ACTIO: Docência em Ciências
ISSN: 2525-8923

http://periodicos.utfpr.edu.br/actio

Chemistry teaching for early grades: correspondence analysis between cartoon and experimentation adopted as strategy in pedagogy course for science teaching

Lucicléia Pereira da Silva
lucicleia09@gmail.com
orcid.org/0000-0002-5311-2407
Universidade do Estado do Pará (UEPA), Belém, Pará, Brasil

Débora da Cruz Arruda
deboraarruda83@gmail.com
orcid.org/0000-0002-6463-3021
Universidade do Estado do Pará (UEPA), Belém, Pará, Brasil

Ligia Amaral Filgueiras
ligiafilgueiras@gmail.com
orcid.org/0000-0001-8845-8654
Universidade do Estado do Pará (UEPA), Belém, Pará, Brasil

Admilson Alcantara da Silva
admilson.alcantara@uepal.br
orcid.org/0000-0003-0658-9832
Universidade do Estado do Pará (UEPA), Belém, Pará, Brasil

ABSTRACT

In the early grades, teachers who work in Science teaching lack appropriate training in teaching strategies for teaching chemical concepts in classes of 1 through 5 years of elementary school. Some proposals, using experimentation and playful activities have been applied in classroom with promising results. In this article, the objective was to evaluate, in the perception of pedagogues in initial formation, the existence of correlation between the use of the cartoon "Earth to Luna!" and experimentation, as strategies for the Chemical teaching in the initial years of elementary school. The investigation was held during the Chemistry and Methodology of Science Teaching discipline, taught in the Pedagogy course of the State University of Pará (UEPA). There were 101 undergraduation students as participants from three classes of different campuses of the State. An Investigative Teaching Sequence (ITS) was applied based on the “Fermentation” theme, exploring the episode “Sweet, Sweet Bread! (Earth to Luna!), integrated to the experimental activity in classroom. The research focus was qualitative and quantitative, with a likert questionnaire being applied, containing five preference scale issues, ranging from Totally Agree (TA) to Totally Disagree (TD), followed by justification on the choice made. Correspondence analysis was performed, where three perceptual maps were generated. It was found: 1) the strong correlation between experimentation and cartoon, as appropriate strategies for Chemistry teaching in the early grades; 2) effectiveness in adopting strategies used simultaneously for learning chemical concepts; 3) higher correlation strength in the option “Totally Agree” with the teaching strategies in the municipality of Moju. With the results achieved, it is suggested, according to the perceptions of the undergraduate students, the adoption of the cartoon associated to experimentation to work chemical knowledge in the early years of elementary school.

KEYWORDS: Science Teaching. Elementary School. Chemical Transformation. Earth to Luna!.

INTRODUCTION

The world is constantly changing due, in part, to the intense scientific and technological progress experienced in recent decades (BATISTA, FUSINATO, RAMOS, 2016). In today's society, to teach scientific concepts, the teacher needs an integrated and contextualized preparation, so that she can develop an adequate view on the nature of the scientific knowledge with her students, since early years of schooling (ROSA; BEJARANO, 2010; BATISTA, FUSINATO; RAMOS, 2016).

According to Rosa and Bejarano (2010), the teacher who works in the early grades in Brazilian schools, is usually the pedagogue, a professional who has extensive and integrated initial education in different areas of knowledge such as Educational Sciences, Psychology, Sociology, Philosophy, History and also the fundaments and methods in different teaching areas. There are also teachers who have passed the Higher Normal Course or even the mid-level teaching courses (LONGHINI, 2008).

Based on Lima, Belo and Siqueira (2015), in the curriculum design of Brazilian Pedagogy Graduation courses, there is usually a discipline related to Methodology of Science, planned to give subsidies to future teachers when they are in Science classes in early grades.

However, in a critical analysis, researchers in the area of Science Education consider teachers from early grades, most of the times, do not have appropriate training to teach the subject, highlighting among other aspects the small workload dedicated to this formation (LONGUINI, 2008), besides, these professionals lack specific content, proper and focused on Science education (BATISTA; FUSINATO; RAMOS, 2016).

In the Pedagogy Licentiate course of the State University of Pará (UEPA), the preparation of teachers in initial formation to work with Science teaching in the early grades is not different. The formation process is developed through three disciplines of 80 hours each, such as Biology and Methodology for Science Teaching; Physics and Methodology for Science Teaching, and Chemistry and Methodology for Science Teaching. In these disciplines, emphasis is given to methods and techniques over the theoretical and practical conceptual approach of scientific contents.

Thus, it is considered the need to rethink the formation process of these professionals, in order to introduce/broaden the approach of structuring concepts of each area of knowledge present in the Science curriculum for the early grades, addressing contents and methodologies in an integrated manner (LIMA; MAUÉS, 2006; LONGUINI, 2008; BATISTA; FUSINATO; RAMOS, 2016).

Therefore, in the context of the research developed throughout the discipline Chemistry and Methodology for Science Teaching, the structuring concept chemical transformation was approached, through the integrated use of the cartoon “Earth to Luna!” and experimentation, developing an Investigative Teaching Sequence (ITS) on the theme “bread fermentation”. In this article, the objective was to evaluate, in the perception of pedagogues in initial formation, the existence of correlation between the use of the cartoon "Earth to Luna!" and experimentation, as strategies for teaching chemical concepts to children.

CHEMICAL TEACHING TO EARLY GRADES: AA BRIEF OVERVIEW

The chemistry teaching in the early grades, in the context of the discipline Science, is presented in an integrated way to the knowledge of Biology and Physics area, with gradual advances over the schooling grades (MORAES; RAMOS, 2010).

To Moraes and Ramos (2010), Chemistry teaching at this level of schooling should start from the students' context, thus enabling a better understanding of the real world. For the authors, it is important to study everyday themes, exploring the chemistry present in the kitchen, cars, industry and in different professions.

[...] proposing an activity of dissolving table salt (sodium chloride) or sugar (sucrose) in water, in the first or second year of elementary school, is a way of operating with the concept of substance, enabling the students to acquire this concept by practice. From this, the teacher can integrate the students in the chemistry language, although without intending to come up with explanations they would not understand at this time and without having to express definitions and more complex theoretical explanations (MORAES; RAMOS, 2010, p. 46-45).

The authors assure in the initial grades the activities are developed based on the concepts of substance and transformation, structuring in the study of chemistry. Through these concepts, for example, bridges can be established with other concepts such as acids, metals, reagents, products (MORAES; RAMOS, 2010).

The structuring concepts are defined as a “set of concepts that cover all areas of the Natural Sciences and are necessary to understand various everyday phenomena” (ESPINOZA apud THEODORO; KASSEBOEHMER; FERREIRA, 2014, p. 390).

To Theodoro, Kasseboehmer and Ferreira (2014), these concepts are basic and determinant for learning more specific concepts of Chemistry, Physics and Biology. Silva et al. (2007) also point out the basic knowledge of chemistry approached in the initial grades will allow students to have base on the theoretical deepening that will take place in subsequent grades.

In the book “Trails to teach Science for children”, Lima and Loureiro (2013) present, in the chapter entitled “The materials and their transformations”, two topics that bring together chemical concepts to be worked on in the early grades. Box 1 presents the properties and uses of materials.

Box 1- What things are made of: properties and uses of materials

Description	Year				
	1st	2st	3rd	4th	5th
Materials and objects	X	X			
Mixture Separation			X	X	
Material Properties	X	X	X	X	X
Material Transformations				X	X

Source: Lima and Loureiro (2013).

Box 2 shows the material transformations.

Box 2- Material Transformation

Description	Year				
	1st	2nd	3rd	4th	5th
Food production Reaction	X	X			
Combustion Reaction – candle burning			X	X	
Photosynthesis and Respiration				X	X
Metal Oxidation Reaction – rusting					X
Organic matter decomposition reaction				X	X

Source: Lima and Loureiro (2013).

In each topic indicated in boxes 1 and 2, the authors present a content description to be addressed according to the school year, as well as suggestions as how to perform this approach.

Oliveira et al. (2016) point out Chemistry teaching in the early years of schooling does not characterize an anticipation of chemistry discipline teaching, but an approach that should be directed to themes of the area itself, listed on the official documents and in the current version of the Common National Curriculum Base (CNCB).

As proposed by the CNCB in the Thematic Unit - Matter and Energy, for the 1st year the objects of knowledge related to the material characteristics should be explored; for the 2nd year properties and uses of materials; in the 4th year mixtures and transformations and in the 5th year physical properties of materials (NIGRO, 2017).

As an example of application of chemical knowledge to the initial grades, we highlight the didactic intervention performed by the authors Belian, Lima and Freitas Filho (2017) with students from the 4th year of a public school in the State of Recife, Brazil. The authors developed and evaluated four thematic modules, exploring different chemical concepts through playfulness and experimentation.

In the first module, they worked on the chemistry conception as a science; in the second they introduced the concepts of mass, density, temperature and physical states; in the third they addressed physical and chemical transformation; they finalized the fourth module with substances and system (BELIAN; LIMA; FREITAS FILHO, 2017).

In the results presented, improvement and restructuring of the children's conceptions about chemistry were evidenced, as well as the approach of contents through contextualized themes and student-centered strategies were considered the strong spots for approaching chemistry in the early grades (BELIAN; LIMA; FREITAS FILHO, 2017).

THE CARTOON "EARTH TO LUNA!" AND THE INVESTIGATIVE EXPERIMENTATION IN SCIENCE TEACHING

"Earth to Luna!" is a Brazilian cartoon production that explores, in a playful and funny way, themes involving scientific knowledge of different areas such as astronomy, biology, physics, paleontology, chemistry. Luna, the protagonist of the cartoon, represents a six-year-old child, curious and fascinated by science. With the help of her brother and a pet, she asks questions about how things work and looks for answers "using scientific methods such as hypothesis formulation, experimentation, observation and conclusion" (CATUNDA, 2015, s.p.).

The cartoon was released in 2014 and its episodes have an average duration of 12 minutes. Its exhibition are on open TV networks such as "TV Brasil"; and closed ones as "Discovery Kids". They are also aired in the United States through the NBC Sprout channel and in Portugal through the SIC channel (CATUNDA, 2015). Some episodes are available on the Youtube video sharing platform (http://www.youtube.com).

Aimed at children's audience, it was created by Célia Catunda and Kiko Mostorigo, produced by Ricardo Rozinno and has been used in activities for education and scientific dissemination (MENDONÇA et al., 2018; LELES; MIGUEL, 2017) and strategy for science teaching in initial grades (PAULA et al., 2017; OLIVEIRA; MAGALHÃES, 2017) and elementary school II (LELES; MIGUEL, 2017).

Mendonça et al. (2018) highlight the cartoon differential because it shows science is everywhere. Luna's questionings are drawn from a curiosity that arises on the beach, in the kitchen, at the bakery shop, zoo or in her backyard. According to the authors, the cartoon allows the clarification of doubts of most children about scientific phenomena related to daily life.

Leles and Miguel (2017) analyzed 52 episodes of the "Earth to Luna!" and confronted them to the science contents presented in the National Curriculum Parameters (NCP), as well as to textbooks in the area. From the total analyzed, 30 episodes were selected in which the contents included those presented in the subject Science for the elementary school II. The authors produced a didactic sequence that was validated by Science teachers, whom most agreed the proposal would be of great help during classes.

Paula et al. (2017) identified the viability of application in Science teaching in the early grades after analysis of ten episodes. By identifying different themes and concepts worked (rainbow formation; water cycle, atmosphere, evaporation; location and characteristics of the planet, telescope use, solar system; among others) and the way in which they are presented during the cartoon, they concluded it can be used as a strategy in Science teaching for the early years, highlighting characteristics such as playfulness and the use of common situations of the child's daily life toward to making science.

Oliveira and Magalhães (2017) worked with different episodes with children of early years and were able, for example, to explore through the episode "How Water Becomes Rain", concepts related to the physical states of water (solid, liquid and gaseous). In the episode "Wings to Fly" they worked on the bird theme and why they can fly. According to the authors, the various themes the cartoon

addresses provide a discussion about science in a playful way and with an appropriate language for children.

In addition to the playful aspect and language, great importance is given to the experimental activities performed by the characters in searching of answers to the different questions that arise throughout the episodes.

> [...] the characters observe a phenomenon, ask questions about it, test hypotheses and, after a long organization of thoughts and knowledges that are presented and obtained throughout the process, come to a conclusion, whether it is a unique answer or with several response possibilities (PAULA et al., 2017, p. 6).

In this sense, it is believed in possible contributions of the experimental activities presented in the cartoon to the Science teaching, considering that, in the early grades, the experimentation assumes a relevant role, because it allows the teacher to develop different activities that are able to instigate in the student the science taste.

However, it is noteworthy it is not enough just proposing or reproducing the experimental activities, because the way they will be presented, the proposed questions, the discussions and the generated reflections will determine if the experiment will really constitute a strategy that will effectively contribute to the teaching/learning processes (PRADO; WENSENDOK, 2019).

Although simple, the experimental activities presented in the "Earth to Luna!" are structured from a question elaborated by her, as well as the hypotheses raised, are formulated in the context of interaction with other characters. In this configuration, experimentation with an investigative approach can be introduced, in the classroom context.

According to Oliveira (2010, p. 149),

> The investigative-type experiments, much cited in the most recent studies on experimentation, represent a strategy for allowing students to take a more active position in the knowledge-building process and for the teacher to become a mediator or facilitator of this process. At the heart of the investigative experimental activities is its ability to provide students with greater participation in all stages of the investigation, from problem interpretation to a possible solution to it.

Experimentation as an investigation allows to organize various teaching situations that awake in children the interest in understanding phenomena, as well as to exercise and share their thoughts. Thus, “from an early age we need to give children chance to develop a taste for science and the perception they can learn easily” (ABIB, 2013, p.93).

METHODOLOGY

The research has quali-quantitative approach, being of the exploratory type. According to Moreira (2003), in the qualitative approach the central interest in an investigation revolves around the meanings attributed by people to events and objects, their actions and interactions within a given social context, which are elucidated and interpreted by the researcher. In the quantitative approach in

educational research, the analysis of the phenomena of interest usually occurs through experimental or correlational studies for error reduction, characterized by objective measurements and statistical analysis (MOREIRA, 2003).

According to Resolution 510/2016 of Ethics in research with human beings, that provides rules applicable to research in Humanities and Social Sciences which methodological procedures involve the use of data directly obtained with the participants, as in the case of this research, it is highlighted In the Sole paragraph, that will not be recorded or evaluated by the CEP / CONEP system:

> I - public opinion poll with unidentified participants, beyond paragraph
>
> VIII - activity carried out solely for the purpose of education, teaching or training without the purpose of scientific research, undergraduate students, technical courses or professionals in specialization (BRASIL, p.44).

The research was developed in the Chemistry and Methodology of Science Teaching discipline, taught in the 5th semester to undergraduate students of the Full Licentiate Pedagogy Course of the State University of Pará (UEPA) from three campuses in the State (Moju, Igarapé Açu and Cametá). During the discipline, an Investigative Teaching Sequence (ITS) was applied to three pedagogy classes. It is noteworthy the course load is 80 hours, being taught in a modular format (16 days), making it difficult to triangulate the ITS with the application in classes of early grades.

According to Carvalho (2013) an ITS consists of planning activities or classes with objectives of valuing the student's prior knowledge, promoting the ability to progress from spontaneous knowledge to scientific knowledge, teacher's action in the mediation process and collective discussion on the studied subject.

> [...] an investigative teaching sequence should have some key activities: most of the time the ITS begins with a problem, experimental or theoretical, contextualized that introduces students to the desired topic and provides conditions for them to think and work with relevant variables of the central scientific phenomenon of the syllabus (CARVALHO, 2013, p.9).

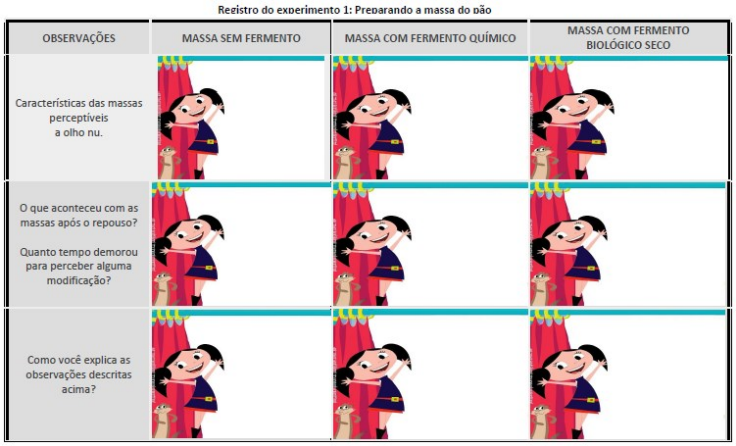
The structuring activities of an ITS described by Carvalho (2013) are the problem, knowledge systematization activity to be constructed by the student, daily knowledge contextualization activity, assessment and/or application activity at the end of each cycle.

Box 3 - ITS developed in the Chemistry and Methodology for the Science Teaching discipline

Investigative Teaching Sequence (ITS)	
Main Public	Graduation students of the 5th semester of the UEPA Full Licentiate Pedagogy Course
Question (s)	How is the bread production process? What is fermentation? How is wheat turned into bread? What is chemical transformation?
General Objective	Promote investigative activities that favor the teaching and learning process about Chemical Transformation through the theme bread fermentation, aiming at establishing relationships between scientific and everyday knowledge, through the use of problematizing strategies such as the “Earth to L Luna” cartoon and experimentation.
Steps	**Activity Description**

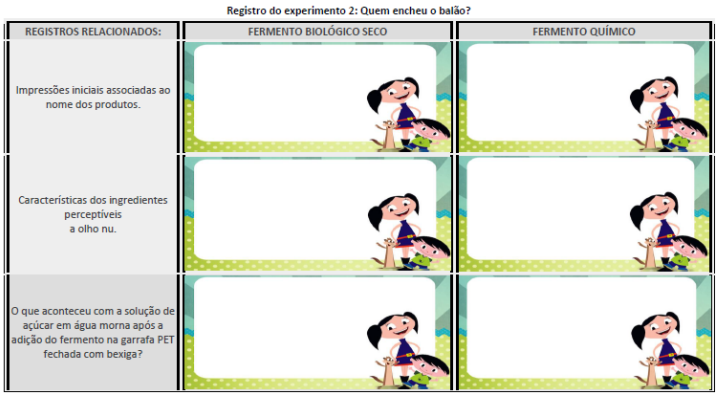
<table>
<tr><td>1st</td><td>Survey of previous conceptions
Questionnaire application on family bread making practice, types of yeast known at home, and knowledge about the fermentation process: Have you or anyone in your family ever made bread? What is the process like? Do you know what fermentation is? What are the types of yeast to make bread? Do you know the difference? Do you know Earth to Luna! cartoon? Has any teacher ever used it to teach science? If so, describe the class. What is experimentation for?</td></tr>
<tr><td>2nd</td><td>Theme Problematization: Cartoon Exhibition “Earth to Luna!” episode: Sweet sweet bread! Part: 0’:00” – 3’35” (Available at: https://www.youtube.com/watch?v=taN7zaZqTXM, access in: Jun 08. 2018).

Synopsis: Luna watches Newton making the delicious sweet bread she loves so much. Playing with a piece of raw dough, Luna is faced with a question: How can that small, soft dough can turn into a big, fluffy bread?... We need to find out how dough becomes bread! She, Jupiter and Claudio will pretend to be sweet bread to find out the secret that makes baguettes, donuts and croissants grow and be so tasty (RODRIGUES, 2016).</td></tr>
<tr><td>3rd</td><td>Experimentation
- Experiment 1: Dough Production.
STEP 1) Preparation of the dough with mixture of ingredients in three trays: a) Tray 1 - unleavened dough b) Tray 2 - chemical leavened dough; c) Tray 3- dough with biological yeast. STEP 2) Conditioning the different masses in transparent pots and observation for 10 minutes the behavior in the three different situations. STEP 3) Record the observations and make assumptions as requested in the following box:

Figure 1 - Record box of the information about the bread production
 

Source: Own authorship (2018).

2) Experiment 2- Who filled up the balloon?
STEP 1) Initially mix 100 mL of warm water and 1 tablespoon of sugar in previously identified transparent PET bottles; at the same time add one tablespoon of chemical and biological yeast to each bottle; close immediately with two balloons. STEP 2) Observe for 10 min; record the observations and elaborate explanatory hypotheses, as requested in the box below.</td></tr>
</table>

<table>
<tr><td></td><td>Figure 2 - Record box of the information about yeast uses
 

Source: Own authorship (2018).</td></tr>
<tr><td>4th</td><td>Experiment Discussion
Cartoon continuation with snippet display (3': 36”- 10':58”). Opening for discussion, relating the explanations contained in the episode with the observations and explanations elaborated by the groups throughout the experiments performed.</td></tr>
<tr><td>5th</td><td>Knowledge Systematization
Collective discussion about the chemical transformations involved in the fermentation process, followed by text reading from the Superinteressante magazine: What is the difference between chemical and biological yeast? Available at: http://super.abril.com.br/saude/qual-a- difference-between-biological-and-chemical yeasts. December 2003. Finalization with clarification of doubts and answers to questions made by the undergraduate students.</td></tr>
<tr><td>6th</td><td>Applied Strategies Evaluation
<table>
<tr><td>The adoption of the Earth to Luna! cartoon, to work on the theme of bread fermentation, favored learning.</td><td>TD</td><td>PD</td><td>I</td><td>PA</td><td>TA</td></tr>
<tr><td>The investigative experimentation helped to understand what fermentation is.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>The strategies are suitable to the chemical knowledge approach in the early grades.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>There was comprehension of the chemical concepts approached from the adopted strategies.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Additional Comments on positive and/or negative aspects about the applied methodology.</td><td colspan="5"></td></tr>
<tr><td colspan="6">Application of a likert questionnaire evaluating the potential of the developed strategy</td></tr>
</table></td></tr>
</table>

Source: Own autorship (2018).

According to the presented guidelines, the developed steps during the investigation were systematized in Box 3.

CORRESPONDENCE ANALYSIS (CA)

According to Lúcio et al. (1999), Correspondence Analysis (CA) is a method to determine an association system between elements of two or more groups, and thereby tries to demonstrate the association structure of the factors involved, that is, it allows the visualization of the most important relationships of a set of variables to each other. The results can be presented in graphs, with the categories of each variable represented and the relationships between them, from the distance between the points drawn (LEBART et al., 1984). Although considered a descriptive and exploratory technique, CA simplifies complex data and produces information analyzes, that indicate conclusions about these analyses. CA shows how the variables arranged in rows and columns are related by a perception graph and if there is a relationship between them.

It is recommended the CA perception graph be presented as a geographical map, understanding that: the shortest distances between the row and column categories present the strongest associations between them and the greatest distances the dissociations between them (MOSCAROLA, 1991; LAGARDE, 1995).

It is important to remember, before applying the Correspondence Analysis technique, some tests should be performed to verify the dependence of the studied variables, such as the Chi-Ssquare Test (x^2) and then the β Criterion Test, to confirm the dependence between the variables and indicate whether the application of the Correspondence Analysis between the variables is valid or not. If β> 3, the variables are dependent on a risk less than or equal to 5%, and therefore it is suitable. In this work we adopted: if H_0: $\beta \leq 3$, the variables are independent and if H_1: $\beta > 3$, the variables are dependent (MONTEGOMERY, 1994).

When there is a high value of the Chi-Square statistics, according to Faria (1993), it is indicated that, geometrically, there is a significant difference between the profiles and their respective centroids. This fact indicates the variables are independent, leading to the impossibility of applying the Correspondence Analysis.

Another important aspect to consider is the percentage of inertia obtained during the CA. This percentage refers to the variation explained by each dimension. Since the analysis is built on a two-dimensional plane, the percentage of inertia measures the representativeness of each dimension. Therefore, the sum of the inertia percent of dimensions 1 and 2 should be greater than 70%, indicating the result of the correspondence analysis is valid.

To analyze the results in this study, only the data obtained with the application of the Likert questionnaire to 101 undergraduates (stage 6 of ITS) were considered. The answers were typed and submitted to CA with the aid of *software* Statistica version 8.0. For this, random groupings were made, considering the central objective of each statement presented in the questionnaire. Three categories of analysis were generated: 1- Cartoon *versus* Experiment; 2-Strategies *versus* Worked Concepts; 3-Strategies *versus* Municipalities.

RESULTS AND DISCUSSION

In the correspondence analysis for this work, a total of 101 records were used. With data presented in Table 1, it was especially found, the β values for all variables

tested were greater than 3, that is, all present the necessary conditions for the application of the studied technique.

Table 1 - Calculation values of *β* criterion, x^2 and inertia, validating CA for the analyzed variable

Analysed Variables						
1- Cartoon *versus* Experiment						
Total Inertia=1,0489			**Chi - Square=105,94**		**fd = 4**	
Seq.	Singular	Autovalues	% Inertia	% Cumulative	x^2	*β*
1	1	1	95.33679	95.3368	101	211. 88
2	0.22116	0.048913	4.66321	100	4.9402	
2-Strategy *versus* Worked Concepts						
Total Inertia=1,0026			**Chi-Square=101,27**		**fd = 7**	
Seq.	Singular	Autovalues	% Inertia	% Cumulative	x^2	*β*
1	1	1	99.73798	99.7378	101	248.04
2	0.051255	0.002627	0.26202	100	0.2653	
3-Strategy *versus* Municipalities						
Total Inertia=0,06479			**Chi - Square=6,5441**	**fd = 6**	**p=0,36510**	
Seq.	Singular	Autovalues	% Inertia	% Cumulative	x^2	*β*
1	0.238193	0.056736	87.5646	87.5646	5.7303	16.02
2	0.089762	0.008057	12.4354	100	0.813785	

Source: Own authorship (2019).

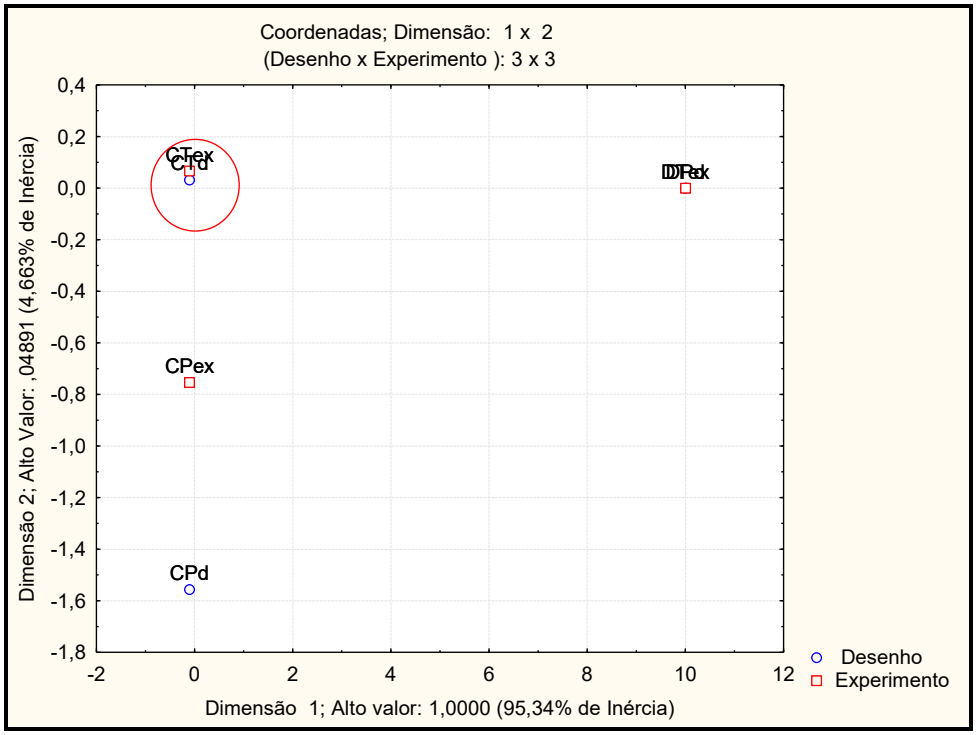
1) CA between the variables Cartoon versus Experiment

In this item, we analyzed the correlation existence between two strategies used simultaneously, the cartoon “Earth to Luna!” and the problematized experimentation.

The dependence between the variables Cartoon x Experiment was confirmed by the *β* value criterion = 211. 88 with a 5% risk. In Figure 8, there is a simple AC for the two variables. Note the first two axes (dimensions) have explanatory capacity (95.34% + 4.66%), with a total of 100% of the information. This result allows us to observe these first two major components, and it is not necessary to explore the third axis/dimension, with 0% of the information, as this is not an aggregator of significant information for understanding the data mass.

In Figure 3, the perception graph shows there is correspondence between the variables CTex (Totally Agree with the Experiment) and CTd (Totally Agree with the “Earth to Luna!” cartoon), that is, the application of the “Earth to Luna!” cartoon and experimentation are appropriate for the applied Investigative Teaching Sequence (ITS).

Figure 3- CA between the Cartoon X Experiment variables.



Source: Own authorship (2019). Caption: CTd – Totally Agree with the cartoon; CTex - Totally Agree with the experiment; CPd - Partially Agree with the cartoon; CPex-Partially Agree with the experiment; DTd - Totally Disagree with the cartoon; DTex- Strongly Disagree with experiment.

For most undergraduate students “Earth to Luna!” cartoon was considered suitable to be used in the early grades. As an example, we have the following justifications:

Undergraduate student 13- “The cartoon works in a playful and entertaining way on important subjects, which are often the curiosity of the student and which are often difficult to understand” (2018).

Undergraduate student 24- “The cartoon explains the phenomena in a very playful and interesting way” (2018).

Undergraduate student 40- “Children always like cartoons and the Earth to Luna! is very educational, not mentioning it can be contextualized in a class” (2018).

In addition to entertainment, cartoons can be used as a strategy for science teaching in the early grades (PAULA, et al., 2017). Since it is part of children's daily life and presenting different playful characteristics (script, sound, moving image, colors) it allows its use in classroom serving as a basis for discussion and concept problematization.

In agreement with the analysis presented by the authors, it is reassured in this research Earth to Luna! can be used by the teacher in order to show each stage of knowledge production, arousing the curiosity of students when seeking answers to everyday questions, developing scientific knowledge about chemical

transformation in a dynamically and playfully way, as it occurs in the episode "Sweet, sweet bread!".

As for the experiments developed, the undergraduate students pointed out different positive aspects and contributions to chemistry learning in the early grades:

Undergraduate student 8- "Through experimentation we see the reactions and changes that occur with the dough when adding the yeast" (2018).

Undergraduate student 40- "It helped a lot, because it was the contact with the experiment that every problem could be solved" (2018).

Undergraduate student 83- "Experimentation is of great relevance, because it arouses curiosity and relates to other scientific knowledge that students have, causing reflection to try to discover new concepts" (2018).

Regarding the development of experimentation, in the educational context, Malheiro (2016) points out that phenomena, whether biological, physical or chemical, need to be associated to contexts inherent to daily life, so they can make sense for students.

To Carvalho et al. (2009) the experiment has the function of generating a problematic situation, surpassing the simple manipulation of materials. To Karmiloff-Smith (apud CARVALHO et al., (2009) the main function of experiences in the school space, with the teacher's mediation, is to broaden the student's knowledge about the phenomena, testing hypotheses, making them build relationships with the different ways of seeing the world.

Thus, by approaching the concept of chemical transformation, starting from the theme of "bread fermentation", performing the problematization and conducting the experiment with everyday materials, the undergraduate students could relate theory and practice, in order to answer the different questions raised during the teaching and mediation process.

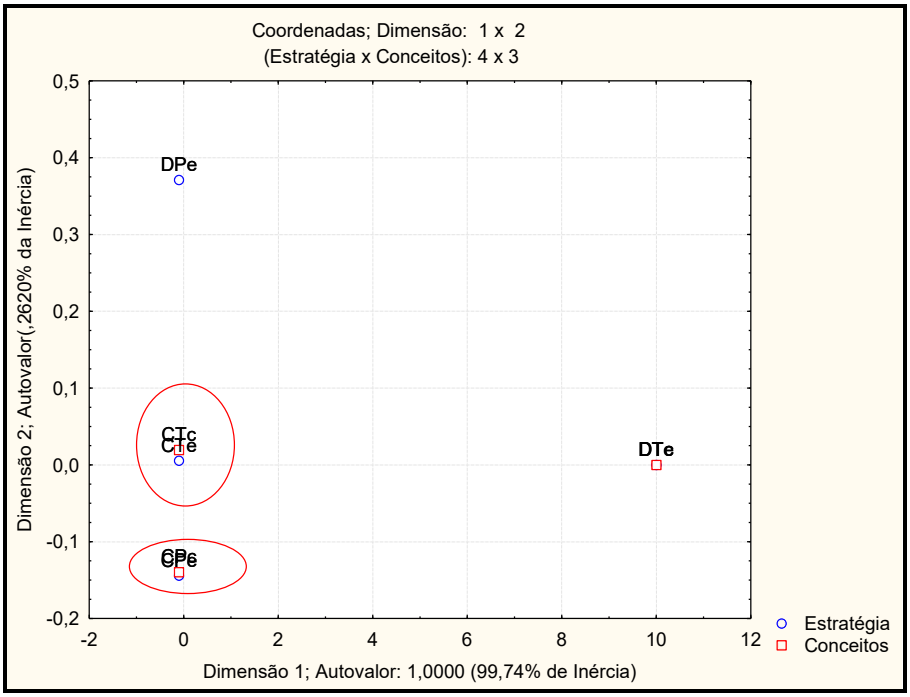
2) CA between the Strategy versus Concepts variables

In this item, we analyzed the contribution of the strategies used during the discipline to the learning of concepts related to the theme of "bread fermentation", highlighting the concept of transformation or chemical reaction.

The dependence between the Strategies versus Concepts variables was confirmed by the β criterion value = 248.04. Note the first two axes (dimensions) can be explained (99.74% + 0.26%), with a total of 100% of the information. This result allows the analyst to focus on these first two main components, and it is not necessary to explore the third axis/dimension, only 0% of the information, as it does not add significant information for the comprehension of the whole data mass.

In Figure 4, the perception graph shows there is correspondence between the variables CTe (Totally Agree with the Strategies) and CTc (Totally Agree with the learning of Concepts), that is, for the majority of the undergraduate students, it is noticeable the contribution of strategies for teaching and learning of chemical transformation concept.

Figure 4 - CA between the Strategies X Concepts variables



Source: Own authorship (2019). Caption: CTe – Totally Agree with the strategy; CTc – Totally Agree with the concept; CPe – Parcially Agree with the strategy; CPc – Partially Agree with the concept; DPe – Totally Disagree with the strategy; DTe – Totally Disagree with the strategy.

Considering the cartoon was adopted to problematize the fermentation theme and, together with the experimental activity, to develop the chemical transformation content, in addition to the strong correlation between the variables, the justifications presented by the undergraduate students stand out:

Undergraduate student 30 - “It urges us, pedagogues in training, to use more attention-grabbing methods that release students' curiosity and interest” (2018).

Undergraduate student 10- “It was very constructive, since the cartoon was very interesting and educational to clarify the processes that were performed. In addition, practice was essential for observing chemical reactions” (2018).

Undergraduate student 18- “The methodology employed is ideal, because it allows the student to produce, interact and think about the concepts worked on, besides valuing teamwork” (2018).

During the process of initial teacher formation for the early grades, it is necessary that during the methodology disciplines, conceptual, procedural and attitudinal approaches related to science teaching be discussed in an integrated manner.

It is believed it is the role of the teacher trainer to work, through real examples and problematic situations, the scientific knowledge of the science area, giving the opportunity for teachers in initial formation to have during the course, as highlighted by Ribeiro and Neves (2015), theoretical (to know) and methodological (know how) base.

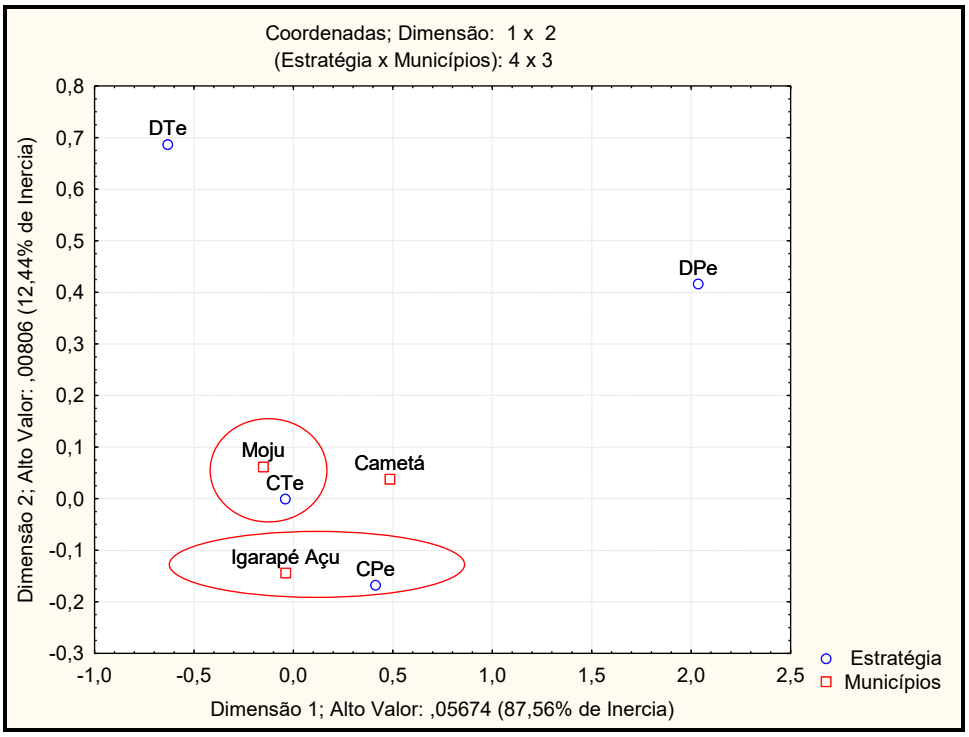
3) CA between the Strategies X Municipality variables

In this item, we evaluated the efficiency of the methodology adopted by municipality in the different classes of the Pedagogy course (Cametá, Igarapé Açu and Moju), applying the CA to ascertain in which of the municipalities there was greater acceptance of the strategies used during the discipline.

To the Strategy x Municipalities variables, a β = 16.02 was found, attesting they are dependent on a 5% risk. Figure 10 shows the first two axes (dimensions) have explanatory capacity (87.56% + 12.44%), with 99.9% of the information. This result allows us to focus on these first two main components, and it is not necessary to explore the third axis/dimension, only 0.1% of the information, as it does not add significant information for the comprehension of the whole data mass.

In Figure 5, the perception graph shows a higher correspondence between the variables CTe (Totally Agree with the strategy) in the municipality of Moju, followed by CPe (Partially Agree with the strategy) in the municipality of Igarapé Açú.

Figure 5 – CA between Strategies x Municipalities variables



Source: Onw authorship (2019). Caption**:** CTe – Totally Agree with the strategy; CPe – Partially Agree with the strategy; DPe – Partially Disagree with the strategy; DTe – Totally Disagree with the strategy.

With the results presented, it was found the acceptance of the applied methodology was higher among the pedagogy undergraduate students in the municipality of Moju, followed by those of Igarapé Açu and Cametá, respectively. Thus, a greater possibility of adoption of the strategies in the future teaching practice by the teachers in initial formation of the Moju campus is inferred.

FINAL CONSIDERATIONS

Teaching chemistry to children in the early grades, within the science subject, has not been an easy task. It is noticeable in the Brazilian educational scenario, barriers related, especially, in the initial formation of teachers who are being qualified to work from the first to the fifth year of elementary school.

It is emphasized here, the importance that in the methodology disciplines of teacher formation courses, playful and experimental strategies are adopted, integrating theory and practice, without leaving aside the theoretical foundation of scientific concepts by area of knowledge, because the praxis will allow the future teacher to feel safe and, with mastery of content, she can bring science closer to the student's daily life, arousing curiosity for the facts, which are often simple, but that end up going unnoticed in school life.

Through the Correspondence Analysis performed, a strong correlation between the adopted cartoon and the experimentation was attested. Thus, it is suggested to the teacher who is going to use a cartoon in the classroom, whenever it is possible, make the association with experimentation, because the combination of strategies will better assist in the construction of chemical knowledge by the students.

Finally, the use of statistical analyzes in educational works is indicated, considering the possibility of obtaining greater accuracy in the results when associated with qualitative analysis techniques. It is noteworthy that to ensure this accuracy, it is necessary to apply a good sample design of the experiment, with appropriate sample size and the application of a technique that guarantees the randomness of the variables involved in the study.

Ensino de química para as séries iniciais: análise de correspondência entre desenho animado e experimentação adotados como estratégia no curso de pedagogia para o ensino de ciências

RESUMO

Nas séries iniciais, professores que atuam no ensino de Ciências carecem de formação adequada sobre estratégias didáticas para ensinar conceitos químicos em aulas do 1º ao 5º ano do Ensino Fundamental. Algumas propostas, utilizando a experimentação e atividades lúdicas vêm sendo aplicadas em sala de aula com resultados promissores. Este artigo objetivou avaliar, na percepção de pedagogos em formação inicial, a existência de correlação entre o uso do desenho animado "Show da Luna" e experimentação, enquanto estratégias para o ensino de Química nos anos iniciais do Ensino Fundamental. A investigação foi realizada durante a disciplina de Química e Metodologia do Ensino de Ciências, ministrada no curso de Pedagogia da Universidade do Estado do Pará (UEPA). Teve como participantes 101 graduandos de três turmas de diferentes *campis* do interior do Estado. Aplicou-se uma Sequência de Ensino Investigativa (SEI) sobre o tema "Fermentação", explorando o episódio "Doce, pão doce!" (Show da Luna), integrado à atividade experimental em sala de aula. O enfoque da pesquisa foi quali-quantitativo, sendo aplicado questionário do tipo likert, contendo cinco questões com escala de preferência, variando as opções de: concordo totalmente (CT) a discordo totalmente (DT), seguidas de justificativa sobre a escolha. Procedeu-se a análise de correspondência, onde três mapas perceptuais foram gerados. Verificou-se: 1) a forte correlação entre experimentação e desenho, enquanto estratégias adequadas para o ensino de Química nos anos iniciais; 2) a eficácia na adoção das estratégias usadas simultaneamente para aprendizagem de conceitos químicos; 3) maior força de correlação na opção "concordo totalmente" com as estratégias de ensino no município de Moju. Com os resultados alcançados, sugere-se, conforme as percepções dos graduandos em formação, a adoção do desenho animado associado à experimentação para se trabalhar conhecimentos químicos nos anos iniciais do Ensino Fundamental.

PALAVRAS-CHAVE: Ensino de Ciências. Ensino Fundamental. Transformação química. Show da Luna.

ACKNOWLEDGES

To the undergraduate students who participate in this research.

REFERENCES

ABIB, M. L. V. S. Por que os objetos flutuam? Três versões de diálogos entre explicações das crianças e as explicações científicas. In: CARVALHO, A. M. P. (Org.) **Ensino de Ciências por Investigação:** Condições para implementação em sala de aula. São Paulo: Cengage Learning, 2013, p. 1-20.

BATISTA, M. C.; FUSINATO, P. A.; RAMOS, F. P. A formação de professores dos anos iniciais para o ensino de astronomia no estado do Paraná. **Ensino & Pesquisa**, v. 14, n. 02, p. 214-231, jul/dez 2016. Disponível em: http://periodicos.unespar.edu.br/index.php/ensinoepesquisa/index. Acesso em: 24 ago. 2017.

BELIAN, M. F.; LIMA, A. A.; FREITAS FILHO, J. R. Ensinando química para séries iniciais do ensino fundamental: o uso da experimentação e atividade lúdica como estratégias metodológicas. **Rev. Experiências em Ensino de Ciências**, v. 12, n. 4. Disponível em: http://if.ufmt.br/eenci/artigos/Artigo_ID368/v12_n4_a2017.pdf. Acesso em: 15 jan. 2018.

BRASIL. Ministério da Saúde. Conselho Nacional de Saúde. **Resolução nº 510, de 7 de abril de 2016.** Diário Oficial [da] República Federativa do Brasil, Brasília, DF, 24 maio 2016. Seção 1. p. 44-46. Disponível em: http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?jornal=1&data=24/05/2016&pagina=44. Acesso em: 10 de out.2019.

CATUNDA, C. Entrevista com Célia Catunda. **Blog Bom para criança**. 25 de novembro de 2015. Disponível em: http://www.bomparacrianca.com.br/tag/celia-catunda/. Acesso em: 07 out. 2019.

CARVALHO, A. M. P. O ensino de ciências e a proposição de sequências de ensino investigativas. In: CARVALHO, A. M. P. (Org.) **Ensino de Ciências por Investigação:** Condições para implementação em sala de aula. São Paulo: Cengage Learning, 2013, p. 1-20.

CARVALHO, A. M. P. et al. **Ciências no Ensino Fundamental:** o Conhecimento Físico. São Paulo: Scipione, 2009.

FARIA, R. T. **Tratamento de dados Multivariados através da Análise de Correspondência em Rochas Carbonáticas**. 1993. Dissertação (Mestrado em

Geoengenharia de Laboratório) – Universidade Estadual de Campinas, Campinas, 1993.

KASSEBOEHMER, A. C.; THEODORO, M. E. C.; FERREIRA, L. H. Análise do tratamento de conceitos químicos em coleções das séries iniciais. **Revista Eletrônica de Educação**, v. 8, p. 388-405, 2014. Disponível em: http://www.reveduc.ufscar.br/index.php/reveduc/article/view/791. Acesso em: 17 jul. 2017.

LAGARDE, J. **Initiation à l'analyse des données**. Paris: Dunod, 1995.

LELES, D. G.; MIGUEL, J.R. Desenho animado como instrumento de ensino das Ciências. **Revista de Educação, Ciências e Matemática**, v. 7, n. 1, jan/abr 2017. Disponível em: http://publicacoes.unigranrio.edu.br/index.php/recm/article/view/4343/2314. Acesso em: 07 out. 2019.

LEBART, L.; MORINEAU, A.; WARWICK, K. M. **Multivariate Descriptive Statistical Analysis:** Correspondence Analysis and Related Techniques for Large Matrices. Nova York: J. Wiley & Sons, 1984.

LIMA, L. R. F. C.; BELLO, M. E. R. B.; SIQUEIRA, M. R. P. A Formação de Professores das Séries Iniciais e sua Relação com o Ensino e Aprendizagem: Uma Revisão em Periódicos Brasileiros. **R. B. E. C. T**., v. 8, Ed. Sinect, jan-abr. 2015. ISSN 1982-873X. Disponível em: https://periodicos.utfpr.edu.br/rbect/article/view/2955. Acesso em: 21 de mar. 2018.

LIMA, M. E. C. C.; LOUREIRO, M. B. **Trilhas para ensinar ciências para crianças**. 1. ed. Belo Horizonte: Editora Fino Traço, 2013.

LIMA, M. E. C. C.; MAUÉS, E. Uma releitura do papel da professora das séries iniciais no desenvolvimento e aprendizagem de ciências das crianças. **Ensaio - Pesquisa em Educação em Ciências**, v. 8, n. 2, p.161-175, 2006. Disponível em: http://www.scielo.br/pdf/epec/v8n2/1983-2117-epec-8-02-00184.pdf. Acesso: 10 jul. 2019.

LONGHINI, M. D. O conhecimento do conteúdo científico e a formação do professor das séries iniciais do ensino fundamental. **Investigações em Ensino de Ciências**, v. 13, n. 2, p.241-253, 2008. Disponível em: http://www.if.ufrgs.br/ienci/artigos/Artigo_ID183/v13_n2_a2008.pdf. Acesso em: 27 mai. 2018.

LÚCIO, P. S.; TOSCANO, E. M. M.; ABREU, M. L. Caracterização de séries climatológicas pontuais via análise canônica de correspondência - estudo de caso. **Revista Brasileira de Geofísica**, Minas Gerais, v. 17, p. 41, 1999.

MENDONÇA, L. G.; MEIRELLES, B. B.; SILVA, L. A.; MOURA, F. S. P. Luna empoderada canta uma ciência animada: Possibilidades do uso de desenho em sala de aula. V Encontro Nacional de Ensino de Ciências da Saúde e do Ambiente. **Anais...**, Niterói/RJ, 2018.

MALHEIRO, J. M. S. Atividades experimentais no ensino de ciências: limites e possibilidades. **ACTIO**, Curitiba, v. 1, n. 1, p. 108-127, jul./dez. 2016. Disponível em: https://periodicos.utfpr.edu.br/actio. Acesso em: 07 set. 2018.

MONTGOMERY, D. C.; RUNGER, G. C. **Applied Statics and probability for engineers.** 10. Ed. Library of Congress Cataloging, 1994.

MORAES, R.; RAMOS, M. G. O ensino de Química nos Anos Iniciais: Ampliando e Diversificando o Conhecimento de Mundo. In: BRASIL. Ministério da Educação Secretaria de Educação Básica. **Ciências**: Ensino Fundamental (Coleção Explorando o ensino, v. 18). Brasília: MEC/SEB, 2010, p. 43-60. Disponível em: http://portal.mec.gov.br/docman/abril-2011-pdf/7835-2011-ciencias-capa-pdf/file. Acesso em: 12 jun. 2018.

MOREIRA, M. A. **Pesquisa Em Ensino: Aspectos Metodológicos**. Porto Alegre: UFRS, 2003.

MOSCAROLA, J. **Enquêtes et analyses de données**. Paris: Vuibert, 1991.

NIGRO, R. G. **Ápis Ciências, 3º ano:** Ensino Fundamental, anos iniciais. 3. ed. São Paulo: Editora Ática, 2017.

OLIVEIRA, A. S.; SILVA, A. C. A.; REGIANI, A. M.; BRONDANI, P. B.; YUNES, S. F.; GIESE, E. Educação na sociedade contemporânea e o Ensino de Química para crianças: apontamentos iniciais. **Revista Dynamis**, Blumenau, v. 22, n. 1, 2016. Disponível em: https://proxy.furb.br/ojs/index.php/dynamis/article/view/6088. Acesso em: 17 ago. 2018.

OLIVEIRA, J. R. S. Contribuições e abordagens das atividades experimentais no ensino de ciências: reunindo elementos para a prática docente. **Acta Scientiae**, v. 12, n. 1, p. 139-153, 2010. Disponível em: http://w3.ufsm.br/laequi/wp-content/uploads/2015/03/contribui%C3%A7%C3%B5es-e-abordagens-de-atividades-experimentais.pdf. Acesso em: 08 out. 2019.

OLIVEIRA, L. R.; MAGALHÃES, J. C. Esse é o Show da Luna: investigando gênero, ensino de ciências e pedagogias culturais. **Domínios da imagem**, v. 11, n. 20, p. 95-118, jan./jun. 2017.

PAULA, L. M.; CUSTÓDIO, J. C.; COSTA, R. M. J.; PEREIRA, G. R.; SILVA, R. C. Ensino de Ciências para os Anos Iniciais: uma abordagem utilizando o desenho animado "O Show da Luna!". XI ENPEC - Encontro Nacional de Pesquisa em Educação em Ciências. **Anais**... Florianópolis: UFSC, 2017. Disponível em: http://www.abrapecnet.org.br/enpec/xi-enpec/anais/resumos/R2574-1.pdf. Acesso em: 15 de jun. 2018.

PRADO, L.; WESENDONK, F. S. Os objetivos de utilização da experimentação presentes em produções acadêmico-científicas publicadas nos anais de um evento da área de ensino de ciências. **ACTIO**, Curitiba, v. 4, n. 2, p. 148-168, mai./ago. 2019. Disponível em: https://periodicos.utfpr.edu.br/actio/article/view/9236/6469. Acesso em: 07 de ago. 2019.

ROSA, M. I. P.; BEJARANO, N. R. R. Química nos Anos Iniciais para Integração dos Conhecimentos. In: BRASIL. Ministério da Educação Secretaria de Educação Básica. **Ciências:** Ensino Fundamental (Coleção Explorando o ensino, v. 18). Brasília: MEC/SEB, 2010, p. 145-158. Disponível em: http://portal.mec.gov.br/docman/abril-2011-pdf/7835-2011-ciencias-capa-pdf/file. Acesso em: 12 jun. 2018.

SILVA, C. S.; ZULIANI, R. D.; BUENO, F. S.; OLIVEIRA, L. A. A. A química nas séries iniciais do ensino fundamental. VI ENPEC - Encontro Nacional de Pesquisa em Educação em Ciências. **Anais**... Florianópolis: UFSC, 2007 Disponível em: http://www.nutes.ufrj.br/abrapec/vienpec/resumos/Resumo13.html. Acesso em: 20 abr.2016.

RIBEIRO, H. M. F.; NEVES, M. L. R. C. Concepções de professoras das séries Iniciais sobre o ensino de ciências e os impactos de um curso de formação Continuada. X ENPEC **-** Encontro Nacional de Pesquisa em Educação em Ciências. **Anais**... Florianópolis: UFSC, 2015. Disponível em: http://www.abrapecnet.org.br/enpec/x-enpec/anais2015/resumos/R0879-1.PDF. Acesso em: 10 jul. 2019.

RODRIGUES, R. M. N. **A Divulgação científica e o desenho animado O Show de Luna!:** uma possibilidade de iniciação do método da pesquisa científica na infância. 2016. Monografia (Bacharelado em Biblioteconomia e Gestão de Unidades de Informação) – Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2016.

TV PINGUIM. Disponível em: http://www.tvpinguim.com.br/. Acesso em: 30 de jan. 2018.

Received: 10 aug. 2019
Approved: 14 oct. 2019
DOI: 10.3895/actio.v4n3.10499
How to cite:
SILVA, L. P.; ARRUDA, D. C.; FILGUEIRAS, L. A.; SILVA, A. A. Chemistry teaching for early grades: correspondence analysis between cartoon and experimentation adopted as strategy in pedagogy course for science teaching. **ACTIO**, Curitiba, v. 4, n. 3, p. 226-247, set./dez. 2019. Available in: https://periodicos.utfpr.edu.br/actio. Acess in: XXX
Contact:
Lucicléia Pereira da Silva
Centro de Ciências Sociais e Educação (CCSE), Departamento de Ciências Naturais (DCNA), Universidade do Estado do Pará (UEPA), Rua do Una, 156, Telégrafo, 66050-540, Belém, Pará, Brasil.