

The process of *obutchénie* of equations of the 2nd degree based on the Zankovian didactic system for the ethical and moral formation of students¹²

O processo de obutchénie de equações do 2º grau fundamentado no sistema didático zankoviano para a formação ética e moral de estudantes

Lóren Grace Kellen Maia Amorim³
Fabiana Fiorezi de Marco⁴
Mariana Martins Pereira⁵

RESUMO

Neste artigo, recorte de uma tese, temos como objetivo analisar a organização do processo de *obutchénie* de equações do 2º grau fundamentado no sistema didático zankoviano para a formação ética e moral de estudantes. Como metodologia de pesquisa utilizamos o experimento microciclo realizado com 24 estudantes do nono ano do ensino fundamental de uma escola pública de Uberlândia-MG. Na análise percebemos que a organização intencional das ações e os diálogos entre os estudantes ou entre estudantes e professora-pesquisadora foram impulsionados por reflexões ocasionadas pela vivência da situação-problema em que

ABSTRACT

In this article, cut from a thesis, we aim to analyze the organization of the process of *obutchénie* of equations of the 2nd degree based on the Zankovian didactic system for the ethical and moral formation of students. As a research methodology, we used the micro cycle experiment carried out with 24 students from the ninth year of elementary school in a public school in Uberlândia-MG. In the analysis we noticed that the intentional organization of actions and dialogues between students or between students and teacher-researcher were driven by reflections caused by the experience of the problem situation in

¹ This article is a clipping from the doctoral thesis entitled "Equations of the 2nd degree and the Zankovian didactic system: a look at student development", available at: <https://doi.org/10.14393/ufu.te.2022.5322>. Accessed on Feb. 22, 2023.

² Translation: Silvia Iacovacci. E-mail: siacovacci@gmail.com.

³ PhD in Education from the Federal University of Uberlândia, Brazil. Teacher of Basic Education. Uberlândia/MG, Brazil. Orcid: <https://orcid.org/0000-0002-7086-0159>. E-mail: lorengekma@gmail.com.

⁴ Post Doctorate in Education from the University of São Paulo / SP, PhD in Mathematics Education from the State University of Campinas. Coordinator of the Study and Research Group on Mathematics Teaching and Pedagogical Activity (GEPEMAPE). Professor of the Postgraduate Programs in Education and in Science and Mathematics Teaching at the Federal University of Uberlândia, Brazil. Orcid: <https://orcid.org/0000-0002-7126-5626>. E-mail: fabiana.marco@ufu.br.

⁵ PhD in Education from the Federal University of Uberlândia, Brazil. Professor at the School of Basic Education of the Federal University of Uberlândia, Brazil. Orcid: <https://orcid.org/0000-0001-5109-8165>. E-mail: marianamartins@ufu.br.

estavam envolvidos. Os resultados da pesquisa revelaram que os momentos vivenciados pelos estudantes durante o experimento microciclo contribuíram para que eles: fossem sujeitos ativos no processo de *obutchénie*, conduzindo-o com responsabilidade; entendessem que o nível de dificuldade e a variedade de conteúdos novos propostos na situação-problema foram provocativos e impulsionadores de operações mentais mais complexas indicando formação nos aspectos morais e éticos.

Palavras-chave: Formação ética e moral do estudante. Equação do 2º grau. Sistema zankoviano.

which they were involved. The results of the research revealed that the moments experienced by the students during the micro cycle experiment contributed to them: being active subjects in the process of *obutchénie*, conducting it with responsibility; understand that the level of difficulty and the variety of new content proposed in the problem situation were provocative and drivers of more complex mental operations indicating training in moral and ethical aspects.

Keywords: Ethical and moral formation of the student. Equation of the 2nd degree. Zankovian system.

1 Introduction

This article presents reflections on student actions in a task, consisting of seven steps, which makes up doctoral research entitled Equations of the 2nd degree and the Zankovian didactic system: a look at student development, developed in the Postgraduate Program in Education of the Federal University of Uberlândia.

In this article, cut from the thesis mentioned, we aim to analyze the organization of the process of *obutchénie* of equations of the 2nd degree based on the Zankovian didactic system for the ethical and moral formation of students. Given this objective, in this article we intend to answer the question: *in the process of obutchénie of equations of the 2nd degree, based on the Zankovian didactic system, is it possible to have evidence of the beginning of an ethical and moral formation of students?*

With regard to morality, paraphrasing Figueiredo (2008), we consider that it concerns the set of customs and judgments that are determined and admitted in a society according to its tradition or cultural reality. Ethics, on the other hand, according to Korte (1999) is consistent with the relationship between the individual and the socio-cultural rules imposed by a given society.

We chose to work with the Zankovian didactic system, as it emphasizes the introduction of different methodologies, teaching procedures, innovative resources and the articulation of different curricular components, in order to

analyze and verify the contributions of the organization of the *obutchénie* process based on the bases of such a system for the integral, or multilateral, formation of the students' personality. In this article the focus is on the moral and ethical formation of students, as dimensions of personality.

In view of the above, we adopted as methodology in the research the didactic-formative experiment based on the system proposed by L. V. Zankov, which is based on historical and dialectical materialism. However, due to the longitudinal format of the didactic-formative experiment that results in long periods of study, we used to develop a micro cycle experiment, which, according to Longarezi (2019c, p. 190) based on Zuckerman (2011), "can be carried out in weeks or days and, within this modality, the experimenter himself follows the whole process."

Using Zankov (1963, 1968, 1984), we organized the micro cycle experiment, which was carried out in two months, anchored in the didactic and methodological principles of the Zankovian didactic system, in the search to contribute to the moral and ethical formation of students.

The task that composed the micro cycle experiment was composed of seven stages and developed with 24 students from the 9th year of elementary school of a municipal school in Uberlândia-MG, aged between 13 and 16 years. Most of the students who participated in the research studied with the teacher-researcher since the 6th grade.

Once presented the central question and the objective of this article, as well as the methodology adopted and the research subjects, we proceed to present the didactic principles and methodological guidelines of the Zankovian system.

2. Didactic principles and methodological guidelines of the Zankovian system

Leonid Vladimirovich Zankov (1901-1977) was a Soviet psychologist, student and member of Lev Vigotsky's circle, and conducted relevant scientific research in the Soviet Union. He graduated from the Faculty of Social Sciences of Moscow State University in the 1920s, specialized in psychology of memory, psychology of abnormal development (defectology) and educational research and

practice. He was the founder of one of the most eminent educational theories, called the Zankovian developmental didactic system (1957-1977) (GUSEVA; SOSNOWSKI, 1997).

This system aims to highlight the possibilities of the school to generate circumstances that contribute to the development of the student, taking into account the need to provide an environment for individualities. Of course, collective work cannot be reduced, considering that, for C. Marx, "the development of an individual is conditioned by the development of all the others with whom he is in direct and indirect exchange."⁶ (MARX apud ZANKOV, 1984, p. 34). In this perspective, to learn, one needs interaction, contact, dialog, something that instigates the search for knowledge, which brings satisfaction and pleasure to the student.

In this way, Zankov (1984) establishes five didactic principles on how to guide the structuring of the content and methodology of *obutchénie* that represent a unit and cannot be apprehended separately or independently. They are: I. *Obutchénie* at a challenging level of difficulty; II. Emphasize the *obutchénie* of theoretical knowledge; III. Active and increasing pace of *obutchénie*; IV. Developing students' awareness of the *obutchénie* process; V. Organizing classes to promote the intentional and systematic development of each student.

The principles act on different planes and have specific functions, but which interconnect with each other, the field of action of the first four principles being defined by the last, considering that, in order to achieve the objectives of each principle, the organization of *obutchénie* is fundamental. (ZANKOV, 1984).

The *Obutchénie principle at a challenging level of difficulty* contributes to the student's recognition of his abilities and offers a development space that stimulates the typical processes of the student's psychic activity in understanding the concepts and meanings to be apprehended. In this process, when students

⁶ "El desarrollo de un individuo se halla condicionado por el desarrollo de todos los demás con quienes se halla en intercambio directo e indirecto." (MARX apud ZANKOV, 1984, p. 34).

have mastered some contents, these need to lead, at the same time, to the improvement of subsequent knowledge (ZANKOV, 1963, 1968, 1984).

The second principle, *emphasizing the obuthness of theoretical knowledge*, highlights the relevance of theoretical thinking for the cognitive development of the student and estimates the formation of a web of concepts and skills of the subjects. Theoretical thinking is more than definitions or terms, it is formed in the apprehension of dependencies and laws governing phenomena, in the broader and deeper appropriation of concepts.

The active and growing rhythm of obutchénie considers the intellectual needs of students, their thoughts being stimulated by plurality, as opposed to what happens with the repetition of exercises. As Zankov (1966 apud GUSEVA; SOSNOWSKI, 1997, p. 19) ponders, "focusing on endless exercises and the monotony of excessive revision produces mental laziness, spiritual apathy and serves to obstruct rather than facilitate development⁷." This principle plays an auxiliary role in relation to *obutchénie* at a challenging level of difficulty, with an independent function that requires unceasing progress.

The fourth principle, *developing students' awareness of the process of obutchénie*, "[...] refers to the student's self-awareness of their progress or development in the course of a specific *obutchénie* experience" (GUSEVA; SOSNOWSKI, 1997, p. 20), with various mental activities being involved in the process of self-awareness or self-monitoring of *obutchénie*.

Thus, the process of mastering concepts and skills becomes the object of awareness until certain moments and the various issues concerning the understanding of the concept and skills are the object of constant attention by the student.

The field of action of the four principles of the Zankovian experimental system will be outlined in the fifth principle, establishing the relevance of the teacher organizing his work in an intentional and systematic way for the general development of all students, including those with more difficulties in

⁷ "Focus on endless drill and the monotony of excessive review produces mental laziness, spiritual apathy and serves to obstruct rather than facilitate development." (ZANKOV apud GUSEVA; SOSNOWSKI, 1997, p. 19).

the process of *obutchénie*, since they need a greater systematic effort than the others for their development.

Guseva and Sosnowski (1997) mention that, for Zankov (1984), the segregation and organization of students considering performance are antagonistic to the development and essence of *obutchénie*, and that "the development process can be slow, can be uneven for a variety of reasons - psychological, personal experience" (GUSEVA; SOSNOWSKI, 1997, p. 21, our translation). 21, our translation), however, students, regardless of their difficulty, need to learn together, since, for Zankov (1967), the class is the organization of collective *obutchénie* in which,

[...] given the proper organization of activities, each student makes a unique and valuable contribution to the common life of the class. When all weak students are grouped together ... the enrichment that comes from working alongside stronger students is denied. Moreover, such arrangements tend to diminish the student's self-concept and self-esteem⁸. (ZANKOV, 1967 apud GUSEVA; SOSNOWSKI, 1997, p. 21).

In the Zankovian system there is valorization of collective work that stimulates individual development and, in this movement, the teacher needs to intervene, using the contributions of colleagues to promote the cognitive development of each student in the class.

In addition to the five didactic principles that constitute the Zankovian system, there are also the methodological guidelines that compose it: *multilaterality, the character of the process, collisions and variability*⁹. (ZANKOV, 1984).

Multilaterality, from the perspective that methodological procedures fulfill several functions, we understand that the focus is "on the development

⁸ "Is a learning collective in which, given appropriate organization of activities, each student makes a unique and valuable contribution to the common life of the class? When all weak students are grouped together they... are denied the enrichment that comes from working alongside stronger learners Moreover, such arrangements tend to diminish learner's self-concept and self- esteem." (ZANKOV, 1967, *apud* GUSEVA; SOSNOWSKI, 1997, p. 21).

⁹ "[...] tanto en la comunicación de los conocimientos teóricos, que evidencian, en uno u otro grado, la esencia del material de estudio como en el orden de las tareas que se dan a los escolares." (ZANKOV, 1984, p. 223).

of the real diversity of students' psychic activity, to the detriment of the exclusive assimilation of knowledge and habits". (FEROLA, 2019, p. 62). In this perspective, according to Zankov (1984), emotions and will are involved in the study activity.

The character of the process is summarized in the fact that the didactic process consists of steps that follow one after the other in an organic and integrated relationship. (ZANKOV, 1984). This particularity of the methodology acts at the various levels of the didactic process, that is, "both in the communication of theoretical knowledge, which highlights, to one degree or another, the essence of the study material, and in the order of the tasks given to students". (ZANKOV, 1984, p. 223).

The authors Nechaeva and Roshchina (2006, p. 87) announce that collisions are found "whenever previous and new knowledge and skills are incorporated into a unified structure¹⁰." Thus, in order to have a new way of doing an action, it is essential that it clashes with previous experiences.

Variability allows the Zankovian system to be transformed according to the personal needs of the teachers and students who will use it, but it has its limits set by didactic principles. Flexibility does not change the system as a whole, because the didactic principles take a guiding and regulating role in the task and define what changes can be made (ZANKOV, 1984).

In this article we present the five didactic principles and the four methodological orientations of the Zankovian system that permeated all the stages of the task developed in the micro cycle experiment that we elaborated, and in the next article we announce the steps adopted to carry out the didactic-formative experiment and the methodology for analyzing the results.

¹⁰ "[...] обнаруживаются всякий раз, когда прежние и новые знания и навыки включаются в единую структуру." (НЕЧАЕВА; РОЩИНА, 2006, p. 87).

3. Methodology

Considering the particularities of the Zankovian system, we planned the task with a focus on the students' development process, articulated with the plan of the object of study's *obutchénie* and the anticipation of possible interventions by the teacher-researcher. For this, it was necessary to stick to the movement of necessary actions and operations, as well as to the principles of theoretical knowledge that would enable us to perceive the mental operations evident in the process of understanding the concepts by the students.

It is worth mentioning that, for the development of the research, some adaptations were necessary, considering that L. V. Zankov's experiment took place with children from the initial years of Russian elementary school, in the 50s and 60s. And our research, carried out in the 21st century, had the participation of subjects who have cultural, social aspects and economic and ideological mode quite different from those of that time. In addition, we worked with adolescents who were completing elementary school in Brazil in 2018. Given these singularities, it would not be possible to replicate exactly some aspects present in the Zankovian system, but the proposed didactic and methodological principles were respected.

L. V. Zankov presented the didactic experiment in three stages, but, according to Aquino (2014), the details are not enough to base ourselves on them. Thus, in this study, we adopted the expression didactic-formative experiment according to Aquino (2014) and followed the four stages he proposes, always maintaining the fundamentals of the Zankovian system and the actions to carry out the micro cycle experiment, which is carried out through the following actions:

1. determination of the stages, phases and levels of the development of the quality to be projected of a child's action and its potential;
2. search for ways to identify what the student (or the class as a learning community) is like, together with the criteria for identifying the innovations of a child's action; and
3. search for ways to give pedagogical support (ZUCKERMAN, 2011). (LONGAREZI, 2019c, p. 190)

According to Aquino (2014, p. 4650), in the first stage of the didactic-formative experiment named Review of the literature and diagnosis of the reality to be studied, after the production of the empirical material, we had the condition to organize "the theoretical framework of the research", make the "diagnosis of the traditional teaching methodology" and "the diagnosis of the group of students and teachers involved in the work."

In the second stage, called Elaboration of the Experimental Didactic System, we have: "1) The elaboration of the experimental didactic system, consisting of the new program of the discipline, the tasks or learning problems, the methods to be employed and the teaching resources; 2) The preparation of teachers who will assist in the application of the experimental didactic system." (AQUINO, 2014, p. 4652).

In the third stage, entitled Development of the didactic-formative experiment, Aquino (2014) proposes the realization of tasks such as: 1) Development of the experiment; 2) Capture of the phenomenon and monitoring of the experimental situation through video observation, registration and in person; 3) Use of interviews with teachers and students; 4) Preparation of the captures of the phenomena for their analysis.

Aquino (2014) names the last stage of data analysis and report writing. For the author:

The analysis is carried out in view of a set of categories previously elaborated and supported by evidence of learning and the integral development of the students' personality. These evidences appear in the students' and teachers' speeches, in the research subjects' behaviors, in the records we make about the conditions in which the learning process takes place, in the attitudes, habits, skills and values manifested by the participating subjects. We work with clues, with evidence, with symptoms [...] (AQUINO, 2014, p. 4653-4654).

Thus, in the practical experiment implemented in the classes, the analysis of the conjunctures contributes to the discovery of fundamental

relationships, which are not always visible, establishing the nature of the phenomena investigated.

We emphasize that, in the didactic-formative experiment presented here, the stages were not watertight, as we experienced a movement of comings and goings, reviewing and restructuring what was proposed, according to the needs that arose during its development.

In order to analyze the material produced in the development of the micro cycle, as a methodological contribution, we chose to work with isolates (CARAÇA, 1951), considering these as a set of elements that announce interaction, conceptual meaning, in addition to enabling us to unveil "revealing actions of the training process of the participating subjects." (MOURA, 2004, p. 272).

For this, the records of the actions that developed over 24 classes, recorded in video and audio, recorded in the field diary of the teacher-researcher and in the students' records, made it possible to apprehend the objective and subjective products of the students' formative path. All of them constitute the structure of analysis of the development of the object of study and, consequently, subject and object, process and product are considered in their unity.

As presented, we have a hermetic context, rich in details, with many interdependent relationships, of a reality in motion. Thus, at the moment of analyzing the phenomena, in order to reach the isolated ones, we approach the idea of Caraça (1951), who mentions that the isolated one is explained by the "impossibility of embracing, in a single blow, the totality of the Universe [observed reality], the observer cuts, highlights, from this totality, a set of beings and facts, abstracting from all the others that are related to them." (CARAÇA, 1951, p. 1). (CARAÇA, 1951, p. 105).

Caraça (1951, p. 105) emphasizes that, in order to achieve the cutout of reality, it is necessary to "understand in it all the dominant factors, that is, all those whose interdependent action sensibly influences the phenomenon to be studied". In other words, it is necessary to consider the movements undergone by students throughout the process in order to be able to grasp their qualitative changes and transformations.

Thus, to expose the research process carried out, we used the episodes and scenes in the sense conceived by Moura (2004), in which:

Episodes may be written or spoken sentences, gestures and actions that constitute scenes that may reveal interdependence between the elements of a formative action. Thus, episodes are not defined from a set of linear actions. It may be a statement by a participant in an activity that has no immediate impact on the other subjects of the collective. This impact may be revealed at another time when the subject was asked to use some knowledge to participate in an action in the collective (MOURA, 2004, p. 276).

The episodes allow us to investigate "those moments in which a conflict situation becomes evident that can lead to the learning of a new concept" (MOURA, 1992, p. 77), so that they constitute and reveal the isolates (MOURA, 2000). It is also necessary to consider the actions carried out in an isolate that can generate new actions so that the development process continues.

In view of this, the structure of analysis of the episodes is based on two isolates: *Relationship between theoretical concepts, emotion and will and Student development in the ethical, moral and health awareness dimensions*, but in this article the focus is on the second isolate *Student development in the ethical, moral and health awareness dimensions*. In our research, these isolates are formers of the formative path, revealing the way students attributed meanings and meanings to their actions in the systematization of *obutchénie* and formation of the concept of equations of the 2nd degree. The isolated people have a relationship with each other and cannot be understood without each other.

In the isolated *Student development in the ethical, moral and health awareness dimensions*, we seek evidence of how the process of *obutchénie* of the concept of equations of the 2nd degree enabled the ethical and moral formation of students.

In view of the above, in the next item, we present a scene from one of the episodes analyzed - *moments indicative of the development of students' ethics and morals* - which makes up the thesis that gave rise to this article.

4. Unveiling the indicative moments for the formation of students' ethics and morals

In this scene, we sought evidence in dialogues that would allow us to make inferences about the ethical and moral formation of students in the course of the micro cycle experiment. It is worth remembering that the scene that is now presented was developed during four classes.

In the proposed task, in its step 1, Trajectory of the ball, we started from the following problem situation:

The Italian physicist Galileo Galilei (1564 - 1642) studied movements like that of this ball and found that, disregarding air resistance, anybody thrown into the Earth's gravity field moves in the same way. That is, in the goalkeeper's throw, after 1 second the ball would travel about $5 \times 1^2 = 5$ meters; after 2 seconds, it would travel about $5 \times 2^2 = 20$ meters; after 3 seconds it would travel, $5 \times 3^2 = 45$ meters; and so on. Considering this throw, how long does the ball take to travel the distance of one soccer field?

In the development of this problem situation, several moments helped the ethical formation of the students, while they dialogued in the class group about the field of variation:

Dulce¹¹: Wow, if we have a function, the variation field can be any measure greater than zero.

Henrique: I agree with Dulce, but if we think of an official soccer field, our answer is not wrong.

Dulce: Yes, Henry. I just thought not to restrict it too much.

Aline: Dulce, but if the length is zero, we don't have a soccer field.

Dulce: True, I hadn't thought of it that way, Aline. I'll talk to the group so we can define the intervals better.

(Class-group, step 1)

¹¹ Please note that the names used are fictitious.

In this dialog, we infer from Dulce's speeches that she expressed the ethics of listening and respecting the arguments of her colleagues and this process contributed to the conflict of ideas, allowing the student to change her opinion and feel the need to talk again with her group about the answer they had defined. Thus, the process of *obutchénie* contributed to the formation of a new element and synthesis of previous elements (LONGAREZI; DIAS DE SOUSA, 2018) and made it possible to work with students on the manifestations of ideas, opinions and arguments, in order to make themselves understood by the other and the purpose of listening to the proposals, opinions and arguments of colleagues and reconsidering points of view when relevant (BRASIL, 2017).

Thus, step 1, based on the characteristics of the Zankovian system, in addition to allowing students to reflect on their responses regarding the field of variation, after listening to the colleague, provided an opportunity for dialogue on subjects that in traditional teaching are developed in Science and Physical Education classes. This movement was possible due to the pedagogical quality, variability, of the *obutchénie* method proposed by L. V. Zankov.

The variability, pedagogical quality of the Zankovian system, allows us to make changes considering the personal needs of students and teachers, but without changing the didactic principles. In this way, in the course of the task, considering the interdisciplinary perspective recommended in the Zankovian system, the teacher needs to make his planning more flexible and take advantage of the subjects present in the classroom dialogues to provoke concerns in the students, stimulating their criticality and power of argumentation.

These particularities were fundamental so that the teacher-researcher could confidently take advantage of the subject - the violence practiced by fans in soccer stadiums - that arose after asking students about their favorite sport. This situation occurred in step 1, in the group-class moment, providing an opening for dialogue that provided reflection on the causes, consequences and solutions to combat this act, in order to guide students on ethical behavior and repudiation of violence in relation to others. The interlocutions

provided a reading of the students' underlying convictions regarding morals, ethics and sportsmanship, as we can see in the transcription of the voices of Dulce, Filipe, João, Lauro and Fran.

Lauro: I like soccer better, but I don't agree with the fights between fans. I am against violence.

João: I don't agree with violence either. There are some organized supporters who do not respect each other, there are also some players who do not comply with the rules and end up having fights on the field.

Dulce: For the players there are punishments when they break the rules. And for the fans?

Filipe: I think that in Brazil there is no law to solve these problems.

Fran: The big clubs try to punish the organized supporters, but not everyone who fights has links with the organized supporters.

Dulce: This violence brings a lot of sadness to families, most of the time innocent people die.

Teacher-researcher: Do we solve the problems with violence with punishments?

Silence

Gustavo: That would be one way. Perhaps the imprisonment of those who commit aggression would be an example for others not to commit violence.

Tetê: True, Gustavo, but some people will only learn when they feel it. I believe that the laws are not being applied, which is why there is so much aggression.

Dulce: Perhaps not allowing those involved in crowd fights to attend matches would be a way to stop or even reduce violence. Knowing that they won't be able to do what they like, they sometimes think before they act.

Silence

Paula: These situations are difficult; I think that raising people's awareness would be one way. But those who practice it cannot go unpunished.

Aline: I agree with Paula, the conscious person can solve the intrigues by talking.

[...]

Dulce: I'm thinking here, when it comes to violence, the ideal is that the laws are complied with. And as Paula said, to try to solve the problem the way is to make people aware.

(Group-class, stage 1)

In the dialogue, there is evidence that, for the students, violence is contrary to the moral values and principles that guide life in Brazilian society. This statement can be observed in the speech of the student Lauro, who reports feeling uncomfortable with the behavior of some soccer fans: "I like soccer more, but I do not agree with the fights of the fans. I am against violence". In addition, João highlighted the lack of respect for others and the disregard for the rules when he said: "I don't agree with violence either. There are some organized fans who do not respect each other, there are also some players who do not respect the rules and end up fighting on the field". This dialogue, which took place in a group class, is a manifestation that reveals the students' understanding of certain socially accepted ethical values, since they have identified circumstances that violate the dignity of the human being, confirming the development of a dialectic that has made it possible, through dialogue and debate between committed interlocutors, to indicate a process of affirmation of their truths on the subject and ratification of their ethical formation. Considering that ethics studies the relations between "what is individualized and the world around it [the moral world]" (KORTE, 1999, p. 136), we can conclude from the statements of the students Lauro and João that violence violates their ethical values, for which violence cannot be practiced because it violates the morals of today's society.

In the dialogue presented, the students emphasized that not respecting the rules could lead to punishments, facts observed in the speech of the student Dulce, when she says: "For the players, there are punishments if they break the rules. And for the fans? The student's question leads us to conclude that she wants justice for fans who break the law and reject injustice. (BRASIL, 2017).

Given Dulce's position, the teacher-researcher provoked the students with the following question: "Do we solve the problems of violence with punishment?".

This question sparked a dialogue among the students, who expressed their opinions and justified their points of view. Gustavo expressed that punishment would be a way, but that he thought it was not effective. This

statement was expressed as follows: "It would be a way. Maybe the imprisonment of those who commit aggression would be an example for others not to commit violence.

Gustavo's argument prompted student Tetê to take a stand against his statement, seeking an answer as to why the punishment was not effective. Tetê reiterates that the non-effectiveness of punishment is a reason for violence to continue to be practiced. This justification can be confirmed in the following words of Tetê: "True Gustavo, but there are people who will only learn when they feel it on their skin. I believe that the laws are not being applied, which is why there is so much aggression". We infer that this dialogue contributed to students reflecting on the importance of complying with the laws that define rights and duties and, for them, violence is a "social issue directly related to justice." (BRASIL, 1998, p. 74).

Like the other colleagues, student Dulce felt comfortable presenting a possible solution to decrease violence among soccer team fans when she proclaimed: "Perhaps, not allowing those involved in fan fights to watch the matches would be a way to stop or even decrease violence. Knowing that they won't be able to do what they like, they sometimes think before they act". After her colleagues expressed their opinion, Dulce re-examined this position and made the following statement: "I'm here thinking, when it comes to violence, the ideal is that the laws are enforced". We observed that the dialogue allowed Dulce to reflect on her ideas and the responses of her colleagues regarding the punishments of those who practice violence and reorganize her opinion, presenting indications that can contribute to her ethical formation, as proposed by Zankov (1984). Thus, we understand that the micro-cycle experiment may have provided the beginning of "[...] a broader type of education of the subject, including the formation of ethical values that constitute his character and personality, whose process takes place in the various sociocultural contexts in which he is inserted. [...]" (LONGAREZI; FRANCO, 2017, p. 265).

In search of a way to mitigate or even end violence among fans, Paula expressed that to solve this problem, one of the ways would be to raise people's awareness. In the words of the student: "Difficult these situations, I think that raising people's awareness would be a way. But those who practice it cannot go unpunished". We found that the conversations about the violence practiced by some fans enabled student Paula to express her ideas, opinions and arguments in a clear and understandable way to her colleagues and boosted her creative, logical and critical thinking in relation to the theme, as highlighted by the BNCC (BRASIL, 2017).

Based on Vygotsky, Rego (1996) points out that the specificities of each individual happen through interaction with the environment, and that life in society requires the elaboration and compliance with norms and rules that permeate relationships, enabling dialogue and cooperation between human beings. We share the idea of Rego (1996) and thinking about the dialogue of the students, the ideal would be the awareness of the fans in the sense of learning to respect others and use dialogue as a means to resolve the conflict, as proposed by Aline: "I agree with Paula, the conscious person can solve the intrigues by talking".

The debate on violence provided students with "a constant critical attitude, recognition of the limits and possibilities of subjects and circumstances, problematization of actions and relationships and the values and rules that guide them". (BRASIL, 1998, p. 61).

We noticed that the students felt comfortable to expose their ideas, seek solutions and give explanations when engaging in dialog with satisfaction to understand a problem of reality, which according to Zankov (1984), is only possible if the "environment is encouraging and welcoming." (GUSEVA, 2017, p. 1). (GUSEVA, 2017, p. 234).

Thus, we believe that students felt confident in reporting their conceptions, as they were encouraged in the course of step 1, "to listen and listen; look and see; think and reflect; not repeat and; be happy and experiment." (GUSEVA, 2017, p. 234). (GUSEVA, 2017, p. 235).

The *sport* theme, worked in Science, Physical Education and Mathematics classes, specifically in stage 1 of mathematics in which the subject of soccer was addressed, enabled students to reflect on the causes that lead to fights between fans of the same team and/or opposing teams that are playing. In addition, we infer that the dialogue encouraged the students' critical posture and the debate on the importance of respect for others. This evidence is clear in the following dialog:

Teacher-researcher: What can cause fights between fans?

Mark: Among the fans of the same team, it can be that one curses the player and another feels the pain or one fan hinders the other to watch the game by getting up all the time.

Paula: I saw in the newspaper a while ago that fights between players on the soccer field also provoke fights between fans.

John: I think that not being able to accept your team losing is also the reason for the fights.

(Class group, step 1)

In the dialogue, among the factors that trigger fights between fans, aggression through words towards the other and violation of respect for others are evident. These attitudes seem to violate the ethical values of the students. This statement can be seen in the speech of student Marcos: "Among the fans of the same team, it may be that one curses the player and another feels the pain or one fan hinders the other from watching the game by getting up all the time". We observed that the teacher-researcher's question led to reflections related to the conditions that make decision making non-valuative.

The interlocutions allowed students to recall and bring to the discussion newspaper news, as we observed in Paula's speech: "I saw in the newspaper a while ago that the fight between the players on the soccer field also causes the fight between the fans". The dialogues contributed to the students analyzing, with the guidance of the teacher-researcher, the theme of violence between soccer fans, disseminated in the various media,

contributing so that they could relate, evaluate and counter the idea of justice. (BRAZIL, 2017).

After expressing the possible causes of the fights, referenced by Marcos, Paula and João, the students were invited to reflect on whether these can be used as justifications by the fans. This moment was conducive for students to express their ideas and raised the subject of sportsmanship, as we can follow in the dialog:

Teacher-researcher: Do the causes that Lauro, Paula and João mentioned justify the fights between fans?

Silence

Dulce: No, we need to respect others and know how to lose. We should not do to others what we do not want them to do to us.

[...]

Gustavo: In a game we will have a winner and a loser. It is important to know how to win and lose, because life is not only made of victories.

Maria: We need to have more efficient rules in Brazil and the fans need to exercise more sportsmanship.

(Class-group, stage 1)

The teacher-researcher's question mobilized students to reflect on the need to respect others in the same way they would like them to respect them, as stated in Dulce's speech: "No! We need to respect others and know how to lose. We should not do to others what we do not want them to do to us".

Maria's statement: "We need to have more efficient rules in Brazil [...]", reinforces the importance of having morals well outlined in all segments of society, considering that morality is a key element in the life of the child.

[...] refers either to customs or to the rules of conduct accepted in a given society. Therefore, a moral fact is accepted for a type of society according to its tradition or cultural reality. Moral reality, in this sense, will refer to the set of these customs and judgments about customs that are the object of observation or verification according to sociocultural rules (FIGUEIREDO, 2008, p. 6-7).

With well-defined customs and rules, it is necessary to make students and society aware of their rights and duties so that they are respected and fulfilled, as expressed by student Maria: "[...] the fans need to exercise more sportsmanship".

In relation to sportsmanship, students understand that it can be constituted within the family and the school, as we can see in the statements of Paula and Henrique:

Teacher-researcher: Unfortunately, some fans and players do not show sportsmanship. How can we improve this situation?

Paula: Families need to teach that we also lose.

Henrique: Besides the family, schools can also teach. In Physical Education classes, teacher Jú talked about the importance of respecting opponents, since they are people with feelings like us.

(Group-class, stage 1)

We know that school, family and society are the pillars of students' education, thus:

[...] the family, being the most elementary and primitive form of human community, has been called a social cell. In it is realized the principle of propagation of the species and develops largely, the process of education of the individual in his early years, as well as the formation of his personality. For all this it assumes great importance from the moral point of view (VÁZQUEZ, 1993, p. 196).

Therefore, the family needs to play its role in moral formation, as Paula ("Families need to teach that we also lose") and Henrique ("In addition to the family, schools can also teach"). The stance adopted by the two students seems to reveal that they are aware of who is responsible for the formation of moral and ethical principles.

In view of the words pronounced by Henrique that "In addition to the family, schools can also teach. In Physical Education classes, teacher Jú spoke of the importance of respect for opponents, since they are people with feelings like us", we realize that the student understands the role of studies for his social

formation and, as Vigotski (1991 apud LONGAREZI; FRANCO, 2017, p. 279) points out, we understand that the school "[...] produces the social selection of the outer personality. From man as a biotype, education, through selection, forms man as a social type."

The dialogue enabled students to reflect on which moments teachers provide opportunities for reflection on the spirit of sport, as we can see in the dialogue:

Teacher-researcher: Is it only possible to teach sportsmanship in Physical Education classes?

Luana: No, when we use games in math and science classes, we are also learning sportsmanship, since when we play, we respect the rules and accept when we lose, taking advantage of defeat to rethink our strategies.

Dulce: That's right, Luana, in games classes we learn not to appeal to defeats and analyze what we need to do to improve, when the game does not depend on luck. We have to create our strategies.

Filipe: It is not only in the game that we learn about sportsmanship, but in the classes, we talk giving our opinions without offending anyone, being able to say what we think, as we are doing now.

Choir: That's right.

Luana: In the group classes we learn to listen to each other, to dialog and respect their opinions. When we respect the other, we are honest and accept defeat.

(Group-class, step 1)

According to student Luana's statement ("No, when we use games in mathematics and science classes we are also learning the sporting spirit, since when we play we respect the rules and accept when we lose, taking advantage of defeat to rethink our strategies"), it is evident that in science, physical education and mathematics classes, game situations were worked out that allowed them to experience respect for others, recognize their limits and value their identity.

We observed that the students considered that moments in which they expose their ideas, listen to each other and argue, contribute to the

awareness of the sporting spirit. Affirmation is presented in the statements of Filipe and Luana.

Filipe: It's not only in the game that we learn about sportsmanship, but in class we talk giving our opinions without offending anyone, being able to say what we think, as we are doing now.

[...]

Luana: In group classes we learn to listen to others, to dialog and respect their opinions. When we respect the other, we are honest and accept defeat.

(Group-class, stage 1)

In this way, the opportunity for students to work in groups, reflecting on and being heard by teachers and classmates, allows them to learn to articulate their own actions with those of others, to respect privacy as a right of each person, and to be careful not to offend human dignity.

So far, we have seen that, from the students' point of view, the sporting spirit is violated by facts related to physical violence between players and between fans, often caused by defeats. In order to make them think about other moral values that are also violated, the teacher-researcher asked some questions:

Teacher-researcher: Does only physical violence between fans and between players hurt the principles of sportsmanship?

Mark: There is violence between players and referees.

Silence

Teacher-researcher: What other problems do we have in sport?

Filipe: Swearing.

Aline: Some players use drugs or take too much medication.

Dulce: There is a lot of dirt, which destroys the reputation of our soccer.

Lauro: There is also a lot of theft in some of the teams' boards.

[...]

Teacher-researcher: So, guys, as you mentioned, in addition to physical and verbal violence, we have problems with doping and corruption.

(Group-class, stage 1)

From the dialogue above, we note the importance of the teacher-researcher's intervention, so that students cite the ethical values that are not complied with in soccer and that they position themselves in the face of these factors, contributing to their ethical formation as proposed by Zankov (1984) and present in Dulce's speech: "There are many dirt that end the reputation of our soccer."

We observed, in the interlocutions of the scene named Indicative moments for the development of ethics and morals, how important it is for the teacher to carefully plan his class, to provide moments that students experience, discuss, reflect and develop ethical values, as proposed by Zankov (1963, 1968, 1984). We understand that in this way there can be a contribution to the formation of the qualitative attitude towards reality, because "being educated means having values, forms of social and individual conduct, citizen responsibility, sensitivity and emotion." (AQUINO, 2017, p. 326).

5. Results

From the scientific point of view, the organization of the *obutchénie* based on the Zankovian didactic system awakened in the student "independent, restless thinking, linked to living emotions¹²" (ZANKOV, 1984, p. 62), presenting indications that the activity developed enabled indicative contributors to the ethical and moral formation of students.

The students were in a process of *obutchénie* and formation in which, mobilized from the movement provided by the proposed task, they interacted and shared knowledge according to their experiences. Through the movement of interaction, they were able to appropriate the concept discussed, attributing a new quality to the process of *obutchénie* and having a predominance of reflecting rather than knowing how to do, of theoretical knowledge to the detriment of empirical knowledge, in an environment of respect for the ideas pronounced by others and of incessant combinations.

¹² "[...] el pensamiento independiente, inquieto, del escolar, ligado a emociones vivas." (ZANKOV, 1984, p. 62).

The scene presented expresses some positive points of the micro cycle experiment that give us subsidies to answer the research question proposed in this article, in the *process of obutchénie of equations of the 2nd degree, based on the Zankovian didactic system, is it possible to have indications of the beginning of an ethical and moral formation of the students?*, enabling us to recognize the importance of students articulating the knowledge previously acquired with the knowledge in formation for the human constitution in its entirety. It also allowed us to observe that students were active subjects in the process of obutchénie, conducting it responsibly, since the dialogues were directed by the needs presented by them; to realize that the intentional organization of actions and dialogues between students or between students and teacher-researcher were driven by reflections caused by the experience of the problem situation in which they were involved; understand that the level of difficulty and the variety of new content proposed in the problem situation were provocative, driving more complex mental operations and presenting evidence regarding the moral and ethical formation of students articulated with the concept of 2nd degree equations in mathematics class.

In addition, for the teacher-researcher, it was possible to recognize that the collective solutions of the proposed problem situation were of paramount importance, since they listened to the other, sought to complement or reiterate dialogues expressed by colleagues or to conflict ideas in order to better elucidate the problem presented; observe the importance of the articulation of mathematics content with other areas of knowledge assisting in the integral formation of the student and, accompany reflections on the students' posture in relation to their opinions in the face of the colleagues' arguments that contributed to the ethical formation of the group. group.

El proceso de *obutchenie* de la ecuación de segundo grado basado en el sistema didáctico zankoviano para la formación ética y moral de los estudiantes

RESUMEN

En este artículo, parte de una tesis, tenemos como objetivo analizar la organización del proceso de *obutchenie* de ecuaciones de segundo grado basado en el sistema didáctico zankoviano para la formación ética y moral de los estudiantes. Como metodología de investigación, se utilizó el experimento del microciclo realizado con 24 alumnos del noveno año de la enseñanza fundamental de una escuela pública de Uberlândia-MG. En el análisis, percibimos que la organización intencional de acciones y diálogos entre estudiantes o entre estudiantes y profesor-investigador fueron impulsados por reflexiones provocadas por la experiencia de la situación problema en la que estaban involucrados. Los resultados de la investigación revelaron que los momentos vividos por los estudiantes durante el experimento del microciclo les ayudaron a: ser sujetos activos en el proceso de *obutchenie*, llevándolo a cabo con responsabilidad; entendieron que el nivel de dificultad y la variedad de nuevos contenidos propuestos en la situación problema eran provocadores y potenciadores de operaciones mentales más complejas, indicando formación en aspectos morales y éticos.

Palabras clave: Educación ética y moral del alumno. Ecuación de 2º grado. Sistema zankoviano.

6. References

AMORIM, L. G. K. M. *Equações do 2º grau e o sistema didático Zankoviano* [recurso eletrônico]: um olhar para o desenvolvimento do estudante. Tese (Doutorado) – Faculdade de Educação, Universidade Federal de Uberlândia, Uberlândia, 2022. Disponível em: <https://repositorio.ufu.br/handle/123456789/36194>. Acesso em: 01 mar. 2023. DOI: <http://orcid.org/0000-0002-7086-0159>.

AQUINO, O. F. L. V. O experimento didático-formativo: contribuições de L. S. Vigotski, L. V. Zankov e V. V. Davidov. In: LONGAREZI, A. M.; PUENTES, R. V. (Orgs.). *Fundamentos psicológicos e didáticos do ensino desenvolvimental*. Uberlândia: EDUFU, 2017. p. 325-350. (v. 1).

AQUINO, O. F. L. V. O experimento didático-formativo: contribuições para a pesquisa em didática desenvolvimental. In: ENCONTRO NACIONAL DE PRÁTICA DE ENSINO, 27., 2014, Ceará. Anais [...]. Ceará: ENDIPE, 2014. p. 04645-04657. Disponível em: <http://www.uece.br/endipe2014/index.php/2015-02-26-14-09-14/search?author=1056>. Acesso em: 29 mar. 2021.

BRASIL. Ministério da Educação. *Base Nacional Comum Curricular*. Brasília: MEC, 2017. Disponível em: <http://basenacionalcomum.mec.gov.br/>. Acesso em: 25 mar. 2020.

BRASIL. Secretaria da Educação Fundamental. *Parâmetros Curriculares Nacionais: terceiro e quarto ciclos: apresentação dos temas transversais, ética*. Brasília: MEC/SEF, 1998.

CARAÇA, B. J. Conceitos fundamentais de matemática. Lisboa: Tipografia Matemática, 1951.

FEROLA, B. C. *O desenvolvimento integral na obra de L. V. Zankov (1957-1977): um olhar para os princípios e orientações metodológicas*. 2019. Dissertação (Mestrado em Educação) – Faculdade de Educação, Universidade Federal de Uberlândia, Uberlândia, 2019. Disponível em: <https://repositorio.ufu.br/handle/123456789/31542>. Acesso em: 14 jul. 2022. DOI: <http://doi.org/10.14393/ufu.di.2021.5510>.

FIGUEIREDO, A. M. Ética: origens e distinção da moral. *Saúde Ética & Justiça*, São Paulo, v. 13, n. 1, p. 1-9, 2008. Disponível em: <https://www.revistas.usp.br/sej/article/view/44359>. Acesso em: 21 maio 2022. DOI: <https://doi.org/10.11606/issn.2317-2770.v13i1p1-9>.

GUSEVA, L. G. Transição na educação russa: o sistema zankoviano no atual ensino fundamental. In: LONGAREZI, A. M.; PUENTES, R. V. (Orgs.). *Fundamentos psicológicos e didáticos do ensino desenvolvimental*. Uberlândia: EDUFU, 2017. p. 225-242.

GUSEVA, L. G.; SOSNOWSKI, A. Russian Education in Transition: Trends at the Primary Level. *Canadian and International Education*, [s. l.], v. 26, n. 1, p. 14-31, 1997. Disponível em: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2355163. Acesso em: 19 mar. 2021.

KORTE, G. *Iniciação à ética*. São Paulo: Editora Juarez de Oliveira; 1999.

LONGAREZI, A. M. Teoria do experimento formativo. In: PUENTES, R. V.; LONGAREZI, A. M. (Orgs.). *Ensino Desenvolvimental: Sistema Elkonin-Davidov-Repkin*. Campinas: Mercado de Letras; Uberlândia: Edufu, 2019c. p. 161-212.

LONGAREZI, A. M.; DIAS DE SOUSA, W. D. Unidades possíveis para uma *obutchénie* dialética e desenvolvedora. *Linhas Críticas*, Brasília, v. 24, p. 453-474, 2018. Disponível em: <https://periodicos.unb.br/index.php/linhascriticas/article/view/19815>. Acesso em: 17 jun. 2022. DOI: <https://doi.org/10.26512/lc.v24i0.19815>.

LONGAREZI, A. M.; FRANCO, P. L. J. Atividade pedagógica na unidade significado social sentido pessoal. In: LONGAREZI, A. M.; PUENTES, R. V. (Orgs.). *Fundamentos Psicológicos e Didáticos do Ensino Desenvolvimental*. Uberlândia: EDUFU, 2017. p. 265-291.

MOURA, M. O. A construção do signo numérico em situação de ensino. 1992. Tese (Doutorado em Educação) - Faculdade de Educação, Universidade de São Paulo, São Paulo, 1992.

MOURA, M. O. O educador matemático na coletividade de formação: uma experiência com a escola pública. 2000. Tese (Livre Docência) - Faculdade de Educação, Universidade de São Paulo, São Paulo, 2000.

MOURA, M. O. Pesquisa colaborativa: um foco na ação formadora. In: BARBOSA, R. L. L. (Org.). *Trajetórias e perspectivas da formação de educadores*. São Paulo: Editora UNESP, 2004. p. 257-284.

REGO, T. C. R. A indisciplina e o processo educativo: uma análise na perspectiva Vygotskiana. In: AQUINO, J. G. (Org.). *Indisciplina na escola alternativas teóricas e práticas*. São Paulo: Summus, 1996. p. 83-101.

VÁZQUEZ, A. S. *Ética*. 14. ed. Rio de Janeiro: Editora Civilização Brasileira S.A., 1993.

ZANKOV, L. V. *La enseñanza y el desarrollo*. Moscú: Editorial Progreso, 1984. (Investigación Pedagógica Experimental).

ЗАНКОВ, Л. В. (ZANKOV, L. V.). *Дидактика и жизнь* (Didática e vida). Москва: Просвещение, 1968.

ЗАНКОВ, Л. В. (ZANKOV, L. V.). *Развитие учащихся в процессе обучения* (I - II классы) (Desenvolvimento de escolares no processo de *obutchénie*) (I - II Ano). Москва: издательство академии педагогичес, 1963.

НЕЧАЕВА, Н. В.; РОЩИНА, Н. Н. (NECHAEVA, N. V.; ROSHCHINA, N. N.). *Педагогическая система развивающего обучения Л.В. Занкова: Учебное пособие* (Sistema pedagógico desenvolvimental de educação L.V. Zankov: manual de treinamento). Самара: Издательский дом «Федоров», 2006.

Received in March of 2023
Approved in June of 2023