

PRE-SERVICE CHEMISTRY TEACHERS' BELIEFS ABOUT ARGUMENTATION AND ARGUMENTATIVE PRACTICE

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Abstract

The purpose of this research was to gain an understanding of pre-service chemistry teachers' beliefs about argumentation and argumentative practice in the context of school after they have participated in intentional argumentation training. A month after completing their training, the researchers conducted interviews with them and analyzed the responses using the content analysis method in which there are a de-contextualisation, re-contextualisation, categorization, and compilation of information. The results show that pre-service chemistry teachers' beliefs about argumentative practice are in line with the literature of the area.

Keywords: *argumentative practice, content analysis, pre-service chemistry teachers.*

Introduction

Over the last 20 years, the relation between argumentation and science education has been attracting the attention of many researchers and a growing number of scholars is focusing on strategies for implementing argumentative tasks and analyzing their effects (Faize, Husain, & Nisar, 2018). The teacher plays a central role in engaging students in actions that enhance argumentative knowledge construction. Among other things, teachers are expected to establish and nurture argumentative discourse in class activities in order to engage students in the promotion of their argumentative skills (Archila, 2014). Pre-service training programs may need to prepare science teachers for dialogue and argumentative knowledge construction in the classroom.

In initial pre-service education, teachers can be encouraged to practice argumentation and thus, their beliefs and practices can be progressively refined. Although the teachers' professional development in argumentation practices is extremely relevant, it has not been studied in depth (Faize, Husain, & Nisar, 2018). Consequently, this research attempts to address the following question: *What are the pre-service chemistry teachers' beliefs about argumentation and argumentative practice in the school context after they have participated in intentional argumentation training?*

Research Methodology

The group of participants consisted of 6 pre-service teachers (PSTs) from a Brazilian university-University of São Paulo. They were enrolled in a Teaching Practice Course, offered in the last year of Initial Teacher Training for Chemistry. The purpose of the course was to qualify PSTs to teach chemistry at high school level. The data collection spread out over two stages. In the first stage, the PSTs participated in training to support and create an adequate argumentation environment for high school students (Lourenço, Ferreira, & Queiroz, 2016). To support the development of the PSTs' argumentation skills, 7 sets of activities were developed in learning scenarios, to provide a suitable and stimulating learning environment, to provide instructions about the structure of argumentation, and to create an environment for PSTs to think and ask questions. These scenarios included the presentation of argumentation models, a reading workshop, and the design of chemistry argumentation lessons. The training extended over two semesters. In the second stage, semi-structured interviews were conducted with the PST. A set of questions was asked to identify their beliefs about the definitions of argumentation and the benefits of argumentation in the classroom. In this research, the interview data was explored and a content analysis method was used in which the information was analyzed in four stages: de-contextualisation, re-contextualisation, categorization, and compilation of information (Bengtsson, 2016).

Research Results

Definitions of Argumentation

Table 1 shows the results of the PSTs' beliefs about the category *definitions of argumentation*. The PSTs understand the definition of argumentation as a way to express ideas and opinions with the intention to convince. For this purpose, valid arguments are needed on a scientific base. This conception is close to the definition of literature (Ogan-Bekiroglu & Aydeniz, 2013).

Table 1. PSTs' category of perception about the definition of argumentation.

Category	Pre-service teacher					
	PST1	PST2	PST3	PST4	PST5	PST6
Argumentation is a way to express ideas and opinions with the intention of convincing using arguments validated on a scientific base.	•	•	•	•	•	•

Below is an excerpt to illustrate the beliefs of PST1 about the definition of argumentation: “*You have a point of view. You have to talk about it and defend it. In order to be more credible about what you are defending, generally you have to base your opinion on scientific concepts or experiments*”. The fact that PSTs consider using a theoretical base to construct arguments corroborates with the literature that argumentative practice in the context of school should relate claims and data (Xie & So,

2012). Moreover, the PSTs' beliefs show that argumentation has a persuasive nature and affords a reasonable critic as a co-participant. Another aspect that was identified is the collaborative nature of argumentation as considered by Faize, Husain and Nisar (2018).

Benefits of Argumentation in Science Education

The category *Benefits of argumentation* compiled the beliefs of the PSTs about the benefits of the practice of argumentation in the school context. The PSTs' beliefs are separated into these two types of tasks: *Arguing to learn* and *Learning to argue* (Table 2). The division was based on the work of Walker and Sampson (2013) "students need to engage in argumentation in order to develop a better understanding of the content (i.e., arguing to learn) but also students need to learn what counts as an argument and argumentation in science (i.e., learning to argue) as part of the process" (p. 592) [emphasis added].

Table 2. PSTs' subcategories of beliefs regarding the benefits of argumentation in the classroom.

		Pre-service teacher					
	Category	PST1	PST2	PST3	PST4	PST5	PST6
Arguing to learn	Help the students' learning of scientific concepts	•	•	•	•	•	•
	Help students to correlate scientific concepts in everyday contexts	•		•	•	•	
	Allow students to formulate scientific hypotheses	•	•	•		•	•
	Help students to learn how to build scientific arguments	•	•	•	•	•	•
	Allow students to solve scientific problems			•	•		
	Allow students to relate scientific concepts	•		•	•		
	Help in the evaluation process of students' scientific knowledge	•		•		•	•
Learning to argue	Develop the students' critical thinking	•		•	•	•	
	Allow students to play a more conscious role in society	•	•		•	•	
	Help students defend their own point of views	•	•	•	•	•	•
	Help master scientific language				•	•	
	Help students to evaluate an argument	•				•	

In *Arguing to learn*, the subcategories identified for all PSTs are *Help the students' learning of scientific concepts* and *Help students to learn how to construct scientific arguments*. In relation to the first subcategory, the PSTs pointed out the importance of argumentation to support the student's understanding of scientific concepts, laws and theories. Below an excerpt illustrates PST4's perception that shows that engaging in

argumentation discourse is an effective way for students' learning. *"If one has to talk about something, defend a point of view, form an opinion or decide something, one has to have some knowledge to do so in order to assimilate the content better"*.

The other subcategory with high frequency was *Allow students to formulate scientific hypotheses*. In relation to this aspect, existing research points out that prior knowledge influences the process of learning. Here is a part of speech of the PST3 which falls into this subcategory: *"So, when you say what you are thinking, you start to formulate hypotheses, opinions about the subject that perhaps you did not even believe you had, so, I think that if something is well done, it is great and encourages learning"*. PSTs also pointed out how argumentation contributes to students relating concepts discussed in the school context to everyday aspects. This benefit is represented in the subcategory *Help students to correlate scientific concepts to everyday contexts* and illustrated in the following excerpt. *"The fact that the activity is related to everyday aspects ... attracts many students who usually do not pay much attention in the classroom, and it stimulates reflexion and decision taking"*. PSTs also noted that they could obtain feedback on students' understanding beyond exam periods, i.e. dialogue in the classroom served as a means of continued evaluation of the learning progress (see category *"Help the evaluation process of scientific knowledge of students"*).

In *Learning to argue*, the identified subcategory for all PSTs was *Help students defend their own point of views*. This category points out that the argumentative practice in the context of school helps the students to defend their ideas while developing the elements of their arguments. For example, in the following transcript, PST3 identifies elements of a persuasive argument: *"In an argumentative activity you know that you have to expect hypotheses, draw conclusions, justify your opinion, face rebuttal and defend your point of view"* PST3. Another category that stands out is *Develop the students' critical thinking*. The ability of critical thinking helps the student to become a citizen who is capable of participating actively, for example, in socio-scientific topics and scientific dialogs. This ability involves the category *Allow students to play a more conscious role in society*. The following excerpt illustrates the perceptions of the PST1 in this area: *"The students really learn, they have their own opinion... develop their critical sense ... They act more in society and thus become a real citizen"*.

Conclusions and Implications

This research sought to gain an understanding of PSTs' beliefs about argumentation and argumentative practice in the context of school after they have participated in intentional argumentation training. The PSTs' beliefs were identified concerning the definition of argumentation and the benefits of using argumentation in science education, learning to argue and arguing to learn, are close to the ones we find in the literature. The importance of training in the refined belief of the PSTs can be pointed out. It can be considered that the approximation of the PSTs' beliefs of our research with the literature is a way for PSTs to implement the argumentation in their future teaching practice in chemistry teaching.

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