

Teachers' and students' beliefs on developing argumentative competence

Creencias de profesores y estudiantes sobre el desarrollo y la evaluación de la competencia argumentativa

CAMILLA SPAGNOLO

University of Ferrara, Italy

spagnolo.camilla@gmail.com

<https://orcid.org/0000-0002-9133-7578>

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Abstract: When we deal with argumentative competence in class there are many points of view: teacher's and student's point of view and the external point of view of knowledge (in a theoretical sense). The research shows a qualitative experimental study that allows a comparison between different perspectives in order to measure argumentative competence. The study involved 5 classes and 9 teachers. First, the idea of argumentative competence was discussed from a theoretical and institutional point of view in the Italian school system. Then questionnaires were administered to teachers and deep interviews were conducted with students. Finally, teachers participated in focus groups, and this allowed reflections and encouraged discussion. The process implemented allowed an in-depth key on the concept of argumentative competence. Also, the analysis of the results of the questionnaire and interviews shows how classroom practices are related to teacher and students' attitudes and beliefs in mathematics.

Keywords: Argumentative Competence; qualitative study; beliefs; teacher practices; Mathematics Education.

Resumen: Cuando abordamos la competencia argumentativa en clase hay muchos puntos de vista: el punto de vista del cuerpo docente, el del alumnado y el punto de vista externo del conocimiento (en un sentido teórico). Esta investigación muestra un estudio cualitativo experimental que permite comparar diferentes perspectivas para medir la competencia argumentativa. En el estudio han participado cinco clases y nueve docentes. Primero, la idea de competencia argumentativa ha sido discutida desde un punto de vista teórico e institucional en el sistema educativo de Italia. Posteriormente, se han administrado cuestionarios al profesorado y

se han desarrollado entrevistas en profundidad con el alumnado. Finalmente, el profesorado ha participado en grupos focales, que han permitido emerger reflexiones y fomentar la discusión. Todo este proceso ha permitido profundizar sobre el concepto de competencia argumentativa. Además, el análisis de los resultados del cuestionario y de las entrevistas muestra cómo las prácticas de aula están relacionadas con las actitudes y las creencias hacia las matemáticas que tienen tanto profesorado como alumnado participante.

Palabras clave: Competencia argumentativa; estudio cualitativo; creencias; práctica del profesor; Educación Matemática.

INTRODUCTION

The development of argumentative competence represents a crucial moment in learning because it is a transversal feature of competence, related to specific aspects of linguistic competence, but also because it is closely linked to the development of some of the fundamental structures for mathematics (Hanna & Jahnke, 1996). The crucial role that argumentation should play in classroom practices is also emphasised in national and international documents (Furinghetti & Morselli, 2011). In particular, Furinghetti and Morselli revisit the subject of proof from the perspective provided by current lines of research on mathematics education.

Therefore, it is useful to reflect, from a didactic point of view, on the conditions that make it possible for students to develop competences. Certainly, attention to the setting up of teaching situations for development of competences and the assumption for their observation and assessment are crucial steps (Reid & Knipping, 2010).

Today, research shows a general agreement about importance of the development of argumentative competence in mathematics education (Prediger, 2019), so that there seems to be a general trend towards its inclusion in classroom activities. Examples of studies focusing on teaching experiments concerning the development of argumentative competence can be found in the literature (Spagnolo et al., 2021).

Other studies show which are the main difficulties that students face in relation to the ability to argue and what is the origin of these difficulties (Planas, 2018). Based on this evidence, it is possible to design teaching interventions. Also, in the process of argumentation, students actively construct personal beliefs mostly related to teachers' practices (Beswick, 2007). Specifically, Beswick identify particular centrally held beliefs of mathematics teachers that underpinned the establishment of classroom

environments that were consistent with the principles of constructivism. Crucial beliefs identified were held by one or other of two teachers and emerged from teacher and student surveys, interviews with the teachers and classroom observations.

Difficulties in developing argumentative competence cannot be merely reduced to a lack of or superficiality in study, but must be investigated in a larger context which also includes beliefs, attitudes and linguistic difficulties such as the ability to read discontinuous texts or texts using different semiotic registers, the ability to identify data and interpret them, the ability to make connections between information, to construct an argumentative text, to use technical language, coherence between natural and specific language, or the use of specific registers in the chosen disciplines (Durand-Guerrier et al., 2012). For this reason, for the classes involved from grade 2 to grade 10, both the maths and language teachers were involved.

1. THEORETICAL BACKGROUND

In this section we want to further examine the argumentative competence from a theoretical and institutional point of view in the Italian school system.

The need to enhance argument skills through education has become increasingly evident during the past 20 years (Rapanta et al., 2013). This need has resulted in an ongoing discussion that focuses on students' and teachers' argumentation and its support. However, apart from the extended competence-based discourse, no clear and homogeneous definition exists for argumentative competence and its constituent skills.

Argumentation is generally defined as the valid combination between claims and premises (Plantin, 1996), which in education is highly related to high-quality teaching and learning. As Cox and Willard (1982) put it, "argument can be seen as a method of knowledge . . . [and] arguments in differing ways produce knowledge" (p. xiii). Thus, argumentation is one of the mostly discussed competences in the educational field, due to its proven relationship with critical and higher-order thinking. More concretely, argumentation increases the complexity of knowledge (Venville & Dawson, 2010), the use the students make of this knowledge (Zohar & Nemet, 2002), and the critical revision of it (Cross et al., 2008), which comes along, hand in hand, with the quality of reasoning involved (Kuhn, 1991), resulting in general educational gains. Thus, argumentation

seems to provide opportunities for students to refine their understanding of the content, prompting them to sort relevant from irrelevant information, make connections across contexts, and increase the explanatory power of their knowledge.

Expected institutional knowledge has changed from the 1979 secondary school curricula and 1985 primary school curricula to the current directions, also considering the Cultural Axes of the end of the millennium. These are distinct moments in which different school cycles were reformed; in fact, the reform that began in 2009 and ended in 2012 was the first since Gentile's time in which schools were reformed all at the same time.

Knowing how to argue is a skill that must be built over time. It is important to allow all students time to structure thoughts, to imagine solutions, to make mistakes. Moreover, the development of argumentative competence is a crucial moment in learning because it is a cross-curricular aspect of competence.

The crucial role that argumentation should occupy in classroom practices is also emphasized in the Italian Guidelines (MIUR, 2012):

The new Directions confirm the validity of the educational and cultural framework of the Italian basic school that has been consolidated over so many years, with its vocations of welcome and inclusion, but we are aware that we need to thoroughly rethink the way of being of the school; that we need to do more for our children; that we need to guarantee in a changed scenario, also from the demographic point of view, more solid skills for our young people. This starts with mastery of the Italian language, argumentation and problem-solving skills, an encounter with our historical, artistic and environmental heritage, and increasingly indispensable digital skills. (p. 1).

The Italian Guidelines also highlight the importance of linguistic aspects in learning processes (MIUR, 2012), in which it is emphasized how attitudes, beliefs, emotions, are intertwined in the learner creating, on different levels, potentials and difficulties, often related to communication skills and language issues, especially in the study of scientific disciplines.

We explicate the meaning of argumentative competence to which we adhere in the analysis of the results, both from the theoretical point of view and from the Italian institutional point of view.

Since the object we will discuss is very broad and its definitions very specific regarding fields involving it, we specify that, starting from a general description, we will also focus on the specific aspects related to the teaching of language and mathematics. We have considered the disciplines “Italian language” and “mathematics” as representative of two fundamental cultural axes that identify argumentative competence as a key competence.

2. METHODOLOGY

The research design aims to analyse argumentative competence from the perspective of both the teacher, the student and the external viewpoint of knowledge (in the theoretical sense). The qualitative study involved 5 classes and 9 teachers.

We have chosen classes vertically in order to monitor also the development of argumentative competence according to age; in particular, we involved a kindergarten class (i.e., the beginning of mandatory school attendance in Italy), a grade 2 class, a grade 5 class, a grade 8 class and a grade 10 class (i.e., the end of mandatory school attendance in Italy). The teachers invited to participate in the research were the teachers of the classes involved: one teacher for the kindergarten class and two teachers for the classes from grade 2 to grade 10 (both the mathematics teacher and the language teacher).

The study is divided into two different phases:

Phase 1. Implementation of a questionnaire which each teacher had to fill out individually, and in-depth interviews with students.

Phase 2. Focus groups with the purpose of sharing with teachers the reflections gathered in Phase 1. Finally, the 9 teachers designed activities aimed at overcoming the difficulties identified in Phase 1, related to the argumentative competence.

2.1 PHASE 1

The questionnaire developed aims to investigate, in an exploratory way, teachers’ beliefs and practices regarding the development and assessment of argumentative competence. It has a mixed structure (with open-ended and closed-ended questions) and it is designed for teachers at

all school levels (preschool, elementary school, first and second grade secondary school) who teach the subjects of mathematics and Italian language. The questions in the questionnaire address the following content: (i) the relationship between argumentation and teaching subjects; (ii) the relationship between argumentative competence and curricular objectives; (iii) the teacher's teaching actions in relation to argumentation; (iv) teaching practices and strategies that can be traced back to argumentation; (v) students' behaviour in relation to the exercise of argumentative competence. In order to take into account the specificities of each school, the questionnaire was formulated differently for each of them (for example, the questionnaire uses the expressions "mathematics" and "Italian", but in the case of kindergarten, these expressions were replaced by logical-mathematical and linguistic field, respectively).

The design of the questionnaire was divided into four different phases: a first validation phase, a second tryout phase, a third pre-test phase and a fourth and final focus group phase. The 9 teachers involved in this research filled out only the final version of the questionnaire. Meanwhile, in-depth interviews were conducted to bring out the student's perspective as well.

2.2 PHASE 2

The analysis of the registration sessions and questionnaire, along interview data, allowed teachers to discuss using personal and comparative data. They designed activities together for the development of argumentative competence, in a vertical perspective.

Related to argumentative competence, when a student is grappling with a mathematical task or a teacher is designing one, we believe that, in addition to the characteristics of the task, affective factors can strongly influence his or her idea of the task. McLeod (1992) considers the three constructs of beliefs, emotions and attitudes to describe the general term of affect. Among the works addressing the need to develop theoretical frameworks on affect, we refer in particular to Di Martino and Zan's (2010) study on attitude, as we recognized some similarities with their study in reading and analysing the responses of the teachers and students involved in the study. In their work, Di Martino and Zan read and analysed 1600 papers in which Italian students from grades 1 to 13 narrated their experience with mathematics. A three-dimensional model of attitudes toward mathematics emerged from their study. According to their work, the emotional dimension relates to liking/disliking mathematics, but also

includes essays in which students explicitly write about emotions such as love, anger, etc. This dimension thus refers to students' emotional disposition toward mathematics and can be characterized as *positive* or *negative*.

The second category (Perceived Competence) is “marked by utterances like ‘I succeed/fail in mathematics’, ‘I understand/don’t understand mathematics’, ‘I get good/bad marks in mathematics’” (Di Martino & Zan, 2010, p. 38). This dimension could be labelled as *high* or *low*.

Thanks to the third category, called Vision of Mathematics:

[...] some indications emerge, often through the writers' theories of success (Nicholls et al. 1990), that is their beliefs about what needs to be done to be successful in mathematics. In particular, an instrumental view can be spotted in theories of success which emphasise the role of memory and recall a vision of mathematics as a set of rules to be memorised (Di Martino & Zan, 2010 p. 38).

This model was helpful in better interpreting our results, as will emerge from the Discussion.

3. DATA ANALYSIS

In this section, we present a discussion of the results for each phase of the study.

3.1 PHASE 1

The analysis of the questionnaire data is qualitative. The questionnaire consisted of 14 questions: 6 open-ended questions and 8 closed-ended questions. These questions aimed to make explicit beliefs and practices of the teachers involved related to argumentative competence.

We provide an example of a question that was asked both to the teachers in filling out the questionnaire and to the students at the time of the interviews: “*What does it mean for you to argue?*”.

The teacher of the grade 5 class answers “Exploring reality, reflecting on experiences, listening to those of peers, analysing them, describing/telling them, representing them and reorganizing them”, while the teacher of the grade 10 class answers “proving a claim”. It emerges

that some teachers have focused the definition on the processes that the student performs, while others have associated it to proving and others to telling.

Many of the students interviewed point out that an argument, to be such, must be valid and constructed following a rigorous logic; for example, a grade 10 student states that to argue means “To clearly and coherently explain one’s point of view, one’s idea, one’s strategy”.

We want to highlight that in all classes the term that recurs most in connection with the definition of argumentation is “explaining”. Explain is understood with four different meanings: (i) explaining what was done, meaning describing the reasoning done in solving a problem; (ii) explaining why it was decided to proceed in a certain way, meaning justifying the strategy of solving a problem; (iii) explaining whether something is true or false and why, meaning explaining as an answer to a question involving the use of mathematical properties; (iv) explaining to peers, meaning explaining as a means of communication.

3.2 PHASE 2

The second phase involved all 9 teachers in a few moments of confrontation.

These interviews were conducted through focus groups that allowed the teachers to compare themselves, not only with the researcher, but also with the other teachers. The discussion with other teachers was really important to open a vertical comparison with teachers belonging to different school orders. Three focus group sessions of 3 hours each were organized (for a total of 9 hours).

One of the first reflections that emerged from a focus group was that of a Secondary School teacher:

The questionnaire led me to so many more reflections. Some of the questions seem obvious, but they are not obvious at all.

From this it emerges that the questionnaire allows to make explicit some aspects of teaching that are often part of teaching in an implicit way. The same observation was echoed by other teachers from different school grades:

I had a lot of difficulties in defining an argumentation. When in a question in the questionnaire we had to classify some argumentations, I realized that, for me, it is argumentation even if it is not completely correct. For this reason, I then corrected the definition I had initially given.

These moments of discussion led teachers to reflect vertically and to confront the causes of the difficulties that students face when they have to argue. In the last meeting, teachers designed activities with the purpose of overcoming the difficulties made explicit by steps 1 and 2.

4. CONCLUSIONS

Through the analysis of the data, we saw how attention to the setting up of teaching situations appropriate to the development of argumentative competence is also a prerequisite for their observation.

The relevance of the topic of argumentative competence as a field of work in several respects is explicit both in terms of the expected profile of skills and in terms of its transversal characteristic (it intercepts the interest of several disciplinary areas).

Reconnaissance of teaching practices related to the development of argumentative competence has allowed a qualitative analysis aimed at bringing out the epistemic and didactic-general/disciplinary characteristics of argumentative competence.

These results, together with the questionnaire submitted to a group of teachers at different school orders and the related in-depth interviews, granted the hypothesis of defining some criteria and some categories of didactic analysis of ordinary situations related to the exercise of argumentative competence.

The result of the specific general-domain analysis made it possible to clarify some aspects regarding the intelligibility of didactic situations, which can also be used in teacher training. First, some aspects related to argumentative competence as a task or activity. Since the first classes of elementary school, in contextualized situations, the teacher should try to accustom students to the use of connectives, quantifiers and linguistic indicators to facilitate the construction of unambiguous arguments. Subsequently, but also simultaneously, it will be possible to work on the construction and comprehension of complete forms of argumentation. Only towards the end of elementary school will we try to intervene on the awareness of how argumentation works.

In the activities of argumentation in kindergarten and elementary school, given the age of the students, it seems natural to move from the concrete to the abstract and from the particular to the general, but the opposite can also happen, and, in the literature, there are several examples (Boero, 2011). It is important to activate a continuous return from one to the other level to allow students to move away from the particular and concrete examples to go towards the general and abstraction, and to know how to bring back the abstract thinking to concrete and particular examples.

So, as we have seen repeatedly, knowing how to argue is a skill that must be built over time. It is important to allow all students time to structure their thoughts, to imagine solutions, to make mistakes.

The teacher plays a fundamental role because he or she is the architect of argumentation didactics: he or she alternates individual and collective activities, encourages comparison, constructs targeted assignments, positively evaluates errors and argues his or her own choices. In this way, the didactic contract commits the teacher and the students to a work of conscious construction of knowledge and of being an individual in a class.

The analysis of the results of the questionnaire and interviews shows how classroom practices are related to teacher and students' attitudes and beliefs in mathematics. Specifically, this research highlights some features related specifically to teachers' and not students' beliefs (and vice versa), which influence how to approach argumentative competence in mathematics. Affective factors, such as beliefs, emotions, and attitudes (McLeod, 1992), are the ones that come closest to the purpose of our research.

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