Doctoral education, pedagogy and supervision in Science Education PhD

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Abstract: Doctoral education is the higher level of education in the education systems. Associated with education comes the pedagogy that is implemented and the supervision process. In this research work, we start to study the pedagogy and the supervision practices that were perceived by doctoral students in a specific population - Science Education PhD. First, an exploratory survey was applied to PhD students that were participating in a national meeting of Science Education for young researchers. Secondly a similar survey was applied, but in another specific context –students enrolled in Science Education PhD at Nova Lisbon University (UNL). Some similarities were found: the pedagogy perceived by students and the evidence that students' don´t monitor or evaluate the research process during the PhD. In addition, some differences were also verify not only in the supervision practices, but as well as in the supervisor engage in the PhD research process.

Keywords: Doctoral Education, Doctoral Supervision, Students' point of view

1. Doctoral education

The interest about doctoral education as grew in the last years all over the world, but in Europe since the Bologna process, it has been highlighted. In Europe, higher education assumed a new rule since the implementation of the Bologna process in 1999 and doctoral education since the approval of the European Union Lisbon strategy in 2000 [1]. Higher education is considered crucial to promote innovation and knowledge, it has the responsibility of being the support of a knowledge-based society, but is also the ideal environment to build a European research area. Both areas, educational and research, defined as two pillars of a developed society have been connected by the doctoral education since being the place where is developed not only the researchers but also the research (Berlin, 2003). So in this context doctoral education emerges has a key to innovation and development of countries. As Pearson, Evans and Macauley refer "doctoral education is both part of the higher education system for teaching and learning, and part of the research enterprise" [2].

Dublin descriptors (2004) and the ten principles for the third cycle (Salzburg, 2005) emphasize the supervision as a fundamental element for doctoral training, guaranteeing critical mass and the development of research competence and abilities. Being so, doctoral supervision is crucial to promote doctoral success and to shape future researchers and academics. But from research in the field, it is possible to verify that doctoral supervision can also increase the completion rate or increase attrition; it can develop competence and research skills, or it can lead to traumatic experience. It can be also a time of personal and intellectual growing or it can promote the exhaustion and leave students to abandon the academy [3-6].

PhD is not a linear journey and PhD students must learn to construct new ways of thinking, and work in a new environment - the academic research environment- but also must develop skills and abilities [7]. To accomplish these aims students must feel safe and the socialization and sense of belonging are the keys to this integration process [8]. So in this context the supervisory practices must be considered intimately related to the purpose. But a question arises, "what is the purpose of a PhD?" Is the product (original knowledge/ thesis) or the person/ process/ journey (research competence development and the autonomy as research)? [9].

2. Doctoral pedagogy and doctoral supervision – different faces of the same coin

Doctoral supervision can be considered a "form pedagogy" since being the time when supervisor must know how to teach a PhD student to become a researcher, and this is related to supervisory procedures and practices [10]. In this sense pedagogy is related to the development and the progress of the young apprentice/ learner, including his motivation to complete the degree, being the supervisor called to meet his needs [11]. But pedagogy can also be regarded "as the active, productive power relations between the student, the teacher (or supervisor) and knowledge" (Lusted, 1986 cited by Manathunga, Lant and Mellick, 2006), in this sense the characteristics of the relationship established between student and supervisor is crucial to define the pedagogy that will be developed [12, 13]. But if a mutually respectful relationship occurs, the doctoral pedagogy "must be supported by a flexible learning structure which enables modelling of scholarly practices and opportunities for scaffold participation and reflection" [14].

Doctoral pedagogies are also influenced by institutions that provide the context in which doctoral students do the degree [9, 15]. Departmental policies and disciplinary practices also influence the practices, and in this sense they influence and shape the students lived experience. McAlpine and Amundesen (2012) based on research evidences propose doctoral pedagogies that emphasis "what we think and value" and "not only what we do" [9].

Doctoral supervision can also be seen as a form of teaching in higher education and in this context a pedagogy is associated with it [16]. The applied pedagogy must have in account the diversity of students, not only regarding the background, experience, the culture, the social barriers, but also the economic and financial conditions of them (part-time students / full-time students). In this sense it is necessary a humanizing pedagogy that takes into account these factors during the PhD journey [16]. Khene (2014), presented some suggestion related to a humanizing pedagogy: based on the phase of PhD, she characterized the supervision practices and the activities she proposes.

Some generic doctoral pedagogies that can be identified: participating supervision meetings to receive guidance; making project plans and work time tables; writing research proposals or writing and getting feedback; making literature reviews; attending skills workshops, presenting/ participating in departmental seminars, attending conference and presenting papers; writing papers; participation in peer groups (reading and/or writing and/or motivation). Others doctoral pedagogies are particularly of a discipline, such as working in the laboratory or in a library, learning bench techniques or how to analyse data [13].

PhD can also be seen as a reading and a writing journey, where the students learn [17, 18]. And doctoral pedagogical model underlined is based on the fact that reading like writing are acts of meaning-making. And construction of the new knowledge is erected upon this making sense understanding. The supervision model that arises is the cognitive apprenticeship, and is developed based on a framework that as three dimensions: learning strategies, learning spaces and learning support [18].

The analysis to PhD logs permitted to have evidence that there are no rules to supervise and that depending on doctoral journey different supports are needed. Personal agency and responsibility are the keys to a good doctoral journey, but also the assumption of the department and the supervisory responsibilities. Another evidence from the research also points out the necessity of developing strategies that allows the integration of the cycle reading (thinking) – writing (learning) –feedback efficient [9, 17]. This implicates different supervisory practices, depending on the research backbone, and different writing strategies [9, 15]. As McAlpine and Amundsen refer "Doctoral pedagogies relating to writing need to be framed developmentally and integrate reading-writing-feedback" [9]. So, the role of publication with peer reviews is very important in doctoral education, and can have meanings. Low publications rates can be attributed to poor supervision and "as a problem in the quality of doctoral education" as Lee and Kamler refer [6]. A pedagogy of doctoral writing/publishing will help PhD students in the doctoral research process, not only by developing competences but also support them to make sense and re-contextualized their research work among the academy.

From research among interdisciplinary doctorate it was possible to perceive that the interdisciplinary doctoral pedagogy, presents four dimensions: "relational, mediated, transformative and situated learning experiences; to develop intercultural knowledge and skills; learning activities that enhance students' higher order thinking metacognitive skills; and research tasks that build upon students´ epistemological understanding of disciplines and interdisciplinary knowledge" [12]. This pedagogical approach has a holistic perspective of what should be a doctorate in a developed society.

3. PhD in Portugal a crossroad or a challenge to higher education- a reflection

The number of students enrolled in PhD in Portugal grown since the year 2000. On one hand, this may be related to the implementation of the Bologna Process with bachelor degree of three years, instead of four or five, as it was before bologna, on the other to the massification of higher education. The needs for financial support and the reduction of students (demographic consequence) may lead to the universities to invest in promoting the third cycle. Nevertheless, with the entries in the academic world closed to this population since the nineties of the twenty century, some challenge/problems grown. With more students entering in the third cycle, more supervisors were needed. However, the supervisors' courses were not developed or a condition to be a supervisor. So supervision maintained as a closed issue that were developed between the PhD student and the supervisor.

PhD in Science Education also accompanied the movement of grown, and in 2014 a maximum of students that complete the degree was achieved (Figure 1).
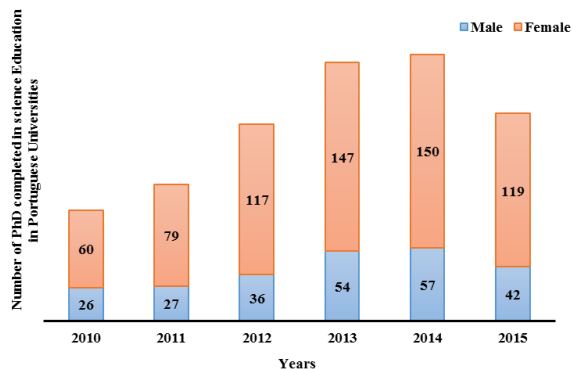
Figure 1. The number of PhD complete since 2010 until 2015 in Portuguese Universities. (Retrieved from RAIDES)

It should be highlighted that, in Portugal, there are more women concluding the degree than men, but also more women enrolled in the PhD.

The number of students that conclude the degree in Science education in the NOVA Lisbon University is lower (Figure 2).
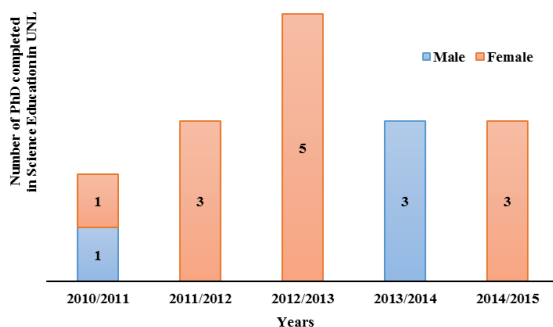

Figure 2. The Number of PhD completions since 2010/2011 until 2014/2015 in UNL. (Retrieved from RAIDES)

In 2010/2011 only two students finish the PhD; in 2011/2012, three students completed the PhD degree; in 2012/2013, five students concluded the PhD; in 2013/2014 three students acquire the degree; in 2014/2015 only three students accomplished the PhD degree (see Figure 2). Considering that in all these years, the number of students enrolled where approximately twenty, the attrition is a fact in this PhD. However, why it happens, what causes it?

With the goal of deepening knowledge about the doctoral student supervision experience in Portugal, two surveys were implemented in two different populations: PhD Science Education students attending an early researcher's event in which they were involved following their supervisors´ encouragement; and students that were enrolled in the Science Education PhD in a Portuguese University, UNL.

4. An exploratory survey applied in the meeting: "II National meeting of young researcher in education-Braga"

Trying to understand the causes of this attrition, an exploratory survey regarding PhD supervision was developed. The aim was to obtain data that allowed a first approach to doctoral supervision. The sample was PhD students in Science education that were enrolled in attending an early researcher's event in which they were involved following their supervisors´ encouragement.

4.1 Students' profile

The questionnaire was distributed to 74 doctoral students attending an early educational researchers' conference and 42 of them answered it. The PhD students (n=42) were mainly enrolled in public universities (90.5%) and only 9.5% in private universities. Seventy-one percent of the students were full time doctoral

students, but twenty nine percent were at the partial time. Twenty one percent of the students were in the first year, 29% were in the second year, 24% were in the third year of the doctoral program, 10% in the fourth year and 12% in fifth or more years (5% didn´t answer).

Concerning previous academic degrees, 4.7% specify that they already have a PhD, 71.4% refer that they have concluded a master, 7.1% refer the first-degree and 16.6% didn´t answer. The survey shows not only significant age diversity among the students (from 25 to 55 years old, with an average of 38) but also a significant diversity regarding professional experience: 42.9% were non-higher education teachers, 16.6% were FCT (national science and technology foundation) grant students, 11.9% were psychologists, 11.9% were students, 4.8% were sociologists, and 11.9% had other professions.

4.2 Survey items

The survey focuses on seven domains: Contact type; Feedback type; Work environment; Supervision monitorization (mechanism and instruments); Supervision practices; Autonomy development, students' perceptions about supervisor; supervisor engages in the supervision process. In order to answer the questions doctoral students had to agree or disagree with positive and negative statements. The scale's internal reliability was analysed by Cronbach's alpha, being 0.910.

4.3 Results

The results suggest that supervisors usually meet the students individually and regularly contact them by e-mail. The students perceive the regular feedback given by supervisors as important and good. Only 29% of the students work alone while developing the doctoral research project, and 76% share the sense of belonging to a research group, which indicates that they feel integrated within the research community. Typically, students do not monitor the supervision process: only 38% use a research matrix, 21% use a diary and 24% portfolio. The supervision practices comprise participation in workshops (95%), seminaries (60%), oral presentations (62%) and individual meetings (81%). Supervisors promote students´ autonomy, by encouraging not only them to write (93%) but also supporting research planning (86%) and management (88%). Students´ perceptions about the supervisor and his engagement with their doctoral research project show that supervisors are involved in doctoral research (95%), accompany students' progress by debating the research project (90%) and consider students competent (86%). These results of the exploratory survey clearly convey the general profile of the supervisor as quite near the ideal doctoral supervisor (Baptista, 2015) [19].

4.4 Final Remarks

The results of this exploratory study indicate that the age profile of doctoral students surveyed is similar to the one reported in previous research about doctoral students in Education [20, 21] (Alves & Azevedo, 2010), but in the current survey, 28.5% of the PhD students do not have full-time professional activity as they are researchers in the early stage (PhD students). Supervisor's availability is very well appreciated by doctoral students in both studies in contrast with the results presented by Baptista (2015) according to which mature students often refer to the lack of timely feedback and availability to schedule meetings [19]. This contrast might have different explanations: in the one hand, it might be due to a new type of PhD student profile in Education, but on the other hand, it might be a consequence of the fact that the questionnaire was distributed to students attending an early researcher's event in which they were involved following their supervisors´ encouragement.

5. A preliminary questionnaire applied at the Universidade Nova de Lisboa

The first survey was slightly modified; the number of sentences by domain increased in some of them. The scale was also changed and some sentences were rewritten to be clearer for the reader.

5.1 Students' profile

The population that answered in the survey where Science Education PhD students. The profile of these students is, particularly, since almost all of them are teacher in secondary school or in Portuguese higher school (Polytechnics), but none of them works at the Universities. 50 % of the students were full time doctoral students and 50% were at the partial time. Nine percent of the students that answer the survey were in the first year, 18% were in the second year, 32% were in the third year of the doctoral program, 18 % were in the fourth year of frequenting the PhD and 23% in fifth or more years. The survey shows not only significant age diversity among the students (from 25 to more than 50 years old) but a tendency of students with age higher than 40 years old (77 %) with an average between 45 to 50 years old.

5.2 Survey items

This new survey focuses on the same seven domains that were previously analysed (see 4.2): Contact type; feedback type; work environment; supervision monitorization (mechanism and instruments); supervision practices; autonomy development, students' perceptions about supervisor; supervisor involvement in the supervision process. But in some domains, there were more questions to give a better understanding of the students' perceptions.

In order to answer the questions doctoral students had to agree partially, agree, partially disagree or disagree, with positive and negative statements.

Regarding the scale´s internal reliability, Cronbach's alpha was 0.900.

5.3 Results

The preliminary results suggest that 73% of the supervisors meet the students regularly, but only 45% does it individually. It´s interesting to note that only 27% of the PhD students refer that each meeting with the supervisor, they made a registration of it. 73% of the supervisors give regular feedback, but 18% of the students refer that is unclear. 73% of the students´ felt that their supervisor have engaged with their research project, but 23% of the students refer that need more support. Supervision practices comprise participation in workshops (60%), seminaries (35%) and meetings with other PhD students (50%). It´s important to note that from the point of view of the students, 59% are encouraged by supervisor to publish their work, and 55% refer that supervisors encourage students to present their results in congresses or conference. Students do not monitor the supervision process: only 5 % use a diary, 10% do written reports, and 5 % use portfolio.

Not all supervisors promote students´ autonomy and trust student to manage the doctoral research. Only 55% of the PhD students perceive that his/her supervisor consider them competent and capable to take decisions about the PhD research. Only 23 % of the students plan and guide is one PhD research project, but about 50% refer that they plan the research PhD with the supervisor. Considering that this particular PhD is a three year PhD, students in full-time enrolment, in the third, fourth or more years should be able to plan the research process which demonstrate their autonomy development – they are 27% of our sample. Considering the partial-time students, PhD students with more than four years of enrolment (9%) should be able to plan the research. If only 23% of students plan and guide their PhD research process, 13% hadn´t yet develop their autonomy, and they are not yet capable of doing independent research. Which is one of the attributes that a doctorate should have to obtain the PhD degree. This is explicitly referred in the Portuguese law publish in "Diário da República", 2nd series - n.º 59 of March 25 of 2010, in the PhD Regulation n.º 295/2010, Article 2 (c), with the following text: "Capacities for the design and conduct of an investigation respecting the requirements imposed by international quality standards".

Socialization process and the sense of belonging to the academy, which indicates that they felt integrated within the research community is not felt by all students: only 55% of the students refer that supervisor encourages them to participate in meetings with other PhD students and 68% refer his/her supervisor encourages them to participate in work meetings with other research. It should be highlighted that 27% of the students consider that the PhD is a solitary process, and 55% partially agreed with that statement.

These results suggest that some change must be done not only to allow the socialization and integration in the research community but also to support students in the research. This conclusion reinforces the conclusion obtained by Baptista in 2015 [19].

5.4 Final Remarks

The results of this preliminary study indicate that the age profile of doctoral students surveyed is analogous to the one reported in previous research about doctoral students in Science Education in UNL, indicating that we are in the presence of mature students [19 - 21]. Although 73% of the students' have the perception that supervisor's availability is good, 18% of the students reported lack of timely feedback and availability to schedule meetings. This contrast might be a consequence of the fact that the questionnaire was distributed to students by institutional e-mail, which implies that students contact regularly with the institution (feel connected in some way), but don´t contact regularly with the supervisor.

6. Conclusions

The results reveal same similarities regarding the reduce monitorization of the research process by students, supervisor feedback, students´ perception about supervisor but, also, some differences about the supervisor engagement with students' projects, include them in the research fields' area as well as in the autonomy development.

In both cases the results suggest that some change must be done regarding the monitorization of the research process once doctoral students in both situations don't use instruments to plan, monitor or evaluate the doctoral research progress.

These results give some clues related to some of the strategies that can be used to help reduce the attrition. One is to monitor the research process by the students, which is not done by them. Another is related to the socialization process, which include participation in the group and department activities as research group meetings, seminars, workshops, lessons, which is not clear if it appends.

Further developments of these explanatory surveys aimed at a broader sample of doctoral students will enable to better understand these results, regarding the PhD students of UNL.

7. Final remarks

The lack of students' research monitorization is significant in both studies reported, and this may lead to attrition and higher time to complete the PhD.

To contribute to a better PhD research process some authors based on research evidences gave suggestions regarding instruments that support students during the PhD. These strategies and instruments may facilitate the doctorate monitorization, but they are not a rule. The progress logs allow students to monitor their research process and evaluate it; the cycle reading-writing-feedback can also help students to structure and reconstruct the research work [9]. Others instruments that can support doctoral research are the conceptual maps, that facilitate the research structure design, and the connection between concepts. The usage of the conceptual framework in the doctoral research process, can be used to monitor the research process since it allows a prospective but also retrospective look to the research work that is being developed [22, 23].

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