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Argumentative Skills in Higher Education: A Comparative Approach

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Abstract

This text analyzes how curricular units of distinct areas of knowledge may refer, demand and promote argumentative reasoning. This is considered to be a fundamental feature in Higher Education within the framework of the Bologna Process. The objective of the study is to establish how argumentative skills developed by students should be promoted and assessed in courses from two different areas of knowledge. The sample was made up from 282 students' assessment elements developed in 4 undergraduate courses for students majoring in Psychology, Educational Science and Engineering, of University of Porto. The methodological approach used was content analysis and data were treated by N-Vivo software. Data in relation with the courses supply the bases to infer that the current position held by argumentative skills in Higher Education depends on the area of knowledge, as well as on the conditions and methods of student assessment.

Keywords: Argumentative skills, curricular development, higher education, qualitative analysis

1. Introduction

Promoting argumentative reasoning is considered to be a fundamental feature in Higher Education. This is a topic worth discussing as Higher Education policy and pedagogy are more and more centered on students' learning, according to the Bologna Process recommendations.

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An objective that Dublin descriptors emphasizes to sustain this process, when provide a set of five criteria, phrased in terms of competence levels, that value: i) acquiring knowledge and understanding; ii) applying knowledge and understanding; (iii) making informed judgments and choices and (iv) communicating knowledge and understanding and (v) capacities to continue learning (European University Association website). An objective that must be understood as an epistemological trademark of the reflections related to Higher Education Pedagogy on the new knowledge societies. In this sense, argumentative reasoning is a specific topic from a broader concern: how can we develop a student-centered learning approach at Higher Education? How can we contribute to develop students' critical thinking in tertiary education contexts?

In terms of its foundation, argumentation is based on three basic ideas: *demonstrative communicability*, according to which the reasoning behind a topic or theme is not detachable from discursive communication; *potential of discussion*, that explains why argumentative discourse proposes instead of imposing; and *contextual character* that refers to the meanings of the discourse that "cannot stand independently from the concrete and particular situation of the speaker, nor from the consequences that the discourse produces over the audience" (Grácio, 1998, p. 56), even though the speaker and the audience are perceived in an universal fashion. This doesn't contradict the main idea that a universal audience is the typical audience of science as it is characterized by a logic rationality that follows the logical principles of the formal validity of propositions. A demonstrative text (and reasoning) stands on premises that are not discussed and that consists in the development of a structure where logic and formality lead to a necessary conclusion. The argumentative text (and reasoning) derives from a persuasive intention in which someone wishes to convince the other of the goodness/priority of a certain theory. Thus, the argumentative reasoning is inscribed in the domain of the possible, the preferred, the choice, bringing into a need to put forth the best arguments (Perelman, 1987).

At more proficient levels of production and use of knowledge, all academic and learning conditions require the possibility of choice, which in turn entails the argumentative reasoning and text, as requirements for the significant appropriation of that same knowledge. An argumentative text assumes a structure, which is not rigid as its elements can be moved and sub intended. However, it entails a regularity which adds credibility to the person who speaks, supports what is said and allows the listener to make a more conscious approval or rejection.

The regular pattern of the argumentative text (and reasoning) includes differentiated elements, which depend on the theoretical lines that are adopted in the basic tendencies of the argumentation. These are determined by linguistic and philosophical approaches (Amoussy & Koren, 2009). Therefore, it is possible to speak of an argumentative structure where the following elements can be found:

- Problem. It relates to the question that is answered in the text. It is not necessarily explicit but adds unity and consistency to the text.
- Theory or Assertion. It refers to the answer to the problem referred above and it constitutes the author's option/choice. It can be found in any part of the text, but it must be explicit.
- Arguments or Evidences (theories, facts (=data) and / or examples).The arguments are used to justify the preference of the theory, giving its sustainable facts.
- Objections (theories, facts, and / or examples). These objections constitute arguments with reverse meaning to the chosen theory and are sustained by theoretical positions or factual contexts that negate the possibility of the theory.
- Counter-arguments or reinforcement (theories, facts and / or examples). These constitute new arguments (arguments not yet used) that are directed at the objections in order to reduce its importance or even to demonstrate its formal insignificance.
- Conclusion. It is the result of the argumentative process and coincides with the theory, even if weakened by the objections.

The research is contextualized in the macro dimension of higher educational policies that follow the Bologna process with particular emphasis on the significance that the topic encompasses at University of Porto. The data used come from two Faculties of University of Porto. The results and follow up discussion are presented after the methodological explanation.

2.1. Theoretical support

The definition of argumentation that supports our research follows S. Toulmin (2001), as he defines argumentation as a process that produces theories or assertions and provides support and justification by way of evidence.

The argumentative value given to theories, facts and examples is not identical, considering that the strength of the argumentation resides in the coherent use of the first two types of arguments (Weston, 2005). Furthermore, as noted by Perelman (1987), over and above the bare data, facts support or indicate the way to interpret and favorably describe data, as well as at the level or layer of generalization in which the fact can be described. As stated by Perelman (1987, p. 245), "The same action can be described as the way to squeeze a screw, to assemble a vehicle, earn one's life, favour the exportation flow". On the other hand, the use of examples contains the problem of hypothetical generalizations. If it is used as proof, in that the case applying to a general tendency, it cannot be used, inversely, as irrefutable evidence. Teachers frequently invite their students to give examples to illustrate a phenomenon, using case studies that support the theory. What the teacher is actually doing is testing the students' correct understanding of the theory. What is at stake here is the use of the example in its argumentative capacity and the distinction between example/illustration and typical case. However, it is quite common to use, discreetly, one, two or even three types of arguments.

In the current study we follow the theoretical conceptualization of argumentation and the two main tendencies on the theme that support the categories of S. Toulmin (2001) and Perelman (1987) who proved the pragmatic dimension of argumentative reasoning.

An argumentative text uses patterns of reasoning by which the argumentation is built, both in producing arguments, objections, and counter objections, and in producing conclusions. They may be:

- Deductive. It refers to the deduction of a particular effect of a general premise before it is postulated (cause and rule).
- Inductive. It refers to the inference of a general proposition (rule) or generalizing a proposition about a limited set of particular propositions (cause and effect).
- Abductive - hypothetical-deductive. It refers to the production of reasoning that develops (deduces) consequences of a specific premise taken as hypothesis. The abductive inference model can be expressed in the following way: An amazing fact, C, is observed (effect). But if A was true, C would be natural (hypothetical rule). Therefore, there is reason to suspect that A is true (cause).

- Analogical. It refers to the production of reasoning on the basis of other realities that seem to have similarities of structure or functioning with the argument that is being built. Usually, it is drawn according to proportion (exemplified by the rule: A is to B as X is to Y). However, and contrary to the other 3 reasoning types explained above, analogy compares realities that are not of the same kind, facts that are not of the same nature. Therefore, the admission of the rule (expressed in its similarity) has another meaning in virtue of its inapplicability in terms of cause and effect.

The analytical focus of this paper is the importance of argumentative skills in higher education. The objective of the study is to establish how courses, coming from two different areas of knowledge, promote and assess argumentative skills developed by students. This study resulted from the will to understand how the courses concern, impose and/or promote argumentative reasoning, in its relationship with the teaching paradigm of the Bologna Process. This paper aims to examining actual written work produced by students in order to promote Higher Education pedagogy knowledge.

2. Literature review

In order to pursue this study, a revision of studies that have been published in the last 5 years was done within the scientific field of research about Higher Education in Europe or with direct influence in the European area. Furthermore, relevant studies were identified by key words such as *argumentation, argumentative skills* and *argumentative reasoning*. A set of 24 studies were identified for inclusion in this section. Those studies carry on empirical research on the subject and the remaining were of a theoretical type. The purpose of this literature review was to identify the main trends related to the importance given to argumentation in educational research.

Throughout the revision of the literature about argumentative skills we realized that most authors had mainly didactic concerns, as they focused on the development of scholastic activities, of assessment and/or students support, leading them to develop better arguments (Inglis & Mejia-Ramos, 2009; Lupton, 2008; Simon, 2008; Okada & Shum, 2008; Ravenscraft & McAllister, 2008; Kember, McKay, Sinclair, & Wong, 2008; North, Coffin, & Hewings, 2008; Davies, 2008; Amossy & Koren, 2009). Strategies that refer to programs and ICT resources with the same aims come frequently together with this finality.

Thus, a great number of these studies constitute empirical validations of these pedagogic proposals (Davies, 2008; Loureiro, Moreira, & Pereira, 2008; Andriessen & Schwartz, 2009). Some studies support the need for argumentation as a skill in educational context and evoke a conceptual framework that varies from social constructivism to significant learning (Andrews, 2010; Costa, 2008). Following the research, that is centered on the problem of argumentation and its development among students' skills, some of the studies that were analyzed in order to organize the university course curricula with that in mind. Such proposal may be seen both as a task to be developed collectively and as a routine to be implemented in specific courses (van Amelsvoort et al., 2007; Lea, 2004).

In the studies that included an experimental, or quasi-experimental, component whether it was centered on students' or teacher's work, the majority concluded that there was an improvement in students' results, due to the development of the work proposals, particularly relevant in the case of studies carried during a long time (Bangert-Drowns, Hurley, & Wilkinson, 2004; Abrami et al., 2008).

When the studies tried to identify factors associated to argumentative skills, as is the case of "the awareness of the argumentative structure in textual production" (Pinheiro & Leitão, 2007) or in the knowledge of basic elements that help understand reading material (Zarzosa Escobedo, Pérez, De Parrés Fong, & Guarneros Reyes, 2007), as well as factors that are associated with teachers' practices (Davies, 2008), the results also showed clear evidence of a positive correlation. One of the studies focused on the importance of peer work as facilitator of the production of increased quality argumentation and concluded that the argumentative production was greater when the peers belonged to the same degree program but the quality still improved when the students were in diverse degrees (Joiner, Jones, & Doherty, 2008).

In this overview of studies on argumentative skills, it was found out that there is a close relationship: (i) between argumentative skills understanding and the development of reflexive skills and (ii) students' development of critical reasoning (Mitchell et al., 2008; Stupnisky, Renaud, Daniels, Haynes, & Perry, 2008; Bramming, 2007; Wells & Mejia Arauz, 2006; Bulpitt & Martin, 2005; Kember et al., 2008; Lattuca, Voigt, & Fath, 2004; Choo, 2007; Abrami et al., 2008; Bisault & Le Bourgeois, 2006; Bangert-Drowns et al., 2004).

Other studies present argumentative skills as something that should be developed as a specific component of academic literacy which is shown, for example, in the writing of essays (Bramming, 2007; Lupton, 2008; Wells & Mejia Arauz, 2006; Kember et al., 2008; Lattuca et al., 2004; Choo, 2007; Abrami et al., 2008; Bisault & Le Bourgeois, 2006; Bangert-Drowns et al., 2004). Furthermore, final results that justify the development of those skills are frequently associated with the promotion of a learning culture characterized by the deep understanding of the relationship between theory and practice (Saltmarsh & Saltmarsh, 2008; Wells & Mejia Arauz, 2006; Bulpitt & Martin, 2005). We also found a close relationship between the development of written argumentative skills and the possibilities offered by ICT resources to reach that objective in an efficient and effective way (Coffin & O'Halloran, 2008; North et al., 2008; Ravenscroft & McAlister, 2008; Schwarz & Glassner, 2007; van Amelsvoort et al., 2007; Lea, 2004; Zarzoza et al., 2007; Joiner et al., 2008). On-line forums stood out amongst the ICT resources because they stimulate students' participation in discussions. Such forums were seen as stimulators of a critical attitude in regard to knowledge, which helped to promote the procedural skills needed for the presentation of the arguments supported the most (North et al., 2008).

It is worth noting that amongst the studies on argumentative skills, some of them focus on Primary and Secondary education and not specifically on Higher Education, but in some way, they prepare students for the academia, as is illustrated in the research coordinated by Bisault and Le Bourgeois (2006). The development of argumentative skills not being exclusive to higher education (Simon, 2008) is another interpretation of these research focuses. However, one can frequently see that the students of this educational level do not possess these skills, as they do not apply them. Thus, we can infer that the ability to use the argumentative skills does not occur in the same manner in all learning environments (Costa, 2008). It is therefore interesting to explore the contexts that are relevant to the students' living conditions. Another inference from the literature is implicit in a good many of the studies analyzed. That is the idea that even though argumentative reasoning is desirable in all social levels of citizenship, it is nobody's territory for explicit work (Andrews, 2010).

According to the references presented, we are able to infer that argumentative skills have been studied in different ways and for diverse reasons, the majority found in Communication Studies and Philosophy.

Research in argumentation with education in mind has increased in the last few years, and has been frequently associated with the production of academic texts for assessment. That research has focused on the development of good writing (Coffin & O'Halloran, 2008). Such is the trend found on Writing Across Curriculum studied by Melzer (2010) and its two primary approaches: "writing to learn" and "writing in the disciplines." . Moreover, the diversity of students and teachers' interpretations about what an argument is indicates a minor understanding of the epistemological elements of reasoning that support argumentation (Mitchell et al., 2008).

3. Research context

The Bologna Process debate has brought up many issues related to the role of Pedagogy in Higher Education. Some find it unnecessary and others value only its technical elements. There are also those that attribute it a fundamental role (Vieira, 2009) to meet the change of the Higher Education paradigm, where the Bologna Process is but a sign. It has been recognized that the pedagogical work, within an approach of transmission of knowledge has to give way to a different approach which emphasizes the students learning processes.

This has been clearly announced by the policies at this Educational level in Portugal and has allowed for a diversity of initiatives of the Higher Education Institutions aimed at producing that change of direction. Teachers' recognition of the need to rethink their pedagogical practices, in the light of the global framework of the mission of this Educational level, has been gradual (Esteves, 2008).

It is within this context that the University of Porto has defined the improvement of the learning and teaching processes as one of the four strategic objectives that guide its institutional action plan. It is the job of the Faculties of this University to adjust their courses to the changes of the Higher Education principles, namely the definition of the students' work components conducive to the development of skills. Argumentative reasoning is inscribed in the group of transversal skills to be developed by students, who are frequently challenged to sustain results from experimental processes, to choose argumentatively a theoretical or technical option and to organize their project work with supported intervention guidelines. This intent inspired research carried out on Courses delivered at the Faculty of Psychology and Educational Sciences (FPCEUP) and the Faculty of Engineering (FEUP) from University of Porto, during 2009-2010, respectively in the areas of Human and Social Sciences and Technologies. This paper presents the results of that research.

4. Methodology

4.1. Sample

In order to pursue this research we analyzed 282 pieces of students' work from the two Faculties (FPCEUP and FEUP), corresponding to two courses of each institution. The courses selected were "Microprocessors" and "Programming", of the Integrated Master Degrees in "Electrical and Computer Engineering, and Computer Science from FEUP, and "History and Epistemology in Psychology" of the Integrated Masters' Degree in Psychology, and "Processes and Curricular Development", in Educational Sciences Course from FPCEUP. Texts used to assess students' learning were analyzed. The work to be examined included comments in forums (occurring in two courses), a semester final project and the answers to an open question in a summative assessment test. In the courses where the texts written by the students were on a compulsory on-line forum, the comments produced were analyzed during a longer period of time (from the launch of the issue or topic of discussion until its finalization).

For that reason, but also because in the "Microprocessors" course the work resulted from group effort, there is no link between the number of pieces of work and the number of students registered in the course. In the case of the "Programming" course and according to the quantity of students registered for examinations (almost 400), students' texts were selected from one of the exams. The exam included similar and comparable content material. This information was given by the course's main teacher. In the course where the final paper was analyzed, the preparation time was longer, even though the submission date coincided with the end of the semester. A limited time frame with respect to the open ended question in the "Programming" test was the exception. It was this time criterium that produced interesting elements of analysis (Table I).

The students were from different curricular year groups: 109 from first year, and the remainder from second year. In the distribution among the 4 courses and the course curricular years, we considered the two areas of knowledge, namely, Social and Human Sciences and Technologies (Table I).

Table I. Features of the courses' assessment

Curricular Units	**H. & Epist. of Psychology**	**Curriculum Development**	**Microprocessors**	**Programming**
Number of research pieces analyzed	***N*=71**	***N*=153**	***N*=20**	***N*=38**
Assignment type assignment features	comments in forums Compulsory individual	comments in forums Compulsory individual	final paper Compulsory task group	open ended question Compulsory individual
Time to do assessing task	Extended	Extended	Extended	Limited
Course year	2nd	2nd	2nd	1st

4.2. Procedures

The data were analyzed through content analysis (L'Écuyer, 1990), with the N VIVO 8 program. As units of analysis, we considered, sentences, or paragraphs that constituted a unit of meaning, which transmitted an idea, in terms of the conceptual structure previously presented. The information was grouped into two categories: argumentative elements and reasoning structure. The first was subdivided into *Arguments, Objections, Counter-arguments, Problem, Thesis/theory and Conclusions*. The second one, related to reasoning structure, was distributed by *Abductive, Analogical, Deductive* and *Inductive* issues.

In general, the tables took into account the discourse units, in terms of the number of references. However, in some cases, the outlining of sources was relevant (specifically the number of work deliverables that were analyzed). That information is explicitly provided in the caption of each table. The second column rates were calculated according to the number of students' work pieces that were analyzed (number of sources), because they seemed to constitute sustained information in terms of the research question: how do the curricular units demand and/or promote argumentative reasoning?

4.3. Results

The analysis of the data from the course studied showed that "Microprocessors" is the one with stronger appeal to argumentative reasoning relative to the number of sources considered in each case and in their diverse constitutive elements, as shown in Table II.

Table II. Distribution of the argumentative elements by course

	H. & Epist. of Psychology		**Curriculum Development**		**Microprocessors**		**Programming**		**Totals**	
	***N*=71**		***N*=153**		***N*=20**		***N*=38**			***N*=282**
Arguments	124	1.75	176	1.15	19	0.95	1	0.03	320	1.13
Conclusions	13	0.18	33	0.22	8	0.40	1	0.03	55	0.20
Counter-arguments	1	0.01	3	0.02	9	0.45	0	0	13	0.05
Objections	16	0.23	24	0.16	11	0.55	0	0	51	0.18
Problem	25	0.35	23	0.15	1	0.05	0	0	49	0.17
Thesis / theory	18	0.25	161	1.05	4	0.20	0	0	183	0.65

In the "Programming" course, one part of an exercise was selected for analysis. The student was asked to explain "in words how he/she would describe the function *calculate- mode* (…), which determines and returns the value that occurs more frequently in one set of values (vector units)". As a result of that request, almost all students described the function without referring why he/she would do it in that way; therefore they do not appeal to the argumentative skills.

Another result that we can extract from Table II is that the elements that are jointly mobilized by students are arguments and objections. A finer analysis of the basis of the arguments and/or objections allowed us to realize that students' argumentative reasoning is supported by facts, resulting from experience or from simulations. This can be shown by the following examples:

> If the value of X is smaller, the overflow will take longer to occur, and consequently, each new value of the wave will be more slowly updated. Therefore, the form of the wave will last longer, and its sound will be lower. (Microprocessors)

> A study published in 1996 by the University of Berne involving a huge sample of Swiss human resources companies, found that the study of the written test performed by candidates was the first psychological method used (67% of the cases), largely used over other classical projective methods. (History and Epistemology of Psychology)

However, in the case of the students from FPCEUP we found more arguments supported in theories, as illustrated below:

> Just as Sternberg said, intelligence cannot be measured (…). Intelligence is a lot more than just a test that does not cover all the skills, only the analytical ones. (History and Epistemology of Psychology)

It is feasible that this occurs due to the way the question was formulated, guiding students towards the need to theoretically support the judgment produced. Similarly, in what concerns the mobilization of arguments, as referred above, the use of objections also appears centered on facts. The majority of the cases relates to problems or limits picked up during the practical exercises, as shown in the following example:

> According to the circuit test we noticed on the contrary, that there were omissions that put at risk the correct operation of the prototype. (Microprocessors)

or supported by facts experienced by the person:

> I already feel that the mentality is changing, probably because there are psychologists in different areas. For example, when I told people that I was going to Psychology, some would say "to treat madmen", but others would say "you can give me some free consultations". More and more I believe people are perceiving Psychologists as competent professionals, who are more than just a friendly shoulder or a doctor for the 'mad'". (History and Epistemology of Psychology)

The reasoning elements that were less apparent in students' work from the courses of FEUP were: the problem, the explanation of the thesis. That is different from what we found in the students from FPCEUP.

The argumentative reasoning elements that proved some evidence of production of counterarguments were the ones of the "Microprocessors" course. We admit that this happens as a result of the typical thinking that is part of the idea of simulation – which puts forth possible outcomes, as expressed in the following example:

> My first option would be to connect a DA converter directly to port P1, the problem with this implementation was the inability to produce frequencies that were sufficiently high to meet the design specs. (Microprocessors)

One of the rare times when we found counter-arguments in other courses was in an on-line forum which instructed participants to take into account the previous interventions, and that constituted a subtlety of the argumentative structure:

> Nonetheless, I don't consider that my schooling in the Primary and Secondary Education was 'castrating' in cognitive, technical and social skills terms. The great issue is the pressure of results, which culminates with sitting national examinations, almost forcing teachers to stick to the prescribed curricular program and adopting a scheme of 'dry and heavy' transmission of series of excessive and poorly connected topics. (Curriculum Development Process)

In what regards the reasoning structure used by the students, we can conclude that the deductive reasoning is most exercised within the work load (Table III).

Table III. Distribution of the type of reasoning structure used by course

	H. & Epist. of Psychology		**Curricular Development P.**		**Microprocessors**		**Programming**		**Totals**	
	***N*=71**		***N*=153**		***N*=20**		***N*=38**		***N*=282**	
Abductive	19	0.27	4	0.03	16	0.80	1	0.03	40	0.18
Analogical	31	0.44	0	0	0	0	0	0	31	0.14
Deductive	74	1.04	88	0.58	10	0.50	1	0.03	173	0.78
Inductive	8	0.11	50	0.33	1	0.05	0	0	59	0.27

A few examples are the following:

> When this interruption occurs, the program calls the routine “wave”, which sends a voltage value to the DA converter. Then, the value for the converter is returned every time there is an overflow of the timer, as explained previously. This is the way to control the frequency of the wave and consequently the time interval generated by the value in TH0. (Microprocessors)

> And so “our” child teaches “our” adult, that the experience of the child molds the adult. Freud looked to understand the way the past conditioned the future and explained that the past was quite often 'guilty' of making a less happy future. (History and Epistemology of Psychology)

The abductive reasoning is the dominant tendency in the “Microprocessors” course and has an interesting numeric representation in the “History and Epistemology of Psychology” course:

> If the computer program is sufficiently long and complex, then no human designer of that computer could say with precision what was the generated output or even if the random generator associated to the program would be able to generate original content; it would be impossible for the creator of the machine to predict and explain. (Microprocessors)

> If a man suddenly becomes interested in red ties, does a woman suddenly start to wear pink? – something in the subconscious may be leading this behavior. A man could be interested in dating a partner or vice versa. Therefore the sudden interest for red (the most active and sexual color) denotes a noticeable sexual vitality in the man or the woman who expressed the phenomenon. At that moment, the sign is expressed in something special, like a new sexual relationship that needs cultivation. (History and Epistemology of Psychology)

In addition we found a wide occurrence of inductive reasoning in the course “Curriculum Development Process”. This may be associated with the teachers’ instructions, as they explicitly required it, and the occurrence of this type of reasoning is larger in the set of texts that were published on the on-line forums as a follow-up of the topic and not of the other two that were analyzed.

> If I can speak about the Primary School, the time I spent in the primary school was positive, each student was accepted regardless his characteristics; we were guided along as members of a heterogeneous community. (Curriculum Development Process)

In the case of the "History and Epistemology of Psychology" course, 31 cases of analogical reasoning were found. This situation constitutes a clear example of how the reasoning outcome seems to be influenced by the argument given as a basis. In the case studied, students replicated the same analogy introduced in the debate by their classmates. They use it again, in 26 situations, and at times to support new arguments.

> I think that as a medical doctor can "let it all go by the side" when he prescribes the wrong medicine, with psychologists the same thing can happen when they offer a wrong answer or one that is unacceptable/misinterpreted by the other person. (History and Epistemology of Psychology)

When we cross-checked the types of reasoning with the argumentative conditions of its use, we realized that the separate analysis of the argumentative elements and of the types of reasoning used separately expressed the same tendency, once cross-checked with the sources (student work analyzed). Thus, the students produced more arguments than objections and used the objections that the used the most were deductive and inductive, as illustrated in Table IV.

Table IV. Distribution of the type of structure of reasoning used when applied to produce arguments and objections

	H. & Epist. of Psychology N=71		Curricular Development P. N=153		Microprocessors N=20		Programming N=38		Totals N=282	
	arguments	objections	arguments	objections	arguments	objections	arguments	objections	arguments	objections
abductiv	11	0	2	2	15	0	1	0	29	2
analogi	24	0	0	0	0	0	0	0	24	0
deductiv	40	8	39	10	8	0	1	0	88	18
inductive	3	0	25	12	1	0	0	0	29	12

5. Discussion of results

With respect to elements of the argumentative structure, the results obtained lead us to assert that a group of students prefer the arguments and the description of the thesis and, less frequently, a second group prefers the objections, the formulation of the problem and the conclusions. Clearly, these results are distinct in both established subgroups: courses from Engineering and Psychology/Education, which leads us to believe that the differentiated inclusion of argumentative reasoning elements, such as the problem and the thesis, are dependent on the manner of producing texts associated to the epistemic culture of the Social and Human Sciences.

In terms of the argumentative reasoning elements, we observe that the data we treated qualitatively (papers and activity reports) display a minor heterogeneity in the mobilization of the different elements. In other words, there seems to be a more balanced appeal to the different types of elements that constitute argumentative reasoning.

Results of this kind seem to bring to light that the assessment work that requires students to develop a certain topic on theoretical and empirical basis, lead them to build more complex argumentative reasoning skills as displayed in the mobilization of different types of elements. We also see some in those kinds of assessment evidence of a more frequent appeal to objections, which reveals a questioning attitude in the course of the work, keeping in mind the problem solving. Contrary to this, the data relating to the summative assessments show that the focus of student's attention is in the immediate satisfaction of instruction. It seems that there is a more linear relationship between the question and the - demonstrative – answer, leaving no place to the elaboration of far more complex discourse (probably because of lack of time).

In terms of the structure of argumentative reasoning, students seem to use the deductive type more frequently. The other types of reasoning skills seem to remain dependent both with respect to the specific instructions given by teachers – which reveals the type of mental work that characterizes each particular course -, and with respect to the contingencies in which the texts were constructed, as it was the case of reasoning by analogy. The identification of a type of mental work in direct connection to the courses becomes apparent in our results in the distinction amongst the courses from Psychology/Education and Engineering. The strong presence of abductive reasoning in the "Microprocessors" course is a good evidence of this. It is noteworthy in this case that the appeal to simulation guided students to a reasoning procedure that we characterized as abductive. These results seem to be related to the strong explanative component that is quite present in the text material of the Engineering students. Moreover, the request made to the "Curricular Development Process" students to share their school experience, in order to add empirical data to the studied theories, conditioned them into using deductive reasoning – if they wanted to move from the general theory to the concrete case or to inductive (though incomplete) reasoning, when they supported on their life experience a general conclusion that resembled a theory.

It is possible to interpret these facts through the dimension of the proof of knowledge which is associated to learning. The latter is seen as identical to the production of truthful knowledge on the basis of theoretical and /or experimental foundations, which allows for the development of reasoning that in turn can justify a certain assertion.

Thus, it is possible to invoke again the different epistemic cultures associated to the two groups of knowledge as the basic reason underlying this distinction. It is also possible to conclude that the production of reasoning and sustained arguments is a time consuming task. This is the only way to explain the near absence of identifiable arguments and reasoning skills in the only course where students' work was circumscribed vis-à-vis to an answer to an open question, as part of a summative assessment test within a time limit.

As far as the Engineering results are concerned, their poor expression may be related with the "limited" time conceded to the assessing task and surely with the low quotation of that task within the whole evaluation test. Different results would be delivered if the students were formally invited to stand for a particular and questionable way to solve a problem and given the necessary time to elaborate on it.

In fact, science and technology, being so much based in facts and evidences, don't provide such a large room to controversy as other subjects. The argumentative skills should then be focused on the logical articulation of those facts and stimulated by the presentation of different solutions for the same problem, corresponding to different routes to be followed.

6. Conclusion

We recognize that the discourse that comes together with the Bologna Process stimulates the introduction of needed change in the pedagogical domain which in turn adds value to the argumentative skills in Higher Education. Hence, we can consider that there is much to be done to promote argumentative practices in students teaching and assessment processes. This is in line with some literature findings related to the limited uses of writing found in many courses by Melzer, (2010)

The data relative to the courses supply the bases to infer that the current position held by argumentative skills in Higher Education depends on the area of knowledge, as well as on the conditions, modes and proposals of students' assessment. This idea is according with findings presented by Wolfe (2011).

Furthermore, this study allows us to conclude that the assessment methods used on students influence the way they develop and structure their argumentative reasoning capacity.

Thus, we can state that the characteristics of argumentation are dependent on the conditions and the way in which the teachers propose assessment tools. Another conclusion could be that some of the argumentation sub categories are far more present than others, like objections and counter-arguments. This means that argumentation is usually more related with a need to prove than to argue. It is possible to further conclude that there is a more typical way of reasoning as it is explicited about it by students. It crosses the epistemic cultures of the two areas of knowledge that were the subject of this study (Social and Human Sciences and Technologies) and was brought to light in this paper through students' work samples.

This study highlights the importance of further research focused on the argumentative writing effects on learning. The findings also point to the need to proceed with research related with assessment criteria, more argumentative informed.

In spite study limitations, related with comparability among different scientific areas, the research show the importance of argumentative skills development by students as a key feature to improve learning quality, accordingly with Bologna process challenge.

7. References

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