

STUDIES ON UNDERGRADUATE RESEARCH IN BRAZIL: A REVIEW

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ABSTRACT

This article presents a review of published studies on undergraduate scientific research in Brazil, based on a survey of academic publications related to this theme. Covering the period from 1983 to the first half of 2007, the examined literature offers useful information for understanding the current stage at which important questions relating to undergraduate research find themselves. The results show an emerging field of study and how it has been academically approached are here described.

UNDERGRADUATE SCIENTIFIC RESEARCH – LITERATURE REVIEW – HIGHER EDUCATION – CHEMISTRY

The definitions of undergraduate studies, as presented below, supply clues as to the application of this concept within the scientific context and allow us to consider scientific undergraduate research (USR) as a process in which knowledge is supplied that is

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indispensable when it comes to starting young people in the practices, techniques and traditions of science: “The act of giving or receiving the first elements of a practice or the rudiments of an area of knowledge. e.g. undergraduate scientific research (Houaiss, 2007).

From this perspective the USR concept has been developed in Brazilian universities as an activity carried out during the undergraduate period, in which the student is initiated into the “game” of science and gains experiences that are linked to a research project, prepared and developed under the guidance of a teacher (Simão et al., 1996).

Surprisingly, despite the wide disclosure of USR activities in Brazil, there are few studies on the subject. This work seeks to prepare an integrative summary about USR, based on an analysis of the dissertations and theses presented in post-graduate programs in Brazil and in articles published about the matter. To do so, we carried out a bibliographic study that undertook an examination of the work published about the theme from 1983 to the first semester of 2007, using the following databases: the Capes [*Coordination Agency for Further Developing University-educated People*] Theses database, the Digital Thesis and Dissertations Library and the Capes periodicals website.

Below we present a brief history of the institution of USR and how it functions in Brazilian universities and point out some of the characteristics of the research whose field of investigation is USR.

THE INSTITUTION AND FUNCTIONING OF UNDERGRADUATE SCIENTIFIC RESEARCH IN BRAZILIAN UNIVERSITIES

Recognition of the strategic importance of science and the need to institutionalize the action to encourage and foster research led to the creation of the Brazilian National Council of Scientific and Technological Development (CNPq) in 1951. Thus started the funding of USR activities, through the granting of annual scholarships to foster undergraduate research, “although, in practice, an incipient research activity already existed, with the students helpers of the 1940s and 1950s” (Bariani,1998). The CNPq, however, is not the only body fostering undergraduate research. The Research Protection Foundations (FAPs), which exist in some states in Brazil, also fund USR.

The funding of USR activities found backing in the University Reform Law of 1968 (Article 2, of Law 5540, of 11/28/1968), which determined the principle of the “indissociability of teaching-research” as a “disciplining rule of higher education” (Maldonado, 1998). This association was later incorporated into the Constitution of 1988 and consequently into the new Guidelines and Bases of National Education Law (Law 9394, of 12/20/1996).

According to Bazin (1983, p.82), “to create the Undergraduate Scientific Research Program, Brazilian universities sought inspiration in countries that already had an institutionalized scientific activity: the United States and France”. In the USA, the Research and Development program involves science and engineering students in the production of a thesis related to departmental course activities in their final undergraduate year. In France, a less formal activity consists in a period being spent as a trainee in a university or industrial laboratory, following which the student presents a final report.

Data relative to USR scholarships given by the CNPq (Brasil, 2007a) show a marked increase in the number of scholarships distributed between 1963 and 2005. Currently, the number of USR scholarships is considerably greater than the number of scholarships for other purposes being awarded by the CNPq (Brasil, 2007a), which highlights the importance given to USR by the body. Marcuschi (1996) considers the 1970s and 1980s as the period of the “installation and strengthening of research and post-graduate studies”, and the 1990s, the period in which we saw a growth in the number of scholarships, as the phase of “attributing value to” USR, defined by Martins and Martins (1999), as the “USR period”.

USR scholarships on spontaneous demand, or “over the counter”, could only be distributed following a direct request from a researcher. Requests were judged by Advisory Committees and awarded by quotas to researchers, who then chose those who would receive a scholarship. In 1988 the CNPq created the Undergraduate Scientific Research Scholarships Institutional Program (Pibic), an additional fostering instrument, by which USR scholarships started being granted directly to Institutes of Higher Education (IHE) and to Research Institutes (RI), which were responsible for directly managing the granting of these scholarships. The IHEs and RIs have the quotas under their administrative control and must create their own devices for distributing them, as well as annually promoting “a meeting, in the form of a seminar or congress, where scholarship holders must present their scientific

production in the form of posters, summaries and/or oral presentations”, with their performance being assessed by the Pibic Institutional Committee (Brazil, 2007).

So far the CNPq has carried out two evaluations of the Pibic, “with the aim of obtaining information that will help with the definition of parameters for more detailed planning of the program”, as Neder (2001, p.33) says: one qualitative assessment (Marcuschi, 1996) and another that was quantitative (Aragon, Martins, Velloso, 1999). The results of this research indicate that scholarship holders are predominantly female (51%) and have an average age of 23.6; those in the Human Sciences areas are older and the last to become scholarship holders, while Engineering scholarship holders are younger and the first to win scholarships, taking on average 1.9 years between entering university and entering Pibic.

Despite the considerable increase in the number of USR scholarships over the last few years, the CNPq recognizes that the number awarded “is minimal”, given the installed tutoring capacity in the country and the number of students in higher education, which has already reached more than 1.6 million in total” (Marcuschi, apud Neder, 2001, p. 79). Another relevant aspect is the heterogeneous distribution of scholarships by region in Brazil: 47.5% are awarded in the southeast, 21.6% in the northeast, 17.8% in the south, 8.1% in the mid-west and just 5% in the north (Neder, 2001). Between 1989 and 2000, there was an increase in the number of scholarships in the northern, mid-western and southern regions and a significant increase in the south-eastern region. Neder (2001) argues that this heterogeneity only represents the tutoring capacity of the regions and highlights the relation between these data and the number of institutions involved in the program in 2000.

The limited reach of the program is a constant criticism of USR, because this restricts activity to the “best students”. In interviewing professors from the State University of Campinas Bridi (2004, p. 79) saw that the limited number of scholarships makes USR a “selective activity that benefits few and discriminates against many, apparently favoring the most ‘skilled’ and ‘promising’”. Another recurring criticism of the USR model proposed by the CNPq, and applied in most universities is that, in addition to the restrictions imposed on students, some IHEs, mainly the private ones, are also excluded from the process. Bazin (1983) argues that the historical bases of the establishment of USR in universities, defined as being a “selected” and “elitist” activity, have contributed to limiting it “in practice to universities where there is research”.

In private higher education institutions (PIHEs) few professors dedicate themselves to research (because of the characteristic of the universities and their work regimes) and consequently the number of students involved in USR is very small. Despite this picture, USR activity is not fully excluded from PIHEs. In 2006, 1880 Pibic scholarships were awarded to these institutions, the equivalent of 10.5% of the total. It is worth highlighting the work of the Pontifical Catholic Universities (PCUs) that received the largest number of scholarships of all the PIHEs, 34.3% (Brazil, 2007b).

RESEARCH INTO UNDERGRADUATE SCIENTIFIC RESEARCH IN BRAZIL

Our bibliographic survey indicates that little research about USR activity has been done in Brazil. In fact, a little over 10 years ago Marcuschi (1996) was already drawing attention to this situation when he said that “there are very few institutions that have already carried out any kind of survey among scholarship holders to know what they think about the program”. Since then the picture has remained practically unchanged.

On the theme in question 6 doctoral theses, 11 Master's dissertations and 4 complete articles published in national journals were located. Reading this collection of documents allowed us to locate 6 other works in other journals, such as *Ciência e Cultura* [Science and Culture], *Biológico*[Biological], *Integração Ensino-Pesquisa-Extensão* [Teaching-Research-Extra-Curricular Further Studies Integration], *Estudos e Debates* [Studies and Debates], *Educação Brasileira*[Brazilian Education], *Brasília e História* [Brasilia and History] and *Ciências e Saúde* [Science and Health], and some works presented at the National Association of Educational Policy and Administration (*Anpae*) and the National Association of Post-Graduate Studies and Research in Education (*Anped*).

Most of the work was published in the form of a dissertation or thesis, and came from different institutions in various states in Brazil. Some pieces of work related to more than one course or did not determine the courses researched, because they intended to establish a general profile of the IHEs. In some cases the work was based on an analysis of documents provided by the CNPq and the course was not specified. In only two pieces of work did the institution investigated not coincide with the one where he the post-graduate work was defended.

The theses and dissertations on USR that were located were produced between 1990 and 2004, most of them after 2000. Most of the studies on USR were developed at Unicamp (Bariani, 1998; Melo, 2003; Fior, 2003; Bridi, 2004), the University of Brasília (Neder, 2001; Carvalho, 2002) and the Federal University of Santa Maria (Oaigen, 1990, 1995). Generally speaking, the undergraduate courses investigated are located in the southeast (58.8%), south (23.5%) and midwest (11.8%) and only one in the northeast (5.9%). Most belong to public institutions, with only four are in private universities (23.5%). Humanities courses were the most investigated (35.3%), followed by courses in Biological Sciences (17.6%) and Pure Sciences (11.8%). Psychology courses were focused on by three separate investigations and were, therefore, the most investigated (Bettoi, 1995; Bariani, 1998; Breglia, 2002). All the articles that were published in the journals mentioned above are listed in chronological order in Table 1.

TABLE 1
ARTICLES PUBLISHED ABOUT UNDERGRADUATE SCIENTIFIC RESEARCH IN BRAZIL

	Author and title	Publication and year
1	BAZIN, M. J. <i>O que é a iniciação científica</i> [What is undergraduate scientific research]	<i>Revista de Ensino de Física</i> , v.5, n.1, p.81-88, 1983
2	ZAKON, A. <i>Qualidades desejáveis na iniciação científica</i> [Desirable qualities in undergraduate scientific research]	<i>Ciência e Cultura</i> , v.41, n. 9, p.868-877, 1989
3	CAMPOS, L. F. L.; MARTINEZ, A.; ESCUDERO, R. M. P. <i>Perspectivas de alunos sobre sua iniciação científica</i> [Student perspectives on their undergraduate scientific research]	<i>Integração Ensino-Pesquisa-Extensão</i> , n.14, p.179-182, 1998
4	SILVA, R. C.; CABRERO, R. C. <i>Iniciação científica: rumo à pós-graduação</i> [Undergraduate scientific research: on the way to post-graduate studies]	<i>Educação Brasileira Brasília</i> , v.20, n.40, p.189-199, 1998
5	MARTINS, R. C. R.; MARTINS, C. B. <i>Programas de melhoria e inovação no ensino de graduação</i> [Improvement and innovation programs in undergraduate teaching]	<i>Estudos e Debates</i> , n.20, p.189-221, 1999
6	QUEIROZ, S. L.; ALMEIDA, M. J. P. M. <i>Do fazer ao compreender ciências: reflexões sobre o aprendizado de alunos de iniciação científica em química</i> [From doing science to understanding it: reflections on learning from undergraduate scientific research students in chemistry]	<i>Ciência e Educação</i> , v.10, n.1, p.41-53, 2004
7	BECCENERI, J. C.; KIENBAUM, G. S. <i>A iniciação científica e o programa espacial brasileiro</i> [Undergraduate scientific research and the Brazilian space program]	<i>Integração Ensino-Pesquisa-Extensão</i> , n.47, p. 377-385, 2006

Regarding the works investigated, in addition to their contributions to understanding USR activity in Brazil, which will be discussed below, it is also important to mention the data collection methodology employed in the majority of them: questionnaires completed by USR scholarship holders, under-graduate students who do not have scholarships, former

scholarship holders who have graduated and professor-tutors. Another instrument, similar to the questionnaire and also widely used, was the semi-structured or open interview, usually conducted with pre-selected subjects at the questionnaire stage.

CONTRIBUTIONS OF THE RESEARCH INTO UNDERGRADUATE SCIENTIFIC RESEARCH IN BRAZIL

Analysis of the works investigated allowed them to be classified with respect to their contributions to the understanding of USR activity into three distinct segments, which will be discussed at a later stage:

- Assessment of USR as a university training activity;
- Assessment of PIBIC with regard to the objectives pursued by the program;
- Characterization of some of the peculiarities of the development of USR activity.

Assessment of USR as a university training activity

Breaking the dichotomy that has historically existed in Brazilian higher education, between theory and practice, teaching and research, and undergraduate and post-graduate studies, has been discussed for a long time by many researchers (Demo, 1997; Peixoto, 1992). The difficulty in relating research and teaching at the undergraduate level goes back to the fact that some professors differentiate between the classroom and the research space. As a result, undergraduate studies are still an area for the reproduction of knowledge rather than its production, while the research area is much more highly valued and changes the behavior of professors in their preparation of routines, in their relationship with students and in the investments made. From this perspective the creation of USR in universities emerged as a possibility for developing closer and stronger relationships between teaching and research, theory and practice and undergraduate and postgraduate studies (Bernardi, 2003; Caberlon, 2003, Damascus, 1999, Alma, 2003). The integration between teaching and research promoted by USR is effective because it allows

for the construction of a two-way street between teaching and research and goes beyond establishing an interdependence relationship between them: it also gives new meaning to undergraduate teaching, when it views the classroom as yet another area for acquiring knowledge (Breglia, 2002, p.64)

USR, therefore, represents "an excellent educational tool that moves between research and teaching" (Bridi, 2004). This association can be visualized "through the information that students bring to research from other disciplines, by means of the information and data produced by scholarship holders which are used in the discipline and even students compiling samples for investigation" (Maldonado, 1998, p.87) .

Undergraduate performance

Many authors argue that USR scholarship holders perform better in their undergraduate courses (Leitão Filho, 1996; Caberlon, 2003; Aguiar, 1997; Bridi, 2004; Breglia, 2002; Pires, 2002). This is because USR students develop new learning strategies; as a result of their research experience they "learn how to learn" (Aguiar, 1997). In the view of Adams (1996, p.22) "it seems clear that scientific research can be an excellent educational tool to the extent that it helps students cope with the knowing process and not just the product of this process.". From this learning they feel motivated to "fulfill their main function, which is to study. Research gives study a sense of *learning*. This fact is recognized by tutors, professors, scholarship holders and students "(Pires, 2002, p. 104). So USR allows "better advantage to be taken of the undergraduate course, which becomes more valued" or "better advantage to be taken of undergraduate disciplines, thereby broadening the scope of analyses and the teaching content" (Caberlon, 2003). In addition, USR provides "comprehensive training", "because of the possibility of acquiring scientific and specific knowledge" (Bridi, 2004).

Breglia (2002, p. 83), in his interviews with professor-tutors, noted that they see USR as "an activity that can motivate the student in the classroom, and provide a broader view of the course, a greater basis for prior knowledge and clarify concepts and theories." These findings confirm the data analyzed by Aguiar (1997, p.88), according to whom "for many students, USR has in some way reduced their dissatisfaction with the curricular structure of their undergraduate course." Their complaints are centered mainly on the curricular structure, on

excessive content, on how little this means in their presentation and on the prevalence of lectures.

Personal Development

With regard to personal development, the research indicates some of the "qualities / skills" "aroused" by the practice of research and "internalized" for future professional life, "whether as a service provider or in academia, especially" (Maldonado, 1998), among which are reasoning / critical thinking, autonomy, creativity, maturity and responsibility (Calazans, 1999). The authors also emphasize that USR favors the "intellectual evolution of the student", the "development of the student's interpretative, analytical, critical and contributory skills" (Caberlon, 2003), "induces scholarship holders to form their own judgment, to become masters of their work and form their own opinion" (Pires, 2002, p.130), and it improves "leadership skills, ease in interpersonal relationships and the development of altruistic values" (Fior, 2003).

The work of Bazin (1983) pays special attention to the development of autonomy that is provided by USR. He believes that in high school the student's position is "extremely dependent and obedient", while in higher education there is a "break", which consists in liberating students from their attitude of asking the teacher "is this what you want?" to calling him into the room and saying to him "look what I found, what I discovered."

Pires (2002, p.117) realized that in university culture the "USR program ends up becoming a status symbol that is going to attract an increasing number of students / candidates." This status is revealed in the interviews conducted by the researcher through phrases like "being considered good at what you do" and "making people see you in a different light", which suggests that this activity promotes the self-valuing and self-esteem of the scholarship holder, "recognized by him in the look of another, projected onto the other. "

New vision of science

Some authors indicate that USR enables an understanding of "doing science", by destroying the myth of the act of research, an understanding of the role of the scientist, "

participation in the construction of scientific knowledge, an appreciation for research – satisfaction in producing research work and the construction of a sense of what research is.

Among the works that have paid most attention to the contribution made by USR, we highlight that of de Queiroz and Almeida (2004) and of Aguiar (1997). The first conducted a qualitative, ethnographic-type study with USR scholarship holders in chemical laboratories and concluded that:

... the "immersion" of the students in the research laboratory, which allowed them to become acculturated "to laboratory life", brought great benefits to the formation of each of them, to the extent that it took them out of the same old story of concluding a chemistry course without having any real notion of how chemistry is practiced and without having the chance to question concepts that are so deep-rooted in society about the role of the scientist and how science is practiced. (Queiroz, Almeida, 2004, p.53)

Aguiar (1997, p.94) questioned USR scholarship holders regarding their conceptions about science and scientists: 65.5% said they knew nothing about the science environment before doing USR, and "some found their previous conceptions about science were distorted, but subsequently modified as they had greater contact with it through USR" (34.5% of those interviewed).

Professional socialization

Aguiar realized that when asked about their scientific work, USR students did not limit themselves to declaring the number of papers they had produced and presented; they showed just how satisfied they were with making this stage of their scientific activities a reality.

The student is happy to see his work published and presented to their USR colleagues, post-graduate students and professors. This is a route to professional socializing, because he begins to be recognized and respected by colleagues and members of the laboratory and the department to which they belong. (1997, p.99)

Professional socialization is "the experience of direct contact with his tutor, post-graduate students and other undergraduates with their various professional experiences". In this context, the professor getting closer to the student is discussed by many authors as

extremely beneficial for both parties, since this contact is not only restricted to discussing the project being developed; a close relationship with the tutor contributes to an exchange of information and personal experiences.

In addition to the tutor, living and working alongside other people in the group also contributes to professional socialization and favors the good development of USR activities. In a survey of Biological Sciences students from the Federal University of Rio de Janeiro (UFRJ), Aguiar (1997, p.72) discovered that "student tutoring is also shared with other members of the laboratory, including associate professors and post-graduate students". This process was termed by the author as "cascade tutoring", "the head of the laboratory and the associate professor tutor post-graduate students, and post-graduate students tutor undergraduate scientific research students", despite the head of the laboratory sharing in USR student tutoring, he remains ultimately responsible for it.

Evaluation of PIBIC with regard to the objectives of the program

Within the scope of the CNPq, as the research support agency in Brazil, it is quite clear that the objective of USR is:

... to awaken the scientific vocation and to encourage potential talent among undergraduate students through their participation in research projects, *preparing them for post-graduate studies; to contribute decisively to reducing the average time for completion of their Master's and PhD studies.* (Smith, Cabrero, 1998, p.193, our italics)

This objective appears, among other places, in the evaluation documents produced by the CNPq, in its attempt to check the destinations of former scholarship-holders and the time they started and completed their post-graduate studies. Cabrero, Costa and Hayashi (2006, p.6) compare the "trajectory of Master's and PhD students" in the USA, who finish their PhDs between the ages of 28 and 32, with the trajectory taken by Brazilians who, in 1995, "were defending their theses at 40, on average", and highlight the need to alter this aspect of Brazilian post-graduate courses; "a mechanism that has contributed a lot to changing the picture was the granting of scholarships for undergraduate scientific research". An Information Bulletin from Pibic states that

...in the sense of contributing to reducing the time that Master's students and PhDs take to get their titles the CNPq has been investing massively since the 1950s in undergraduate scientific research, arousing in young university students a new mindset with regard to research, enabling them to learn new techniques and scientific methods. (apud Cabrero, Costa, Hayashi, 2006, p.6-7)

Neder (2001) in an extensive evaluation of USR as a CNPq development activity, believes that "Pibic has been showing the effectiveness of USR in training future researchers" and "the motivational power it exerts over IHEs in the expansion and consolidation of research centers". These data are confirmed by the research of Aragon, Martin and Velloso (1999), which was commissioned by the CNPq, in which it was revealed that a former Pibic scholarship student is six times more likely to start a post-graduate course than a non-scholarship holder graduate. This is because "3 in every 10 Pibic scholarship holders reach the Master's degree level [...] the average transition period between graduating and starting a Master's degree for a former Pibic scholarship holder is 1.2 years", while for non-scholarship holders it is 6.8 years, on average (Aragon, Martin, Velloso, 1999, p. 34, 36).

Besides data from the CNPq it is also worth noting the work of Cabrero, Costa and Hayashi (2003), the result of research carried out at the Federal University of Sao Carlos. This work shows that approximately 60% of those graduating after a Pibic scholarship look to do a Master's degree in the same institution and that "in terms of preliminary research, it is believed that over 40% of those graduating from Pibic/UFSCar, whose scholarship ended between 1994 and 1998 defended their Master's dissertation and / or PhD thesis "(Cabrero, Costa; Hayashi, 2003, p.10).

Maccariello, Novicki and Castro (1999) investigated USR at the State University of Rio de Janeiro (UERJ) and highlighted the number of former USR scholarship holders who entered post-graduate programs as an indicator of the success achieved by Pibic. They said that a preliminary survey (1997/1998) found that 22% of the students who graduated from UERJ and who enrolled in post-graduate programs at the same university with holders of USR scholarships.

Camino and Camino also reported encouraging data about Pibic results and the spontaneous demand ("over the counter") for scholarships at the Federal University of Paraíba, a process which started in 1988. Comparing the years 1985 and 1993 the authors observed a decrease in the age for admission to a Master's degree course from 30.6 to 28.4; the percentage of theses defended increased from 20% to 87.5%, and the duration of the

Master's degree process reduced from 3 to 2.5 years. Furthermore, the average number of student publications is 1 per student and participation in congresses is 2 per student. The authors justify these indices by the fact that "many of today's students are beginning to disclose what they produced while a USR scholarship holder". They point out that

... if on the one hand, students are starting their Master's degree very much younger and practically as recent graduates, on the other hand, thanks to the experience gained in research activities during the scholarship, these young people are proving more productive and guaranteeing that their dissertation is defended in less time. (1996, p.51)

There is no denying that the USR directs scholarship holders towards the academic life and allows them, in a unique way, to experience this possible professional activity option, even before they have graduated. In general, the contribution of USR to the formation of the researcher is reflected in the student being directed towards post-graduate studies and in the quality that is added to post-graduate courses. Guimarães (1992, p.29) argues this point by saying that scholarship holders "who go on to do post-graduate studies are going to more than compensate for this by reducing the average time it takes them to get their title, by having lower dropout rates, by by-passing the Master's degree as a mandatory step towards a PhD and by a noticeable qualitative improvement in experimental work". Leitão Filho justifies the "time saving" resulting from the USR experience

.. because of the previous training that made them familiar with basic techniques of bibliographic consultation, scientific methodology, use of laboratory equipment and informatics and greater fluency in reading foreign languages. Besides these advantages, USR scholarship holders are normally already familiar with and involved in the thesis project, which represents a not inconsiderable advance. (1996, p.21)

According to Campos, Martinez and Escudero (1998), 53.13% of the students "see USR as an opportunity to start a career as a researcher". Bridi (2004, p.71), through questionnaires distributed among teachers, identified that "42.8% reveal an understanding that the greatest contribution of USR comes in relation to postgraduate education, in terms both of 'directing students towards it/ entering it' as well as 'facilitating / speeding up' their development". Neder (2001), in an analysis of USR results published by the CNPq, observed that, of the scholarship holders interviewed, almost 100% considered it to be important or

very important to participate in the Pibic, “seen as an 'instrument' for professional practice in academia”, and for more than 50% of the respondents “participation in Pibic represented the opportunity to be introduced to research activities”. Researchers interviewed by Oaigen (1995) cite participation in USR activities as “facilitating aspects for training as a researcher” (p.116), and “important moments in their student life that marked the time when they defined conducting research professionally” (p.131). According to Breglia (2002), 76.9% of those interviewed chose to respond positively when questioned about the influence of USR on their choice of professional activity. Pires determined that USR contributes to the prospect of the student continuing with their training after graduating because:

... it represents a tool for the scholarship holder for decision-making, helping him define a course and develop strategies in the vast and diversified curriculum of undergraduate courses; it makes it possible for the scholarship holder to follow the example of his tutor as a reference point for building his own professional future, influencing him to enroll directly in the Master's course, or even for a PhD; it creates the perception in the scholarship holder that he is more likely than the others to deliver a concrete project outcome after his course and become more competitive; non-scholarship students also make plans to enter a post-graduate course, but many do not yet know how to do a Master's degree or why they should; it allows the scholarship holder to create a link between different areas – that of the course and of the project, thus opening up a range of training possibilities for the future exercise of any profession. (2002, p.131)

By interviewing undergraduate scholarship holders, non-scholarship students and Master's degree students, Camino and Camino (1996, p.62), perceived that “the profile of the undergraduate student, a USR scholarship holder, is similar to that of the Master's degree student. This similarity seems to indicate that changes in attitude are determined not by the level of training, but by research practice”. As a result of his analysis, Carvalho (2002) indicates that “contact with research activities and the relationship with the tutor involve scholarship holders in the functioning logic of the scientific field, leading them to develop an interest in continuing with an academic career”. The data also suggest that the interest to follow a career in science tends to be greater for scholarship holders who participate in research being conducted by the tutors, indicating that the best understanding of the scientific field, its rules and its possible “symbolic profits” favors developing an interest in the area; in other words

.. participation in already well-established research seems to lead to a better understanding of the various possibilities of the scientific field, such as achieving satisfactory results, publishing opportunities, participation in events and social recognition, among others. (Carvalho, 2002, p.152)

Despite moving on to post-graduate studies being one of the main objectives of USR, and therefore being the main contribution of this activity indicated by the research, many authors also highlight the contribution of USR to the professional activities of scholarship holders outside the research environment. In an interview with professor-tutors, Breglia (2002) saw that for them, “research experience is a differential for what they call the ‘labor market’ and he emphasizes that from this perspective USR “is seen by professors as a possibility for working and learning without the competitive climate and constant pressure of a traineeship”.

Maldonado (1998, p.118) points to professionals, who were former scholarship holders, being led towards post-graduate courses “early on” as the main contribution of the USR activity. She says that “its main contribution is in raising awareness of research, with all the by-products involved, such as developing the capacity for reasoning, for abstraction, for problem creation and for thinking critically, in other words, the development of scientific *habitus*”. So USR also contributes to the professional practice of those students who do not pursue an academic career.

Characterization of some peculiarities of the development of the USR activity

Although official programs provide the main guidelines for the development of USR in universities, there are some differences in how these guidelines are followed - at least in the IHEs that have been the target of investigation in recent years and that have had some features of their USR programs disclosed in dissertations, theses and scientific papers. These differences reveal that, despite following the official procedures, the development of work is determined principally, or almost exclusively, by the tutor, who defines the different ways the research should be carried out with regard to the type of activity, selection of the scholarship holder, difficulties encountered, etc.

Scholarship holders do not always have experience of all stages in scientific research, which includes the bibliographic survey, preparing the research project, conducting experiments aimed at collecting data, analysis and discussion of results, etc. Caberlon (2003)

estimated the percentage of participation of scholarship holders in the different stages of scientific research and pointed to the existence of a concentration of USR students in activities such as “bibliographic review”, “data collection” and “tabulating data”. There are few who participate in preparing the “theoretical reference point” or the “systematization and evaluation of results”.

Furthermore, Simon et al. (1996) recognized two “models” of student inclusion in the research developed by the group coordinated by the tutor: the “individual project” and the “integrated project”. In the “individual project”, professor and student begin by discussing a research problem and, thereafter, the student participates in all the preparation stages of the research project. In the “integrated project”, the student engages in some already existing project in the professor’s research group, thereby effectively developing parts of some ongoing research and having, therefore, access to knowledge of the whole. The authors pointed out that “in some cases, the student engages in an integrated project initially and then, based on issues arising, begins to develop an individual project” (Simon et.al., 1996, p.112). Initial inclusion in an “integrated project” frequently serves as a way of checking the intention and persistence of students in carrying out research; subsequently, the request for a scholarship for this student is made on the basis of an “individual project”. Carvalho (2002) also investigated this issue and, data taken from research conducted by the Center for Research on Higher Education of the University of Brasilia (Nesub / UnB) found that 51.9% of all USR research projects were part of the tutor’s larger research, 35.1% were individual projects linked to the tutor’s own research, and only 13% were individual pieces of research and not tied to the tutor’s own research.

Research Motivation

Campos, Martinez and Escudero (1998), from their interviews with 28 university students from a IHE in the State of São Paulo, who were enrolled in non-governmental USR programs, perceived that, generally speaking, scholarship holders feel very motivated to participate in USR (68%) and point out that there is a lot of (36%) or an extreme (50%) need for research and knowledge production in their particular study area. Aguiar (1997) investigated USR students from the Federal University of Rio de Janeiro, who were enrolled on Biological Science courses, and the results confirm the high levels of motivation found by

Campos, Martinez and Escudero (1998). According to the author “70.1% of the students sought to do USR on their own initiative and a smaller percentage was invited by a professor (29.9%) or a member of the laboratory” (Aguiar, 1997, p.63).

Other authors investigated the possible reasons that lead students to participate in USR programs: “complementing undergraduate education” through the “search for / expansion of knowledge” (Caberlon, 2003); the development of “skills in the undergraduate course area”; “investment in their undergraduate education” (Pires, 2002), and the possibility of “living alongside researchers in a family environment” (Maccariello, Novicki, Castro, 1999). Also mentioned was a “certain dissatisfaction with the linear relationship of the classroom when it comes to transmitting knowledge” (Maldonado, 1998) and the search for “finding out what research is all about” (Caberlon, 2003) and “starting down the path towards post-graduate studies” (Aguiar, 1997). To a lesser extent, appear the importance of the activity “for the résumé” (Aguiar, 1997); the “possibility of contributing to society” (Caberlon, 2003) and “forming a professional attitude” (Maldonado, 1998).

In his research Pires (2002) pointed out that only 2% of the interviewed students looked to USR “just as a source of income”. This result is consistent with other research that indicates funding as not a factor that determines whether students become involved with the project.

Selection of the research student /tutor

Among the research projects that determined the selection criteria of the research student/tutor, the number that focused on the selection criteria of the tutor is smaller. Pires (2002) perceived that research students choose the tutor “because of the research subject (33.3%) or the line of research (21.6%)”; only 33.3% said they had been “sought out / invited by the tutor”. The author believes that there “are the volunteers, those students already engaged in the research group of a certain project of a tutor who, when there is need for some replacement, recruits one of these volunteers” (p.79). The only work that investigated the criteria for selection of the tutor was that of Zakon (1989), who questioned both the scholarship holders as well as the professors on the desired profile of the tutor.

The two groups coincided with regard to the following attributes: being accessible, being sincere and friendly, motivating research and knowing the research subject. Those

setting out on the process want the tutor to be communicative and didactic, to inform the student about research and train him in how to carry it out. Tutors highlight the desirable profile characteristics of the tutor as being: taking an interest in the student formation process and designating work/a project to each student. Zakon (1989) also questioned tutors and scholarship holders with regard to the desirable profile of the student and obtained the response: interest in the work developed, responsibility and available time. Students give more priority than tutors to own initiative and knowing how to organize activities, thoughts and texts. In their turn, the professors indicated wanting students to have a research vocation (the capacity to observe, discern and propose solutions), intellectual characteristics (curiosity, willingness to learn, creativity, facility to learn, intelligence), dedication to undergraduate research activities, persistence in research and the capacity to live and work alongside others (communicate, hold dialogue and participate). Therefore, “being a good student (with better than average marks)” is not a highly valued aspect in the statements from both groups, despite being expected by the research development bodies.

It is interesting to see that the data collected by Zakon (1989) 20 years ago from tutors and research students in the Chemistry and Chemical Engineering area fully coincide with the results obtained in the more recent research by Perrelli and Gianotto (2005) carried out with 40 Biological and Health Sciences professors. According to these authors, in their choice of undergraduate research students in the scientific field, professors value competences like the “capacity to take decisions and solve problems on their own”, but do not consider “mastery of specific material in their research area” as being so important.

Simão et al. (1996) determined that the selection of students for USR is done on the basis of the undergraduate courses given by the professor-tutors. Often “teachers even give their courses with a view to suggesting research possibilities to the students” (p.112). Maldonado (1998) perceived that, in general, the selection is done by interview with those intending to do research. In these interviews the tutors mentioned as criteria: how long the student has been studying - some prefer to take them at the beginning of the course because they have more time, while others prefer it to be later, because they have already been studying the discipline of the teacher-tutor for some time; the return coefficient, which is usually important, but not definitive; mastery of English and notions of informatics. But according to Maldonado, “the most valued criterion is the organizational capacity relative to his tasks as a student and scholarship holder. Activities relative to the course,, like tests,

seminars and visits cannot be obstacles to complying with the demands of the research” (p.90).

Expectations, disappointments and difficulties experienced in undergraduate scientific research

Bridi (2004, p.58), in interviews with 400 students from Unicamp, acknowledged that expectations regarding participation in research during the time as an undergraduate had to do with “a good education (42.2%)”, “professional direction (12.1%)”, “good tutoring (6.8%)”, and “recognition of the work (5.4%)”. With regard to tutors, most students (67.1%) mentioned the “search for direct, personal guidance, which would help them construct and develop their research project”. These expectations were fully met for 61.5% of the student respondents; partially met for 34.6% of them and not met for just 3.8% of the research students. Frustration with tutors, although low in percentage terms, is linked to the tutor’s lack of time and his/her excessive activities (27.8%). However, some students felt that their tutors remained distant from their tutoring activities (6.3%) or had little interest in the subject (3.8%).

Generally speaking, 53.8% of those interviewed had experienced some level of disappointment during the development of the program. Disappointment with the tutor was the category that appeared most frequently, a result, for 17.7% of the students, of the little contact they had with the tutor, but there was also disappointment with the actual progress of the work (10.1%). Some students were disappointed with the lack of application of the results obtained, with the little value given to the material produced and its reduced usefulness (8.9%), when the lack of extension of their research activities, described as being one of the purposes of universities (teaching, research and extension studies), was mentioned. A smaller percentage mentioned aspects that relate to their frustration with the bureaucratic system (7.6%), with the size of the scholarship (6.3%), with the lack of structure of laboratories and of materials needed for research (6, 3%) and individual disappointments (2.5%).

According to Campos, Martinez and Escudero (1998) and Bridi (2004), in their turn, the main difficulties with USR are “a lack of time for USR and an excessive number of activities”, a “lack of knowledge needed for doing USR” and “a lack of guidance from / contact with the tutor”. Another, fairly frequent difficulty mentioned by 32.9% of the

scholarship holders interviewed (Bridi, 2004, p.66) refers to the project's progress; “the students complained of difficulty in writing their reports, in choosing the bibliography, in the choice of the research methodology, in errors in experiments and in the complexity of data analysis”. In private institutions, or those with little tradition in research, students also face other types of problem. Alma (2003) describes some of the negative points of the USR research being carried out in an IHE that were identified through interviews with students: “experiment costs”, “lack of financial support for research” and “poorly trained technical and support staff to guide them”.

FINAL CONSIDERATIONS

This article has highlighted the nature and discussed the contributions of research into USR carried out in Brazil between 1983 and the first half of 2007 in order to obtain an understanding of this activity. Analysis of the research pointed to the existence of a broad consensus about the relevant role that USR plays in training undergraduates, especially with regard to activities undertaken in the undergraduate course, for personal development, for the construction of a new view of science and for professional socialization. There is, likewise, agreement about the important objectives achieved by the USR funding programs, particularly Pibic, bearing in mind that they awaken and encourage the scientific vocation of undergraduates and favor the expansion and consolidation of research groups in IHEs.

Despite the relevance and importance of the contributions coming from USR activities in IHEs, there are few investigations in this regard. In this context, there is a concentration of investigations in certain areas of knowledge such as the Human Sciences, and a tiny amount of work done in areas such as Health Sciences, Pure Sciences and Technology. Analysis of the research, therefore, also points to the need to encourage the development of investigations that will contribute to filling this gap in order to favor the progress of discussions regarding the issue. Also remarkable is the similarity between the research issues and methodologies adopted for collecting and analyzing data in various works, which suggests the need for diversification of these procedures, which may result in important contributions being made to this field of research.

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