CLASSROOM MATHEMATICS AND CURRICULAR INTEGRATION: CONTRIBUTIONS OF A PROJECT TO TECHNICAL COURSES INTEGRATED TO HIGH SCHOOL

A MATEMÁTICA DA SALA DE AULA E A INTEGRAÇÃO CURRICULAR: CONTRIBUIÇÕES DE UM PROJETO PARA CURSOS TÉCNICOS INTEGRADOS AO ENSINO MÉDIO

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ABSTRACT

When analysing the curriculum of the technical courses integrated to high school, there is a concern about the reformulation of the school curriculum focused on professional training. However, it is necessary to think about the integration of this curriculum in such a way that the contents addressed in the classroom link with the concepts used in the practice of each technical area through the contextualization of the contents, since research indicates that the textbooks used in this method of teaching does not offer the student the link between content addressed in the classroom and the technical area. For that reason, this work intends to discuss the reformulation of the curriculum of the integrated technical courses, as well as the use of new resources in the classroom, presenting the results obtained in the application of contextualised questions, for the contents of mathematics of the 2nd. grade of high school, with students of the classes of mechanics and buildings, in order to analyse the contributions of this tool for their training. Therefore, it was verified that the contextualisation is a possibility of integrating mathematics, approaching what is studied in the classroom with what is practiced in his area of professional training.

Keywords: Contextualisation. Curricular Integration. Mathematics Teaching. Integrated Technical Course. Professional qualification.

RESUMO

Ao analisar o currículo dos Cursos Técnicos Integrados ao Ensino Médio tem-se uma preocupação acerca da reformulação do currículo escolar voltado para a formação profissional. Entretanto, é necessário pensar na integração desse currículo de forma que os conteúdos abordados em sala de aula façam ligação com os conceitos utilizados na prática de cada área técnica por meio da contextualização dos conteúdos, visto que pesquisam apontam que os livros didáticos utilizados nessa modalidade de ensino não oferecem ao aluno o elo entre conteúdos abordados em sala de aula com a área técnica. Para isso, esse trabalho pretende discutir sobre a reformulação do currículo dos Cursos Técnicos Integrados, bem como a utilização de novos recursos em sala de aula, apresentando os resultados obtidos na aplicação de questões contextualizadas, para os conteúdos de Matemática da 2ª série do Ensino Médio, com alunos das turmas de Mecânica e Edificações a fim de analisar as contribuições dessa ferramenta para sua formação. Assim constatou-se que a contextualização é uma possibilidade de integração da Matemática, aproximando o que se estuda em sala com o que se prática na sua área de formação profissional.

Palavras-chave: Contextualização. Integração Curricular. Ensino de Matemática. Curso Técnico Integrado. Formação Profissional.

1. Introduction

The discussions about the changes that have been taking place with the high school and the educational context in Brazil emphasise the importance of constantly rethinking the educational process in which it is, so that learning becomes significant in the construction of knowledge. In relation to the changes that have been taking place throughout the educational system, we highlight in this work those related to the technical courses integrated to high school.

For Araújo and Silva (2017, p. 33) the concept of technical courses integrated to high school is related to the product of historical-social relations and the reality in which one lives, considering that the political-pedagogical project aims at integrating social practice, work, science and culture into student training.

Subjects related to the technical courses integrated to high school have gained space in pedagogical discussions in Brazil due to the great changes that have been taking place in this environment, highlighting the difficulties encountered by this modality when being inserted in the Brazilian reality, mainly in what concerns to the subject of the curricular integration. In view of this, Silva, Melo and Nascimento (2015) affirm that for integration to take place, the curriculum must be effectively linked to the concrete reality.

In this way, Machado (2009) says that

> in the perspective of an integrated curriculum, a good question is what one does to what to integrate. To begin with, a good starting point is the integration between the aims and objectives of the school and the pedagogical practice, making them effectively concrete. (Machado, 2009, p. 03)

The manner in which this curriculum is integrated should be thought of in such a way that the content addressed in the classroom is important in the process of building knowledge and in the personal and professional formation of the student. For this, we must think of a curriculum different from the traditional one of basic education, in a contextualised and interdisciplinary way with the reality of each course, as proposed by the National Curricular Parameters for Secondary Education (PCNEM) (Brazil, 2000). Thus, Opinion no. 39 of the National Education Council (CNE) (Brazil, 2004) makes clear that "it is a single course, with a unique pedagogical project, with a single curricular proposal (...) all

its curricular components must receive integrated treatment, according to the pedagogical project of the educational institution".

It is thinking of the oneness of this curriculum that it is necessary to propose forms of integrating the mathematics of the basic curriculum with the necessary mathematics in professional education, providing more dynamic, significant and quality conditions in the process of knowledge construction.

Hence & Setti (2016) emphasises that students see difficulties in mathematics mainly due to the lack of applicability of the contents addressed in the classroom and, to heal these difficulties, it is necessary to seek different methodologies so that the teaching and learning process becomes more pleasurable and meaningful for the learners, so they gradually make more sense of the mathematics they study. Lopes (2011) emphasises the importance of making new scientific productions for this modality of teaching, and affirms that the published research works have prioritised a certain mathematical content and/or the use of technological resources.

To that end, this research, which is being developed at the Fluminense Federal Institute of Education, Science and Technology (IFFluminense) Campus Campos Centro - aims to evaluate how pedagogical resources elaborated by using contextualization as a tool contribute to the classroom, so that they be relevant for the construction of students' knowledge, enabling better qualified training, and bringing classroom mathematics closer to the mathematical concepts that are needed in the technical area.

In the light of what has been discussed, this work focuses on the area of mathematics in the technical courses integrated to high school and from what was exposed, it is important to reflect about the practices of mathematics teachers of these courses and the role they play in the process of teaching and learning.

2. Theoretical Reference

2.1. Technical Course Integrated to High School

The insertion of the integrated higher education modality, included in article 36, section IV to the Law of Directives and Bases nº 9394/96 through Law nº 11.741/08, has as main objective "the general preparation for the work, and, optionally, professional qualification may be developed in secondary schools or in cooperation with institutions specialized in professional education" (Brazil, 1996). More than preparing for the labour market, what is expected of the integrated higher education, according to Araújo and Silva (2017, p. 09), is to ensure that the new generations are fully educated and able to understand the world and the contradictions present in their nature.

From the historical point of view, the conception of school education in Brazil emerged in the Jesuit period and was linked only to the formation of the elite classes, leaving only the labour (slave) for the disadvantaged. It was only during the Empire that, according to Bezerra (2013), the expansion of professional education began, with the creation of the Commercial Institute of Rio de Janeiro. To attend the demand of the orphaned and abandoned children, they created schools of arts and crafts (Liceu de Artes e Ofícios) in six cities across Brazil, whose purpose was to prepare workforce for the professional exercise.

With the abolition of slavery and the beginning of the Republican period in the country, in addition to the Industrial Revolution, factories were installed, but lacked workforce to begin operating.

From the expansion of factories and the great demand for professional labour force, the then Governor of the State of Rio de Janeiro, Nilo Peçanha, created the Apprentices and Artisans School (Escola de Aprendizes Artífices) which, for Bezerra (2013, p. 21), " constitute the germ of the current Federal Network of Vocational and Technological Education and, consequently, of the Federal Institutes".

With roots in Campos dos Goytacazes, during his time as President of Brazil, Nilo Peçanha brought numerous benefits to the city, such as the creation of the current Fluminense Federal Institute of Science, Education and Technology (IFFluminense).

According to Vieira (2016)

> The initial idea was to establish schools in the capitals of the states, cities with greater capacity of absorption of workforce, because these places were the right destination for people looking for new job opportunities in urban centres. Exceptionally, that of the State of Rio de Janeiro was installed in Campos, today, Campos dos Goytacazes, RJ, because the President of the Republic wished to benefit his hometown. (Vieira, 2016, p. 40)

In 1965, then called Federal Technical School of Campos, IFFluminense offered Buildings, Mechanics and Electrotechnology technical courses. In 1995, it became the Federal Centre of Technological Education of Campos (CEFET), and, according to Vieira (2016),

> the purpose was then to train and qualify professionals in the field of technological education, at the different levels and modalities of teaching, for the various sectors of the economy. In addition, it aimed to carry out applied research and promote the technological development of new processes, products and services, in close coordination with productive sectors and with society, especially at a local and regional level, offering mechanisms for continuing education. (Vieira, 2016, pp. 42-43)

Currently, the now called Fluminense Federal Institute of Science, Education and Technology offers courses in the various teaching modalities, such as the subsequent technical course, technical course integrated to high school, higher education, technical course integrated to high school in the mode of youth and adult education (EJA), *lato sensu* and *stricto sensu* graduation studies.

The technical course integrated to high school from the IFFluminense, *Campus* Campos Centro, offers Mechanics, Industrial Automation, Buildings, Electrotechnical and Computing technical courses.

2.2. Contextualized Curriculum in the Integrated Technical Course

Before discussing the need for a differentiated curriculum for this teaching modality, we must understand what curriculum is. Curriculum conceptions, according to Moreira and Candau (2007),

> Derive from the different ways in which education is conceived historically, as well as from the theoretical influences that affect it and become hegemonic at a given moment. (...) is thus associated with the set of pedagogical efforts developed with educational intentions. (Moreira & Candau, 2007, p. 17)

According to Sabaini and Bellini (2007, p. 2), "a curriculum is not a set of contents arranged in a summary or index", but a "result of a selection: from a wider universe of knowledges and know-hows, you selected that part that will constitute, precisely, the curriculum" (Silva, 1999, p. 15). It should be borne in mind that there is no single concept of curriculum, since the word curriculum, from the Latin, brings the sense of course, route and place where it occurs, reflected in the historical, political and socioeconomic context.

Silva (1999) states that curriculum is not just knowledge, but knowledge constitutes the curriculum centrally in what we become, in the construction of identity and subjectivity. The author discusses these issues and places them in what he calls curriculum theories.

Curriculum theories are, according to Silva (1999), identified as traditional, critical and post-critical. Traditional theories consider know-hows and knowledges unquestionable, concentrating only on the organization of how they are transmitted. Critical curriculum theories, on the other hand, shift "the emphasis from simple pedagogical concepts of teaching and learning to concepts of ideology and power" (Silva, 1999, p. 17).

Post-critical theories, as well as critical theories, seek "[...] connections between knowledge, identity and power" (Silva, 1999, p.17). Given this, it is possible to see that critical theories allow us to see education under a new conception. Thus, when presenting a possibility to work on mathematics contents in a contextualized way in technical courses integrated to high school, it is considered that the dimensions of these theories influence this research. From this, it becomes indispensable to reflect on issues that involve this problem, such as: What does it take for the integration to actually happen in the curricula of those courses? What contents can be integrated? What are the contributions of contextualisation in the process of integrating curricula?

Thinking about the need for an integrated curriculum, teachers need to change their way of acting, their professional posture, which requires, according to Machado (2009, p. 04), "a rupture of the cultural model that hierarchises knowledge and confers less value and even negative connotation to those of a technical nature, associated in a prejudiced way to manual labour".

Teachers need to understand that the teaching-learning process is a complex and global process. Thus, Araújo & Silva (2017) verify that the success of the EMI of the federal network depends on the daring of education professionals in search of structural changes, as well as the maintenance of the conditions to guarantee quality standards to make the education of the federal network function.

In view of the social and political context we are experiencing, "the integration of professionalizing education brings the marks of this dichotomy and faces the great challenge of dealing in an integrated way with these two modalities of teaching, which tendentially were related in an antagonistic way." (Diniz, 2016, p. 12).

Positive results in the technical course integrated to high school scenario requires that educational professionals do not show an "excessively academic, discursive, and reproductive posture of educational practices." (Machado, 2009, p. 04). The educators of this modality of education must deconstruct the character of a teaching and learning process overly technical, making it less mechanised.

According to Machado (2009),

> in both cases, but in a different way, it is a question of confronting the dialectical tension between scientific thought and technical thinking and the search for other relations between theory and practice, aiming to establish other modes of organization and delimitation of knowledge. (Machado, 2009, p, 04)

Therefore, the teacher who is concerned with the ethical training of his students should not accept that teaching is merely a transmission of ready concepts that do not fit into the different types of receptors of knowledge, "should not limit their teaching practice only to previously determined objectives, without considering the context in which his student is inserted" (D'Ambrósio & Lopes, 2015).

Thus, the teachers, thinking about the training of their students, should be concerned with the proper use of materials contextualised according to the reality and social context in which they are inserted, because, according to D'Ambrosio and Lopes (2015),

> If, in our professional actions, we prioritise a merely technical approach, with a perspective that restricts mathematics to itself, we can only train the person in calculus skills and in the use of algorithms, denying him/her the mathematical knowledge necessary for the reading of the world to which he/she is entitled. (D'Ambrosio & Lopes, 2015, p. 12)

The proposal to insert contextualisation in the school life of the student makes it possible to direct the knowledge acquired in the classroom of the propaedeutic teaching with the specific disciplines of the technical area, since these require the basic knowledge learned in the classroom. When addressing a proposal contextualised in the classroom, the teacher has to understand the whole concept of contextualisation. Vieira and Curi (2016) affirm:

> The term contextualization often varies from author to author. Some authors argue that it is knowledge that is contextualised, others say it is teaching, and still some say that it is activities. However, much of it relates the idea of contextualisation to the use of student reality situations or to the applicability of mathematics. And everyone agrees that contextualisation can contribute to the teaching and learning of mathematics, as well as the construction of mathematical knowledge of the student. (Vieira & Curi, 2016, p. 58)

For D 'Ambrósio (2001), in any education program, contextualisation must be present as an essential form for the whole population, regardless of their different classes. If we want to achieve equity and a fairer society, it is fundamental that this tool is used by teachers in the classroom.

> After all, how to let of relating the Elements of Euclid to the cultural panorama of Ancient Greece? Or the adoption of Indo-Arab numeration in Europe as the flowering of mercantilism in the fourteenth and fifteenth centuries? And we can't understand Newton decontextualising. (D'Ambrósio, 2001, p. 114-115)

In view of the foregoing, Pires (2013, p. 34) points out the need to "(...) widen the debate about what it means to 'contextualize' in mathematics, so that it is not restricted only to 'being part of everyday or reality' (...)" of the student. The teacher must analyse and study the whole process of contextualisation, since it can be based on the daily life of the student as well as appear in"... proposals of interdisciplinarity, transversality..." (Pires, 2013, p. 33). Thus, care must be taken not to use the concept of contextualisation as a way of justifying the non-teaching of some curricular themes, "(...) with the justification of not being part of daily life or reality, revealing large doses of prejudice about the ability to learn from this part of the population" (Vieira & Curi, 2016, p. 58).

When discussing contextualisation in mathematics teaching, Skovsmose (2008) defines three types of references that can be used in the classroom by the teacher during contextualised activities. It should be noted that the author stresses that there is no single correct approach, because the teacher should evaluate, according to each context, the most coherent approach for each moment. Thus, according to Skovsmose (2008), we can contextualise mathematics in the classroom through three scenarios, pure mathematics, semi-reality and reality.

Pure mathematics, according to Skovsmose (2008, p. 22) can be approached when "mathematical questions and activities can refer to mathematics and only to mathematics". Yet semireality, "(...) is not a reality that 'in fact' we observe, but a constructed reality (...)", for example, the author cites the mathematical activities presented in textbooks (Skovsmose, 2008, p. 22). Finally, it presents the reality scenario,

defining it as being activities where "(...) students and teachers can work tasks with references to real-life situations" (Skovsmose, 2008, p. 22).

Vieira (2016, p. 89) reinforces the importance of the teacher's role in identifying the best moment for different approaches to contextualised activities and highlights that "(...) whatever the context of the activities, there will be enriching situations and also limitations." Still in this context, Skovsmose (2008, p. 38) points out that references to reality "(...) seem to be necessary to establish a detailed reflection on how mathematics can operate in our society."

In this way, the teacher should look for new and different paths to mathematics teaching, because "it could provide new resources to lead students to act and reflect, because a critical subject is also a reflexive subject, thus offering a mathematics education of critical dimension." (Vieira & Curi, 2016, p. 60).

Mathematics education, has also contributed strongly to the critical formation of students, since, according to Godino (2011),

> mathematics can exercise an enormous influence in two totally opposite directions: on the one hand, mathematics reduced to simple routine calculations can reinforce passive and compliant attitudes, and on the other hand, mathematics in its broadest sense can develop critical and alternative thinking. (Godino, 2011, p. 14, our translation)

In this way, the teacher should propose situations that bring multiple meanings to what will be taught to the student. These situations, when answered by the students, allow the knowledge acquired to be used in other circumstances, filling gaps left by the lack of connection between what is taught and what is learned.

2.3. The Teaching of Mathematics in the Technical Courses Integrated to High School: The Case of IFFluminense, *Campus* Campos Centro

With different characteristics of the regular high school, the technical course integrated to high school provides the student with basic training along with technical training, leaving the student the possibility to access other levels of education related to his area of training. According to Carvalho, Nacarato and Reinato (2016), if the training of the students make the technical course integrated to high school equivalent to the regular high school, we can assume that the teaching of mathematics follows what is presented in the official curricular documents.

For this, it is necessary to provide learning environments that are favourable to the process of knowledge construction, seeking differentiated methodologies that complement the resources made available to the teacher in the classroom.

According to Izaias, Melo and Pinto (2015), even with technological advances and the variety of resources available, the textbook continues to be the most used pedagogical resource in the classroom, being an important instrument in learning.

In contrast, a survey made by Vieira and Curi (2016) about the textbooks used at the IFFluminense for the technical course integrated to high school analysed that about 74.9% of the activities presented in the book are in the context of pure mathematics. In the context of reality, approximately 3.9%. The activities in the context of semi-reality correspond to approximately 21.2%. In this way, it can be observed that the textbook presents a small number of contextualised exercises that make a connection with the courses offered. It emphasises only activities and facts in a perspective of forced semi-reality and it does not have any relation with the technical courses.

Currently, the IFFluminense Campus Campos Centro integrated technical course works in five technical areas: Industrial Automation, Mechanics, Buildings, Electrotechnology and Computing. Since the mathematics discipline has a structure of 400 hours per class during the entire high school and in the second grade, the mathematics course has four classes per week for all courses, in a total of 160 classroom hours.

In the syllabus of mathematics for the second year, contents of trigonometry, encompassing the initial concepts, functions, equations and trigonometric inequalities; matrices and determinants, systems of linear equations and spatial geometry are present.

From this information, the contents of the specific subjects were analysed in the syllabuses of each technical course and a comparative of the necessary mathematical concepts in these subjects, according to the board (Board 1).

Board 1 - *Comparative content of mathematics and specific subjects.*

2nd grade in Integrated High School	
Building Technician	
Specific Subjects	Mathematical Concepts
construction technology	notions of area and volume of flat and spatial figures, classification of geometric figures
hydraulic plant design	classification of spatial figures
computerised drawing	notions of flat figures and space, planning, angles
topography	notions of angles, trigonometry, geometric notions (classification of figures)
Mechanical Technician	
Specific Subjects	Mathematical Concepts
mechanical drawing (cad)	notions of flat and spatial geometry, planning angles
industrial electricity	resolution of linear systems
metrology	prism (standard block)
mechanical tests	cylinders, prisms
Industrial Automation Technician	
Specific Subjects	Mathematical Concepts
algorithms and programming techniques	matrices
electrotechnology	trigonometry
electronics lab	trigonometric functions
Electrical Technician	
Specific Subjects	Mathematical Concepts
electrotechnology II	sine function
Computer Technician	
Specific Subjects	Mathematical Concepts
applied mathematics	matrices
algorithm and programming techniques	operations with matrices

In view of the above, it can be observed that it is possible to establish a relationship between mathematics and the specific subjects of the technical area, since it is possible to use the contextualisation of contents as a differential tool in the classroom, according to the need of each course.

However, one of the problems found in the proposal of the curricular integration for the 2nd. Integrated high school grade, for example, is the presence of the contents of complex

numbers for the study of alternating current, in electrotechnology II, of the electrotechnology technical course integrated to high school, since the content of complex numbers is present in the mathematics curriculum only in the 3rd. high school grades and not in the 2nd grade. That is, in a specific subject of the technical area, the student needs concepts that have not been presented in propaedeutic teaching yet.

In this way, the need for a curricular reformulation is once again evident, in order to make integration between the resumes of basic education with professional education more coherent for a more solid construction of knowledge, since that the analysis of the current curricular structure allows us to observed that it is not adequate for the objective of a technical course integrated to high school, as evidenced by Domingues, Toschi and Oliveira (2000, p. 70), "in general, this model of curriculum, with a prescriptive and content list of disciplines (subjects and their programs), has been inadequate."

Although we think of a curriculum focused on the technical course integrated to higher education that prioritizes the integration of contents, it should be clear that

> integration is much more than juxtaposition of curricula, but a path with shared goals. Considering the improvement of the individual as a priority, not the market demand, we can contribute with a sufficiently reflective person who can understand the mechanisms of this market and be aware of the space it occupies in the world. (Zitzke & Calixto, 2018, p.3)

Therefore, a more interdisciplinary action is emphasised in the courses, favouring the contextualisation in the teaching of mathematics, in order to think about the student as a whole, thinking about his complete formation. According to Moura (2007, p. 25), "contextualization must be understood as a strategy of problematization of social, historical, economic and political conditions and to apply school knowledge." The teacher must know well the possible relations between the knowledge to be developed and stimulated in the students, because, according to Moura (2007, p. 25), "in this perspective, the content gains meaning in relation to the relationship between what is taught/knowledge and situated knowledge in a given reality."

3. Methodology

From the theoretical deepening, based on a survey of a bibliographic collection about the discussions on contextualisation, integration and the importance of a differentiated curriculum for the technical course integrated to high school, combined with the analysis of the syllabuses of mathematics in each technical course integrated to the 2nd grade of the high school, and after having identified which contents of mathematics of the second grade are present in the specific disciplines of the technical area, contextualised questions that were better adapted to the practice of the student's classroom were approached, according to the need of each technical area.

The research is of a quantitative nature and qualitative aspects were used in the data analysis. "[...] Quantitative research uses mathematical language to describe the causes of a phenomenon, the relationships between variables, etc. The combined use of qualitative and quantitative research allows us to gather more information than could be achieved in isolation" (Fonseca, 2002, p.20).

The methodology focuses on a pedagogical intervention for the integration of mathematics in the technical course integrated to high school of IFFluminense, since the pedagogical intervention are

> the interferences (changes, innovations) purposely carried out by teachers/researchers in their pedagogical practices. Such interferences are planned and implemented based on a certain theoretical framework and aim to promote advances, improvements in these practices, as well as to test such a reference, contributing to the advancement of knowledge about the teaching/learning processes involved in them. (Damiani, 2012, p.3)

This work aims to evaluate the contributions to the classroom of pedagogical resources elaborated by using contextualisation as a tool, in a way that is relevant for the construction of students' knowledge, enabling better qualified training, bringing the mathematics closer to the classroom with the necessary mathematical concepts in the technical area. Hence,, the following specific objectives were outlined: a) to understand and analyse the need for an integrated curriculum for technical course integrated to high school; b) research and adapt contextualised issues according to each technical area; c) apply and verify the contribution of pedagogical material contextualised as the initial process of intervention in the classroom; d) identify the opinions of the students regarding the contextualised issues.

The research was developed through the following steps: i) elaboration of a complementary material for mathematics teachers, composed of contextualised and adapted questions for each technical course, where the focus turned to the contents addressed in the mathematics course; ii) elaboration and application of the initial questionnaire, aiming at a survey of information about integration in mathematics classes and whether they did some kind of integration with the technical area as well as the students' opinion about the importance of contextualisation in mathematics classes; iii) application of the issues contextualised in the integrated technical courses in mechanics and buildings; iv) application of a final questionnaire to identify the relevance of these questions in the process of integrating mathematics with the technical area, and the students' opinion about the use of this tool in the classroom.

We hoped that in the realm of reality, according to the conception of Skovsmose (2008), because, according to Vieira (2016, p. 89) "(...) the contexts closest to the student, such as their personal life, their daily life and their coexistence, contribute to give meaning to the contents of learning (...)." However, faced with the difficulties of interacting with teachers in the technical area, we decided to work in the semi reality context, seeking to use current situations constructed in a way that is more interesting and closer to the practice of each technical course.

From the mathematical contents present in the syllabus of the second grade, the spatial geometry content was the one chosen for the application. In order to verify the contribution of contextualised questions related to the content studied in the 2nd grade of high school, these were good students who were starting the academic year in the third year of the technical courses in mechanics and buildings integrated to high school of the IFFluminense Campus Campos Centro, because it was necessary that the students had already studied the content addressed in the questions.

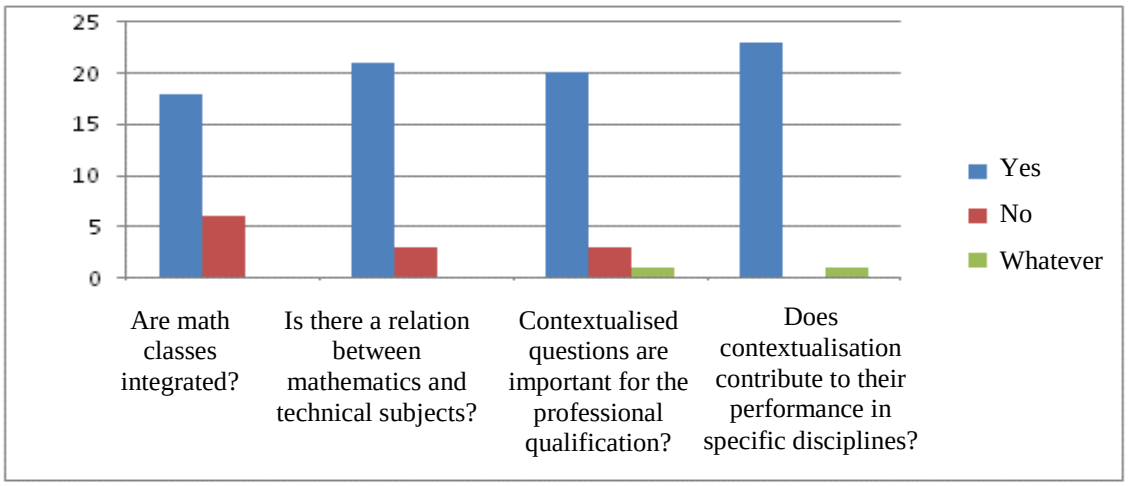
4. Results and Discussion

The activities of this work were applied in a class of a mechanics technical course and a buildings technical course, both integrated to high school, for the students of the beginning of the third grade of high school, who recently passed through the content of space geometry.

For the activities, 24 students of the technical course in mechanics and 16 students of the technical course in buildings were presented. The initial and final questionnaires used in the research were the same for the two groups, however, the application was differentiated by the use of contextualised questions, according to the needs and applicability in each course.

In the initial questionnaire of the mechanics class, the objective was to collect information about how students think about the contextualisation of mathematics and whether they see any relation of mathematics addressed in the classroom with the specific disciplines of the technical area (Graph 1).

Graph 1 - *Opinion of the students of the Technical Course in Mechanics.*



According to the information obtained by the questionnaire (Graph 1), the students emphasized that in some contents they believe that it is possible to integrate mathematics with subjects of the technical courses. Gonçalves and Pires evidenced it (2014, p. 245) when they affirm, "this integration would emphasise the unity that must exist between the different disciplines and forms of knowledge in school institutions." So that, in fact, this integration becomes part of the daily life of classrooms

> it is necessary that there be a systematization of integrated actions, nevertheless, without prioritising any specific discipline or content, since the primordial or essential is to awaken the potential of the learner so that he takes on a transforming agent role, which will demand that we consider from the interests and needs of the students to the development of thinking, feeling and acting, essential conditions for meaningful learning to take place. (Silva, Melo & Nascimento, 2015, p. 6)

Analysing the graph 1, we observed that 83.3% of the mechanics course students consider that the contextualisation is important for their professional formation. This can be reaffirmed in Fernandes statement (2006, p. 03), when he says that "contextualisation is situated on the perspective of performance formation that will be evaluated in the centralised exams and in the work processes."

The activity applied in the mechanics course (Figure 1) covered issues of volume of parts, plates, quenching process for volume calculation, solids of revolution and cost of manufacturing parts.

4. (FUVEST) A parallelepiped tank is based on a horizontal rectangle of sides 0.8 meters and 1.2 meters. During the temper of a metal piece, an individual plunges it completely into the tank, causes the water level to rise to 0.075 meters. Then the volume of the piece, in liters, is:

a) 66
b) 68
c) 70
d) 72
e) 75

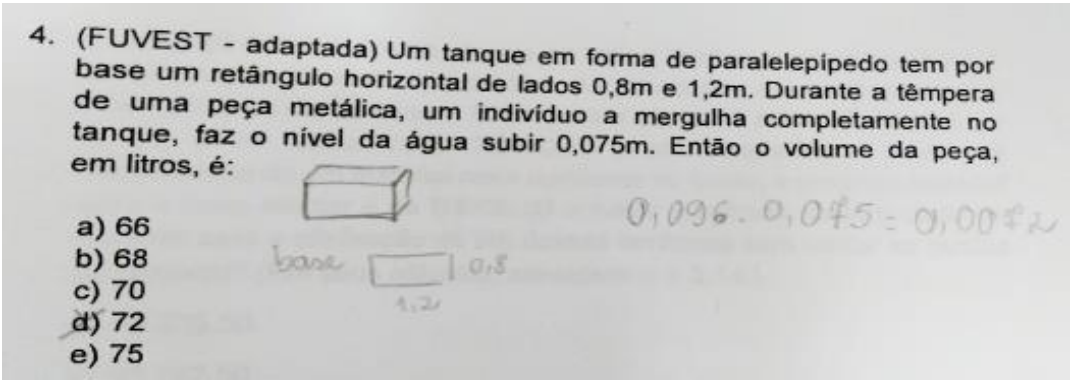


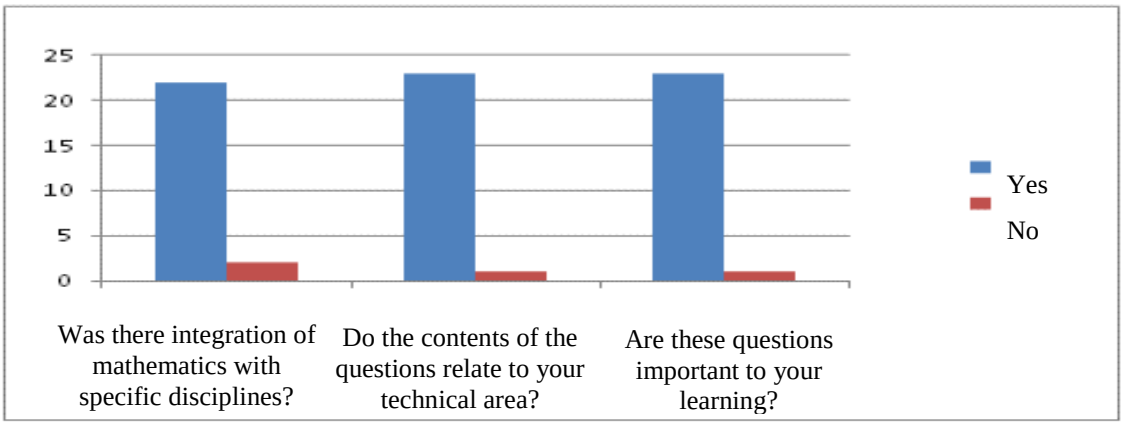
Figure 1 - Resolution of the question by a mechanics student.

In relation to the contents of the second grade of high school, those that have more applicability in the area of mechanics is space geometry, used mainly in the discipline of technical mechanics and resistance of materials (MTRM) and autoCAD, and trigonometry, widely used in the discipline of metrology.

Soon after the activities, the final questionnaire was applied to analyse the contributions that the contextualised questions brought to the classroom, as well as to identify the relevance of this tool for the professional formation of the student.

In the final mechanics questionnaire, students were able to identify some content relations with specific disciplines, with similar approaches to what they learn in the technical course, being relevant to learning (Graph 2).

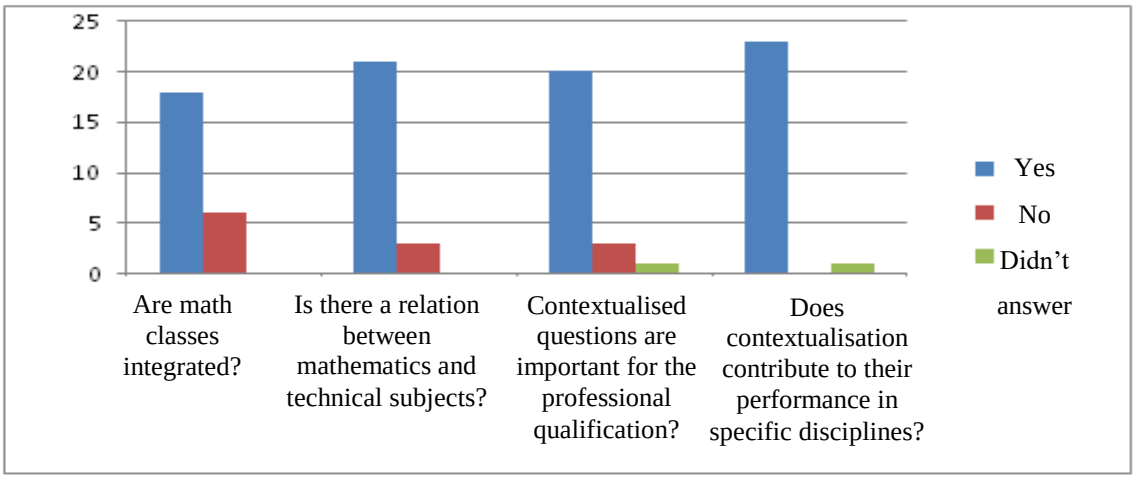
Graph 2 - *Students' opinion on the activities of the Technical Course in Mechanics.*



The information collected shows that the applied questions resemble the content addressed in some subjects of the technical area and with this, according to student 1, "makes a good relationship with the course", in addition, according to student 2 "evolves the relationship with mathematics". They also point out that the questions bring an approximation of the contents addressed in the specific disciplines with the content of mathematics of high school. For Machado (2009), this approach through contextualisation establishes success when the student develops the ability to understand, relate and use in practice what he or she learns.

With the same objective of the mechanics class, the initial questionnaire of the buildings class identified the students' opinions on the aspects of contextualisation and the link between the mathematics discipline and the technical area (Graph 3).

Graph 3 - *Opinion of the students of the Technical Course in Buildings*.



According to the students' answers in the initial questionnaire, contextualisation helps to understand the content, favouring the construction of knowledge. It is observed that, in this perception, the mathematics classes of the mechanics course are more contextualised when compared to the course of buildings.

According to Fernandes (2006, p. 12), "through the contextualisation, the mathematics is shown more applicable in reality, which allows for greater understanding on the part of students."

According to the students' answers in the initial questionnaire, what is observed is that the mathematics classes of the mechanics course are more contextualised in relation to the course of buildings, thus emphasizing that "contextualisation is not a full act by itself, but dependent on the subject that contextualises and the conception of context that it considers " (Souza & Roseira, 2010, p. 5).

Analysing the graph 3, 93.7% of students in the buildings course consider contextualisation important for their professional formation, and the students showed how contextualisation contributes to performance in other disciplines. In addition, Micotti (1999) evidenced it in his researches when he says that

> The application of learning in different contexts of those ones that were acquired, requires much more than the simple memorization or mechanical solution of exercises: mastery of concepts, flexibility of reasoning, capacity for analysis and abstraction. These skills are necessary in all areas of study (...). (Micotti, 1999, p. 154)

The activity applied in the course of buildings (Figure 2) included questions on the volume of concrete used in construction, construction of water reservoirs with overestimated volume, volume of land required for earthmoving and cost of material for manufacture, as well as calculations using scale.

2. (Fei) In the design of a building the construction of a water tank with cylindrical shape was initially planned, whose measurements would be: base radius of 2 meters and height at 3 meters. It was later found that the volume of the reservoir had been underestimated, which in fact was twice the volume originally forecast. What should be the radius of the base, knowing that the height of the reservoir can't be changed?
(Consider $\pi = 3.14$)

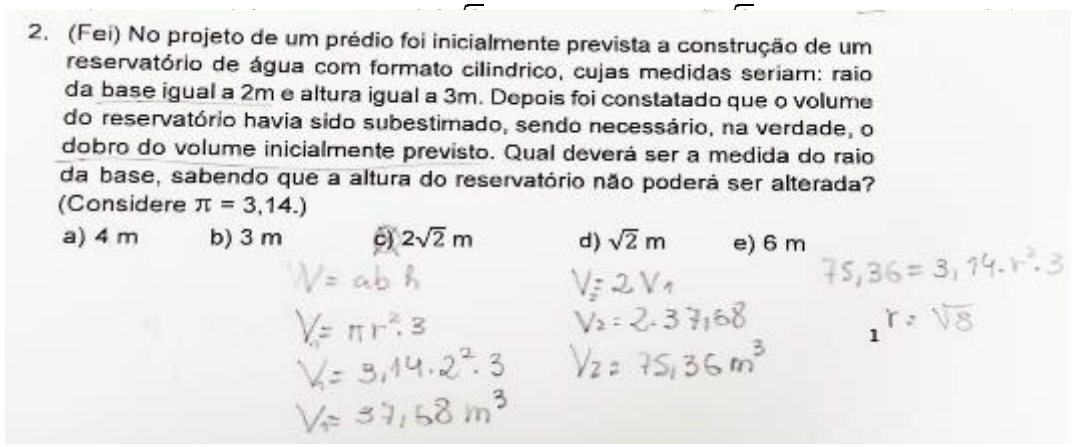


Figure 2 - Resolution of the question by a student of Buildings.

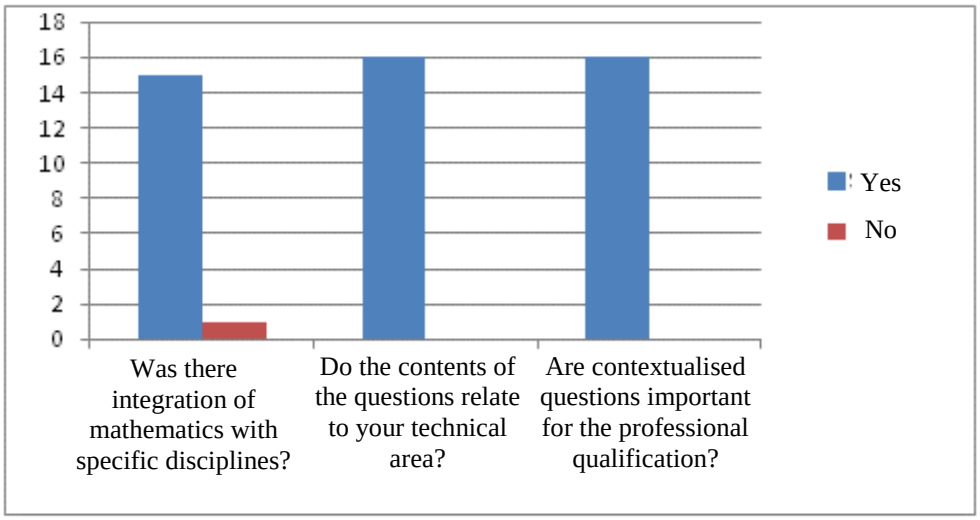
The contents of the second grade of high school that contains more applicability in the area of buildings is flat and space geometry, used mainly in architectural projects, earthwork and laboratory tests, and trigonometry, since it has a great applicability in topography discipline.

Soon after the activities, the final questionnaire was applied in order to analyse the contributions that the contextualised questions brought to the classroom, as well as to identify the relevance of this tool for the professional formation of the student.

The information obtained from the students of the technical course in buildings emphasise that the use of contextualisation as a tool helps in learning. According to student 3, it is "a basis for the technical course, clarifying the contents", in addition to reinforcing the practice and assisting in learning, and contributes to improving technical training, giving wider knowledge in the area, with a according to what they use on a daily basis.

Ávila, et al. (2017, p. 12) reaffirm that the integration of the disciplines must "represent a strategy to overcome the excessively fragmented teaching of school contents and make it contextualized, capable of contributing to the understanding of more complex systems."

Graph 4 - *Students' opinion on the activities of the Technical Course in Buildings.*



Thus, it is understood that "contextualisation is necessary in this type of teaching, since there may be gaps between the content taught and the professional learning of the students, making it difficult to identify them with the objectives proposed by the course" (Santos, Nunes & Viana, 2017, p. 524).

Considering the information analysed, the use of contextualisation in the activities proposed in these courses underlies the importance of bringing didactic resources and integrative actions through a pedagogical intervention to the classroom that complement the material already used, aimed at improving the understanding of the content of mathematics and the professional training of students, since the approach of this tool had a positive contribution to the teaching and learning process. To do so, it is necessary to rethink the practices that enable learning in a way that meets what refers to human integral formation.

Pereira (2012, p. 28) reaffirms this when he says, "It is possible to generalise contextualisation as a resource for meaningful learning by associating it with experiences of everyday life or spontaneously acquired knowledge." The author also affirms that "(...) the interaction of new information with the student's prior knowledge plays a fundamental role for meaningful learning (...) making them more enjoyable" (Pereira, 2012, p. 08).

In addition to the use of contextualisation, it is necessary to think about the curriculum integration of the contents addressed in the classroom. Since the basis document of technical course integrated to high school emphasizes, "the integrated curriculum organizes the knowledge and develops the process of teaching-learning in such a way that the concepts are learned as a system of relations of a concrete totality that it intends to explain/understand" (Brasil, 2007, p. 42).

In this way, it is acceptable to believe in the possibility of integration and contextualisation of all contents of mathematics of high school, based on the results obtained by the application of the specific content of spatial geometry.

5. Conclusion

The achievement of this work, from the bibliographical survey to the application and analysis of information, allowed us to highlight the possibilities of contextualization and integration of mathematics contents, aiming at the enrichment of mathematics classes.

It is essential to emphasize that, for this integration happen, it is also up to the teacher to use the various resources available to complement the pedagogical material used in the classroom. One of the notions that the teacher must have when teaching in an institution that has technical courses integrated to high school is that, in addition to the course being differentiated, it is necessary to have a collective effort to make the curriculum in fact integrated, differentiating a proposal of juxtaposition of them. The construction of an integrated curriculum with the technical areas in the institution is a work that must be done together, with the aim of improving vocational training.

A curriculum is not only a description of contents, but it needs changes in which they reflect on the process of teaching and learning, especially in institutions with integrated high school, providing the teacher with transformations in the methodologies, creating classroom adaptations, which are much broader than the guidelines described in a paper.

From the moment that the teacher brings to the classroom differentiated resources that allow the connection and approximation of the math content with the content they use in their practice, the students tend to realise that studying this discipline is relevant to their learning and professional training process.

Thereby, it can be evidenced that the use of contextualisation awakens in the student the interest in the content, to perceive the relation of what is necessary in its area of formation, besides understanding that the content that is studied in the classroom is not a content that is far from the reality of their future practice.

References

Araújo, A.; & Silva, C. N. da (Orgs.). (2017). *Ensino Médio Integrado no Brasil: Fundamentos, Práticas e Desafios.* Brasília: IFB. 578 p. Retrieved from http://www.anped.org.br/sites/default/files/images/livro_completo_ensino_medio_integrado_-_13_10_2017.pdf

Ávila, L. A. B. et al. (2017). A Interdisciplinaridade na Escola: Dificuldades e Desafios no Ensino de Ciências e Matemática. *Revista Signos, [S.l.], 38*(1). ISSN 1983-0378. doi: 10.22410/issn.1983-0378.v38i1a2017.1176

Bezerra, F. A. M. (2017). Institutos Federais: Inovação, Contradições e Ameaças em sua Curta Trajetória... In Ensino Médio Integrado no Brasil: fundamentos, práticas e desafios. *Anais*...Brasília (DF): Instituto Federal de Brasília, 2017. Retrieved from https//www.even3.com.br/anais/SNEMI/55406-INSTITUTOS-FEDERAIS--INOVACAO-CONTRADICOES-E-AMEACAS-EM-SUA-CURTA-TRAJETORIA

Brasil. (2007). Ministério da Educação. *Educação Profissional Técnica de Nível Médio Integrada Ao Ensino Médio.* Documento Base: dezembro, 2007. Brasil: Autor. Retrieved from http://portal.mec.gov.br/setec/arquivos/pdf/documento_base.pdf

Brasil. (2004). Conselho Nacional de Educação. Conselho de Educação Básica. *Parecer CNE/CEB nº 39 de 8 de dezembro de 2004***.** Aplicação do Decreto no 5.154/2004 na

Educação Profissional Técnica de nível médio e no Ensino Médio.

Brasil. (2000). Ministério da Educação. *Parâmetros curriculares nacionais: ensino médio: parte III – ciências da natureza, matemática e suas tecnologias.* Brasil: Autor. Retrieved from http://portal.mec.gov.br/seb/arquivos/pdf/ciencian.pdf

Brasil. (1996). Congresso Nacional. *Lei Federal no 9.394. Lei de Diretrizes e Bases da Educação Nacional: 20 de dezembro de 1996*.

Carvalho, R. M.; Nacarato, D. M.; & Reinato, R. A. O. (2016). Educação Matemática e o Ensino Técnico Profissionalizante em Nível Médio: Uma Análise Curricular. *Revista Eletrônica Pesquiseduca, 08*(15), 25-44. http://periodicos.unisantos.br/index.php/pesquiseduca/article/view/506

D'Ambrosio, B. S.; & Lopes, C. E. (2015). Insubordinação criativa: um convite à reinvenção do educador matemático. *Bolema,* 29(51), 1-17. Doi: 10.1590/1980-4415v29n51a01

D'Ambrosio, U. (2001). *Educação Matemática: da teoria à prática*. 16a ed. Campinas: Papirus.

Damiani, M.F.. (2012). Sobre Pesquisas do Tipo Intervenção. In *Encontro Internacional de Didática e Práticas de Ensino (Endipe)*, 16. Campinas: UNICAMP. Retrieved from http://www.infoteca.inf.br/endipe/smarty/templates/arquivos_template/upload_arquivos/acervo/docs/2345b.pdf

Diniz, P. M. (2016). *Ensino Médio Integrado: Um campo de tensão no exercício da docência?* Dissertação de Mestrado em Educação, Universidade Cidade de São Paulo. São Paulo. Retrieved from http://www.unicid.edu.br/wp-content/uploads/2016/09/Disserta%C3%A7%C3%A3o-Priscila-Martins-Diniz.pdf

Domingues, J. L.; Toschi, N. S.; & Oliveira, J. F. de. (2000). A Reforma do Ensino Médio: A nova formulação curricular e a realidade da escola pública. *Educação & Sociedade, XXI* (70), 63-79. http://www.scielo.br/pdf/es/v21n70/a05v2170

Fernandes, S. da S. (2006). *A Contextualização no Ensino de Matemática – Um Estudo com Alunos e Professores do Ensino Fundamental da Rede Particular de Ensino do Distrito Federal*. Retrieved from http://www.ucb.br/sites/100/103/TCC/22006/SusanadaSilvaFernandes.pdf

Fonseca, J. J. S. (2002). *Metodologia da pesquisa científica*. Fortaleza: UEC. Apostila.

Godino, J. D. (2011). Indicadores de la idoneidade didática de processos de enseñanza y aprendizaje de las matemáticas. In *Conferência Interamericana de Educação Matemática (Ciaem),* 13. Recife: Universidade Federal de Pernambuco. Retrieved from http://www.lematec.no-ip.org/CDS/XIIICIAEM/artigos/CP-godino.pdf

Gonçalves, H. J. L.; & Pires, C. M. C. (2014). Educação Matemática na Educação Profissional de Nível Médio: análise sobre possibilidades de abordagens interdisciplinares. *Bolema,* 28(48), 230-254. Doi: 10.1590/1980-4415v28n48a12

Izaias, R.D.S.; Melo, M.R.; & Pinto, M. F. S.. (2015). Análise da Experimentação em Livros Didáticos Produzido em Diferentes Contextos. In *Encontro Internacional De Formação De Professores (Enfope)*, 8. Aracaju: Universidade Tiradentes. Retrieved from https://eventos.set.edu.br/index.php/enfope/article/viewFile/1451/199

Lopes, C. E. (2011). Os Desafios e as Perspectivas para a Educação Matemática no Ensino Médio. In *Reunião Anual Da Anped - Trabalho encomendado pelo GT19 - Educação Matemática*, 34. Natal: Centro de Convenção. Retrieved from http://www.ufrrj.br/emanped/noticia/docs/TextosGT19Anped2011_TrabEncomendado.pdf

Machado, L. R. de S. (2009). Ensino médio e técnico com currículos integrados: propostas de ação didática para uma relação não fantasiosa. In: J. Moll & Colaboradores. (Org.). *Educação profissional e tecnológica no Brasil contemporâneo: Desafios, tensões e possibilidades*. (1a ed.) Porto Alegre: Artmed Editora S.A..

Micotti, M. C. de O.. (1999). O ensino e as propostas pedagógicas. In M.A.V. Bicudo (Org.). *Pesquisa em Educação Matemática*: Concepções e Perspectivas. São Paulo: UNESP, 1999.

Moreira, A. F.; & Candau, V. M. (2006). Secretaria de Educação Básica (Org.). *Currículo, Conhecimento e Cultura: Documento em versão preliminar*. Retrieved from https://academico.iff.edu.br/Uploads/MATERIAIS_AULAS/53553-Curr%C3%ADculo_1.pdf

Moura, D. H.. (2007). Educação Básica e Educação Profissional e Tecnológica: Dualidade Histórica e Perspectivas de Integração. *Holos, 23*(2), 4-30. http://www2.ifrn.edu.br/ojs/index.php/HOLOS/article/view/11/110

Pereira, V.S. S. (2012). *Ensino de funções*: *Uma abordagem contextualizada do tratamento da informação no ensino médio.* Dissertação de Mestrado, Vassouras, Universidade Severino Sombra. 2012.

Pires, C. M. C.. (2013). Currículo, avaliação e aprendizagem matemática na educação básica. In INEP. (Org.). *Avaliações da Educação Básica em debate: Ensino e matrizes de referências das avaliações em larga escala*. (pp. 31-54) 1a ed. Brasília: INEP. Retrieved from https://bit.ly/2IuqNiX

Sabaiani, S. M. G.. (2007). Porque estudar currículo e teorias de currículo: (proposta de estudo para reunião pedagógica). In O professor PDE e os desafios da escola pública paranaense. *Cadernos PDE, 2*, 1-12.

Santos, F.P., Nunes, C.M.F., & Viana, M.C.V.. (2017). A Busca de um Currículo Interdisciplinar e Contextualizado para Ensino Técnico Integrado ao Médio. *Bolema: Boletim de Educação Matemática*, *31*(57), 517-536. https://dx.doi.org/10.1590/1980-4415v31n57a25

Setti, E. J. K. (2016). Modelagem Matemática no Ensino Médio Técnico Integrado em Informática - desafios e possibilidades na efetivação de um trabalho interdisciplinar. In *Encontro Brasileiro De Estudantes De Pós-Graduação Em*

Educação Matemática, 20 (pp. 1-11). Curitiba: Ebrapem. Retrieved from http://www.ebrapem2016.ufpr.br/wp-content/uploads/2016/04/gd10_elenice_setti.pdf

Silva, L. M.; & Melo, T. G. S.; & Nascimento, J. M.. (2015). Ensino Médio Integrado e Práticas Pedagógicas Integradoras: Caminhos para a formação humana integral. In *Colóquio Nacional*, 3. Natal: IFRN. Retrieved from https://ead.ifrn.edu.br/portal/wp-content/uploads/2016/02/Artigo-19.pdf

Silva, T.T.. *Documentos de identidade: uma introdução às teorias do currículo*. Belo Horizonte: Autêntica, 1999. 156 p.

Skovsmose, O. (2008). Cenários para Investigação. In O. Skovsmose. *Desafios da Reflexão em Educação Matemática Crítica.* (O. de A. Figueiredo & J. C. Barbosa, Trans.). Campinas: Papirus.

Souza, N., & Roseira, N. (2010). *A Contextualização no Processo de Ensino-Aprendizagem da Matemática.* Acedido em http://www.mat.ufrgs.br

Vieira, V. S. F. (2016). *O ensino de Matemática proposto na coleção de livros didáticos usada nos cursos técnicos de nível médio do Instituto Federal de Educação, Ciência e Tecnologia Fluminense: contextos e aplicações.* Tese de Doutorado em Ensino de Ciências e Matemática, Universidade Cruzeiro do Sul. São Paulo.

Vieira, V. S. F., & Curi, E.. (2016). Situações Propostas no Livro Didático de Matemática Utilizado no Ensino Médio Integrado à Educação Profissional: Contexto e Aplicações**.** *Vértices*, *18*(3), 51-71. Doi: 10.19180/1809-2667.v18n32016p51-71

Zitzke, V., & Calixto, P. (2018). Integração Curricular No Ensino Médio Integrado À Educação Profissional Técnica: A Percepção Dos Educandos Do Curso Técnico Em Vestuário Do IFUL/CaVG. *Revista Brasileira da Educação Profissional e Tecnológica, 2*(15), e7474. doi: https://doi.org/10.15628/rbept.2018.7474