12 ARGUMENTS, VALUES & BELIEFS OF PRE-SERVICE TEACHERS DISCUSSING SOCIO-SCIENTIFIC ISSUES

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Abstract

This study explores and compares the argumentations of British and Catalan pre-service teachers given in peer discussions about socio-scientific issues (SSI) related to two topics: Designer Babies and Animals Research. Our main aim is to identify types of arguments, beliefs and values of these two samples.

Data analysis comes from the transcriptions of peer student discussions about the two proposed tasks. The analysis is mainly qualitative although some quantitative comparison has been carried out of argument elements, between these countries and the tasks. We mainly identify from the base of the recognised premises, ideas, beliefs and values, as well political ideology of the pre-service teachers from the two European countries.

Results show us that there are more differences in the types of argument schemes found between the tasks than between the countries. It was found that the arguments for a given country are based on premises which are not used in the other country. In particular, we can deduce from peer discussions beliefs and values of the students. We also identify some particular structures in the argumentation discourses which are indicators of the open or closed thinking of these students.

Keywords: Argumentation, Teacher Training, Science Education, Socio-scientific issues, Pre-service Primary Teachers

1. Introduction and background

The main aim of this study is to explore the argumentations of British and Catalan pre-service teachers given in peer discussions about socio-scientific issues (SSI) related to two topics: Designer Babies and Animals in Research. We are interested as well in knowing whether pre-service teachers from two different European universities think in an open way related to these topics.

Researches into students' scientific preconceptions over the last 30 years demonstrate children develop and maintain ideas and conceptions from an early age. There is agreement that certain differences in the student conceptions may depend on the culture in which they live. Our idea is that thesis and premises of the arguments of students, are related to ideas, conceptions, but also to beliefs and moral or ethical values. Our thought is that patterns of arguments, or schemes, may also be influenced by the culture of the communities and that these argument schemes will present differences in different communities. Both English and Catalan contexts belong to the western cultural context of developed societies; they bear many resemblances but, perhaps, they may have important differences as well, influenced by their specific national, social and cultural context. Our research tries to discover similarities and differences.

Relevant to the aim of our research are the attempts that have been made to identify general reasoning patterns which were not related to the specific topic content of the questionnaire or the interview commonly used in research into students' conceptions in science (Andersson, 1986; Guidoni, 1985, Viennot, 1996). These studies, and others, suggest that beneath the students' specific forms of reasoning some common or general ways of reasoning, or argumentative patterns, can be found and we agree this conception applies also in relation to argumentation about SSI.

In recent years, researchers have become increasingly interested in the discursive interactions that occur during classes and in particular the interest in rhetoric, argumentation and communication in general, and much of the research in Science Education has moved in this direction. Some of the Driver's last works were about argumentation (Driver et al., 2000) and within few years the argumentation became a topic of research (Erduran & Jiménez-Aleixandre, 2007; Buty & Plantin, 2008).

The results of the research on argumentation vary, but there is the agreement that practice in argumentation improves both students' ability to argue and their scientific learning. This amount of research on argumentation is fitting with the central role in doing science or in building moral and ethical values that psychologists and scholars of science education or in ethics (Sadler, 2004; Simoneaux, 2006) attribute to argumentation. For many researchers (Osborne et al., 2001; Albe & Gombert, 2010) SSI offers opportunities for the development of argumentative skills of students, and the interest of students in science learning.

Over the last years, our research group has been mainly interested on the spontaneous forms of reasoning (in the meaning Viennot give to those) related to science topics. More recently we also enlarge our focus on topics that are in the intersection between science and moral and ethics. Our main interest is to contribute in improving science education and face the difficult

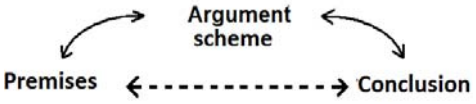
integration between science and moral and ethical values, and (religious or cultural) beliefs. We consider that the teachers do not know very well the exact way of reasoning of the students. That is the main reason why it is very difficult for the teachers to be able to help in changing the science misconceptions of the students. Besides, in science class, they also have difficulties facing the integration between science and moral-ethical beliefs, and also those of religious or cultural kind. The purpose of this paper is to help the teachers understand the way students argue in order to have elements to improve science education by integrating science with values and beliefs.

2. Theoretical framework

2.1.Perspectives on argumentation

Argumentation has a long tradition as an object of study. In spite of this, there is no universally accepted theory or conception. The study of argumentation is becoming increasingly relevant in several fields of knowledge (philosophy, rhetoric, informal logic, pragmatics, psychology, sociology, ...) and research into argumentation has been approached from several theoretical perspectives (Van Eemeren, 1996).

We agree with the authors who state that argumentation is a *social practice*, with specific characteristics. According to those authors when people argue they elaborate arguments. A single argument is made from several *premises*, a thesis (claim) or *conclusion*, and the *argument scheme*. In a single argument, the scheme is a discursive structure that makes possible to transfer the agreements from the premises to the thesis o conclusion. The argumentative process will be effective if the argument schemes proposed by one individual, or by some arguers, fit with the ones proposed by the others (the audience) (Van Eemeren, & Grootendorst, 2004).



2.2. Analytical framework

As we are interested in argumentations in non-formal contexts (among students) of a plausible character and related to questions in which they have to solve a difference of opinion, our research's analytical framework is based on Perelman (1958, 1982) and Walton (1996, 2006). These theoretical bases come mainly from the field of philosophy and have only been used in few studies in science education research (Duschl, 2008; Castells et al., 2010).

We have discussed the *Theory of Argumentation* (Perelman & Olbrechts-Tyteca, 1958) in an earlier paper (Castells et al., 2007). This theory is summarized in a posterior book (Perelman, 1982). Here we will comment only on the argument schemes of Perelman's book. These schemes are categorized in two broad groups: schemes by 'Association' or 'Connection', which joint separated elements in a new structure, and schemes by 'Dissociation' or 'Separation', which separate elements considered linked or part of a whole, therefore changing systems and notions. Inside these broad categories many other subcategories can be

distinguished. In an argumentative discourse, the single arguments combine or link among them, and in this way structuring coherent discourses.

Walton's aim (1996, 2006) is to give a list of forms of inference, from premises to conclusion, named 'argumentation schemes', which represent many common types of argumentation that are familiar in everyday conversations and in the context of a dialogue. In his 1996 book, Walton give a list of 25 argumentative schemes for presumptive argumentation, which were reduced to 17 in his book published in 2006.

3. Research design and method

3.1 Aims

- To find the types of arguments that Catalan and British pre-service teachers use in peer-discussions about SSI focusing on the argument scheme of each identified argument. From this identification a qualitative comparison between both groups is performed.
- To identify ideas, values, beliefs and emotions which are in the base of the students' recognized premises and argument schemes in the arguments about SSI, and to perform a qualitative comparison between both groups of pre-service teachers.
- To identify some argumentative strategies in the process of argumentation in peer-discussion about SSI which give cues about spontaneous argumentative strategies of Catalan and British pre-service teachers.

3.2 Collecting information

Four groups of pre-service primary science teachers from the University of Bristol and of the University of Barcelona were peer-interviewed concerning two tasks about SSI: *Animals in Research* and *Designer Babies* (these tasks are adapted from the English project BEEP). These specific tasks have been chosen because there is a social discussion about these topics in both countries. In fact, there have been presented similar cases in the newspapers of both places. The students participated in the discussions as volunteers and all the groups carried out the tasks outside their normal hours of classes.

3.3 The qualitative analysis and findings

The A**nalysis** involves mainly identifying the single arguments, and in each one, the *theses* (claims) proposed by the students, the *premises* (ideas, beliefs or values below them) from which the theses are transferred and the *argument schemes* used by the students. We also try to identify the *argumentative strategies* that peer-students use in their verbal discussions.

Our analytical framework summarizes the lists of argument schemes of Perelman and Walton, which are completed by some topics from Aristotle. We have proceeded from the theoretical framework to the analysis and from *viceversa* several times arriving to some broad categories,

we synthesize in the below list. For the argumentative strategies we don't have previous categories, we proceed from the analysis to the categories that have to be consistent with our argumentation perspective.

Synthesis of types of argument schemes

- **Consequences**; (Means and ends, Casual nexus)
- **Direction** and **Gradualism**
- The **Waste**
- **Verbal classification** or the **Proper**
- **Rule of Justice** and by **Values**
- **Double Hierarchy**, More → More (Aristotle), Preferable (some types)
- From an **Established Rule** (social /natural or scholar)
- **Example**, Illustration and Model
- **Analogy**
- **Quasi-Logical argument** (of Compensation, of Contradiction, of Comparison, of All and Parts, Division, Addition, ...)
- **Popularity**
- **Authority** and Expert opinion
- From **Bias**
- **Preferable** (sure on insure; less damage; look for an alternative; by the difficulty; by the possible; by moral reasons; by the unique,…);
- **Commitment** and **Emotions** (Ethotic arg.)

We illustrate the analysis done with two pieces of the interventions of students from both tasks (see Table 1).

We will illustrate below (pages 184-189), also, the analysis done through a specific dialogue (Br_Animals_1) studied and by looking mainly for *Types of Arguments* and *Argumentative Strategies*. In this particular case, these strategies seem mainly related to a particular argument scheme from Perelman (1982), the 'Double Hierarchy' scheme (DH). Before this illustration, we will summarize what is the scheme of DH (page 183), according to Perelman (Konstaninidou et al, 2010).

Table 1. Analysis of the arguments of the students in two pieces of discussion

ANIMALS IN RESEARCH
Bcn_animals_1 *Student Intervention:* I am against of this, but I find it logical, because I wouldn't put myself either… it is cruel and I understand that the life of the animals…, I understand that its life is of the same importance but of course, between the animals' life and the mine, well, I would save the mine. It is cruel, but from a sincere point of view, this is what I think and that's all.
Thesis: I am against of this (*Thesis 1:* To do research with animals), but I find it logical and I accept this at specific level (*Thesis 2*). (Not a general theoretical level)
Premises: 1) I wouldn't put myself either (to be used in experiments ….) 2) Doing experiments with animals is cruel. 3) The life of animals has the same importance than our life. (Implicit: We belong all to the same group of animals) 4) Between save the life of an animal and save the mine, I will choose to save the mine.
Arguments: *Argument 1* (for thesis 1): I'm against research with animals because myself will be not disposal to accept to make experiments with me. *Scheme 1:* What is applied to a group (specie) applies to all the members of the group. *Rule of justice (*Perelman*)* *Argument 2* (for thesis 1*):* It is cruel and the life of animals has the same importance that the one of humans *Scheme 2: By consequences* (Perelman, Walton) + *Rule of Justice* (Perelman) *Argument 3* (for thesis 2): Between an animal and me I choice to save myself. *Scheme 3: Preferable* (a member over the group or specie).
DESIGNER BABIES
Br_Designer Babies_1) *Student Intervention:* No (I don't agree to produce babies…). And as you're getting older and they sort of say: Oh, we only had your brother because he was there to cure you', then the younger brother's going to feel like...
Thesis: I don't agree to produce babies.....
Premises: 1) The baby will be useful to cure his brother 2) If a boy knows that it has been produced to cure his brother, this will make to him unhappy.
Arguments: *Argument 1:* I don't agree to produce babies because the finality of having a baby is not to cure his brother. *Scheme arg. 1: By consequences* (means-ends, causal nexus, Perelman), *From the established rule (against)* (Walton) *Argument 2*: I don't agree to produce babies because conceiving a baby in order to help another child can produce unhappiness to this baby when he known about this when he became elder. *Scheme arg. 2: By consequences* (Walton; Causal nexus, Perelman)

The Double Hierarchy argument (Perelman, 1982)

According to Perelman, arguers use the DH scheme when they take an established series or hierarchy, one accepted by, or at least familiar to an audience, and form a second series on the model of the first, in the process of trying to transfer implications of order or value from the first to the second. The goal of the DH argument is to make a second ordering, possible and plausible. DH arguments are based on *liaisons* either of succession or of coexistence and can be classified among the arguments based on the structure of reality, which are arguments that are based to the nature of things themselves. With this kind of argument, a hierarchy is argued from other hierarchy by a correlation between the terms of one and of the other. The DH usually expresses a relationship of direct or inverse proportionality or, at least, a link between the parts of each hierarchy. This type of argument has an interesting inclusive character because, in fact, it groups three elements (two hierarchies and one relationship), and could be considered like a strategy. The hierarchies could be quantitative or qualitative, but depends on the issue.

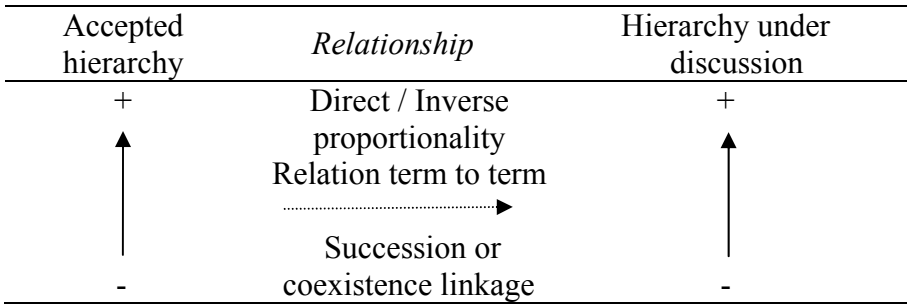


Figure 1. Double Hierarchy scheme

It is interesting that Perelman (1982) not only presents the argument of DH, but the ways to refute o modify these types of arguments. According this author, the DH arguments can be refuted by three ways:

- Denying the correctness of one of the hierarchies
- Denying the relation between the two hierarchies
- Opposing a different DH from the first presented hierarchy and by this way the necessity to change it.

There are also other ways to refute an argument of DH, for example, dividing the accepted hierarchy which means some order into some parts or classes that, in fact, means a new view of this hierarchy and, in consequence, determines or made the second hierarchy not acceptable.

Illustration of the analysis done about a dialogue related to the *Animals in Research* task

The task begins with a poll students have to answer:

Try to tick this poll BEFORE you read the information below
Are you?
O In favour of all scientific research with animals
O In favour only of medical research with animals
O Against all research with animals
Did you vote with your heart or your head?

The task then gives five opposite views, in fact, they are arguments a favour or against research with animals, we copy in Table 2 this 'opposing views'.

We enter then into the group *Br_animals_1* peer-discussion. This group is integrated by three students (S1, S2, S3).

In their written answer, students answer the poll as:

- I vote against research with animals (S1)
- I vote in favour only of medical research on animals (S2)
- I vote in favour of medical research with animals (S3)

In the oral discussion we find at the beginning:

S1: Okay. I think this because I've always been brought up with animals and been taught that you should care for animals properly and they're just as important as humans. I just do not agree with animal testing at all. And to say that animals are less important than humans is just wrong, I think totally wrong.

This intervention comes from the consideration, in the student's thinking, of the first given 'opposite views'. Student S1 agrees with the thesis from the "Animals rights" lobby, but she agrees with this view because her life experience. She has lived very near to animals and she has evidenced that the animals are not so different to the humans.

When we compare the peer-discussions of this group Br_Animals_1 with the others that carried out the debate, we find that in the majority of the peer-discussions the given hierarchy of the Biomedical lobby (hierarchy between human and animals) is introduced, and then they debate about the validity of this hierarchy (it imply values) by refuting it in several ways or to cause a decreasing of the force of this hierarchy. Sometimes this is done on the base of premises that differ from the ones included in the "opposite ways". We can consider this procedure as an *Argumentative Strategy* of the dialogue.

The hierarchy between human and animals is the main topic in some dialogues, while in others as a secondary topic. We present here the representation of the argument of DH based on the first opposite way: 'human are more valuable than animals' (Figure 2). If one student accepts this value, the thesis (claim) to be defended will be the acceptation of the research with animals.

Accepted Hierarchy	Relationship	Hierarchy under discussion
Life of human are more morally valuable than life of animals		**Morally appropriated to do research with**
+ Life of human	As **more** valuable is their life **less** appropriated to be used in research ▶	- human
↑		↑
- Life of animals	Inverse relation	+ animals

Figure 2. DH morally valuable life of human / life of animals

We can read this argument of DH as follows: "As human life is **more** morally valuable than animal life, humans are **less** appropiated to be used in medical research than the animal".

Table 2. The opposing views of the task *Animals in Research*

Opposing views

There are many arguments in favor of using animals in medical and other research experiments however those who oppose animal experimentation have presented a variety of counter arguments. Table 2 summarizes some of the arguments and counter arguments that have been used by each of these groups:

"Biomedical" Lobby	**"Animal Rights" Lobby**
Human life is intrinsically more morally valuable than animal life: we are more important than them.	All sentient animals have equal moral worth: their lives are as valuable as ours.
All mammals have the same organs performing the same functions and controlled by the same mechanisms, via hormones or the nervous system. Animal hormones have been used successfully in humans.	Significant species differences mean that it is impossible to extrapolate with any certainty the results of animal experiments to the human situation.
Whilst non-animal methods such as tissue culture, computer modeling, studies of patients and populations are widely used they do not provide enough information to ensure human safety.	Alternatives such as tissue culture, epidemiological studies and computer models can be used instead of testing on animals.

"Biomedical" Lobby	**"Animal Rights" Lobby**
All experiments must be approved by government inspectors, who are doctors and vets with the knowledge and experience to weight any distress involved in an experiment against the potential benefit for science and for humanity.	Pictures of animals in experiments are taken as clear evidence of cruelty.
Research Ethics Committees of funding bodies are rigorous in their consideration of animal welfare and scientist' rationale for the research when deciding where to deploy their limited monies.	Much research using live animals is thought to be trivial.

At following, we summarize the content of the peer-discussions related to this task. In all the peer-groups the discussion about the hierarchy between humans and animals is included and the DH argument is used, but not in all the peer-groups appears as the main topic (See Table 3).

Table 3. DH human/animals in the peer-discussion about *Animal in Research* task

Groups	In the dialogue there is in any way a discussion about / related to the DH: *As the human life is intrinsically more morally valuable than animal life* (we are more important than them) and as *we think (*premise*) that as less valuable is a life, more appropriated is this life to do research on*. (the animals are morally more appropriated to do research on than humans are)
Br_Animals_1	Yes, it is the main focus of the discussion, but also other issues, many from the list of opposite views given in the task.
Br_Animals_2	It is present, but not exactly as the main focus.
Br_Animals_3	Yes, but like is in the group Br_Animals_2
Br_Animals_4	It begins with the discussion about the hierarchy Human/Animals and after that it turns away to other issues and at the end of the dialogue it appears another time the initial DH.
Bcn_Animals_1	Yes, it is present in the discussion as an important topic, but also other issues that are not directly related with this DH are included in the discussion.
Bcn_Animals_3	The DH is the main focus, but also other issues that are not so related with this DH are in the discussion.
Bcn_Animals_4	It is a very long dialogue which begins discussing about the initial DH, but after that other issues and new hierarchies appear not in order to refute the initial DH but in order to diminish their importance.
Bcn_Animals_5	It is a very long and very rich dialogue in which the initial DH is there, but also new hierarchies appear, as well as new issues to be discussed.

Also other topics are introduced in the discussions of many groups. We illustrate this through one specific dialogue, from the Br_animals_1 group, in the next chapter.

The outline and argumentation (schemes and strategies) in the Br_animals_1

When we analyse all the peer-discussions related to the *Animals in Research* task, we find that the argument of the above DH is in the discussions, but also the application of some procedures or strategies to refute this DH, or to diminish their force, can be recognized. We illustrate this through the study of a peer-group: Br_animals_1.

1 - *Life experience* related living with animals is used *to refute the hierarchy human above animals.* (Refutation of the DH by giving an opposite view. See Figure 3)

2 - As human are more valuable than animals, *testing drugs with animals is better than with men to prevent bad effects on human*. Illustration of the *Thalidomide case from '70s'.* (Consequence from the DH given in the task) (Figure 3 gives force to the chosen option, this convincing force increases through a specific real case)

3 - But they give a concession: 'better *look for an alternative* to animals' research'. (But they are open to alternatives).

4 - Other student accepts *only animals' research for medical purposes, not for other ones, like cosmetics*. (Limitation of the finality of the research with animals, we can see here one arg. 'by division', from Quasilogics (Perelman), they divide the end in two: for medical research and for cosmetics)

5 - One student says: 'we can *accept by necessity Animals in Research* to prevent adverse effects on humans' (better with animals than with humans, because it is a necessity) (it corresponds to a scheme of Means and ends, from Perelman)

6 - And she considers as an inconvenient that 'the genetics is different, and the *research's results will be not sure on the humans'*. (It is a higher thinking seeing an inconvenient in the defended position. Related to arguments, if we consider as an arg. means-ends, this appreciation of genetics diminishes the end.)

7 - They agree that *the only way at present is with animals, if there were alternative, better the alternative*. (They are open to alternatives. We can see here an argument Means-ends, the means we have, justify the end, Perelman)

8 - Some students *accept that doctors will act ethically and will try to decrease any distress to animals*. (It shows a faith in the agents of the science, they have ethical values. It can be considered arg. by Authority)

9 - Although *we don't know the distress of animals because they don't talk, but today it is the only way to do this research*, if in the future there are *alternative*, we will agree with these. (Thinking in a critical way, animals can't talk about its suffering, and they are open to alternatives. Here a new DH is introduced: decision power / morally suitable to be used in research, we represent it in Figure 3)

10 - One student *disagrees with a specific case with a rat*, which consider without medical use. (There is a thinking against doing not necessary experiments)

11 - They discuss the bigger worth of human above the animals because *we have not more rights than the animals*. (Discussion about the given DH from the opposing views represented in Figure 2).

12 - And also by *genetics we are not so different*. (Argument by Verbal classification, we men and animals belong to the same group, it is used to refute o diminish the initial given DH)

13 - Also if *men participate in medical experiments, they do it by choice, but the animals can't choose*. (Being critic with and refuting the initial DH by giving an ethical reason, it can be taken as an arg. from Rule of Justice, Identity (Perelman) and from ethical principles; also we can consider that the refutation of the initial DH is done by giving an alternative DH, see Figure 3).

Figure 3. DH decision power / morally appropriated for research

Accepted Hierarchy	Relationship	Hierarchy under discussion
Own decision power	As **more** decision power has **less** morally appropriated to be used in research	**Morally appropriated to do research with**
+ men (Yes)		- men
↑	⇢	↑
- animals (Not)	Inverse relation	+ animals

14 - Somebody presents *a case of medical test that caused serious bad effect on people*, if those people were asked about the poll of this task, *they will vote surely against any medical research*. (There is critique about not ethics in medical research, or personal implication, arg. From Commitment, Walton)

15 - One *student talks in a very personal way*: We can agree against research on animals because *we don't need to use something that needed research on animals, if we had, and there was no other choice, probably, we changed opinion*. (Personal view, it presents a way to refute the thesis of going against research with animals (a DH opposite to the given initial one, Figure 2) by a personal case, this is a refutation of a DH by refuting the accepted hierarchy considering the group is not uniform, there are differences into the group of the accepted hierarchy)

16 - A student presents *the alternative of using criminals in prison instead of animals*. (This goes against the initial DH human/animals) defending that serious criminals, like paedophiles, can be used in the final stage of the research because they have loss all the rights (so, are below animals). Here is a refutation of the given DH of Figure 2, dividing the group of human in classes (good men, criminal men, serious criminal men) and presenting an alternative hierarchy: serious criminal men are below animals, better using criminal men than animals in medical research. After that, someone justifies this new hierarchy saying: the criminal

offenders are loss all the human rights. It can be considered also as arg. of Verbal classification (Walton), they don't belong to the human class, see Figure 4).

17 - This student also defends this idea because: '*we pay tax to keep these criminals alive in prison*, where they live fantastic, TV, sport facilities,... more than I never seen in schools'. (Arg. from Waste, Perelman)

Figure 4. DH live beings / morally appropriated for research

Accepted Hierarchy	Relationship	Hierarchy under discussion
Having rights		**Morally appropriated to do research with**
+ normal men (Yes)	As **more** rights has **less** morally appropriated to be used in research	- appropiated
↑ animals		↑
- serious criminal men (Not)	Inverse relation	+ appropiated

To appreciate differences in values and ideology, we can see the summaries written after the dialogues from two group of students.

> We all agree that testing on animals for cosmetics is unacceptable and not needed. One specific student believed that testing on animals is wrong full stop, but she does understand that things do need to be tested and animals seem to be the only available method. Most of us think that testing things on rapists and serious offenders (Paedophiles) could provide an alternative. Other student feels that these people have lost all rights. (Br_animals_1, Bristol)
>
> In the discussion several topics have gone out like argue with arguments that were given but after the discussion nobody has changed his opinion. The main arguments have been: 1) We belong to the same group of animals, if I defend a thing (research with animals, I have to defend the other (research with people). 2) We would like a solution for the Medicine but nobody wants to be a body for experimentation. (Bcn_animals_1, Barcelona)

Analysis and findings in relation to the Designer Babies' research task.

The process of the analysis related to the second task, *Designer Babies*, is the same we have done in the first task. However, the argumentative strategies in some groups are a little different; they relate more to ethical and socio-political ideologie, and imply also ethical or socio-political values or beliefs, than to the consideration of a hierarchy accepted for a lot of people which can be discussed or criticizsed. Because of the length of this paper, we will not detail more the analysis and categories of the argumentative strategies found in the dialogues of this second task.

These findings does not contradict the fact that in some dialogues we can find also the '*Double Hierarchy'* argument, as in the example we present in Table 4.

Table 4. Illustration of the analysis of an intervention related to Design Babies task

Bcn_Design Babies_5 *Student's intervention*: Let's see. First of all, we take into account that we always try not to create people to our taste, but to research a cure for other sick people. .... I think that foetuses neither have conscience, nor they are persons yet, nor they are independent living beings. Consequently, I think that they can be used to cure those that have conscience, those that are independent living beings, and I think on what later is asked about the umbilical cord, that not only the father can give the assent, but I also think that it should be compulsory to do this because it does not imply any damage for the baby, and can benefit others that are sick
Thesis: Thesis 1: I think that the foetuses can be used to cure sick people. Thesis 2: The father has to give the assent that the umbilical cord is used to medical applications.
Arguments: *Argument* 1: As **more** conscience has an individual, **more** person is (premisa). As the foethuses are individual without conscience, they will be below the hierarchy of any born person. And, as we think as **more** person is an individual, **less** morally appropiated is to do research on (premisa), so, to do research on foetuses is **more** appropriated than to do research on born persons. (DH argument) Imply some values/beliefs about the foethuses, they don't have conscience and so they are not persons. *Argument* 2: The father have to give assent about the use of umbilical cord because it does not imply any damage for the baby and can benefit others that are sick. (Arg. From consequences (negative) and Arg. From consequences (positive)
Premises: P1: We talk about new research to cure other sick people but not to create people to our taste. (General premise that don't intervene in the arguments here) (In Argument 1) P2:The foetuses don't have conscience, they are not persons yet. P3: There is a hierarchy of being person [not being person yet (not having conscience)--→ being person (having conscience)]. (In Argument 2) P4: The use of the umbilical cord for medical applications doesn't imply any damage for the baby P5: The umbilical cord can be used to cure other people that are sick.

3.4 Quantitative analysis and results

We present some results giving frequencies or/and percentages, but only to make the results more "visible" because, really, our study is not a statistical comparison, but a descriptive qualitative comparison.

1) Counting arguments by tasks (Bristol + Barcelona)

The proposed tasks favour students' argumentation. In the discussions of these tasks we find the higher number of arguments in the *Designer Babies* task. Numbers of arguments correspond to the number of identified arguments in the total of dialogues of dialogues, the number is counted from the identified thesis and from the reasons given in each thesis.

Table 5. Counting arguments by tasks (Bristol + Barcelona)

Task	Total Number of Arguments	Duration (mi) (Total by task)	Number of Arguments per minute (mean)
Animals	**156**	70.25	**2.22**
Designer Babies	**193**	72.97	**2.65**
Mean	174.5		2.44
Total	349		

The *Designer Babies* task favourites given more arguments than the *Animal in Research* tasks, and also the rate of arguments / time is a little higher in this task.

2) Counting arguments by tasks and separated countries

Table 6. Counting arguments by tasks (Bristol + Barcelona)

Task	Bristol (Total Num. of Arg.)	Num Arg/ Duration (mean) Br	Barcelona (Total Num. of Arg.)	Num Arg/ Duration (mean) BCN	Total Number of Arguments
Animals	**69**	2.90	**87**	1.87	156
Des. babies	**102**	3.39	**91**	2.12	193
Mean	85.5		89		174.5
Total	**171**		**178**		349

There is only a small difference in the number of arguments given in both tasks between Bristol and Barcelona. Despite of this, students in Bristol, in both tasks, give a bigger number of arguments/minute than students do in Barcelona. Is it a cultural o linguistic difference?

3) Types of argumentative schemes in the total sample and by countries

In the specific context of these SSI tasks, some types of argumentative schemes appear more frequently than others. The most frequent in the *total sample* (Bristol + Barcelona) (349 arguments) are, in descending order:

Consequences/Means and End (105) 30.1%; Verbal classification/ the Proper (61) 17.5%; Double Hierarchy; More → More; Some of Preference (less damage, by the difficulty, by the possible, ...) (37) 10.6%; the Waste (28) 8.0%; from an Established rule (social/natural) (27) 7.7%; Rule of Justice/ Values (26) 7.4%; Example/Illustration/Model/Precedent (18) 5.2%; Direction/Gradualism/Slope soaped (16) 4.6%; Emotions/Commitment (15) 4.3%; Analogy/Model/Methafor (8) 2.3%; From Expert opinion/Authority (6) 1.7; Quasi-Logical (by Comparison, by Division, the Whole and its parts....) (2) 0.5%.

There are some differences between the two samples of Bristol and Barcelona but not very relevant.

4) Counting types of argumentative schemes by tasks and countries

Differences between the frequencies of types of argumentative schemes by tasks are found, some types of schemes are found only or with a very small frequency in one of the tasks. We will not give the quantitative detail of the differences between tasks, but only comment about some of the biggest differences. For example, the argument from the Waste is mainly related to the task *Designer Babies* and is found more in Barcelona than in Bristol. The argument of the Direction or Gradualism has a large percentage in the *Designer Babies* task and in the sample from Bristol. The Double Hierarchy argument and the More-> more argument can be found in both tasks but with bigger percentage in the *Animals in Research* task. The *Rule of* Justice appears in both tasks but with larger percentage in the *Animals in Research* task. Other schemes are found in both tasks in a very similar percentage as the Verbal classification or the Proper argument, as well as the argument by Consequences which is given with the large percentage in both tasks and countries.

Our results agree with other research results that say that the types of arguments depend on the features of the specific task, one of these can be the content of the task indicating a field depending on the reasoning of the students. We have found this result also in the part of our research in which students performed tasks about scientific topics (Castells, Erduran & Konstantinidou, 2010). Using tasks that are different by several specific features, one of which is the way we present the tasks, we found their influence on the types of arguments the students use (Konstantinidou, A., Castells, M. & Cerveró, J.M., 2012). This happened, e.g., when we included arguments in the presentation of the task as we do in the *Animals in Research* task, e.g., we consider that the rich dialogues we collect are caused by the presented arguments in this task.

3.5 Identifying beliefs, values, emotions and ideology through the premises of the arguments

The identified premises are, like the types of argumentative schemes, tasks-dependent. As we might expect because the demands of the tasks, the premises based on school knowledge are not found in these socio scientific tasks, but we find some personal experiences or

information from the media. Also premises based on beliefs, moral or ethical values or socio-political ideologies are the base of the arguments of students discussing SSI, as well the premises based on emotions. In fact, values and emotions are very relevant in the arguments of students, but also political ideology. Some students based their arguments on the emotions elicited by the case presented in the task, or a similar case that they had experienced or known facing the debate from a very personal point, saying sentences as: "It is an emotional situation, I could think that could be my son that need a therapy of this type or I could think that I could give an embryo that could be my not born son". These emotions guide the claims they defend, expressing the complex links established in all argument between premises, claims and argumentative schemes. These types of considerations seems be above other scientific or more objective criteria when they have to take a decision. Other examples show students stating controversial questions not solved neither ethically or scientifically, as "does or doesn't an embryo be a human life?" Some student think very critically as when he states discussing with others: "we can consider an embryo as a life, but on the other side, could we sacrifice the embryo in order to have the option to cure some illness?"

There are some differences between the countries in terms of the premises on which the arguments are built. The Bristol students based more times than the Barcelona students their arguments on facts and knowledge obtained from media, and these students based their arguments more on ethical values or socio-political ideology or emotional implication. There are also coincidences, e.g., when they introduce the hierarchy humans/animals, but also differences in the way they refute this. In summary, our analysis has been useful to detect some important differences in relation to moral and ethical values and in socio-political ideology. We find that British students are more confident with the Government than the Catalan students, these don't think the government would guarantee that the research with animal will be done applying ethical principles.

There are not very big differences between countries related the open thinking they show, the majority of students don't change their opinions during the discussion, but a general impression is that British students are more in the right side of the political ideology, on the contrary many students from Barcelona show a more open thinking and situated in the left side of the political ideology.

4. Discussion and conclusions

Our analytical framework has been built on different theories of argumentation which, among other aspects, focus on non-formal types of argumentative schemes. The use of several theories of argumentation has been useful to produce a wide list for the categorization of students' arguments answering activities related to SSI that also conform to spontaneous common reasoning.

As a main conclusion, we can say that the way students argue is not so different in the two contexts studied, Bristol and Barcelona, in relation to the types of argument schemes used, in fact, pre-service teachers from both places share the same patterns or schemes of arguments,

although not always with equal percentages. These difference in the percentages are explained by the relationship between tasks' features (among other, its content) and types of argument schemes and the argumentative strategies recognised in the dialogues, which is also a conclusion of our research. In a different way, the social cultural context influences on the type of premises of the arguments, which can be values and hierarchy of values, and the beliefs and political ideology that are below these premises.

The analysis done is useful both for a deep understanding of students ideas, values or beliefs and of types of arguments and argumentative strategies. This knowledge provides a "tool" to contribute to face not suitable ideas, beliefs, or values and to help students to improve their attitudes to take decisions in a democratic society. For example, the knowledge of the "double hierarchy" structure can be a "tool" for teachers to refute or to weaken some arguments and so, the ideas or values of students which are below the arguments.

The study shows that the students participating in the discussion engage in authentic dialogues, asking and answering questions. Some of the students' questions asked to justify or refute the theses presented by others are relevant for the advancement of the argumentation, but the arguments are not directed enough to the premises; students do not have convincing arguments for maintain or amending the theses proposed. It seems that the intervention of the teacher is very necessary to guide the discussion along relevant points.

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