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Spatial relations in the common national curriculum

Spatial relations in the national common curricular base

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SUMMARY

This work is part of the research project entitled "Lesson Study in the Training of Early Childhood Education and Early Elementary School Teachers in the Municipal School System of São Paulo, Focusing on the Teaching of Spatial Relations." One of the exploratory phase actions was to examine, using the document analysis techniques presented by Minayo (1998), how the theme of Spatial Relations appears in the National Common Core Curriculum for Early Childhood Education and the Early Elementary Schools. Evidence was found that Spatial Relations are included in all age groups during the period analyzed.

Keywords: Mathematics Teaching. Spatial Relations. Common National Core Curricular.

ABSTRACT

This work is part of the research project entitled "Lesson Study in the Training of Early Childhood Education and Early Elementary School Teachers in the Municipal School System of São Paulo, Focusing on the Teaching of Spatial Relations." One of the exploratory phase actions was to examine, using the document analysis techniques presented by Minayo (1998), how the theme of Spatial Relations appears in the National Common Core Curriculum for Early Childhood Education and the Early Elementary Schools. Evidence was found that Spatial Relations are included in all age groups during the period analyzed.

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1. INTRODUCTION

Studies conducted in Brazil indicate that changes in curricula result from social transformations and are driven by institutional demands or group pressures social (PALANCH, 2016). In the national context, the initial framework for defining content basic principles in Elementary Education was the Constitution of the Federative Republic of Brazil of 1988. The historical, scientific and educational developments that occurred in the following two decades culminated in the development of the National Common Curricular Base (BNCC).

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The BNCC (BRAZIL, 2018), made official in 2018, represents the curriculum instance prescribed, understood by Sacristán (2000) as the document formulated by competent bodies to guide the organization of the teaching-learning process, with a view to achieving learning goals. Thus, it establishes common parameters that serve as a reference for that States and Municipalities develop their own curricula.

Recognizing the relevance of the BNCC as a guiding document, a step in the research "Lesson Study in the training of Early Childhood Education teachers and of the initial years of Elementary Education in the municipal network of São Paulo with a focus on teaching of Spatial Relations", linked to the Postgraduate Program in Science Teaching and Mathematics at Cruzeiro do Sul University, focused on analyzing how the topic Spatial Relations is addressed in the BNCC for Early Childhood Education and the first years of life. Elementary Education.

2. THEORETICAL FRAMEWORK

The literature consulted shows that the topic of Spatial Relations still receives less highlighted in research in Mathematics Education, especially when compared to the study of Forms, being incorporated more systematically into curriculum documents only recently, especially in the context of Early Childhood Education and the initial years of Education Fundamental (CURI, 2013; ZOGAIB, 2019).

Curi (2013) defines Spatial Relations as a set of skills that involve communicating, interpreting, and representing space. These skills develop based on concrete experiences and interaction with the environment, contributing to the understanding and representation of the physical world. Zogaib (2019) expands this understanding by associate the concept with the spatial sense, characterized as the ability to perceive and understand spatial relationships through object manipulation, displacements and representations, including aspects such as distance, direction and perspective.

In the theoretical field, Clements and Sarama (2011) propose that spatial thinking is unfolds into two main axes: spatial orientation and spatial visualization. The first refers to the ability to locate and move in space, understanding relationships of position and displacement, which evolve from egocentric to allocentric reference frames, as

described by Piaget and Inhelder (1993). Spatial visualization is related to the ability to create and manipulate mental images and interpret two-dimensional representations and three-dimensional, a skill also discussed by Arcavi (2003).

The role of language in the construction of spatial thinking is discussed by Bowerman (1996), which points out how linguistic terms and structures influence understanding and description of spatial relationships. In addition, Mendes and Delgado (2008) highlight that pedagogical practices such as exploring routes, reading and creating maps, as well as the construction of physical models, are fundamental to favor the development of these skills.

The contributions of Piaget and Inhelder (1993) and Luquet (1969) on the development of spatial representation in children's drawings are relevant, even though currently receive criticism regarding the universalist nature of their propositions. Researchers as Iavelberg (2013) argue that children's graphic production should be analyzed considering the cultural contexts and experiences lived by the child, as these factors directly influence the way space is represented.

Thus, the reviewed studies converge towards the understanding that teaching Spatial Relations requires the articulation between bodily experiences, concrete exploration and the work with visual and symbolic representations, in order to enhance both understanding regarding spatial communication throughout the school trajectory.

3. MATERIAL AND METHOD

To answer the central question — how are Spatial Relations contemplated in BNCC — it was decided to carry out documentary research with a qualitative approach, for this allow a contextualized and reflective analysis based on consolidated theoretical references.

According to Minayo (1998), the qualitative approach starts from the natural environment as main source, with the researcher as a fundamental instrument, with emphasis on the processes and not just on the results, prioritizing inductive procedures and descriptive data.

Regarding the documentary character, Cellard (2008) defines this modality as the use of records and productions that have not received previous analytical treatment. To analysis, the procedure described by Minayo (1998) was followed, which involves the selection of

specific excerpts from documents, successive readings and construction of analysis categories through an inductive process.

4. RESULTS AND DISCUSSION

The literature consulted supports the importance of working with thought mathematician since Early Childhood Education (CURI, 2015; LORENZATO, 2008; SMOLE; DINIZ; CÂNDIDO, 2003), as well as the relevance of the investigative approach to dealing with Relations Spatial (MENDES; DELGADO, 2008; ZOGAIB, 2019).

The documentary analysis was conducted based on the assumptions of Minayo (1998). The BNCC was selected because it is configured as a prescribed curriculum (SACRISTÁN, 2000), serving as a reference for the organization of teaching, even though we recognize that, in the process of implementation, adaptations occur.

According to the document itself, the BNCC is normative in nature and defines a set articulated and progressive essential learning that all students must develop throughout Basic Education (BRASIL, 2018).

In Early Childhood Education, according to Ariosi (2019), the BNCC is organized into “fields of experiences”, inspired by Italian legislation, with differentiated learning objectives by age group: babies, very young children and toddlers.
Therefore, for Early Childhood Education, we observe the explicit presence of the theme Relationships Spatial as per the table presented below:

Table 1: Learning and development objectives found in the BNCC that involve Spatial Relations

Learning and development objective	BNCC Field of Experiences / Age
(EI02CG02) Move your body in space, orienting yourself by notions such as in front, behind, above, below, inside, outside, etc., when engaging in games and activities of different natures.	Body, gestures and movements / Very young children
(EI02CG03) Explore ways of moving in space (jumping, skipping, dancing), combining movements and following directions.	Body, gestures and movements / Very young children
(EI01ET03) Explore the environment through action and observation, manipulating, experimenting and making discoveries.	Spaces, times, quantities, relationships and transformations / Babies
(EI01ET04) Manipulate, experiment, arrange and explore space through experiences of moving oneself and objects.	Spaces, times, quantities, relationships and transformations / Babies

(EI02ET04) Identify spatial relationships (inside and outside, above, below, above, below, between and to the side) and temporal relationships (before, during and after).	Spaces, times, quantities, relationships and transformations / Very young children

Source: Prepared by the author based on Brazil (2018)

To analyze the objectives, we considered the contributions of Curi (SÃO PAULO, 2019) which present the textual structure of the objectives composed of:

> at least one verb that indicates the cognitive process being developed and the knowledge expected of the student to mobilize this same process (object of knowledge). In addition, the objective may present a different level of complexity and/or a context in which specific knowledge must be mobilized. These specify standards, conditions, or criteria for expected performance or elaborate on the objective in more detail, and we call them complements (SÃO PAULO, 2019, p. 32).

Thus, the objectives presented in the table were selected because they involve their cognitive processes (verbs in the infinitive), in the object of knowledge or in the complement the ideas of Spatial Relations as skills to communicate, interpret and represent space (CURI, 2013) and the ideas that make up its development as orientation and spatial visualization (CLEMENTS and SARAMA, 2000).

We observed that the configuration in the BNCC does not present sequence or depth of knowledge, since there is no provision for small children from the age of four years of objectives that somehow involve spatial relationships.

As for cognitive processes, there is only one specifically related to ideas. of spatial orientation, to move, and the idea of displacement reappears in two other objectives in the object of knowledge.

Three objectives appear structured with experimental actions announced by cognitive process “explore”.

The remaining objective is organized from the identification and makes up the object of the knowledge with spatial language concepts implying the meaning-relationship concept related to the contributions of Bowerman (1996). In addition to this, the complement that highlights follow guidelines appears in another objective.

For elementary education, the following table was prepared:

Table 2: Objects of Knowledge and Skills found in the BNCC in Mathematics for Elementary Education that involve Spatial Relations

Knowledge Objects Skills	
Location of objects and people in space, using different reference points and appropriate vocabulary	(EF01MA11) Describe the location of people and objects in space in relation to your own position, using terms such as right, left, in front, behind. (EF01MA12) Describe the location of people and objects in space according to a given reference point, understanding that, in order to use terms that refer to position, such as right, left, up, down, it is necessary to explain the reference.
Location and movement of people and objects in space, according to reference points, and indication of changes in direction and sense	(EF02MA12) Identify and record, in verbal or non-verbal language, the location and movements of people and objects in space, considering more than one point of reference, and indicate changes in direction and meaning.
Sketch of simple itineraries and plans	(EF02MA13) Sketch routes to be followed or plans of familiar environments, marking entrances, exits and some reference points.
Location and movement: representation of objects and landmarks	(EF03MA12) Describe and represent, through sketches of routes or using sketches and models, the movement of people or objects in space, including changes in direction and meaning, based on different reference points.
Location and movement: landmarks, direction and sense Parallelism and perpendicularism	(EF04MA16) Describe movements and location of people and objects in space, using grids and representations such as drawings, maps, floor plans and sketches, using terms such as right and left, changes of direction and sense, intersection, transversal, parallel and perpendicular
Cartesian plane: Cartesian coordinates (1st quadrant) and representation of displacements on the Cartesian plane	(EF05MA14) Use and understand different representations for locating objects on the plane, such as maps, cells in spreadsheets and geographic coordinates, in order to develop the first notions of Cartesian coordinates. (EF05MA15) Interpret, describe and represent the location or movement of objects on the Cartesian plane (1st quadrant), using Cartesian coordinates, indicating changes in direction and sense and turns.

Source: Prepared by the author based on Brazil (2018)

From the sixth year onwards, the BNCC knowledge and skills objects present spatial relations exclusively on the Cartesian Plane and with indications for the work of analysis of polygons represented in it.

Given this scenario, we decided to keep the comparison focus on the initial years of the Elementary Education to respect the limits of our objectives and recognizing that even if the learning mobilized from working with the plan involves communicating, interpreting and represent space, the theoretical approximation is greater with Analytical Geometry than with Spatial Geometry.

It also caught our attention that half of the skills were organized from of the cognitive process “describe”, becoming more elaborate actions, such as “interpret” and “understand” restricted to the fifth year.

We also realized that, even with the maintenance of focus on cognitive processes, there is a progression in the development of the objects of knowledge presented in the skills so that in the first year issues related to location are worked on considering the reference, in the second year discussions on displacement and representation, so that in the third year the proposal for consolidation of these can be made knowledge working on the previous questions together.

For years four and five, the skills framework explicitly focuses on introduction to ideas and work with Cartesian coordinates, respectively. Although the document curricular is an instance prior to teachers' planning, we raise the hypothesis that the way skills are presented encourages work to be carried out very more in the practices of graphic representation than with the experimentation of movements of the body or other objects.

FINAL CONSIDERATIONS

The investigation showed that, although Spatial Relations are present in BNCC both in Early Childhood Education and in the initial years of Elementary Education, approach is fragmented and not very progressive, especially in the transition to older children.

The goals of Early Childhood Education emphasize the exploration and identification of relationships spatial in playful and movement contexts, but without clear continuity for children to from the age of four. In Elementary School, there is a progression in the initial years, but the focus quickly shifts to formal representations and Cartesian coordinates, with less emphasis on bodily experiences and practices of movement in space.

These findings suggest that, although the BNCC establishes guidelines for the development of skills to communicate, interpret and represent space (CURI, 2013), there is room to improve the coherence and continuity of the content, integrating more balanced way of physical experimentation and graphical representation throughout the entire initial schooling.

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