech, active listening and time for students to lead the construction of knowledge both individually and collectively.

Keywords: Education for Adults, Project Based Learning, Didatics

Introduction

The teaching practice, especially in higher education, is often a solitary endeavor, and learning occurs with each professor in an individualized manner, in most cases. Despite the high potential of each educator, whether due to a solid academic background or experience gained from working in the industry, or arising from daily classroom activities, individual improvements are often modest when it could be possible to share knowledge and experiences in more opportunities and in a more organized and systematic way. On the other hand, the university professor often ends up dedicating the majority of their time to research, to the pursuit of expanding the frontiers of knowledge. Consequently, concerns related to the act of teaching and didactic issues take a back seat, even though everyone, in essence, was hired to fulfill the role of a teacher, that is, to teach.

Similarly, literature and teaching practice point to the need for reflection on teaching and learning practices, especially when it comes to adult education. Knowles (1973) emphasizes the difference in the learning process for adults and criticizes the scarcity of knowledge on the subject in his time, stating that more is known about the learning of animals than about children, and more about how children learn than how adults do. The term "andragogy" was first introduced by Alexander Kapp in his 1833 book. Although not presenting a theory at that time, he already emphasized the need for adult education to occur differently from the methods employed by pedagogy, introducing the concept of business education. Exploring andragogy and the evolution of teaching and learning theory and practice is of interest to educators, administrators, and anyone involved in the field of education.

This article focuses on the teaching activity within the higher education program in Sound Engineering Technology at FATEC Tatuí, located in the interior of the State of São Paulo, Brazil. This program, outlined in its pedagogical design, aims to shape not only a sound production equipment operator but an operator with refined auditory and musical skills to comprehend the entire intricate process of recording and subsequent actions leading to the completion of a project with the expected quality. The education provided includes both technical and scientific aspects, empowering individuals to work on and generate new technologies and tools, enhancing the quality of recording in listening rooms across the country. The theoretical knowledge acquired enables the generation of innovative solutions at every stage of sound production.

Objective

This paper aims to present the strategy known as the Knowledge Circle, conceived in light of andragogy, through the demonstration of two practical activities in the Sound Engineering Technology program at Fatec Tatuí, a higher education course in Brazil.

Literature Review

Andragogy and the Theory of Teaching and Learning

Some of the key points of the theory that guided the construction of the Knowledge Circle, as it was structured at the end of the year, are briefly presented to contextualize the research effort on andragogy and theories of teaching and learning.

Bellan (2018, p. 17) notes that, according to Knowles' perspective on pedagogy, the science that studies how to teach children, "the teacher decides what will be taught to the students, how this content will be addressed, and determines how to assess whether the content has been learned." In contrast, andragogy positions the adult as the subject of education, not its object. Adults expect to have responsibilities and to direct their own learning.

> Adults prefer to learn in order to solve problems and face challenges rather than simply mastering a subject. The idea of spending hours, months, or years studying before reaching a goal doesn't appeal to most adults. It seems like a waste of time to them. (BELLAN, 2018, p. 23)

Balzan (2014) and Bellan (2018) argue that educational research should contribute to new alternatives for teaching methods, given that education professionals advocate for innovations but often end up using traditional methods in the classroom. Emphasizing the importance of didactic improvement in higher education, Brum and Schumacher (2012) highlight the significance of actions in the classroom to prioritize meaningful learning over mechanical learning. Additionally, Lüdke (2014, p. 82) adds that research in the field of education and didactics should explore new methodologies, stating that research in this field is scarce, "even in countries where educational research activity is more intense." Tavolaro (2019) underscores that teaching practice, especially for adults, often becomes a mere repetition of the teaching and learning processes that the educator experienced. This is further complicated because, in many cases, the educator's experience as a student occurred some time ago, with technologies and resources vastly different from those available today.

Teaching for adults should focus more on the process than on the content because adults, first and foremost, want to understand the reasons behind learning something and need to know that the learning will help them solve their problems, preferably immediate ones. The author, concerned with how students assimilate information, found in the studied sample that learning retention occurs: 50% from what they see and hear, 70% from what they discuss with others, and 90% from what they say as they do it (Bellan, 2018). De Oliveira (1990) asserts that adult learners, after mastering a subject, should demonstrate in some way that they have a command of the material.

Andragogy delineates some key points to maximize the possibility of adult learning, namely: (1) presenting the student with content or activities that they perceive as immediately applicable, not in the future, whether in the medium or long term; (2) after completing a learning process, adult learners need to articulate what they have learned to others; (3) whenever possible, the student should put into practice the learned content; (4) adults have the need to be self-directed (De Oliveira, 1990; Libâneo, 2017; Bellan, 2018).

Ausubel (1968) and Ferreira (2020), in discussing the teaching-learning process, introduce the concept of "subsensors": the need for prior knowledge on a subject for the student to recognize and attribute meaning to it, enabling the assimilation and structural reorganization. This conditions the student to use the acquired knowledge in their life. When subsensors are absent, Ausubel (1968) and Buchweitz (2016) recommend introductory work on the concept to create recognition for the effective realization of learning.

Carvalho and Ching (2016), reflecting on the evolution of teaching-learning methodologies, acknowledge that education remained unchanged for centuries. When educators are introduced to innovative methods, they need to understand and select them appropriately for their own

context. According to the authors, it is naive to believe that everyone can adapt to new processes in just a few years. They also mention a workshop at the Brazilian Congress on Engineering Education (Cobenge) in 2015, led by Professor Maria Weurlander, who demonstrated, with data from her research, that participatory classes result in fewer occurrences of student distractions compared to traditional classes.

Libâneo (2017) recommends a variety of teaching activities, including various types of expository lectures, student assignments that place them as protagonists, and working with smaller groups, always under the guidance of the teacher. The author also acknowledges the importance of students grappling with the subject matter using their cognitive abilities but directed and guided by the teacher to achieve learning. He believes that the confrontation between the content presented by the teacher and the concrete experience of students—what they bring from their environment, the knowledge they already possess, their expectations, and motivations—can (and should) facilitate learning.

Tavolaro (2019) and Ferreira (2020) emphasize that even the use of new tools, such as active methodologies, without context, may not yield the expected results. This context, advocated by andragogy, poses a challenge for the teacher, even in theoretical subjects, to understand how that learning could be applied in the day-to-day life and professional endeavors of adult students (Libâneo, 2017; Bellan, 2018). In his final considerations, Ferreira (2020) mentions the difficulty of implementing structured practical and motivating activities, a solution he deems crucial for university education.

Libâneo (2017) advises that the choice and organization of methods used in a class should be based on the triad "objective-content-method." He asserts that methods should be connected to the immediate objective of the class and linked to the teaching plan of the discipline. The selection of the appropriate method should consider knowledge about the students, including their assimilation capacity, age, and sociocultural and individual characteristics. He also defines methods as the sequence of activities for both the teacher and students, considering their objectives for the specific class to be planned and executed.

An interesting tool for directing the objectives of a class, guiding teaching practice, is Bloom's taxonomy, presented by Shabatura (2020), as shown in Figure 1. Depending on the student's stage of knowledge, whether in content or the competency addressed in the class to be conducted, the teacher can use Bloom to assess what they intend to achieve in terms of the student's development after the didactic activity.

Figure 1: Bloom Taxonomy. (Shabatura, 2020)

According to Masson, Miranda, Munhoz, and Castanheira (2012), the active methodology Project-Based Learning (PBL) has been not only an important practice in active methodology that demands greater commitment from students and teachers. The teacher needs to change the posture of delivering content to guiding students in their learning. Similarly, students also take on greater responsibility for their learning, characterized by a challenge where small groups actively seek the necessary knowledge to solve the proposed problem, typically divided into phases. In their study, a literature review on the active methodology Project-Based Learning, Pasqualetto, Veit, and Araujo (2017) express concern that many PBL initiatives occur without those in charge reflecting on how students learn.

Methodology

The group of teachers, authors of this article, met weekly throughout the year 2022 to discuss students' difficulties in their disciplines: Introduction to Acoustics, Applied Computing to Phonographic Production, and Applied Acoustics to Phonographic Production. In the initial phase of the project, they concluded that the main challenges were in physics and mathematics, specifically with algebra and functions, and in understanding how these concepts are related to the areas in which a phonographic producer works in their professional life. The discussions about the applications of physics and mathematics within the group were extremely interesting. Replicating a space for such debates, as experienced and supported by the teaching and learning theory presented in this article and stemming from Professor Fernandes's research project, guided the dynamics presented here.

The group understood that the topic which covered all the concepts that students found challenging and, at the same time, had a connection with the professional's daily life would be the understanding of the use of basic concepts for building a plugin. Plugins are applications and functions used by musicians, producers, and audio professionals to achieve desired effects in their compositions and music productions (Escolas de Andromeda, 2019).

The characteristics that sparked the group's interest in the dynamics experienced during the weekly meetings, grounded in the andragogical and teaching-learning theories discussed and presented here, are highlighted below:

a) Absolutely practical nature, allowing the identification of the connection between each theoretical aspect, whether in mathematics, physics, or programming languages, and professional practice.
b) Multidisciplinary profile, characterized by the background of each member of the teaching group: architect, computer scientist, naval engineer, physicist, musician.
c) Fluid dynamics of conversation without academic constraints.

Therefore, it was decided to replicate this dynamic, with the possibility of student participation. This action was initially called the "Knowledge Circle" and was conducted, at the end of the pandemic, in a virtual environment, and later, in person, in the college auditorium, as seen in Figure 2.

Figure 2: Second Knowledge Circle, in-person at the college auditorium
Developed by the authors (2023)

On both occasions, the low participation of students was evident. While observing the discussion can provide learning, andragogy advocates for the active participation of adult students in the discussion. Several authors also see the need for students to actively participate for knowledge construction to be more effective. The consensus within the group was that the discussed topic was challenging for most students (mathematics, physics, and programming language). Despite the clear interest demonstrated by everyone in understanding the real-world application of concepts, students lacked the theoretical or practical foundation to actively participate in the discussion. Additionally, the crowded environment may have been intimidating for those who felt insecure about their knowledge, discouraging them from asking questions in public.

Thus, to ensure that the tool could be fully developed, similar to the experience among the group of teachers, it was decided to create an action using the PBL methodology, Project-Based Learning. This was aimed at providing students with a broader foundation, both theoretically and practically, in mathematics (functions and algebraic operations) and physics (acoustics and wave phenomena).

In this way, the Plugin League was created—a group that aimed to bring together students from all semesters of the phonographic production course to study one to two plugins, selected by the students themselves, who were familiar with them. The goal was to work on reverse engineering, understanding the main parameters used by the app, how they were related, and how the application could perform operations based on input data. Table 1 shows the students and their respective semesters in the course.

Course Semester	**Quantity of Students**
1o semester	3
2o semester	1
3o semester	4
4o semester	0
5o semester	1
6o semester	3
Total	**12**

Table 1: Distribution of students who started the Plugin League project in 2022
(Own elaboration)

Fundamental to the entire didactic process is understanding the objectives of the action. For this, Bloom's taxonomy was used for each phase of the PBL. Overall, the project aimed to seek the perception and understanding of learning mathematics and physics as an important resource for the professional, a phonographic producer who aims to be not only an operator of audio equipment but also capable of proposing new technologies and processes. Hence, the importance of the basic foundations brought by mathematics and physics.

The meetings, actions, and discussions of the Plugin League core can be seen in Figure 3.

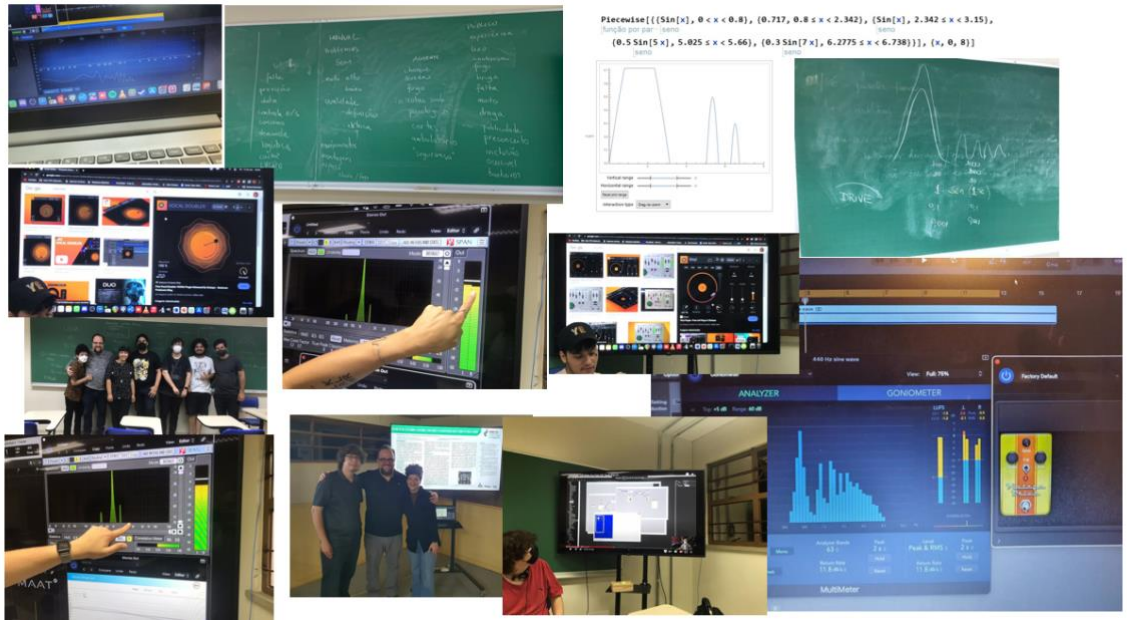

Figure 3: Activities (PBL) of the Plugin League core
Developed by the authors (2023)

During the first semester of 2022, the group of teachers, to test the Knowledge Circle dynamics, found it interesting to create another core with a simpler and more playful theme, according to the perspective of the students themselves. Thus, the Events League core was created to also conduct a PBL and, in the end, hold the Knowledge Circle. This core was responsible for celebrating Halloween at the college, working on concepts such as projects, teamwork, sound engineering, media, among others. As the central organizing team was small, students had to invite more from other courses to help, totaling 20 students in addition to the 6 in the core. The meetings and preparations for the event for this second core, also coordinated by the authors of this article, can be seen in Figure 4.

Figure 4: Meetings and preparation of the Events League for the college Halloween event

Results and Discussion

The PBL core, Plugin League, developed a reverse engineering project for two plugins, seeking to understand how input parameters and each user action directed the presented results. Based on this qualitative evaluation, students were invited to think about which functions could describe the observed behavior. Since it was not possible to have the original source code of the plugin, but following Bloom's taxonomy, the objectives were to understand and apply the observed behaviors, even if they did not exactly reproduce the application's result. Analyses were conducted, even by students in the early semesters, despite presenting more difficulties. This activity stimulated on-site research, peer discussions, and the search for consensus among the groups.

The evolution of the project, as expected by the authors of this article, brought significant difficulties among students due to the more arduous nature of the analyses. It was distant from the central axis of the course, which is recording music in the studio and understanding the artistic processes involving mixing and mastering operations. Thus, there was a depletion of the student group, with six out of the twelve students who started the program, justifying the initiative to create another events core.

The Knowledge Circle took place after the completion of the Plugin League's work, with the presence of 4 students and 4 teachers, lasting for two hours. For this KC, the traditional seating arrangement was preferred, as seen in Figure 5. The aim was to create a space of complete freedom of speech, allowing everyone to converse equally with the teachers without any concern for hierarchy or worries about grades and evaluations. This way, they could freely

express their opinions. At the end of the dynamics, a questionnaire was submitted to the participating students to understand some aspects of the observed dynamics.

Figure 5: Knowledge Circle of the Plugin League

Similarly, the Knowledge Circle for the Events League took place after the project's completion, which can be seen in Figure 6—the Halloween celebration organized by the Events League team, with the help of additional students invited to work as volunteers on the day of the event.

Figure 6: Halloween 2022 organized by the Events League

For the Knowledge Carousel held after the Events League, there were 6 students participating, along with 4 teachers and a former student invited to join because of extensive experience in event organization, lasting one and a half hours. The questions to assess the dynamics were the same as those applied to the students of the Plugins League, with the answers presented in table 2. It is important to note that for each question, the criterion ranged from 1.0 for the worst value to 5.0 for the highest value for each response.

Number	Question for the participating students	The average for the League of Plugins	The average for the League of Events
1	Did you feel confident in expressing your views? Or did you feel intimidated in any way to share them?	4,0	4,2
2	Do you consider that the Ciranda provided enough time for you to express your views on the project or the discussed points?	3,5	3,8
3	Did your participation in the Liga provide enough foundation to participate in a discussion on the presented topic?	3,5	4,4
4	Do you believe that the discussion improved your understanding of the topic?	4,8	4,4
5	Sobre o número de alunos participando, sua opinião é?	3,3	2,0
	Média geral	**3,8**	**3,8**

Table 2: Students' responses to the questionnaires for both Leagues. (Own elaboration)

The proposal of free speech, one of the foundations of the KC, allowed students to feel reasonably comfortable expressing their ideas and points of view for the discussions proposed in the Circle. To identify this point, in the questionnaire, question 1, using the Likert scale, where 1.0 would be very uncomfortable, and 5.0 would be very comfortable, the average responses of the students were 4.0 (comfortable) for the Plugin League and 3.8 for the Events League, showing that the proposed goal was achieved, but there is room for improvement in the process.

One of the variables to be measured was the available time for the activity (question 2). Both actions took place at the end of the academic period, making it difficult to coordinate the schedules of the professors and guests. Additionally, some students who participated in the leagues could not attend due to year-end exams. Thus, the scores of 3.5 and 3.8 indicate that this is an aspect to be improved. However, it is worth noting that the depth of the debate in the Plugin League was greater, with more time for speaking and discussion between some students and the professors. As for the Events League, everyone expressed their opinions but with less time available for the activity. It can be concluded that the debates could have been more thoroughly explored with additional time.

The survey also inquired about how the entire league project provided the minimum knowledge necessary to participate and discuss with the group in the Knowledge Carousel (question 3). Using the same scale (1.0 to 5.0, where 1.0 would be no foundation to more than sufficient foundation), the average responses from the students were 3.5 (from reasonable to sufficient)

for the Plugin League. This result was significantly lower than the score for the Events League, as expected due to the historical recognition of the difficulty of the treated theme and the higher dropout rate of students from the first league compared to the second.

Regarding the effectiveness of the Knowledge Carousel dynamic in the learning process, question 4 (using the same 1 to 5 scale) yielded an average response of 4.75 (from quite to yes, it was amazing) for the Plugin League. This point deserves special attention as it is the central objective of the project described in this article—creating a space to provide a real learning environment for a historically difficult and challenging topic, as assessed by students throughout the course. The PBL project, structured with a practical theme addressing concepts considered very complicated, brought tangible learning, even with the presence of students from all semesters of the course. For the Events League, the result was satisfactory, with room for improvement, especially since it had less real-time available.

Another point of assessment for the dynamic was the number of participants, addressed in question 5. Possible responses ranged from 1.0 (It was very few; if there were more, other students could benefit) to 5.0 (It was excellent; more students could have been disruptive). The average was 3.25 for the Plugin League. One student gave a score of 1.0 and justified it as follows: "The number of students was low, but due to the lack of interest of students in attending the League meetings, which I think is nonsense because it was a very good opportunity." Slightly above the average value, contrary to the initial expectation that they might find few students, it was understood that for a deeper discussion, as occurred, a room with more people would have limited the depth and space for each to speak. It is worth noting that in few moments of academic life, it is possible to have a discussion, after a long period of study in a project, with few students and several professors, in a 1:1 relationship. It is known that it is not feasible on a large scale due to time constraints on the part of teachers, but it became evident that it was a very rich space in terms of learning for the students who participated until the end. For the Events League, the score was even lower (2.0), which ends up being a contradiction since there was a limitation of discussions due to the shorter available time. Further dynamics need to be carried out to explore this issue more thoroughly.

In the open space for considerations about future Cirandas, the following comment from a student stands out: "I think it would be really cool if other teachers did this in their subjects too because it would help a lot with studies and mainly encourage people to participate in other Cirandas; it's a unique experience." Two main types of student behaviors can also be highlighted: participation in discussions to a greater or lesser extent and, in some cases, silence. For students who remained silent for much of the time, a question was asked about the effectiveness of the dynamic, and the feedback was that they felt able to follow and understand everything that was being discussed, even with the high level of discussion, especially for a topic that was much, much above the student's knowledge level at the beginning of the project, giving the student a great sense of satisfaction.

Conclusion

The experiences reported here from the Circle of Knowledge dynamics were based on the pillars of andragogy: (1) preparing didactic activities to bring them closer to professional practice; (2) having adult learners apply knowledge in practice using the active methodology PBL; (3) providing a space for organized speech and discussion to elevate the level of discussion with more teachers and guests present; (4) creating a space for free speech without pressure for grades or evaluations. Regarding the two presented actions, some points proved

interesting in the methodology, meeting the adult learner's learning process. The PBL methodology was important for developing the knowledge necessary to enable students to discuss among peers, teachers, and guests. Creating a pressure-free environment facilitated student exposure, but it was still observed that some students remained silent for most of the activity. For future Circle of Knowledge dynamics, it is recommended to (a) hold them slightly before final exams to allow the participation of all students, as they may be overshadowed by a more challenging exam since they do not count for grades, (b) find a way to enable more reserved students to express themselves without fear, (c) evaluate the average speaking time of each participant, and (d) consider the number of participants, which is directly related to point (c). Based on the results, the Circle of Knowledge activity is considered an important tool to be used in PBL projects.

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