

Concepts and Meanings in Chemistry and Mathematics Constructed by Students with Visual Impairment

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Abstract Before the inclusion in Brazilian public schools, we highlight the case of the visually impaired in the process of teaching and learning, specifically how visual impairment affects the construction of concepts and meanings in Mathematics and Chemistry. We investigated a group of students with visual impairment and the construction of meanings in experimental classes and through modeling, based on the Theory of Semantic Fields.

Keywords: *visual impairment, education, chemistry, mathematics, conceptual fields*

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1. Introduction

The inclusion of disabled students in Brazil was established by the federal constitution. In schools there was no previous preparation or the institution or teachers. Suddenly students were placed in regular classes eager to study. Therefore, the school was faced with students entered the class without knowing how to work in this new context.

According Agyei [1], persons with disabilities are often among the most economically and socially disadvantaged. In many countries, their rights are violated. Despite the severity and widespread nature of the problem, there is a lack of empirical information on disability.

There is a significant difference between enrolling and integrating students with special needs. All teachers should be properly prepared for integrating, rather than merely including, students. Integration should be the task not only of specialized educators, but rather of the entire school.

Inclusion involves a sense of belonging: feeling respected and valued for who you are; and receiving support and commitment from others so you can do your best work (Miller and Katz, 2002).

In the current study, two teaching activities, chemistry and mathematics, are investigated at a school. Participants were students with special needs, with total loss of vision, and students with partial loss of vision; both groups were in the first year of integration.

We agree with Agyei [1] that social inclusion of people with disabilities means working to help them gain equal rights in society. It also means helping society understand their needs. Respecting these rights with social inclusion means providing training and opportunities for people affected by blindness.

In the context of this research, the teachers worked with lesson plans, striving for experimental activities in

chemistry and mathematical modeling to understand the formation of concepts and meanings constructed by students with visual impairment. This is considered significant to our teaching practice and to how students learn.

Qualitative research assumptions were used to establish key attributes, summarized as:

General -Characteristics of disabled students in the school context after insertion; collecting data via open-ended qualitative surveys.

The object of study was to explore how SEN students with visual impairment think and form concepts in relation to experiments involving volume, mass, weight, density, and organoleptic characteristics, and the degree to which these perceptions influence the construction of knowledge in chemistry and mathematics.

Thus, the presence of previously guided pedagogical practice and focusing on integrating and respecting differences are fundamental to the act of learning and true integration of SEN pupils in the school context.

Results were operationalized as performance on interviews, movies, Braille writing, experiment performance, and oral evaluation. Also aimed to compare some concepts to a student who has trouble seeing and a student who has total blindness?

2. Materials and Methods

Participants were two students: Maria (completely blind) and Pedro (partially sighted; names are pseudonyms). They were first developed by the authors following questions: What are the meanings and concepts that visually impaired person down through mental models in class experience in chemistry?

This work was guided by considering the result of interdisciplinary proposals in chemistry and mathematics through meanings - via both training concepts and mental models.

Meaning was defined by the authors as concepts generated and mentally elaborated by students when performing experimental activities in chemistry and as the use of mathematical concepts through modeling.

The concepts discussed were as follows: In chemistry, the quantitation matter, volume, density, reactivity between the compounds, are basic concepts in the chemical solubility of substances. In mathematics, the basic concepts were proportional notions, volume, spatial characteristics, shape, and geometric figures.

For data collection, a model aiming to understanding how students build their concepts through relationships established among the different mental models was used. The analysis is presented in Table 1. On two occasions, the speech of students related to reactive mathematics concepts and chemistry.

Interviews were recorded and filmed in order better to be able to analyze the descriptions and their interrelationships, comparing concepts and evaluating experiments, through written and transcribed interviews, data analysis, categorization, and classification of results.

Table 1. interviews with authors

Interview questions	Loss full vision	Partial loss of vision
1-Age in years.	The A18 Student-Maria	Student B17 - Peter
2-Waste of time vision.	Since birth	Not specified
3- What is the concept you have about chemistry?	Chemistry is a science that prepares various products, with a strong smell that harm health and the pleasant smell that do well will health.	Understanding the chemistry as a science that uses formulas to improve technologies, discover cure diseases.
4-Given a bottle, how much water do you think would fit in that bottle? Which model do you build to get the result? Note the beaker glass was one liter.	Inside the bottle he said after contact with hands that offers tremendous liter, because the measure is a big, full glass.	The bottle should contain about one liter; I make 500 ml playing halfway cup and 500 ml. Playing half u
5- What are some positive experiences in the school context in the chemical classes or in other disciplines.	Positive coexistence with colleagues and treatment of teachers, which considers very nice people.	Of the student has no complaint, teachers are receptive, and colleagues as well.
6- What are some negative experiences in the school context in the chemical classes or in other disciplines.	Did not mention anything negative before Becker was only in another school and considers it good like this.	There were no negative fact, only positive experiences.
7- Name a few features that have been used that have contributed to the learning process.	Books, videos he says that when he hears better understands and performs the tasks.	The resource room the previous school preparing specialized material
8- Name a few features that have been used by teachers who have not contributed to the learning process	The development of chemistry class is satisfactory. Difficulties finding is that in general teachers speak very fast making it difficult to understand the analyzed content.	Preparation of material resource room teachers dictating the content.
9- Do you feel integrated in the school context? What factors contribute to this integration occurs or does not occur?	Considers the school as very large and still can not get around alone, lack adaptations to facilitate individual mobility of the visually impaired.	Feels good, it is considered a normal person, just to copy the frame content is having difficulty, otherwise I'm a normal person do everything.
10- Do you consider that the content covered in chemistry classes contribute to your life everyday? How does this happen?	He is very pleased with the lessons, and at his home performs tasks like cooking and quoted making food, and like to have a device to listen to the CD and DVD of the school content.	In my private life I do not see, but it helps because if someone asks a few things I know, I learned.

In mathematics classes, using modeling, we observed that, to demonstrate mathematical techniques, it was necessary to seek alternatives to motivate the students using learning methods different to those used with other students in the class. Tactile, rather than visual, statements about objects were made.

This enabled differentiation among squares and rectangles, flat areas, function calculations, basic variables and time. Using stimuli and imagination in regular classes awakened the senses of these SEN students.

The student Maria says that using the Perkins machine (Braille) she used the theoretical explanation of the teacher in class and so could play the subjects out of school for a better understanding of the contents.

Teachers and students engaged in mutual help, since repetition was of fundamental importance to learning.

One of the main challenges student with visual impairment confronted was remaining tranquil and peaceful, feeling insecure and afraid of being unable to learn. With the current didactic method, recalling the curriculum, the teacher could use past teachings to shape new areas, such as root extraction, enhancement, sets, functions, and logarithms. This is the normal didactic structure for any student entering the first grade of high school.

The evaluation criteria were established based on the oral evidence of two students. The results were considered satisfactory since these students passed with B concepts above 60% accuracy on examination of the seven questions posed orally in chemistry and 70% in mathematics.

3. Conclusions

The work enables us to state that learning in chemistry and mathematics can be enabled through different teaching strategies.

In this case, they used experimental classes in chemistry and mathematical modeling to understand the meaning built by students within the framework of semantic fields. This path appears more suitable, because it facilitates different methods of meaning construction in different students, either by experiments or by modeling.

The results of the oral assessment suggest that the didactic method was satisfactory, although further research is required for such strategies in all subjects, only two students were observed here. In the current cases, it was observed that the act of using touch to build their cognitive structural comparisons with previous mental

model facilitates allowed the visually impaired students to learn new proposals, whether the volume notion of a container is the volume of a rectangle or a square of the mathematical calculation.

Still quoting Agyei [1] PWD should be encouraged to participate in activities as a member of the society, in order to strengthen the capacity of people with disabilities to achieve the same results. Inclusive education means schools are integrated and are properly prepared to teach these children and to train teachers adequately to meet their special needs.

It is believed that the assessments have yet to be analyzed, but that it is nevertheless possible already to say that the school and the teachers managed the integration, despite having no prior experience or theoretical training for this challenge at public schools.

Two videos are available with some of the activities used:

<https://www.youtube.com/watch?v=o46rOtq1RLU>

https://www.youtube.com/watch?v=YStcp_1yQrU.

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