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TEACHING INTERVENTION COORDINATED BY DIDACTIC SEQUENCE THAT ARTICULATES PHYSICAL PORTFOLIO, DIGITAL INFORMATION AND COMMUNICATION TECHNOLOGIES (TDICS) AND ACTIVE METHODOLOGIES IN THE PROCESS OF MATHEMATICS TEACHING AND LEARNING

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Abstract: The objective of this work is to present a teaching intervention (DI) through a Didactic Sequence (SD) that articulates Physical Portfolio (PF) with Digital Information and Communication Technologies (TDICs), active methodologies and teaching techniques used in the teaching process and mathematics learning. The set of actions articulated by the Didactic Sequence (SD) sought to enable students to engage in active learning and for teachers to experience a didactic experience, which, when teaching, promoted dialogical interaction. The learning process was encouraged through a sequence of key questions asked by the teacher to encourage student development. The study was developed at the Federal Institute of Espírito Santo (Ifes), on the Ibatiba campus, with students entering two classes of the Technical Course in Forestry Integrated into High School in 2022. The methodology involved the Physical Portfolio (PF), Digital Technologies of Information and Communication (TDICs), active methodologies and sequence of key questions as a teaching technique. In the first face-to-face meeting, a Didactic Contract (CD) and presentation of the Didactic Sequence (SD) were established. The physical portfolio (PF) consists of a pedagogical tool used as a formative assessment. The Didactic Sequence (SD) was divided into two stages: remote and in-person. The Didactic Sequence (SD) resulted in a successful experience and the research objectives were met.

Keywords: mathematical education, pedagogical intervention, formative assessment

INTRODUCTION

The evolution of teaching, learning and assessment processes in formal education is based on continuous debates that lead to a search for alternative methods that replace traditional methods. According to Matos and Mazzafera (2022), traditional methods aspire to passive students who develop by memorizing the content exposed by teachers. The teaching and learning process using the traditional method seems to limit autonomy, creativity and criticality, leaving students with opinions close to those of their teachers. The transformations occurring in society with digital information and communication technologies (TDICs) and individuals from different generations living in the educational environment require teaching and learning processes to be more dynamic and encourage interactivity, critical and reflective analysis. According to Freire (2019), the teaching and learning process must be carried out with respect for the students' knowledge, allowing the construction of autonomy and criticality. According to Freire (2019, p. 32-33):

> For me, in the difference and "distance" between naivety and criticality, between the knowledge of pure experience and what results from methodologically rigorous procedures, there is not a rupture, but an overcoming. Overcoming and not rupture occurs to the extent that naive curiosity, without ceasing to be curiosity, on the contrary, continuing to be curiosity, criticizes itself. By criticizing itself, thus becoming, I allow myself to repeat, epistemological curiosity, methodically "rigorizing" itself in its approach to the object, connotes its findings of greater accuracy.

According to Guimarães et al. (2023), the practice of teaching in contemporary times has the meaning in which the teacher also occupies the position of apprentice, due to the universe of development of TDICs. The way of teaching and learning is constituted differently

and, according to Freire (2019, p. 25) "[those] who teach learn by teaching. And whoever learns teaches by learning." To meet the desires of the new generations, mainly "Generation Z" and "ALFA", teaching and learning must be modernized but, at the same time, it is necessary to enable student protagonism where teachers can seek inspiration from them in search of (re)construction of knowledge guided by academic, professional and social knowledge.

To use TDICs, contemporary teachers need to understand the characteristics of individuals from new generations, customs, culture and especially the way they learn. According to Mannheim (apud FEIXA, 2010, p. 187), "Young people who experience the same concrete historical problems, it can be said, are part of the same generation".

According to Silva et al. (2019), throughout each historical period, individuals experience changes in their habits and customs that alter the cultural behavior of the generation, so that they acquire certain characteristics that have been called generations by different authors. The way individuals of each generation search for knowledge changes from generation to generation. Over time and with the advent of TDICs, these people become more connected and more dependent on available digital technologies.

There are several generations living together in the school environment and teachers need to remain attentive to the specific characteristics of students, to continue teaching with learning methodologies capable of being understood by new individuals. Generations are classified by Sociology according to a set of certain characteristics that may have their origin in historical, economic and cultural episodes that motivated the (re)construction of new points of view of individuals (GUIMARÃES et al., 2023).

In contemporary times, society has TDICs available to individuals from new generations and at increasingly younger ages, requiring them to be increasingly prepared with the skills to develop different skills and competencies, depending on the social context in which they are inserted. At the same time, in practice, teachers need to be able and interested in improving their teaching. According to Freire (2019), new ways of teaching must provide opportunities for interaction, autonomy and student protagonism during the teaching and learning process. In this sense, it is necessary to consider the phenomena that occur in the classroom environment to enable teaching, learning and assessment to occur. Examples of phenomena that appear in the classroom environment are the student knowledge involved, the teaching mediation capacity and the use of TDICs.

From this perspective, this work proposed a teaching intervention (DI), in the mathematics I curricular component, which involved a physical portfolio (PF) articulated with TDICs through a didactic sequence (SD). ID enabled the practical organization of classes, prioritizing student development in the schooling process and active participation in the search for the construction of new knowledge. When applying SD, the teacher assumed the role of supporting and facilitating in the educational process and, simultaneously, encouraged student protagonism in search of qualitative-quantitative development, valuing individual and collective growth in the teaching and learning processes.

With technological advances and the prior knowledge acquired by individuals from the new generations who have access to TDIC's, it becomes necessary for teachers to take a more careful look at the teaching and learning processes. The use of a DS allows a different look at the curricular organization, as it prioritizes teaching as a basis for investigating

problem situations and stimulates learning. The investigation organized by SD was motivated by problematizations that made it possible to compare the knowledge acquired in social experiences with that announced in the formal schooling space. By relating the theory of mathematical knowledge with everyday practice, the student can construct new meanings and learn different ways of investigating that enable the creation of new knowledge, processes and products.

In this context, in search of understanding and optimizing the phenomena that occur in the classroom environment and that interfere in the teaching and learning process, the present work aimed to present a teaching intervention (DI) through a Didactic Sequence (DS) which articulates Physical Portfolio (PF) with Digital Information and Communication Technologies (TDICs), active methodologies and teaching techniques used in the mathematics teaching and learning process.

THEORETICAL SUPPORT

Contemporary teachers must seek to recognize which generation they belong to and their main characteristics and, in addition, know how to recognize the generations and characteristics of the students with whom they work. According to Guimarães et al. (2023), the technological generations are chronologically constituted by Traditionalists from 1920 to 1939, Baby Boomers from 1940 to 1960, Generation 2010.

For Marques (2017), the Silent Generation (Traditionalists) is made up of rigid and autocratic individuals, loyal to the company they work for, respectful of authority and very resistant to change. The Baby Boomers generation is made up of rebellious and questioning individuals, participative leaders, open to change, ambitious, materialistic and narcissistic. The individuals who make

up Generation Generation Y is made up of individuals who do not use manuals, are the generation of trial and error, are determined, familiar with technology, do not accept authoritarianism and are generous leaders. Generation Z (Digital Natives) is made up of individuals who are able to perform several tasks simultaneously, are dynamic and innovative, live with technology and science, are known as internet natives, are immediate, critical and change their opinions easily, are concerned with environmental issues, have lower concentration power than previous generations and are believed to be more demanding, versatile and flexible professionals. The individuals who make up the Alpha Generation are curious, more intelligent for starting studies earlier and are more familiar with technology, attentive, hyper-stimulated, adaptable, independent and entrepreneurial.

Technological development, the use of TDICs and the different generations that coexist in the school environment indicate the need to provide education that enables the active participation of students. It is essential that educational institutions and teachers create conditions for student leadership, sharing responsibilities, encouraging autonomy and criticality. Institutions must develop curricula that meet contemporary demands and teachers must have the task of putting these curricula into practice, adapting them to reality.

Faced with this reality, it is necessary to consider pre-existing knowledge, create conditions for teachers to understand the context in which students are inserted, how they construct new knowledge and the phenomena that present themselves during the class. According to Vygotsky (2007), the Zone of Proximal Development (ZPD) consists of the interval (bridge) that exists between the actual level of development,

which is determined by the individual's ability to solve problems autonomously, and the level of development proximal, which is delimited by the resourcefulness in solving problems with help, knowledge in the area or a mediator.

The more experienced subjects, for example, parents, teachers and colleagues who are more developed in that subject, must participate by collaborating with the learning and intellectual development of the less experienced individual, that is, acting as a mediator between the subject and the new person.

According to Vygotsky (2007), there are two processes characteristic of evolution that regulate transfers between pairs, the first is self-regulation that precedes the second by external regulation. The text places self-regulation as a primary process, preceding external regulation. The process of self-regulation emerges decisively depending on the way in which internalization or external affective processes are introjected by the individual. Through self-regulation and external regulation, the learning of skills, competencies and new knowledge occurs.

In this sense, it becomes necessary to discover the other as a being, seek to understand the interpersonal and phenomenological relationships that occur in the school environment, in search of a teaching and learning process more appropriate to contemporary times. Han (2022), in his book "The expulsion of the other: society, perception and communication today", presents himself as a clearing that points to the zeal of the other, which in this work is directed to the phenomena that occur in the classroom environment in teaching and learning processes, providing opportunities for prior knowledge. Giving visibility to phenomena and others in the school environment seems to be the path to a transformative education, which generates autonomy with responsibility

and opens space for students to be active in the educational process.

The mediation of content needs to give space for the other and for the other's knowledge, for coexistence, efforts to interpret the phenomena and adapt teaching and learning for the development of students. In the work Being and Time, Heidegger expresses the idea of care aiming at being-in-the-world. For the author, the term care has specific characteristics that are related to the attributes of being-there, always being in the world. In a language for the classroom environment related to Heidegger's thought, it can be said that the encounter with others does not happen through a prior assimilation in which an individual finds himself initially explained, differentiates himself from other individuals, it does not simply occur through a look at oneself where the reference of difference is determined. Both move toward encounter, having as a starting point the world in which presence[1] is sustained, in a primordial way, applied in tasks directed by circumvision. In an antagonistic way to theoretical explanations that are simply established about the given being of others, it becomes necessary to rely on the demonstrated phenomenological content[1] of its encounter in the surrounding world (HEIDEGGER, 2005).

To articulate Heidegger's thought, education and care (Sorge) we resorted to the thought of Nascimento (2019, p. 96) who states:

> Dasein's ways of being are articulated in care. The term care designates the unity of Dasein's ontological determinations, because all understanding is decadent and disposed, all disposition understands and is decadent, and decay understands and is disposed. Existentiality, facticity and decay, as ontological characters of Dasein, correspond, respectively, to understanding, disposition and decay. They are not, however, independent determinations, but

1 Words with a hyphen, for example presence, refer to Heideggerian philosophy.

make up a unitary phenomenon, precisely because they are just different aspects of a single phenomenon, being in the world, which correspond to each of the ekstases of time.

When articulating the thoughts discussed previously with the teaching and learning processes, it becomes necessary to conceptualize the term physical portfolio (PF) which refers to an adaptation made in the use of a large notebook of 80 or 96 sheets to create the document. The PF is characterized by being a personal document where the student has the responsibility and autonomy to include summaries, conceptual maps, mental maps, exercise resolution algorithms, mnemonics, personal notes and other notes that favor their intellectual evolution (JUBINI et al., 2021).

Freire (2019) seeks to awaken in professionals who work in education the desire to transform the reality of individuals involved in the phenomena that occur in the classroom environment. In teaching Mathematics, I, the human element, whether student or teacher, needs to feel challenged to build knowledge with the inclusion of TDIC's. When considering the technological structure and individuals of the new generations, it can be said that it is no longer up to the teacher to perform the function of transmitting knowledge, but to become a subject capable of engaging students in search of knowledge through the mediation of teaching. linked to TDIC's resources. Corroborating Freire, Camas et al. (2013), states about the importance of mediation.

The experience of remote teaching, which occurred due to the pandemic caused by COVID - 19, allowed those involved to rethink concepts of in-person mathematics teaching. The shares made in the virtual learning environment (VLE) reveal possibilities for using different methodologies. According to Moran (2007, p. 16):

We live in the paradox of maintaining something that we no longer completely believe in, but we do not dare to fully incorporate new pedagogical and managerial proposals, more suited to the information and knowledge society, towards which we are rapidly heading.

The practice of teaching needs to be willing to break with the paradox previously presented with the idea in Moran's text. It is necessary that current teachers are willing to make a break in the operating modes of practice learned from their teachers and reduce the use of expository classes to present content. It is necessary to rethink the way in which learning and retention exercises must be used, to capture students' interest in learning new knowledge. In relation to the curriculum, Moran (2007) states that the curriculum must be connected with everyday life.

Care in using TDIC's in teaching and learning must be exercised by those involved in the process. Teachers and students need to recognize the development process, walk in search of new things as allies, practice mutual help and be willing to start over considering the experience they have had. For Freire (2018, p. 227), the teacher-student and student-teacher partnership must be intertwined around a purpose of completeness in search of scientific, social and human development.

Freire's (2019) thinking appears as an invitation to take care in including TDIC's in teaching and learning processes. It is necessary to be smooth in the partnership so that advances are inclusive and liberating. Seeking to meet the provocation found in Freire's text, Peer Instruction (CI) or Peer Instruction was used.

CI consists of an active methodology developed by professor and physicist Eric Mazur from Harvard University, the technique was created in the 1990s (MAZUR, 2015). The dynamics of this methodology focuses on the effective participation of the student in the

teaching process, in a sequence of activities that enable the development of concepts studied in class, in solving proposed problems, dialogues that provide the opportunity to demonstrate the results obtained to colleagues and persuade them. The interest of the method is to promote learning of the content through the proposed investigation with effective interaction between students (ARAUJO; MAZUR, 2013).

For Moura (2017), dialogue and understanding between peers about a certain path that leads to an answer contributes to the solidification of learning that removes or reduces possible doubts that students tend to present. In IC, the traditionally expository class is replaced by greater interactions between peers, enabling students to be active in the teaching and learning process, which can be mixed with the active flipped classroom methodology (SAI).

The SAI methodology comes from the English Flipped Classroom (FC), which consists of a learning model focused on activities that enable the construction of knowledge. The methodology focuses on students and was presented as an educational model proposed by professors Jonathan Bergmann and Aaron Sams and reached high school in North American schools in 2007 (BERGMANN; SAMS, 2012).

Bergmann and Sams (2018) state that every teacher who decides to use the SAI methodology will have different ways of putting it into practice.

For Zabala (1998), every pedagogical practice demands a methodological organization that precedes its own functioning. During the period of planning and organizing a didactic sequence (SD) or sequence of activities, the teacher needs to deal with fundamental questions that support the carrying out of educational practice. The first question is "Why educate?" and the second is "Why teach?". By understanding what is sought from the answers to these two questions, the movement towards organizing a reflective pedagogical practice takes place.

In view of the above, it is understood that it is viable to organize elementary and essential subjects and content in a DS, which precedes the more elaborate presentation and composed of numerous interconnected elements or functioning as a whole. SD must prioritize the logical organization of subjects that favor understanding by the student, considering that learning involves an integral chain of activities. Progress in learning must be progressive and collaborative, seeking to enable a better understanding of the subjects studied. The execution of a well-planned and organized DS enables the inclusion of convergent themes, provides opportunities for the link between the major areas of a curricular component or within a broader horizon and involves different areas of knowledge (UGALDE; ROWEDER, 2020).

MATERIALS AND METHODS

The study was developed at the Federal Institute of Espírito Santo (Ifes), on the Ibatiba campus, with students entering two classes of the Technical Course in Forests Integrated into High School, in the year 2022. The teaching and learning methodology, used in Mathematics I, involved PF articulated with TDICs coordinated by an SD. In the first face-to-face meeting, a didactic contract (CD) was established, with a presentation of the SD and rules for building the PF using TDICs. The PF was used as a formative assessment instrument. SD was divided into two stages, the first being remote and the second in person. The active methodologies used were SAI and IC.

The research is characterized as a case study carried out through the application of an ID methodology and data collection using

a structured instrument that obtained the opinion of incoming students.

The present research, in terms of nature, is classified as qualitative - quantitative. According to Gil (2017), Richardson et al. (1999), Cervo and Bervian (2002), quali - quanti research is developed in two stages. The first qualitative stage involved the introduction of ID to perceive phenomena. Based on the information observed in the first stage, a closed research instrument was constructed and applied to meet the second stage. Regarding temporality, the study was longitudinal. According to Appolinário (2009), a longitudinal study "evaluates the same variable, in the same group of subjects, with two or more measurements of these variables over a period of time".

The study is characterized as explanatory research, using a methodology that identified factors contributing to the modification of phenomena occurring in the process of mathematics education. In relation to the procedures, the investigation was of a participatory type and through surveys, due to the fact that the researcher participated directly in the educational process of the students who presented their understandings through forms. Furthermore, the dialogical method was used throughout the academic period, because even though interdependent resources were observed in the teaching and learning process, it can be said that they occurred through mutual action between teacher-students, students-students and students- teacher.

The methodology consisted of applying an ID, previously adopted by the author, which had been carried out in previous years and was duly approved in the pedagogical bodies of the Ifes campus Ibatiba. The ID was applied to the sample for the first time.

In relation to agreements between students and teachers for face-to-face Mathematics I

classes, it was established through the CD that the attitude towards behavior in interpersonal relationships must be respectful, welcoming and polite. In relation to the dynamics of entry and exit flow for matters external to the classroom environment, it was established that only one person could be absent from the place at a time. Whoever needed to leave the room wrote their name on the board, following the list and, to leave the room after the second, they waited for the return of the colleague who was absent.

In the CD, it was established that the PF must be created in a large notebook of 80 or 96 pages. The students were instructed on how to build the PF in person, during the first meeting and, in the Virtual Learning Environment (VLE) hosted on the Moodle platform, video links were made available with explanations on how the PF must be created. The document was used as a formative assessment, which required the establishment of rules to be evaluated.

Figure 1 shows the items that must be taken into consideration, when preparing the PF by the student.

Physical portfolio	Criteria for creating the document
Evaluative items	- Identify with: full name, academic year, course and class; - Copy or paste printouts of theoretical texts, exercise texts or questions; - Identify "errors" with "X" and correct them; - Solve exercises and questions in handwritten form; - Include the person who most collaborates with schooling in the context of studies explaining the construction of the PF.

Figure 1: Construction

Source: Survey Data, 2021

The students were instructed on the recommended posture to make the most of their studies using PF and SD (Figure 2).

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Individualized studies	Collective studies
- Plan study routine; - Practice the planned study routine; - Study in a place in the house that has a table and chair; - Leave the smartphone in another environment; - Use timed study time; - Take rest breaks every time you study (5 to 10 minutes); - Use pen and pencil to record in the PF; - Be patient and persistent with yourself, as learning is slow; - Carry out only one activity at a time; - Do not delete "errors" made in the records during studies; It is - Use class to understand and study to learn.	- Carry out individualized and silent reading in the time available in the classroom; - Carry out collaborative and qualitative dialogue in search of a better understanding of the content; - Record doubts and progress in the PF; - Use "errors" as part of the learning process; - Understand individual qualitative evolution; - Do not compare qualitative progress between colleagues; - Maintain a study routine; - Be patient and persistent with the individual and collective learning process; - Seek to understand that the evolution of individual learning helps the evolution of collective learning and vice versa.

Figure 2: Guidelines

Source: Survey Data, 2021

Regarding the distribution of points, we followed the recommendation of Jubini (2020) in which the number of points to be attributed to the document as a formative assessment could be, at most, 20% of the grade for the period. The authors add that using a percentage greater than 20% may have a discouraging effect in relation to other evaluation methods.

In figure 3, the detailed distribution ofevaluation criteria and maximum score to be achieved by the student, in the PF.

Scoring criteria	Points
10 (ten) signatures of the person who most collaborates in the student's schooling;	1.0
10 (ten) personal activities (summaries, mind maps, concept maps, resolution algorithm and/ or records of extra studies);	4.0
Other activities (content recording, learning exercises, fixation exercises, guided study and correction of face-to-face assessments).	5.0
Total of points	**10.0**

Figure 3: Criteria

Source: Survey Data, 2021

Penalty criteria and loss of points in the PF grade established in the CD (Figure 4).

Penalty criteria	Number of points lost
He did not build the PF in a large notebook of 80 or 96 pages;	Loss of 1.0 (one) point);
Do not identify the PF with full name, course, class and year;	Loss of 1.0 (one) point);
Do not include activities (content records, learning exercises, fixation exercises, guided study and correction of face-to-face assessments);	Loss of 1.0 (one) point for each activity not included;
Do not include handwritten resolutions of learning exercises, fixation exercises, guided studies and corrections to in-person assessments;	Loss of 1.0 (one) point for each of the resolutions that was not included;
Activity with wrong resolution	Loss of 1.0 (one) point for each activity with the wrong resolution;
Delay in final delivery	Loss of 1.0 (one) point for each day the PF is late;

Figure 4: Penalty

Source: Research data, 2023.

During the academic period, intermediate checks and notes were carried out in the PF document, to provide all students with the opportunity to make qualitative progress in the teaching and learning process and,

consequently, obtain the maximum grade.

Regarding the organizationIfes institution, for those entering technical courses, was organized by a selection process governed by notices. According to notice 73/2021, the selection process for technical courses integrated into high school in the face-to-face modality, for entry in the first semester of the 2022 academic year, candidate registrations were carried out online from October 8th to November 2nd. The selection was carried out through analysis of school records.

Figure 5 details the reservation of 50% of vacancies for broad competition (AC) candidates and 50% of vacancies for affirmative action candidates 1 (AA1) and 2 (AA2).

CAMPUS IBATIBA													
COURSE INFORMATION				NUMBER OF SPACES BY ENTRY METHOD									
Course	Shift	code	Duration	Broad Competition	Affirmative action 1				Affirmative action 2				Total vacancies
					PPI		OE		PPI		OE		
					SD	CD	SD	CD	SD	CD	SD	CD	
Forests	Masculine	3001	3 years	35	9	2	6	1	9	2	5	1	70
Environment	(*) Evening	2688	3 years	35	9	2	6	1	9	2	5	1	70
Prerequisites: Have completed high school													
Address	Avenida 7 de Novembro, 40 – Centro – Ibatiba – ES												
E-mail: pstecnico.iba@ifes.edu.br													
Note: (*) Courses will have one day per week after school from the first year onwards													

Figure 5: Organization and reservation of places

Source: Ifes, 2021.

Regarding the evaluation process, the Pedagogical Plan for the Forestry Technician Course (PPC) at Ifes campus Ibatiba (2020), on page 82 -83, determines that:

> The student assessment process will occur in a procedural manner, with a diagnostic and formative nature, involving teachers and students, considering qualitative and quantitative aspects present both in the cognitive domain and in the development of habits, attitudes and values. For the Forestry Technical Course Integrated into High School, grades per curricular component will range from 0 (zero) to 50 (fifty) points in each semester.

The document that carries out didactic standardization is the Regulation of the Didactic Organization (ROD) of Ifes Technical Courses (2023, p. 18) determines in Article 76 that:

> The academic result will be expressed in graduated grades, in integer values, in accordance with the course regime and the distribution of points adopted. A grade of 0 (zero) will be given to students not assessed. § 1 For registration purposes, the income result will be expressed. II - from 0 (zero) to 100 (one hundred) points for annual courses, organized in semesters, with the 1st semester: 0 (zero) to 50 (fifty) points; and the 2nd semester: 0 (zero) to 50 (fifty) points.

Supported by the previously mentioned documents, during the 2022 academic year, the PF was used as a teaching, learning and formative assessment instrument for the Mathematics I curricular component. At the end of the academic period, an impact study was carried out the use of the portfolio in the personal study dynamics of the students participating in the research. The study was divided into three parts. The first part was dedicated to understanding the impact of using the portfolio on students' personal dynamics. The second part sought to map the impact on student personal learning. And the third part focused on the impact of the portfolio on student assessment results. The proposal to use the adapted portfolio was unprecedented for all students entering the Forestry course in 2022.The PF was included in the SD, which followed three phases. The first phase was planning, the second was the PF construction process with intermediate checks and notes on the PF and the third was execution with student autonomy.

The data were tabulated in a Google Drive spreadsheet and the results were analyzed by the author. The personal experiences that were carried out during the research period helped to compare the results, using the knowledge acquired through experience and new narrative review texts. It was not the

intention to carry out a phenomenological analysis, however, there is the possibility of correspondences between the research product and the thoughts of some theorists, for example Nascimento (2019) and Kahlmeyer-Mertens (2008) who interpret the education process from a phenomenological perspective Martin Heidegger's hermeneutics.

RESULTS AND DISCUSSIONS

To carry out the teaching of the mathematics I curricular component and research, the PPC syllabus of the TFLI course was organized. The teacher wrote the script, recorded each video class and published it on YouTube. He organized the virtual classroom for the Mathematics I curricular component at the AVA and the students were included by the institution.

The video classes were recorded taking into account the experience of almost 30 years in face-to-face teaching and, due to this history, we sought to bring the recordings closer to the reality of the classroom environment. The period of social isolation helped to break down thoughts contrary to the use of TDICs for teaching and learning in the classroom environment and outside of it.

After the return of in-person teaching activities, an SD was prepared divided into two stages. In the 1st stage, teaching and learning were made possible remotely, seeking to develop student responsibility and autonomy by merging the active Flipped Classroom methodology with the use of TDICs. The development of the 2nd stage was in person and combined a sequence of key questions, mediations and referrals carried out by the teacher, collective and collaborative dialogue, active SAI and CI methodologies and the use of TDICs. In the 2nd stage, the introductory classes on "new subjects" were divided into 3 (three) parts. Figure 7 shows the SD division scheme into two stages.
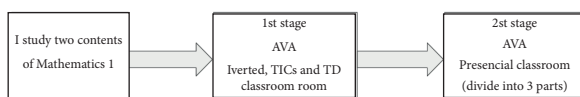

Figure 7: Phases

Source: Survey Data, 2021

The classes were planned and organized to enable students to make the most of the content. The video classes and materials available for reading were hosted in the virtual mathematics room I, located in the AVA. Study materials were made available at least one week in advance of the in-person class. In the 1st stage of SD, students were encouraged to access mathematics room I, in the AVA, and carry out a preliminary study of the materials available.

The AVA has an automatic message trigger system for participants that notifies when the virtual classroom has been supplied with materials relating to the new subject to be studied. The teacher sent messages through the Mathematics Group I, created in the Telegram application, informing about the materials available in the virtual room. Students were encouraged daily, with virtual and verbal messages in face-to-face classes, to carry out preliminary studies (SAI), using TDICs (smartphones, PCs or Tablets) during the remote stage. Students must access the virtual mathematics room I, watch the video classes on YouTube or read the materials, record the theoretical part of the subject, resolutions and development in the physical portfolio (PF). In Mathematics Group I, students must express doubts and collaborate with collective learning, being motivated to be proactive in their studies, taking care of organizing their schedules, maintaining their personal agenda, discipline in carrying out activities, planning and deadlines. Autonomy and shared responsibility were monitored and mediated in the virtual classroom and in Mathematics Group I.

The teacher carried out interventions in the debate forums in the virtual room (AVA) and in Mathematics Group I when necessary. Figure 8 presents a diagram that details the 1st stage of the studies and makes it easier for the reader to see.

According to Jubini et al. (2022), to introduce new Mathematics I content, face-to-face classes were divided into three parts. The 1st part was reserved for the individualized and silent study of the materials available in the AVA and for making records in the
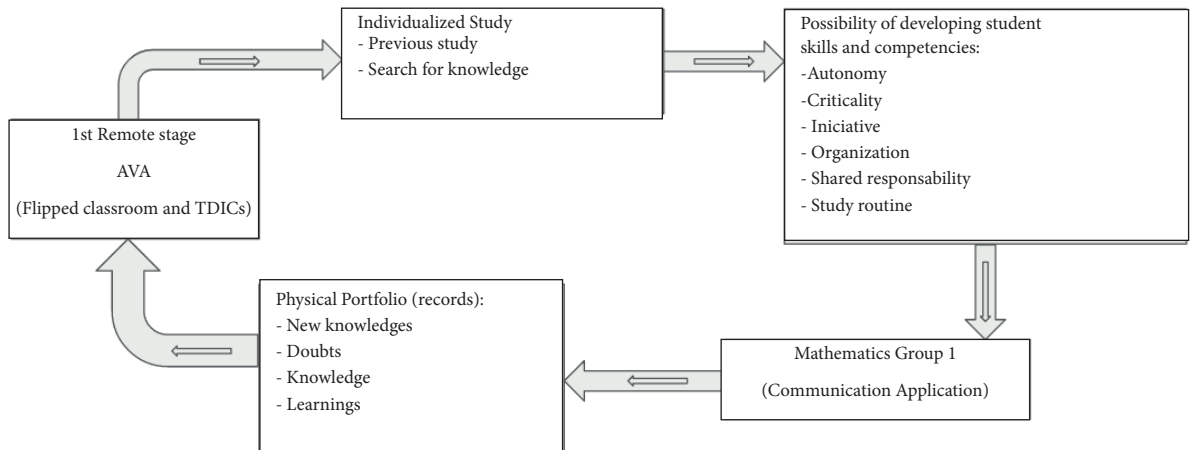

Figure 8: Remote step

Source: Survey Data, 2021

PF. The 2nd part was dedicated to dialogue, allowing students to express their doubts and knowledge verbally or written on the board and records in the PF. The 3rd part was dedicated to active IC methodology through teams with a maximum of 3 students and the process was mediated by the teacher.

Figure 9 details each of the three parts for introducing "new subjects".

The 1st part of the in-person class, lasting 10 to 15 minutes, was for students to review the study and record records carried out remotely. In the 1st stage of DS, remote studies were made possible, in advance and outside the school environment. In the face-to-face class, the 1st part, provided the opportunity for review to establish knowledge, organize materials, structure and develop studies. Moment in which students were able to exercise autonomy and responsibility in a shared way with the teacher. The dynamics adopted were close to SAI's active methodology.

Figure 10 details the 1st part of the face-to-face class with the skills and abilities.

While the students were reviewing, the teacher was able to observe the posture of each student, understand which strategy would work more efficiently, motivate everyone or a particular individual, teach when necessary and learn from the participants. In the first part of the class, the teacher can adopt two different positions, depending on how the class works. The first was to sit in the chair and answer questions with the movement of each student. The second was to circulate around the classroom and assist each of the students as they expressed themselves. Students were able to improve their acquired knowledge by reviewing the studies and records carried out in the 1st remote stage.

The time was allocated so that students could organize materials and knowledge, visiting or revisiting the contents studied. All students were given the opportunity to exercise autonomy, creativity, criticality,

2nd stage of SD	Divisions	Detailing
In-person class - "New subject"	**1st part:**	Time: 10 to 15 minutes; Dynamics: Individual and silent work; Active Methodology: SAI; Resources: TDICs, PF, pencils and pens; Student action: Sharing doubts and knowledge/Records in the PF; Teaching action: Mediation and individualized referrals;
	2nd part:	Time: 10 to 20 minutes; Dynamics: Collective/collaborative/participatory dialogue; Active Methodology: IC; Resources: PF, pencils and pens; Student action: Sharing doubts and knowledge/Records in the PF; Teaching action: Mediation and referrals;
	3rd part:	Time: 15 to 30 minutes; Dynamics: Study in teams with a maximum of 3 components; Active Methodology: IC; Resources: TDICs, PF, pencils and pens; Student action: Sharing doubts and knowledge/Records in the PF/Team study; Teaching action: Mediation and referrals;

Figure 9: In-person stage

Source: Survey Data, 2021

Classroom lesson	Skills and abilities	
	Teacher	**Students**
1st Part:	• Observation; • Perception; • Motivation; • Teaching; • Learning;	• Improve the knowledge acquired through review; • Organize materials and knowledge; • Structure thoughts; • Develop a taste for learning and evolving; • Exercise autonomy, responsibility and reflection;

Figure 10:Skills and abilities

Source: Survey Data, 2021

responsibility and reflection. By contacting the content worked individually and silently, the student had the possibility of continuing on the path he was taking, as he noticed progress in learning Mathematics I. When he did not notice progress in learning, the student had the opportunity to reposition their attitude towards studies and seeking knowledge of mathematics I. The dynamic positively affected several students, who adopted a more study-oriented attitude when observing colleagues acting with autonomy, responsibility, creativity and criticality in relation to the teaching and learning process. The phenomena that occurred contributed to student self-perception and the change from passive to active attitude.

The 2nd part of the face-to-face class, lasting from 10 to 20 minutes, was dedicated to dialogue. The teacher asked a sequence of key questions, chosen as a form of mediation for the construction of student knowledge and motivation for sharing knowledge, explaining learning. Some students expressed that they had doubts and other students who understood the "new subject" proposed to explain the path they took to understanding. Other students felt motivated to make records on the board as a form of mutual collaboration in school progress. Figure 11 shows the 2nd part of the face-to-face class.

The sequence of key questions was prepared according to the "new subject" and the needs of those involved. It was not possible to use a set of questions previously prepared and applied as a "cake recipe". The domain of knowledge for teaching, the teaching perception in relation to the learning difficulties presented by the students and the agreements established in the CD formed the guiding basis for the sequence of key questions.

The mediation was carried out with "care" to encourage and motivate creativity, initiative, responsibility, criticality and student autonomy. When necessary, referrals were made to contribute to the teaching and learning of "new subjects". The appreciation of advances, both individually and collectively, were essential for motivation and sharing of knowledge.

The diagnostic assessment was carried out orally and guided the choice of learning activities and retention exercises, providing opportunities for school development. The interactions carried out through dialogues highlighted difficulties and skills that needed more "care" in the process.

Teaching was carried out by colleagues by listening to or verbalizing experiences that occurred during the learning process, by recording on the board about "how the learning process occurred", through individual records in the PF. The sequence of key questions required care in the assertive stance that the teacher must cultivate when building the teaching and learning path. Those involved had the opportunity to make records on the board and in the PF, respect each other and be respected when sharing doubts and knowledge. The environment achieved with the ID carried out allowed collaboration to occur in the search for new knowledge.

The 3rd part of the face-to-face class, lasting from 15 to 30 minutes, was dedicated to studying in teams with a maximum of 3 (three) components, allowing pairs and individual study. The dynamics applied were close to the active IC methodology and with teaching intervention when necessary. It was observed that teams formed with 3 (three) components showed better performance in learning mathematics I, remained more involved in carrying out the proposed activities, presented greater autonomy in the search to learn the "new subject", in handling TDICs, in commitment dialogue about the "new subject" and shared experiences, avoiding leaving any colleague "behind". The components were more authentic when "complaining" about the behavior of colleagues who were not involved in the studies. Figure 12 details the 2nd part of the face-to-face class.

Classroom lesson	Skills and abilities	
	Teacher	Students
2nd Part:	• Sequence of key questions; • Mediation; • Referrals; • Motivation; • Knowledge sharing; • Diagnostic assessment;	• Knowledge sharing; • Interpersonal relationships; • Learning; • Teaching; • Records; • Collaboration; • Respect;

Figure 11: Skills and abilities

Source: Survey Data, 2021

Classroom lesson	Skills and abilities developed	
	Teacher	Students
3rd Part:	• Comments; • Mediations; • Interventions; • Referrals;	• Self knowledge; • Autonomy; • Responsibility; • Initiative; • Commitment to evolution; • Interpersonal relationships; • Respect; • Solidarity;

Figure 12: Skills and abilities - 3rd part of the face-to-face class

Source: Survey Data, 2021

When teaching, in Technical Secondary Education or Higher Education, the first author of this text has used ID as a teaching and learning methodology. Video classes with mathematics I content are studied in face-to-face classes using links available in the virtual room at AVA and hosted on the Youtube® platform. During the face-to-face assessments, students were given the opportunity to use records made in the PF. The combined guidance when establishing the CD was so that the use of the PF during the assessment occurred to understand specific doubts and not as a subterfuge to just obtain a grade.

It was noticed that students who managed to study a little every day for Mathematics I almost did not need to use the PF during the assessments. The students who were unable to dedicate themselves to studying Mathematics I, in the period leading up to the assessment, presented difficulties that were not resolved simply by accessing the records made in the PF. During the academic period, the students understood ID, dedicated themselves to studies and, consequently, achieved progress in the process of learning Mathematics I content. Several students reported that they noticed qualitative and quantitative evolution when using the methodology in other curricular components.

The methodology allowed each student to use their own physical portfolio for consultation during the assessments. In the process of familiarizing themselves with the methodology, it was noticed that some students were indifferent regarding the responsibility of keeping the activities updated and the PF up to date with the contents worked on. The first evaluation showed that the lack of prior study habits and the misuse of the portfolio hindered some students who were hoping for better quantitative results.

A new dialogue was held revisiting the agreements and guidelines established in the teaching contract. The guidelines were reinforced, mainly regarding the importance of previous studies on a daily basis in search of progress in learning. The importance of using the PF during the assessment was highlighted, only when any specific doubt arises. After carrying out the first assessment, the majority of students showed greater interest in keeping the portfolio with updated activities, a fact that consequently guided the studies and contributed to better use of the content and evolution of learning in Mathematics I.

FINAL CONSIDERATIONS

It was considered that the Didactic Sequence (SD) developed for the Teaching Intervention (DI), encompassing the use of the Physical Portfolio (PF) linked to TDICs for mathematics I classes, enabled active and autonomous learning for students. It gave the teacher the opportunity to experience a teaching experience that promoted

dialogical interaction through a sequence of key questions that enabled the development of teaching and learning of Mathematics I content.

ID was characterized as a successful experience, due to the important process of planning and organizing content and observing phenomena that occurred in the classroom environment. The dialogical mediation and coordination of actions promoted the studies of Mathematics I content based on the phenomena that occurred during the teaching, learning and assessment path. The interpretation of phenomena proved to be essential for carrying out mediations, referrals and interventions. In the remote stage, some students had difficulties in knowing how to use their time with autonomy and responsibility. Due to this phenomenon, the teacher sought to be skillful in carrying out interventions capable of motivating studies and searches for knowledge.

Dialogic or reflection in the form of dialogue led by the teacher through a sequence of key questions proved to be effective in consolidating the learning of new subjects. Students from the new generations seem to be familiar with TDICs, but they do not have the same resourcefulness to dialogue collectively in formal schooling spaces. The conversation conducted in search of teaching and learning seems to leave them insecure. The "fear of exposure" proved to be an inhibiting source of interpersonal interactions, hindering the evolution of the educational process. The methodology adopted allowed students to follow paths towards self-inclusion in dialogues, registering in the PF and in the framework in a public and collective way. The sequence of key questions asked guided the dialogue, promoted learning, inclusion and autonomy.

It was considered that for the construction of teaching and learning, conducting collective dialogues through a sequence of key questions was essential. The questions were modified according to the need presented by the phenomena that arose in the process. Care so that the space in the second part of the class allowed the inclusion of others as part of the whole became relevant and necessary, as it created conditions for self-inclusion, for welcoming others in search of the development of the educational process of those involved in individually and collectively. It was considered essential to encourage students to verbally express doubts, public socialization regarding the learning that occurred during remote studies and the records made in the portfolio.

The appreciation of "wrong" ways to solve an activity presented itself as an opportunity to carry out learning and organize the path to the "correct" resolution and led to "getting it right". The students dedicated themselves to studying during class, had the opportunity to make associations in an applied way using the ZPD (VYGOTSKY, 2007) and, simultaneously, experienced the self-regulation that precedes external regulation.

The formative and procedural assessment carried out at the PF included intermediate checks and notes. The guidelines and notes made by students' PF records provided opportunities for progress in the teaching and learning process and, consequently, obtaining the maximum grade.

It was considered that the research objectives were achieved and the participatory training experience was amplified, improving understanding of the pedagogical process. The methodology contributed to advances in the learning process, students identified developments in organization, autonomy, responsibility, protagonism, creativity, understanding and assimilation of the contents covered in Mathematics I.

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