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Perceptions about the teaching of mathematics mediated with TDIC

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ABSTRACT
The study of this article aims to discuss the perceptions and Freirean contributions in the teaching of Mathematics allied to the use of TDIC. This study proposes as a generating question, the following question: how can we associate the TDIC and Freirean contributions to the teaching process to provide a learning of Mathematics in a more dynamic and attractive way contextualized with the reality of the students? With the purpose of presenting some Freirean perceptions in the teaching of Mathematics regarding the use of TDIC in Mathematics classes. The methodology used in this work was the qualitative bibliographic research supported by Freirean perceptions. The theoretical framework had its main basis the work "Pedagogy of Autonomy" by Freire (1996), supported by other theoretical studies by Amancio (2020), Brasil (2017), D' Ambrósio (1996), Lemos (2018), Schmitt (2018), Silva (2018), among others. With this study we verified the need to insert new pedagogical educational practices with the TDIC to promote different possibilities for the student to build their own knowledge of Mathematics with the use of the TDIC. Moreover, we understand that Freirean perceptions establish a relationship between the use of digital technologies and the teaching of Mathematics in various aspects of Freirean ideas, especially when Freire (1996) reports that the teacher should not transfer knowledge, but produce new possibilities to build and develop the same. With this, we realize that the use of TDIC can offer a new construction in the process of teaching and learning Mathematics in the formation of students more critical, active, dynamic and prepared for the impactful changes that occur in society.

Keywords: DIC, Mathematics teaching, Education, ICT, Technology.

1 INTRODUCTION

Technologies are evolving rapidly in contemporary society, so the age of communication and information is constantly being improved and developed with new and increasingly sophisticated features to serve its users. In the scenario of education, technologies allow the student to seek the knowledge that is allied to his daily life in a faster, reliable and precise way, making him a being capable of transforming his own reality, since according to Freire (1996), man is a conscious being who uses his ability to learn not only to adapt, but mainly to transform your reality.

Learning Mathematics for many students is something distant from reality, because they associate the use of mathematical concepts as dissociated, abstract, detached from reality and imperceptible. But if we pay close attention, Mathematics is always around to make our daily lives easier, such as: the act of shopping requires mathematical calculations in the price of products, the use

of the percentage to check the battery of *Smartphones* and also the quantities expressed in fractions or weight of ingredients for food preparation, in addition, the percentages in bank transactions of interest and the use of money in general, among others, requires knowledge in Mathematics. According to Amancio (2020) these negative aspects about learning in Mathematics arise with the cultural idea already ingrained in society that studying Mathematics is very difficult, which promotes in students a certain disinterest, aversion, difficulty and demotivation in students to deepen their studies in Mathematics. The difficulties when studying the mathematical concepts for Stoica (2015) arise many times, in the traditional theoretical classes of Mathematics in which the students solve some exercises that the reasoning and the solutions

> algorithmic are more or less similar to the exercises solved by the teacher and that usually have no connection with the activities of social reality, but rather a repetition of the content (STOICA, 2015, p. 702).

The teaching of Mathematics has often been approached by teachers in a traditional way, only with the use of the board, chalk, memorization, repetition of ideas, exercises and contents. This teaching modality refers to what Freire (1996), proposed about the ability of the teaching practice to develop the student's criticism, curiosity and also the insubmission, but to succeed it is necessary that the teacher knows how to respect the curiosity, the aesthetic taste, the restlessness, the language, the cultural context and the autonomy of the student, because acting like this, according to Freire (1996), the teacher will be able to be democratic and critical in his pedagogical practices without the need for memorization and repetition of content by students. Through the above, the teaching practice in education, requires from teachers the application of different competences, skills and attributions of the pedagogical work, in order to associate the contents to the experience of the students.

Given these aspects, technology should be an ally of teachers in the teaching and learning process as a mediator to favor more interesting and motivating content to be associated with the daily lives of students. Therefore, the teacher must be the mediator between the student and the use of technologies, so that the teacher can develop a reasoning of ideas aimed at the simulation and creation of mathematical concepts that meet the current demands of society, which makes it clear that technological resources alone do not replace the pedagogical practice of the teacher, but it requires that it be able to develop and improve Mathematics contents that have more meaning with the experience of the students (AMANCIO, 2022).

We must make it clear that currently the term technology refers to technical objects, such as machines and their respective manufacturing processes (LEMOS, 2018). It is also possible to apply the definitions on Information and Communication Technologies (ICT), more comprehensively beyond technologies such as, for example: the Newspaper, Radio or TV, analog technologies and the Internet (ANJOS, 2018). Due to technological advances in the use of applications, *smartphones*, videos

and the Internet in all social spheres including educational institutions. We chose to use in the present work the term Digital Technologies of Information and Communication (TDIC), which according to the research of Valente (2013), the TDIC come from various digital technologies such as: videos, computers, *software,* smartphones*, tablets,* dataShow, digital whiteboard, virtual games, applications that come together to compose the new technologies that are currently more present in society. However, it will also be done in some moments of the work the use of the word technology, ICT in designation the TDIC, in the moments when it is more appropriate in the context of writing.

And yet, authors such as Kenski (2009), use TDIC to refer to digital technologies connected to a network, which also encompasses a more advanced technology: digital. Thus, the TDIC refer to any electronic equipment that connects to the Internet, expanding the possibilities of communicability of its users (VALENTE, 2013). In the field of Mathematics education, it is important to use TDIC to create more interesting and motivating content, since Mathematics is considered difficult and uninteresting for many students. In this way, it is important to rethink the teaching of the concepts that involve Mathematics in a more dynamic, motivating and attractive way with the various digital tools available through the Internet. Therefore, the National Curricular Parameters (PCN) establish some guidelines related to the use of technological resources as instruments capable of motivating exploratory and research tasks,

> which allows teachers to reflect on the use of TDICs in their pedagogical practice to improve communication and the social language of mathematics teaching with the application of technological resources (PCN, 1998, p.46).

According to Paulo Freire (1996), the teaching process does not occur through the transfer of knowledge, but seeks opportunities for its construction and production. Thus, the use of TDIC in educational institutions can provide new skills, competencies and capacities, which can be achieved and disseminated in the teaching of Mathematics through new practices that favor better communication, autonomy and language to improve the teaching and learning of Mathematics in educational institutions focused on the realities of life. Given the aspects presented, we tried to use in this work as our main theoretical reference the book "Pedagogy of Autonomy" by Freire (1996), because this work presents a pedagogy expressed in ethics, dignity, respect and autonomy of the student.

In addition, Freirean conceptions make us reflect on the function of the conservative and authoritarian teacher who does not allow the curiosities, insubmissions, and experiences of the student's social life. These aspects discussed in this work are fundamental to direct the theme addressed in the present work on the teaching of Mathematics with the use of TDIC in educational institutions. Since Mathematics cannot be seen and understood by the student as a mechanical memorization of numbers and formulas as it is usually taught in traditional teaching, since as historical and social human

beings, we have the ability to apprehend, build, reconstruct, criticize, reflect and verify to change reality. Authors such as Mizukami (1986) report that traditional teaching:

> it is concerned with the variety and quantity of concepts/information/notions than with the formation of reflective thinking, in which the teacher exposes the content and the student notes and memorizes. The student who retains more decorated information achieves a better performance in the studies of Mizukami (1986, p.4).

It is not difficult to see that traditional Mathematics classes are reduced only to the use of the book, the board, the chalk and the resolution and memorization of a list of exercises elaborated and solved by the teacher. Due to these facts, the National Curricular Parameters of Mathematics (PCN: Mathematics) come to guide alternatives that collaborate with the formation of reflective thinking aimed at the student's experience with a curriculum that contributes and values the sociocultural plurality and also promotes conditions for the student to become active and stimulated in the transformation of the social space experienced by him (BRAZIL, 1998, p. 28).

In order to make the student become active in the mathematical concepts present in society, the use of TDIC brought several possibilities and opportunities to prepare and organize more attractive and dynamic Mathematics contents which can enable the student to reflect on his own life, because the evolution of technology is advancing every day, and educational institutions should be prepared to deal with the use of TDIC in the classroom (SILVA, 2018). Thus, through a bibliographic review, we support our reading in the premises indicated by the author in the work "Pedagogy of Autonomy" Freire (1996). In addition to the work "Pedagogy of Autonomy", we will also use other works written by him and other theoretical reflections based on Amancio (2020), Brasil (2017), D'Ambrósio (1996), Lemos (2018), Schmitt (2018), Silva (2018), among others. Therefore, this article[1] aims to discuss Freirean perceptions and contributions in the teaching of Mathematics allied to the use of TDIC in the search to establish a relationship between them. These perceptions allow us to present contributions to improve the pedagogical practice in the process of teaching and learning Mathematics. Given the assumptions presented, the following premises emerge: How can we associate the TDIC and Freirean contributions to the teaching process to provide a learning of Mathematics in a more dynamic and attractive way contextualized with the reality of the students?

2 THE METHODOLOGICAL PERCUSSIONS OF THE RESEARCH

The issue discussed in this study is directed to present the relationships that exist between Freirean conceptions in the teaching of Mathematics about the use of TDIC, in order to improve the

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pedagogical practices of Mathematics classes in education. Based on the above, this work is a qualitative bibliographic research on which we base our readings as the main focus on the book "Pedagogy of Autonomy" by Freire (1996), together with other Freirean works, as well as in other works by renowned authors who mention about the process of teaching and learning Mathematics and also about the use of TDIC in education, as a way to direct and better understand the theme presented in this work, because according to Gil (2002), the bibliographic research is the survey or review of published works on the theory to direct the scientific work that needs consultation, study and analysis carried out by the researcher who will conduct the scientific work. The scientific papers used in the research were found through the consultation and analysis of materials available in the literature, both in print and in online archives of books, magazines, articles and websites available on the Internet. We tried to present some sub-items to favor a better understanding and organization about the theme addressed in this work, as shown below.

2.1 THE TDIC PRESENT IN EDUCATION

The importance of the use of ICT is presented by the National Common Curricular Base (BNCC), when proposing the ten general competencies in the pedagogical scope of schools and in social practices as technologies that should be

> used in a critical and reflective way in the school context so that students can communicate, access, solve problems, disseminate information, produce knowledge, exercise protagonism and authorship in social and personal life (Brasil, 2017, p. 9).

For Assis (2011), it is important to discuss technology as a mediator of pedagogical practices in the teaching and learning process between teachers and students, because technology causes changes in the ways of seeing, interacting and thinking in the practical actions of the teacher and also in the way the student studies, which brings critical reflections on the use of technologies in education. Despite the development of technologies, education has not undergone many changes, as the old blackboards, chalk and books and limited teachers still remain in the classrooms without new ways and methods to teach (SILVA, 2018).

The great advantage of TDIC is that they offer facilities such as *music and book downloads, the* exchange of experiences between people, the possibility of downloading various videos and files with the Internet. This interaction of TDIC provides learning and cognitive, cultural and social development, however it is necessary that the teacher understands and understands that in the classroom there will always be different styles and rhythms of learning. Thus, due to the advances of the TDIC in education it is necessary that the teacher has a permanent formation, which Freire (1996) emphasizes based on the critical reflection on the practice and the permanence that provides the opportunity for the critical reflection of the educator on his practice, that is, "it is thinking critically

the practice of today or yesterday that one can improve the next practice" (FREIRE, 1996, p. 39). Thus, Freire (1996) highlights the need for curiosity for the formation of the student and to develop this curiosity in the student the teacher needs to have:

> the curiosity that moves, that rests and that inserts itself in the search, because without curiosity he does not learn or teach. Curiosity allows man to develop real learning of the things of the world (FREIRE, 1996, p. 85).

And still about curiosity Freire (2001), mentions that the teacher must be able to recognize both the curiosities of the student, as well as the different ways of thinking, because there would be no ethical-democratic exercise and we could not talk about respect of the educator to the different thought of the educating if the education were neutral, it is worth mentioning that, if not

> if there were social classes, ideologies and politics, we could speak only of mistakes, of errors [...] in the process of knowledge that involves teaching and learning (FREIRE 2001, p. 38-39).

The fact of using the Internet as a teaching tool can constitute knowledge promoted by an interactive and critical learning environment to arouse the curiosity and social relations of students, because social communication between men allows them to become citizens, because through the various forms of communication incorporated with the use of DID, the human being can establish himself in society. The incorporation of TDIC should help students, parents, managers and teachers to make the school a place with possibilities for the democratic, critical as the right place to promote educational actions that go beyond the classroom, always respecting the thoughts and ideals of the other. It is known that the critical education of Freire's work is presented as "teaching is not transferring knowledge, but creating the possibilities for its production or its construction" (FREIRE, 1996, p. 12).

In addition, according to D' Ambrósio (1996), the teacher has a new role in the face of technologies that needs to start with the knowledge and research society, because according to him the school has the function of stimulating and organizing the knowledge inserted in society. And yet, that the teacher can lead them to think beyond the concepts of their discipline, because only in this way, it will be possible to insert a dynamic curriculum to reflect on the sociocultural issues of the students (D'AMBROSIO, 1996). The biggest challenge facing education today is:

> put into practice what will serve for the future. The school is not justified in presenting outdated knowledge and out of reality, because it will be impossible to use technology based on old practices (D'AMBROSIO, 1996, p. 74).

Thus, in view of the advances of the TDIC it is important that the teacher prepares his class according to the reality experienced by the student. Classes with the use of TDIC can provide learning with discussions, values, discoveries, motivation, curiosities, questions, previous knowledge, values, discoveries and interests. In addition, the teacher who knows and understands the reality of the students

is an active, critical professional who knows how to reflect on the social aspects, because he maintains a constant and current search to develop the teaching and learning process in the education of his students.

2.2 FREIRE'S CONTRIBUTIONS TO THE PROCESS OF TEACHING AND LEARNING MATHEMATICS

From the point of view of the teaching of Mathematics, it is important to seek differentiated and interesting pedagogical practices to teach the contents in order to bring the concepts of Mathematics closer to the reality of the students. Interesting subjects arouse curiosity and motivate the student to question, participate and interact with other students in a school environment, because according to Freire (1996) there is the possibility of methodological reinventions of teaching processes, that is, it is necessary to work on new pedagogical methodologies and teaching methods. According to Amancio (2020), the advancement of technologies in our society allows us to use new digital tools such as videos, games, simulation programs, creation of graphs and tables, among others to improve the teaching of Mathematics.

Thus, the use of TDIC promotes the facilities for the student to develop a faster, easier, interactive knowledge and accompanied by a logical reasoning inserted in the process of teaching and learning in Mathematics for the formation of critical citizens who live in society, because according to Freire (1996), teaching requires apprehension of reality to know the different dimensions of educational practice, since for man to learn it is necessary experiences that allow him to build, rebuild, verify to change, and this is not done without openness to risk (FREIRE, 1996, p. 28).

According to Prado (2000), the world is inserted in the transformations provided by technologies, but the teaching of Mathematics in educational institutions is not prepared to establish connections with the digital technological world. However, it is perceived that technology is increasingly present in everyday life, but it is almost not used in Mathematics classes. This fact tends to distance many contents from the practice of mathematical knowledge, that is, a distance between what society requires and what the student experiences in school about Mathematics. Such aspects, according to Freire (2000, p.101), leads to education focused on a transfer and training of contents, that is, almost a training, which generates the distancing of Mathematics with reality.

Such a conception of education tends to form accommodated individuals who do not know how to solve the real problems of life and do not transform them to be questioners. These conceptions are what Freire (2000) reports as banking education, which does not seek the awareness of students, but instead causes the oppression of student autonomy. However, the DIDs associated with the Internet can provide the teacher and the student with new experiences and discoveries through the resolution of problems or projects that express a real meaning for their learning. In this scenario according to

Freire (2001), education becomes an ethical-democratic exercise in which the teacher respects the student who thinks differently

> because if education were neutral, it is worth mentioning that if there were no ideologies, politics, social class, we would only have misconceptions, of inadequacies in the process of knowledge, which involves teaching and learning (FREIRE, 2001ª, p. 38-39).

The process of inserting the use of technologies in teaching actions serves to direct teachers and students to an active education, in which the student becomes participative and responsible for his own learning, leaving aside the passive subject to become democratic and autonomous citizens of knowledge, which according to Freire (1979) education is a response to the finitude of infinity, for education is possible for man who is an unfinished being, in this way

> Education implies a search carried out by a subject who is human. Therefore, man must be the subject of his own education, he cannot simply be the object of it (FREIRE, 1979, p. 27-28).

2.3 THE IMPORTANCE OF THE USE OF TDIC IN THE TEACHING OF MATHEMATICS

Given the technological evolution, the teacher needs to understand and know how to use the TDIC in education as pedagogical resources to provide a better engagement of the contents taught by Mathematics teachers with the reality of the students. In this way Freire (1996), points out that there is no teaching without discency because the two explain their subjects, despite the differences and are not reduced to the condition of object, one of the other, that is, who teaches learns by teaching and who learns teaches by learning and

> Teachers and students together are transformed into subjects of the construction and reconstruction of knowledge. It is impossible to become a critical teacher, one who is mechanically a memorizer, a repeater of inert phrases and ideas, and not a challenger. He thinks mechanically and wrong (FREIRE, 1996, p.16).

According to Schmitt (2018), we live in a society connected to the Internet in which distance is no longer a problem, since environments and individuals are interconnected by a virtual network where it is possible to articulate computers, televisions, mobile phones and satellites. In addition, with the use of TDIC it is possible to transmit more creative and dynamic content in the teaching of Mathematics with the use of images, audios, videos, texts and interactive applications. These contributions of the TDIC can favor a critical reflection of reality on the part of the students, which Freire (1996), presents as a dimension of human valorization between teacher and student, because for him the critical reflection of reality is constituted in the liberating praxis that always exists

> A question that leads us to reflect on the impossibility of studying for the sake of studying. To study without commitment to the world, distant and out of the world. In favor of which study? Against what study? Who do I study against? For whom? (Freire, 1996, p. 77).

And still on the use of technologies in education, authors such as Amanico (2020), report in their research that the National Curriculum Parameters for High School (PCNEM), predict the influences and changes brought by the use of ICT in the process of teaching and learning Mathematics, and the impact of technology, [...], will require the teaching of Mathematics

> a redirection, which favors in the curriculum the development of skills and procedures with which the individual can recognize and orient himself in the world of knowledge in constant transformation (Brasil, 2002, p. 41).

The facilities offered by TDIC as pedagogical tools of teaching practices in the teaching of Mathematics, it is not only about using digital resources in classes, but reflecting on these practices could reach different individuals to make them more critical and questioning in the teaching of Mathematics, because according to Schmitt (2018), it is necessary to understand that "there is a change in the school environment and in the relationships between the subjects who teach and those who learn" (SCHMITT, 2018, p.28).

For Freire (1981), this change in the school environment is important in the relationship between critical knowledge and the commitment to transformative intervention on reality because for him there is no teaching without discency, where the act of teaching requires some processes such as: methodical rigor, respect for students' knowledge, criticality, risk, aesthetics, research, and ethics, acceptance of the new, critical reflection on the practice, rejection of any form of discrimination, assumption of cultural identity and recognition (FREIRE, 1996). Thus, the teaching process discussed by Freirean ideas involves an unfinished teaching of a being conditioned to respect

> the autonomy of the learner, tolerance and the struggle in defense of the right of educators, the apprehension of reality, common sense, humility, joy and hope and believe that change and curiosity are possible Freire (1996, p. 21).

The learning process of Mathematics needs students a dynamic posture in the classroom. This posture requires both problematization and autonomy. However, for Freire (FREIRE; SHOR, 1993), students are conditioned to a passive learning and distant from their reality. This Learning is defined by (D'AMBROSIO, 1996, p.114) as "Dominant Mathematics", which is considered by him as an instrument of domination, because this domination can eliminate Mathematics from everyday life by those who dominate it and think themselves superior. The author (D'AMBROSIO, 1996), mentions about the mission of the teacher which is constituted in achieving total peace as the greatest mission of mathematics educators in teaching Mathematics from the day to day of the students.

Therefore, it is verified that the teaching of Mathematics with the use of TDIC can help stimulate the active and daily participation of the student and break with the passivity of the same, placing him active before an education that frees and problematizes, which aims at the emancipation of the subjects and the distancing from domination so that the student himself is the protagonist and

transformer of his reality in the society to which he is inserted, for Freire (1996), the historical role of man is not only to verify what occurs, but to intervene in problems, not to adapt to them, but to transform the society in which he lives.

3 CONCLUSION

We observed with this study that the Freirean contributions and perceptions regarding the teaching of Mathematics allied to the use of TDIC, presented in the objective of this article, managed to establish a dialogue capable of establishing a relationship between the use of TDIC and the teaching of Mathematics, as a theoretical basis mainly in the bibliographic research of the book "Pedagogy of Autonomy" by Freire (1996), together with the other theorists who discuss this theme. These Freirean perceptions and contributions were essential to help us answer the central question of this work in the following way: we understand that the integration of digital technologies united to the educational environment of Mathematics teaching has become increasingly indispensable, due to the advancement and development of digital technologies in the social activities of the school, and this aspect, allowed to associate to this study the TDIC along with the Freirean contributions in the teaching and learning process, because the use of the TDIC can transform the ways of thinking, of interacting with people, with the environment, and with the knowledge and influences the relations with the learning in the educational institutions approaching the student to the reality.

Given this, the contributions and perceptions of Freirean teaching, also led us to an understanding, that it is possible an education allied to the teaching work with the use of the TDIC, to promote a more dynamic, reflective, motivating and attractive learning of Mathematics that serves to awaken the curiosity of the students in understanding the reality that surrounds them as an active being and with autonomy to solve the social problems. Given the above, we understand the need to insert new pedagogical educational practices with the TDIC to create new and different possibilities for the student to build their own knowledge of Mathematics. We still understand that Freirean perceptions in the process of teaching and learning in Mathematics with the use of TDIC, can contribute to the formation of more critical students and prepared for the changes of the social environment, because according to Freirean ideas we have to have the awareness of the unfinished, because as human beings we are always in search of novelties, innovations and developments marked by society.

Therefore, we understand that the teaching of Mathematics can not be something repetitive, mechanical and decorated from a list of exercises, but rather as a discipline that must be associated with the daily life of the student, and that he needs to understand that Mathematical knowledge serves to facilitate the practical actions of his life. Therefore, we agree with Freirean perceptions that we must study not only for the sake of studying, but studying to understand and question our role in the world in order to benefit society with our knowledge. Thus, we understand that according to Freirean

perceptions, the Mathematics teacher must arouse curiosity so that the student believes that social changes are possible, and that the use of TDIC aided by games, the use of graphs and tables among others, are digital pedagogical tools that allow the development of teaching and learning of Mathematics, favoring the formation of curious subjects, capable of intervening in the social reality.

In addition, we understand that the teaching and learning of Mathematics in Freirean perspectives, make us reflect on the commitment to change our pedagogical practices in educational institutions and the incessant search for new knowledge. Moreover, with this work we understand and recognize, according to Freire's thoughts, that we are incomplete, inconclusive and historical beings in the search to transform reality in the society in which they are inserted. Thus, to promote more reflections on this theme we suggest that other discussions and other scientific works be produced, as a form of incentive for Mathematics teachers to review their pedagogical teaching practices, in order to make their Mathematics classes more interactive, dynamic, contextualized and motivating to arouse the interest of students in learning Mathematics. It is important that the Mathematics teacher also uses digital technologies in their classes as a transformative tool of the learning environment, which enable students to experience new experiences and apply mathematical concepts.

Therefore, we hope that the teaching of Mathematics will no longer be stigmatized by many students as difficult, distant from the world and inaccessible to most students, to become a more attractive and active teaching with the use of technology mediated by a teacher capable of forming critical students, encouraging them in the construction of their own knowledge to become emancipated citizens in this world in constant transformation, because according to Freire (1996), the teacher needs to research to know new knowledge and communicate the new to students. We observed that the present work also contributed to the PCN, which establish guidelines with the use of TDIC by teachers in the teaching and learning process in mathematics education, not only with a mere substitution of digital tools, resources or methodologies, but as a way to understand the possibilities brought by the freedom to experiment and the diversity of opportunities provided by the TDIC, which can be used to collectively share discoveries and learnings capable of breaking the barriers of individuality and promoting the collaborative organization that favors the multiplication of ideas, knowledge and cultures in the face of human social reality.

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