ARTIGO ORIGINAL

ISSN 0102-2067 / doi: 10.7213/estud.biol.7846

Perception and position of animals used in education and experimentation by students and teachers of different academic fields

Percepção e posicionamento de estudantes e professores de diferentes áreas do saber perante o uso de animais no ensino e pesquisa

Marta Luciane Fischer[a] **Priscilla Regina Tamioso**[b]

[a] Bióloga, doutora em Zoologia pela Universidade Federal do Paraná (UFPR), professora titular do curso de Ciências Biológicas, Escola de Saúde e Biociências da Pontifícia Universidade Católica do Paraná (PUCPR), Laboratório Núcleo de Estudos do Comportamento Animal, Curitiba, PR - Brasil, e-mail: marta.fischer@pucpr.br

[b] Bióloga, mestre do curso de Pós--Graduação em Ciências Veterinárias da Universidade Federal do Paraná (UFPR), Curitiba, PR - Brasil, e-mail: priscillatamioso@gmail.com

Abstract

The way as society treats the animals may interfere in the success of the proposals for new ethical conducts and has the potential to influence the legislative and executive branches, as well as economy. Even in a particular place, such as the university environment, different perceptions on the conduct regarding animal use can be found. This can be related to abilities and competences developed during the academic formation or training. Assuming that the ethical perception in animal use in educational and scientific activities are related to knowledge fields, this study aimed to interview students and teachers of a private university considering the biological, social, technical, legal and human fields. The survey was conducted at 17 courses with 87 interviews, through a questionnaire with 16 both open and closed questions, related to the ethics in using animals for teaching and research purposes, as well as knowledge about the animals; about alternatives; and about companies that test their products on animals. The respondents gave positive answers about their feelings towards the animals, but they still show the inheritance of Mechanistic view, once they use the rationality as a mean of differentiating Human being from the other animals. Our results indicate the obvious acceptance of the animal use for educational purposes, mainly mammals and rats, for the Veterinary Medicine and Biology courses. The majority of the respondents considered the animal use in scientific research and experimentation fundamental, mainly for medicine production and other therapies related to human health. On the other hand, they did not show to have information about experimentation, once they did not show knowledge about alternative methods. These results confirm the traditional view that the benefits for scientific development justify the costs with animal welfare and the acceptance of practices that do not cause unnecessary suffering. The data of this study pointed out few differences among academic fields. This finding suggests that ethical attitudes toward animal use in academic and scientific areas are beyond the carrier affinity. These results indicate that there is few worry with information and awareness, which are essentials for changes in attitude.

Keywords: Alternative methods. Animal use in research. Animal use in teaching. Animal welfare. Bioethics.

Resumo

A forma como a sociedade percebe e trata os animais pode interferir no sucesso das propostas para novas condutas éticas e, potencialmente, influenciar os poderes executivo e legislativo, bem como a economia. Mesmo em um meio específico, como o ambiente universitário, é possível encontrar diferentes percepções na conduta com relação ao uso de animais, as quais podem estar relacionadas com habilidades e competências desenvolvidas durante a formação acadêmica. Partindo da hipótese de que a ética na percepção do uso do animal para finalidade educacional e científica se relaciona com a área do saber, no presente estudo foram entrevistados graduandos e professores de uma universidade particular, considerando as áreas biológicas, sociais, exatas, jurídicas e humanas. Para tal, foram abordados 17 cursos e realizadas 87 entrevistas através de um questionário composto por 16 questões abertas e fechadas considerando aspectos éticos no uso de animais no ensino e pesquisa, bem como o conhecimento sobre os animais, alternativas e empresas que testam ou não em animais. Os entrevistados apresentaram respostas positivas sobre seus sentimentos com relação aos animais, porém ainda refletiram uma herança da visão mecanicista, uma vez que usaram a racionalidade como forma de diferenciá-los do homem. Nossos resultados indicam uma aceitação no uso de animais no ensino, principalmente mamíferos e ratos e nos cursos de medicina veterinária e biologia. A maioria dos entrevistados considera fundamental o uso dos animais na pesquisa científica e experimentação, principalmente para produção de medicamentos e outras terapias relacionadas à saúde humana. Por outro lado, os entrevistados não

Received: 01/08/2013
Recebido: 08/01/2013

Approved: 02/23/2013
Aprovado: 23/02/2013

mostraram possuir informações sobre a pesquisa em si, nem tampouco com relação aos métodos alternativos. Esses resultados confirmam a visão tradicional de que os benefícios para o desenvolvimento científico justificam os custos com o bem estar animal e a aceitação de práticas que não causem sofrimento desnecessário. Os dados mostraram poucas diferenças entre as áreas do saber, sugerindo que atitudes éticas com relação ao uso de animais nos meios científicos e acadêmicos ultrapassam a afinidade profissional. Estes resultados levam a uma interpretação importante de que a falta de informação e conscientização parecem ser componentes essenciais para mudanças de atitudes.

***Palavras-chave**: Métodos alternativos. Uso de animais na pesquisa. Uso de animais no ensino. Bem-estar animal. Bioética.*

Introduction

The use of animals with educational and scientific purposes has provided a long history of public ethical debates (Wilson, 2002; Rose & Grant, 2008, Silla, Sans & Molento, 2010). The development of animal experimentation was founded on Cartesian philosophy of the sixteenth century, whose main representative, Renée Descartes, disseminated the mechanistic view, which is still perpetuated in the scientific environment (Singer, 2004, Fin & Rigatto, 2007, Fischer & Oliveira, 2012). Only after the 1950s, the awareness about animal welfare conquered a significant space in the society. Starting with Jeremy Bentham, a new conception emerged associated with the comprehension of the Darwinian principles that humans are result of evolution and they share morphological, physiological and biochemical features with other animals, beyond mental processes as the emotions (Fischer & Oliveira; 2012; Wilson, 2002).

The modern animal welfare movement in the mid-nineteenth century was evolved under the question of "the Five Freedoms" which has a fundamental issue in animal use whether or not animals should be used for research, teaching or product testing (Rose & Grant, 2008). According to Fraser (1999), there were two groups with different concepts, assumptions, vocabulary and cultures. While the first, represented by authors as Regan and Singer, makes a barrier for animal welfare scientists because of the liberal individualism, simplistic ethical principle, little empirical knowledge and lumps very diverse taxonomic groups together as animals and with the same necessity; the second group, represented by researchers as Rollin, Midgley, Lehamn and Thompson, opens doors to communication. The fact that in limited circumstances animals may experience discomfort, pain or distress leads to the need of a special justification, thus the ethical issues have been important to a final decision. But the diversity of views and a complex cultural, social and personal dimension confound the reaching agreement as to the ethical acceptability taking the support ethical decision-making evolved to ethics committees (Rose & Grant, 2008).

From the end of twentieth century the society has questioned about ethical procedures in animal use for educational and scientific purposes. Therefore the humanitarian principles of the animal experimentation, were developed, known as "the 3Rs principles": replacement, reduction and refinement, having as aim the improvement the experiments conditions, through reducing animal suffering. Since then, the abandonment of the live animal during practical classes has been a tendency, without harming for the learning (Russel & Burch, 1992; Balcombe, 2000) and also stimulating the elaboration of alternative methods as three dimensional models; mechanical, computational and virtual reality simulators; in vitro experiments; death animals ethically obtained; and interactive videos (Jukes & Chiuia, 2003). In Brazil the relatively little use of alternatives is mainly justified due to the high costs (Cazarin, Corrêa & Zambrone, 2004).

The attempt of establishing of rules for experimental research remotes the nineteenth centuries. Presently, the legislation of numerous countries permits the procedures with animals only if the objectives could not be achieved through other alternatives (van der Valk et al., 1999; Balcombe, 2000; Smith & Smith, 2004). In Brazil there is the Brazilian Environmental Act 9.605 which considers "to practice act of abuse and maltreatment, to injure or to maim wild or domestic, native or exotic animals, besides carrying out painful or cruel experiences in live animals, although for educational or scientific purposes, if there are alternatives" as an environmental crime (Brasil, 1998). A new federal regulation was published in Brazil in 2008; the Act 11.794, commonly known as the Arouca Act, this law establishes a set of rules for the use of animals in teaching and research; establishes administrative penalties for institutions that violate these rules; and regulates the creation of National Council for the Control of Animal Experimentation [CONCEA] (Tinoco, 2011).

Ethical, political and technical issues about animal use in teaching and research led also to the foundation of the Institutional committees of animal use, or ethical committees (CEUAs). Initially these committees had a social and educational finality (Feijó, Sanders, Centurião, Rodrigues & Schwanke, 2008; Rezende, Peluzio & Sabarense, 2008; Fischer & Oliveira, 2012) performing the judgment based on the necessity of animal use and on the absence of alternatives, scientific merit and care to animal suffering (Paixão, 2008, Silla et al., 2009, Fischer & Oliveira, 2012).

The way as society treats the animals may interfere in the success of the ethical conducts, once their behavior have the potential to influence retailer, regulation and legislation, thereby impacting on the economy and even the sustainability of the livestock industries, thus government and industry should monitor both attitudes toward animal welfare and their relation to community responses on an ongoing basis (Coleman & Hay, 2004). Therefore, the community value provides a barometer which decision makers can adopt strategies that reflect those values (Coleman, 2008). For this, it is fundamental to diagnose the perception of different sections of the society, to elaborate information, sensitivity and awareness planes, once the enforcement of these regulations is often dependent on public perception (Deguchi, Molento & Souza, 2012). Knowledge may give some indication of how attitude may change scientist seeking support (Knight¸ Nunkoosing¸ Nunkoosing¸ Vrij & Cherryman, 2003). Even in a particular place, such as the university environment, different perceptions on the conduct in animal use can be found (Phillips & McCulloch, 2005). These can be related to abilities and competences developed during the academic formation. Assuming that the ethical perception in animal use in didactic and scientific activities is related with the knowledge fields, the present study interviewed students and professional of a private university considering the biological, social, technical, legal and human areas aiming to characterize their perception about animal use in educational and scientific contexts.

Materials and methods

Survey – the subject

The survey was conducted at Pontifícia Universidade Católica Paraná (PUCPR) between February 2008 and September 2010. The subjects were students and teachers of five knowledge fields: School of health and biosciences (SHB: Nursing, Physiotherapy and Psychology), School of Education and Humanities (SEH: Philosophy, Physical education – bachelor, Languages – Portuguese habitation and Pedagogy), Business school (BS: Accounting Science), Polytechnic School (PS: Information Systems, Mathematics, Civil Engineering, Mechanical Engineering and Chemical Engineering) and School of communication and arts (SCA: Media-Advertising and Social Service). In order to determine the courses evaluated, a list of all courses of each academic field was elaborated and then 30% of them were sorted.

Survey – the Instrument

The research was made through a questionnaire with 16 open and closed questions, related to the ethics in using animals for teaching and research purposes, as well as knowledge about the animals; about alternatives; and about companies that test their products on animals.

Procedure

The questionnaire was applied to one student of each period and one teacher of each course. Thus, 17 courses and 87 interviewees were assessed, from these, 42 were women and 28 men. It was performed a random approach, considering the course and period. Only the Biology teachers were determined by sortation criteria, once they were known. For other courses, the teacher available was interviewed.

Before each interview the clarification about the research nature and aim of the study and after participants filled the consent terms. The participation was voluntary, being guaranteed the secrecy and confidentiality of the information. The answer key and the consent terms are archived at the Laboratório Núcleo de Estudos do Comportamento Animal (NEC-PUCPR), ESB - PUCPR. This study was approved by the Ethics Committee of the University (Report n. 0002344/08).

Statistical procedures

The absolute values of the answers of each question were compared in the same knowledge field through

the qui-square test to verify whether the responses were statistically different across the groups, being considered a confidence level of 95% ($p < 0.05$). For this, it was considered as null hypothesis the homogeneity of the sample. In other words, it had as waiting value, the same proportion for each option. For open questions method the analysis where the main goals were to describe the perspective of the participants and to separate them into different groups based on their answers. Multiple choice responses statistically analyzed help to inferences with the goal of recognizing the main characteristics of the messages.

Results

The respondents gave positive answers about their feelings towards the animals. The majority of them saw differences between the human and the other animals, mainly the rationality (Table 1), although they also had mentioned other differences such as: basic necessities, defense, morphology, intra and interspecific relationships, habits and spirituality. The interviewees pointed that human being has rights to use animals, mainly as food (24.8%) ($x^2_{(7)} = 33.1$; $p < 0.01$). Despite 18% of the respondents said that the human doesn't have any rights on animals, being these results significantly for biological areas, they recognized that they are using animals. Nevertheless, they claimed that the respect in the relationship between man and other animals is necessary between the man and other animals (63.2%) ($x^2_{(2)} = 88.5$; $p < 0.01$). The same frequency of affirmative (59.7%) and negative (40.2%) answers was obtained for the question about if they witnessed an animal being mistreated. The physical aggression was the most mentioned mistreatment (71.1%) ($x^2_{(8)} = 721.6$; $p < 0.01$), but they also mentioned: nonfood (5.8%), pulling load (5.8%), abandonment (3.8%), kicks (3.8%), putting the animal in microwaves (3.8%), training (1.9%), jokes (1.9%) and castration (1.9%). The dog was the most mentioned animal suffering maltreatment (67%) ($X^2_{(3)} = 28.6$; $p < 0.01$), followed by the horse (16.1%) and the cat (11.5%). On the other hand, 98.8% of the respondents witnessed animals being well treated, being the dog the animal most mentioned too (67%) ($x^2_{(4)} = 125.4$; $p < 0.01$), mainly by their tutors (80.5%) ($x^2_{(3)} = 143.5$; $p < 0.01$). In the situations of aggressions witnessed by the interviewees, 71.1% said that did not do anything to prevent the maltreatment ($x^2_{(1)} = 9.3$; $p < 0.01$), but 36.6% demonstrated interest in changing the situation, warning the offender ($x^2_{(3)} = 6.1$; $p < 0.05$) (Table 1).

Use of animals in teaching

The majority of the interviewees agreed with the animal use in teaching purposes, mainly mammals and rats for the Veterinary Medicine and Biology courses (Table 2). The interviewee of the biological and technological areas represented about 50% of agreement with the animal use in teaching, mentioning the greater diversity of the species and courses (Table 3). However, the interviewee did not show knowledge of the correct finality, once the majority mentioned general studies; did not consider more specific uses, such as scientific investigation, anatomy, practical demonstration and surgical techniques (Table 2). The opinions about animal use in teaching were not consensual, since although the majority of the interviewee said they would not use any animal during classes, only 18% know about alternatives, and a total of 26% believe that the use of the animal is necessary for learning (Table 2). All the teachers answered that would only use the amount of animals necessary for learning and those they consider the alternatives.

Use of animals in experimentation

The majority of the interviewees considered fundamental the animal use in scientific research and experimentation, mainly for medicine production and other therapies related to human health. On the other hand, they did not show to have any information about research, once did not cite alternative methods (Table 4). Other contradiction was that the interviewees believed that the animals suffer any kind of maltreatment, and they still agree with the use of mammals, mainly rats (Table 4). The respondents of the biological area represented the least percentage of the sample that believe to be correct the animal use in research. Although they have access to information about companies which use or not animals for testing their products, the majority did not seek this information spontaneously before buying their products. From the respondents who were worried about knowing if the animal is used for test or not, the biological and technological areas prevailed, being the cosmetics the most cited products (Table 5).

Table 1 - Relative frequency of affirmative answers related to the evaluation of the students and teachers perception about animal welfare

	TOT	SHB	PS	SEH	BS	SCA
They have good feelings toward animals	88.5*	96*	81*	94*	80*	88*
They perceived the animals different from the humans	90*	77*	88*	100*	100*	100*
The rationality was considered as the main difference between humans and other animals	72*	47	79	73	100*	80*
They witnessed an animal being well treated	99*	100*	96*	100*	100*	100*
They witnessed an animal being mistreated	60	73*	44	52	70	80
They witnessed physical aggression as mistreatment	71*	68	66	70	71	100
They did not do anything in relation to the mistreatment	28*	42	16*	20	28	25
They believe that human does not have rights to use animals	18	30	17	17	27	40
They believe that men have right to use animals for food	24	20	31	25	9	40
They believe that men have right to use animals for working	14	10	23	12.5	9	0
They believe that men have right to use animals for company	9.5	0	17	8.3	18	0
They believe that men have right to use animals for teaching	2.8	6	2.8	0	0	0
They believe that men have right to use animals for experimentation	16	23	8.5	16	18	20
The relationship between man and other animals has to involve respect	63*	84*	48	58	60	60

Legend: Tot = Total (n = 87); SHB = School of heath and biosciences (n = 26); PS = Polytechnic school (n = 27); SHE = Scholl of education and humanities (n = 19); BS = Business school (n=10); SCA = School of communication and arts (n = 5).

Source: Research data.

Note: The absolute values related to the option of each question were compared using the qui-square test as means to test the homogeneity of the answers. The significantly different values ($p < 0.05$) are accompanied by the asterisk (*) and the significantly higher values are underlined.

Discussion

The characterization of the interviewee's profile, in the present study, showed that despite they showed positive attitudes toward animal welfare, they still present the inheritance of the mechanistic view, once they use the rationality a mean of differencing men from the other animals. This view gives a subordinate condition to the animals and justifies their use for different purposes, with a special tolerance for food production, teaching and research. However, it should be considered that the attitudes toward animal welfare vary and were mediated by a combination of factors.

According to Knight et al. (2003), the animal use for entertainment and decoration, for example, is considered unnecessary, because the human being has choice. On the other hand, the animal use for

Table 2 - Relative frequency of affirmative answers related to the perception of the students about the use of animals in teaching

	TOT	SHB	PS	SEH	BS	SCA
They consider correct to use live animals for teaching	63*	58	56	68	70	100*
They agree with the use of mammals for teaching	49*	47	60	43	50	40
They agree with the use of invertebrates for teaching	13	16	7	7	12	0
They agree with the use of amphibians for teaching	10	21	0	14	0	0
They agree with the use of reptiles for teaching	7	5	13	15	0	20
They agree with the use of any animal for teaching	21	11	20	21	38	40
They mentioned the use of mice in class	27*	25	24	13	57	50
They mentioned the use of frogs in class	14	14	14	27	0	0
They mentioned the use of horse in class	10	8	14	13	0	0
They mentioned the use of cats in class	7	4	10	13	0	0
They mentioned the use of pigs in class	6	8	5	7	0	0
They mentioned the use of rabbits in class	3*	4	5	0	0	0
They mentioned the use of other animals in class	15	29	14	7	0	0
They mentioned the use of any animal in class	18	8	14	20	43	50
They mentioned the Veterinary Medicine	34*	23	38*	39	40	43
They mentioned the Biology	32*	27	29*	33	40	43
They mentioned the Medicine	14	13	17	17	7	14
They mentioned the Physiotherapy	4	10	4	0	0	0
They mentioned the Pharmacy	3	7	4	0	0	0
They mentioned the Nursing	3	10	0	0	0	0
They mentioned the other courses	10	10	8	11	13	0
They mentioned general studies as finality of the animal use	37*	26	50	46	25	33
They mentioned scientific investigation as finality of the animal use	22	26	22	9	12.5	50
They mentioned anatomical knowledge as finality of the animal use	11	20	7	0	25	0
They mentioned practical demonstration as finality of the animal use	9*	7	7	18	12.5	0
They mentioned surgical techniques as finality of the animal use	4*	7	0	9	0	0
They mentioned other finalities of the animal use	15	7	14	18	25	17
They did not know the answer	2	7	0	0	0	0

Legend: Tot = Total (n =87); SHB = School of heath and biosciences (n = 26); PS = Polytechnic school (n = 27); SHE = Scholl of education and humanities (n = 19); BS = Business school (n = 10); SCA = School of communication and arts (n = 5).

Source: Research data.

Note: The absolute values related to the option of each question were compared using the qui-square test as means to test the homogeneity of the answers. The significantly different values ($p < 0.05$) are accompanied by the asterisk (*) and the significantly higher values are underlined.

Table 3 - Relative frequency of affirmative answers related to the opinion of the students about the use of animals in teaching

	TOT	SHB	PS	SEH	BS	SCA
They would not use any animal for teaching	30*	31	29	40	30	0
They would use any animal for teaching	26	15.5	26	33	30	60
They would use mammas for teaching	15	19	10	13	30	0
They would use amphibians for teaching	13	19	13	7	0	20
They would use invertebrates for teaching	10	15.5	6	7	10	20
They did not know the answer	6	0	16	0	0	0
They would use animal for teaching because it is necessary to learning	20*	15	29	6	23	50
They would use animal for teaching because of the importance for the learning	2*	0	0	11	0	0
They would not use animal for teaching because there are alternatives	18	15	25	22	11	0
They would use animal for teaching Because of the proximity with human beings	15	16	13	11	33	0
They would not use animal for teaching because they have empathy with them	6	8	8	5,5	0	0
They would not use animal for teaching for other reasons	35	46	17	39	33	50
They did not know the answer	4*	0	8	5.5	0	0

Legend: Tot = Total (n = 87); SHB = School of heath and biosciences (n = 26); PS = Polytechnic school (n = 27); SHE = Scholl of education and humanities (n = 19); BS = Business school (n = 10); SCA = School of communication and arts (n = 5).

Source: Research data.

Note: The absolute values related to the option of each question were compared using the qui-square test as means to test the homogeneity of the answers. The significantly different values ($p < 0.05$) are accompanied by the asterisk (*) and the significantly higher values are underlined.

teaching and research is tolerated, once it brings a greater benefit for people. An interesting point of the research published by Knight et al. (2003) is that the participants avoid information concerning animal use because it leads to feelings of discomfort and psychological, physical and social difficulty for choosing this opinion. For the resolution of this moral conflict, people often weigh the cost of the animal use versus its benefits, but they realize the animal suffering as less important than human suffering.

The comparison of the answers among the academic fields suggests that the students of biological areas are more conscious of ethical issues than the students of other areas. However, the first group is more tolerant with animal use because of the demands of their careers. The new ethical paradigms which confront with the traditional view and the small possibility to abandon of animal use in short and medium periods, take the expectative that animal use should be lead with consciousness and respect. In our study we also evidence that the students obtain the perceptiveness of ethical issues about animal welfare, but they have difficulties in taking a practical attitude. This data corroborates Coleman and Hay (2004), who related that the Australian community considers animal welfare to be an important issue, although it is associated with a willingness to engage in community behavior such as donating to animal welfare groups, writing to newspapers, but it does not strongly influence the purchasing of animal product (Knight et al., 2003). The interview analysis indicated differences of perceptions about animal welfare related to empathy to some species, as dogs and cats, probably due to the affection nearness. In the same way, they perceived social problems in using horses to work in urban areas. The data of this study supports the view that psychological features can be a determinant factor to perception and attitudes toward animal welfare.

Table 4 - Relative frequency of affirmative answers related to the perception of the students about the use of animals in experimentation

	TOT	SHB	PS	SEH	BS	SCA
They consider correct the use of animals for experimentation	60*	50	63	63	60	80
They believe that the animals are fundamental for research	82*	85*	82*	79*	80*	80*
They mentioned the use of mammals in experimentation	50*	40	56*	46	62.5	50
They mentioned the use of all animals in experimentation	15	13	16.6	31	0	0
They related the species of animal with the finality	10	0	11	15	12.5	17
They mentioned amphibians for use in experimentation	7*	7	5.6	8	12.5	0
They mentioned other animal for use in experimentation	15	33	5.6	0	12.5	33
They did not know the answer	3*	7	5.6	0	0	0
They mentioned the use for medicaments production	29*	28*	27*	22	32	50
They mentioned the use for vaccine production	17	10	21	17	26	12.5
They mentioned the use for treatment and cure of diseases	10	3	13	11	16	12.5
They mentioned the use for stem cell research	8	10	6	11	5	0
They mentioned the use for cosmetic production	8	8	8	6	10.5	0
They mentioned the use for behavior research	6*	13	0	11	0	12.5
They mentioned other uses	19*	25*	21	11	10,5	12.5
They did not know the answer	4*	3	4	11	0	0
They believe that it is not necessary the use of animals for medicine production	26.9	30	28	10.5	40	40
They believe that it is not necessary the use of animals for any research	9.8*	11	6	10.5	20	20
They believe that no is necessary the use of animals for vaccine production	9.7	7	13	10.5	0	20
They believe that no is necessary the use of animals for other scientific activities	25.8	26	22	42.2	10	20
They did not know the answer	28*	26	31	26.3	30	20

Legend: Tot = Total (n = 87); SHB = School of heath and biosciences (n = 26); PS = Polytechnic school (n = 27); SHE = Scholl of education and humanities (n = 19); BS = Business school (n = 10); SCA = School of communication and arts (n = 5).

Source: Research data.

Note: The absolute values related to the option of each question were compared using the qui-square test as means to test the homogeneity of the answers. The significantly different values ($p < 0.05$) are accompanied by the asterisk (*) and the significantly higher values are underlined.

Our results highlight the obvious acceptance of the animal use for educational purposes, including the non-restriction in using them. However the respondents indicated low comprehension of the finality. The interviewees of the Biological fields were the most informed about animal use in teaching and also extended their importance, related to more species of animals, academic courses and aims, agreeing with traditional utilitarian views. According to Fischer and Oliveira (2012), the ideas cultivated by the mechanistic perspective of the 15th century, permeated the men's history, subsiding the animal use in teaching, once they endorsed the

Table 5 - Relative frequency of affirmative answers related to the opinion of the students about the use of animals in experimentation

	TOT	SHB	PS	SEH	BS	SCA
They believe that animals are well treated during the experiments	21	11.5	23	26	20	40
They believe that animals are mistreated during the experiments	30*	42*	33	26	10	0
They believe that animals sometimes are well treated during the experiments	10	15.5	0	0	40	20
They did not know the answer	23	11.5	33	37	10	0
They know the (national or international) companies that test their products in animals	52	73*	37	37	70	40
They are interested in knowing if the product was tested in animals	30*	46	11*	32	30	20
They demand to know if the cosmetics that they use was tested in animals	45*	47	33	33.3	67	0
They demand to know if the medicine that they use was tested in animals	26	17	67	33.3	33	0
They demand to know if the cleaning products that they use was tested in animals	11	12	0	33.3	0	0
They demand to know if the food of that they use was tested in animals	11	12	0	0	0	0
They demand to know if the clothes of that they use was tested in animals	7	12	0	0	0	0

Legend: Tot = Total (n = 87); SHB = School of heath and biosciences (n = 26); PS = Polytechnic school (n = 27); SHE = Scholl of education and humanities (n = 19); BS = Business school (n = 10); SCA = School of communication and arts (n = 5).

Source: Research data.

Note: The absolute values related to the option of each question were compared using the qui-square test as means to test the homogeneity of the answers. The significantly different values ($p < 0.05$) are accompanied by the asterisk (*) and the significantly higher values are underlined.

animal use without guilt, as it does not to have consciousness nor physical or mental pain. In our studies the interviewees showed little knowledge about alternative methods, even if the majority agreed with the non-utilization of animals in education. The students believe that the live animal is necessary for learning. Today, numerous ethical debates have been promoted the need of respect in this practical for the professional formation; and the stimulation of the alternatives of development (Kinzie, Strauss & Foss, 1993; Greif, 2003, Macer, Asada, Tsuzuki, Akiyama & Macer., 1996; Villiers & Sommerville, 2005; Diniz, Duarte, Oliveira & Romiti, 2006; Margalhães & Ortêncio-Filho, 2006; van der Valk, 2006; Fin & Rigatto, 2007, Feijó et al., 2008). It is clear that there is a Lack in information regarding about legislation that regulates the use of animals in education (Villiers & Sommerville, 2005; Deguchi et al., 2012), as the existence of alternative methods, and the right of choosing to participate or not in classes or practical demonstration (Balcombe, 1997). The Brazilian constitution guarantees that nobody will be deprived of their rights neither due their belief nor political or philosophical convictions. For this reason, some judges are releasing the student of the practical class and they are requiring alternative methods for learning. According to Kinze et al. (1996), Biology students prefer such alternatives to dissect real animals; some students believe dissection is the only way to appreciate the intricacies of the body. On the other hand, Biology teachers perceive computer based alternatives to be unacceptable (Bar & Herzog, 2000). An interesting fact is presented by Philips (2007), in a study which 97% of students interviewed by them, despite avoid unnecessary pain, they did not believe the systems needed changing, because it was considered acceptable and necessary. Villiers and Sommerville (2005) recorded the preference of the Biology students for discovering more about an animal during dissection trainings, rather than by using alternative sources such as models and videotapes.

Sometimes the alternatives are met with resistance by both teachers and students, and learning goals could not be achieved with alternative methods (Deguchi et al., 2012). According to Villiers and

Sommerville (2005) the educator is responsible for sensitizing the pro-animal dissection students to ethical, epistemological and physical issues to precede the best education and to encourage the greatest possible learning, to dissect or not to dissect is a question that can be answered only through reflection on learning outcomes of the curriculum. On the other hand, Saucier and Cain (2006) perceived that undergraduate psychology students believed that animal research is unethical; it may be a product of misinformation of how this practice contributes to science and well-being for both animals and humans.

The more drastic animal use in teaching is the vivisection. Before wide reflection by academic community, this practical was regulated by resolutions of the Federal Veterinary Council (CFMV, 2008). The Law 9.605 transformed the vivisection into a crime, if there are alternative methods; and the Law 11.794/08 that sets the accreditation of any institution that uses animal in teaching on National Council for the Control of Animal Experimentation (CONCEA) and that it has to create its own ethical committee (Tinoco, 2011) which, according to Fischer and Oliveira (2012), promoted improvement in the biotery in the reflection about the necessity of using and searching for alternatives. Our results indicate that the student doesn't have an option, if they could choose; the majority said they would prefer taking classes without animals, but they believe it is the importance for their learning.

These findings agree with Villiers and Sommerville (2005) who showed that more than two-third of the students had positive attitudes regarding animal dissection for learning the structure and function of the organisms and despite numerous educational alternatives, animal dissection is included in many Physiology, Anatomy, Biology and Zoology programs. The didactic collections are requested in environmental courses, where hundreds of animals are killed, without ethical procedures and worry about the pain. The pain in invertebrates is very controversial and little understood (Phillips, 2007), for this they are not regulated with the welfare laws. The teachers insist in the importance of the collection for both museum (Zaher & Young, 2003) and education (Walewski, 2007), however didactic collection promotes the unnecessary collection of animals which are poorly maintained and often discarded. The scientists have statistically shown that this collection is irrelevant in terms of population impacts, however super-exploitation and personal collection are considered as causes of many species extinction (New, 1995). Other animals didactically used and widely debated are the rats in Psychology experimental class. The defenders justify the importance of this subject due to the epistemology, cognitive and motivational views (Lopes, Miranda, Nascimento & Cirino 2008); however, the non-identification, and disability in working with an animal, mainly the rats, could cause aversion and lead the students to support the use of animals in teaching, but they are opposed to an animal laboratory requirement for the psychology major (Plous, 1996). Alternatives such as the software "Sniffy: the virtual rat" must be viewed with attention due to the high costs and didactic limitation (Alloway, Wilson & Graham, 2006). Miranda, Gonçalves, Miranda, Cirino et al. (2011) alert for the illegality in the animal use when the results are well known, and they suggest the searching for new didactic laboratories.

The results about animal use in research confirm the traditional view that the benefits for scientific development justify the costs for their welfare and that the practice was acceptable provided that it caused no unnecessary suffering (Baldwin, 1993; Saucier & Cain, 2006; Willians, Dacre & Elliott, 2007, Colleman, 2008). Then, the biomedical research is widely supported by the community (Moore, 2003; Williams et al., 2007), being the acceptance of the use affected by different factors as medical importance, species and animal suffering (Hageli, Hans-Erik & Hau, 2003). According to Knigth et al. (2003) animal in research despite the benefits of these being great with more knowledge about this issue, people tend to reduced support for animal use.

Some scientific data have shown that not always the research with animal results in concrete application (Sharpe, 1988; Greek & Greek, 2000; Regan, 2006), leading to question the influence of the differences in Anatomy, Physiology, Immunology and Genetics. Nevertheless, animals were perceived to be more physically similar to humans; this led to beliefs that they are more mentally similar to humans (Knight et al., 2003). In this situation the absence of worry about alternatives can be viewed as negative, once the human health is considered more important. This view is supported by the community position about cosmetic industry considered the aesthetic, soon superfluous. Due to the pressure, these segments have been looking for alternatives,

and today the use of the tests have been reduced (Moore, 2003). Knigth et al. (2003) and Davey (2006) reported in their studies that the use of animals for testing the safety of cosmetics and household products was rejected, but the participants of the research could rarely think of a replacement for animals that medical research could use, that are the most approved (Colemman, 2004). The problem is that for product validation many official procedures require the tests with animals.

The empathy is considered an important point for animal welfare promotion (Broida, Tingley, Kimball & Miele, 1993; Hills, 1995; Rollin, 1981; Regan, 1983; Coleman, 2008), being intuitive and felling types the most opposed to animal experimentation than sensate and thinking types (Broida et al., 1993), although Mathews and Herzog (1997) found that a few personality traits were related to attitudes towards animal welfare. According to Herzog and Golden (2009), animal activists were more sensitive to visceral disgust than scientists. But the authors point that it is necessary to understand that the moral decisions are formed by two conflicting components: the intuition and the reason, and that the activist and the animal researcher have different values on the cost in suffering and the benefits in lives saved being the scientists more skeptical (Broida et al., 1993). Other authors registered effects of nationality (Pifer, Shimzu & Pifer, 1994), gender and age, being women with more positive attitudes about animal welfare (Pifer et al., 1994; Pifer, 1996; Plous, 1996; Heleski, Mertig & Zanella, 2005; Phillips & McCulloch, 2005; Villiers & Sommerville, 2005; Colleman, 2008; Herzog & Golden, 2009) whilst men and women seem to have similar attitudes in relation to the sentience capacities (Phillips & McAlough, 2005; Broida et al., 1993).

Our results show a tendency for biological field students to support the animal use in research, probably due the characteristic career. However, these respondents present more clarification related to the procedures. The influence of the academic formation on perception and attitudes about animal welfare is controversy. While authors as Broida et al. (1993) show that students who are more likely to encounter animal experimentation in their academic carrier (as Psychology, Biology and Medicine) are more likely to oppose animal research than other students, Knight et al. (2003) believe that science students are more likely to propose improvement in animal research procedures, omitting information for public, because it seems that knowledge leads to reduce support for such practices. The fact that the other interviewees hold less attention for this question can not be justified by their academic field. They are citizen, soon boosters of the legal, moral and ethics procedures that structure the society.

The data of this study underlie the hypothesis that the perception of the ethics on animal use is related to species used, suggesting a lower identification with certain animals as rodents, also found by other authors (Garpow, 1993; Lord & Moses, 1994; Bumans, 2004; Villiers & Sommerville, 2005; Bezerra, Nobre, Alves & Vasconcellos, 2007). In fact, the conflict decreases as the animals are related to minor taxonomic position, it is known as "hierarchy of privilege" (Plous, 1993). Once, people hold different attitudes toward animal use depending on the species to be used, that is classified into value scales which the basis of this discrimination often depends on where the animal was perceived to be on the phylogenetic level, that is in terms of their perceived closer to the human being because of their behavior, physiology and mental abilities as cognition and capacity for sentience of pain and emotions (Plous, 1993; Herzog & Galvin, 1997; Knight et al.; 2003, Levine et al., 2005; Phillips & McAlough, 2005; Philips, 2007) despite an absence of anatomical or physiological evidence to support it (Philips, 2007). This behavior, not always conscious, leads to a non-recognition of the basic necessity of other animals, as insects (Costa-Neto & Pacheco, 2004). According to Colleman (2008), the basis of the perceived mental capacity is the familiar experience, which is limited knowledge of animal use procedures and practice. However, we could wait different positions from the respondents of biological fields, mainly Biology, that present higher level of knowledge about nervous system in all animals (Purves, 2002). On the contrary, the Humanity area students were more aware in not using animals for this purposes and the Technological ones cited more than one answer for alternative uses. Awareness is important for both students and teachers, mainly the existence and use of alternatives, which are already applied in European and north-American countries.

The data of our study showed few differences among academic fields. This result suggests that ethical attitudes toward animal use in academic and scientific ways are beyond the career affinity. It conducts to important finding that there is not great information and awareness, which are essentials for changes in attitudes.

Acknowledgements

We especially thank the interviewees, whose dedication and patience was a key for this research.

References

Alloway, T., Wilson, G, & Graham, J. (2006). *Sniffy: O rato virtual*. (Versão Pro 2.0). São Paulo: Thomson Learning.

Balcombe, J. (1997). Student/Teacher Conflict Regarding Animal Dissection. *The American Biology Teacher*, *59*(1), 22–25.

Balcombe, J. (2000). *The use of animals in higher education: problems, alternatives & recommendations*. Washington: The Humane Society Press, 104.

Baldwin, E. (1993). The case for animal research in psychology. *Journal of Social Issues*, *49*, 121–131.

Barr, G., & Herzog, H. (2000). Fetal pig: The high school dissection experience. *Society and Animals*, *8*, 53–69.

Bezerra, B. M., Nobre, C. E. B., Alves, M. D., & Vasconcellos, S. D. (2007). Percepção e posicionamento de estudantes quanto à exploração econômica de animais: um estudo de caso na Universidade Federal de Pernambuco. *Stientibus, série Ciências* Biológicas, *7*(3), 223–229.

Brasil. (1998). *Lei 9.605, de 12 de fevereiro de 1998*. Dispõe sobre as sansões penais e administrativas derivadas de condutas e atividades lesivas ao meio ambiente, e dá outras providências. São Paulo, *62,* 471–484.

Broida, J., Tingley, L., Kimball, R., & Miele J. (1993). Personality differences in pro- and anti- vivisectionists. *Society and Animals, 1*, 129–144.

Bumans, V. (2004). Use of animals in experimental research: an ethical dilemma? *Gene Therapy*, *11* (Suppl. 1), 64–66.

Cazarin, K. C. C., Corrêa, C. L., & Zambrone, F. A. D. (2004). Redução, refinamento e substituição do uso de animais em estudos toxicológicos: uma abordagem atual. *Revista Brasileira de Ciências Farmacêuticas, 40*(3), 289–299.

Coleman, G. (2004). Public attitudes to animal research. *Proceedings of the ANZCCART Conference*, Christchurch NZ, 18-19 August, pp. 78–86.

Coleman, G. (2008). Australia's ethical framework for animals used in research and teaching. *AAWS International Animal Welfare Conference*, Queensland on 31 August to 3 September.

Coleman, G., & Hay, M. (2004). Consumer attitudes and behavior relevant to pork production. *Proceedings of the Australian Association of Pig Veterinarians*, Canberra, ACT.

Conselho Federal de Medicina Veterinária [CFMV]. (2008). Resolução n. 879, de 15 de fevereiro de 2008. Recovered on Sept 12, 2011, from http://www.cfmv.org.br/portal/legislacao/resolucoes/resolucao_879.pdf

Costa-Neto, E. M., & Pacheco, J. M. (2004). A construção do domínio etnozoológico "inseto" pelos moradores do povoado de Pedra Branca, Santa Terezinha, Estado da Bahia. *Acta Scientiarum Biological Sciences*, *26*(1), 81–90.

Davey, G. (2006). Chinese university students' attitudes toward the ethical treatment and welfare of animals. *Journal of Applied Animal Welfare Science, 9*(4), 289–297.

Deguchi, B. G. F., Molento, C. F. M., & Souza, C. E. P. (2012). The perception of students on the use of animals in higher education at the Federal University of Paraná, southern Brazil. *ATLA, 40*, 83–90.

Diniz, R., Duarte, A. L. A., Oliveira, C. A. S., & Romiti, M. (2006). Animais em aulas práticas: podemos substituí-los com a mesma qualidade de ensino? *Revista Brasileira de Educação Médica*, *30*(2), 31–41. doi:0.1590/S0100-55022006000200005.

Feijó, A. G. S., Sanders, A. L., Centurião, A. D., Rodrigues, G. S., & Schwanke, C. H. (2008). Análise de indicadores éticos do uso de animais na investigação científica e no ensino em uma amostra universitária da Área da Saúde e das Ciências Biológicas. *Scientia Medica, 16*(1), 10–19.

Fin, C. A., & Rigatto, K. (2007). Utilização de animais em experimentação: aspectos éticos, jurídicos e metodológicos. *Revista Eletrônica da Sociedade Rio-Grandense de Bioética*, *1,* 1–15

Fischer, M. L., & Oliveira, G. M. A. (2012). Ética no uso de animais: A experiência do Comitê de Ética no Uso de Animais da Pontifícia Universidade Católica do Paraná. *Estudos de Biologia: Ambiente e Diversidade*, *34*, 247–260.

Fraser, D. (1999). Animal ethics and animal welfare science: bridging the two cultures. *Applied Animal Behaviour Science* 65(3), 171–189.

Garpow, W. J. (1993). *A Cost-Benefit Analysis of Animal Experimentation in Undergraduate Biological Education*. Tese apresentada à Faculdade de Letras e Ciências, Universidade de James Madison. May, 1993.

Greek, C. R., & Greek, J. S. (2000). *Sacred Cows and Golden Geese*, New York, NY, USA: Continuum.

Greif, S. (2003). *Alternativas ao uso de animais vivos na educação pela ciência responsável*. São Paulo: Instituto Nina Rosa.

Hageli, J., Hans-Erik, C., & Hau, J. (2003). An overview of surveys on how people view animal experimentation: some factors that may influence the outcome. *Public Understanding of Science*, *12*, 67.

Heleski, C. R., Mertig, A. G., & Zanella, A. J. (2005). Results of a national survey of US veterinary college faculty regarding attitudes toward farm animal welfare. *Journal of the American Veterinary Medicine Association*, *226*, 1538–1546.

Herzog, H. A., & Galvin, S. (1997). *Common sense and the mental lives of animals: An empirical approach.* In R. W. Mitchell (Ed.), Antropormophism, anedotes and animals. Alvany: State University of New York Press.

Herzog, H. A., & Golden, L. L. (2009). Moral emotions and social activism: the case of animal rights. *Journal of social Issues*, *65*, 485-498.

Hills, A. M. (1995). Empathy and Belief in the Mental Experience of Animals. Reviews and Research Reports. *Anthrozoos, 8*, 132- 142.

Jukes, N., & Chiuia, M. (2003). *From guinea pig to computer mouse*. (2. ed.). Leicester: Interniche.

Knigth, S., Nunkoosing, K., Vrij, A., Cherryman, J. (2003). Using grounded theory to examine people's attitudes toward how animals are used. *Society & Animals, 11*(4).

Kinzie, M. B., Strauss, R., & Foss, J. (1993). The effects of an interactive dissection simulation on the performance and achievement of high school biology students. *Journal of Research in Science Teaching, 30*(8), 989–1000.

Lei n. 9.605, de 12 de fevereiro de 1998. Recovered on Dec. 21, 2012 from http://www.planalto.gov.br/ccivil_03/leis/L9605.htm

Lei n. 11.794 de 8 de outubro de 2008 (2008). Recovered on Dec. 21, 2012 from http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/lei/l11794.htm

Levine, E. D., Mills, D. S., & Houpt K. A. (2005). Attitudes of veterinary students at one US College toward factors relating to farm animal welfare. *Journal of Veterinary Medical Education, 32*, 481–490.

Lopes, M. G., Miranda, R. L., Nascimento S. S., & Cirino S. D. (2008). Discutindo o uso do laboratório de análise do comportamento no ensino de psicologia. *Revista Brasileira de Terapia Comportamental e Cognitiva*, *1,* 67–79.

Lord, T., & Moses, R. (1994). College students' opinions about animal dissections. *Journal of College Science Teaching, 23*(5), 267–270.

Macer, D. R. J., Asada, Y., Tsuzuki, M., Akiyama, S., & Macer, N. Y. (2011). Animal and Experiments and Bioethics in High Schools in Australia, Japan e New Zealand. 998, Eubios Ethics Intitute. Recovered on July 3, 2013, from http://www.eubios.info/Papers/ANIMALEX.htm

Magalhães, M., & Ortêncio-Filho, H. (2006). Alternativas ao uso de animais como recurso didático. *Arquivos de ciência de Veterinária de Zoologia da Unipar*, *9*, 147–154.

Mathews, S., & Herzog, H. A. (1997). Personality and attitudes toward the treatment of animals. *Society & Animals*, *5*, 169-175.

Miranda, J. J., Gonçalves, A. L., Miranda, R. L., & Cirino, S. S. (2011). Ética em experimentação animal: Reflexões sobre o laboratório didático de análise do comportamento. *Psicologia: Teoria e Prática, 13*, 198-212.

Moore, D. W. (2003). Public Lukewarm on Animal Rights. Gallup Inc.; 2003. Recovered on May 21, 2013, from http://www.gallup.com/poll/8461/Public-Lukewarm-Animal-Rights.aspx

New, T. R. (1995). *An introduction to invertebrate conservation biology*. Oxford: University Press, Oxford.

Paixão, R. L. (2008). Os desafios das comissões de ética no uso de animais. *Ciência Veterinária Tropical*, *11*, 84–87.

Phillips, C. (2007). How does pain rank as an animal welfare issue? *Australian animal Welfare Strategy Science Summit on Pain and Pain Management, Proceedings.* Recovered on Nov. 24 2012, from http://www.daff.gov.au/__data/assets/pdf_file/0003/299082/clive-phillips.pdf

Phillips, C., & McCulloch, S. (2005). Attitudes of students of different nationalities towards animal sentience and the use of animals in society with implications for animal use in education. *Journal of Biological Education*, *40*, 17–24.

Pifer, L., Shimizu, K., & Pifer, R. (1994). Public attitudes towards animal research: some international comparisons. *Society and Animals*, *2*, 95–113.

Pifer, L. K. (1996). Exploring the gender gap in young adults' attitudes about animal research. *Society & Animals*, *4*, 37–52.

Plous, S. (1993). Psychological mechanisms in the human use of animals. *Journal of Social Issues*, *49*, 11–52.

Plous, S. (1996). Attitudes toward the use of animals in psychological research and education. Pscychological science, *7*, 352–358

Purves, W. K., Sadava, D., Orians, G. H., Heller, H. C., Vinagre, A. S., et al. (2002). *Vida: a ciência da biologia*. (6. ed.). Porto Alegre: Artmed, 2002.

Regan, T. (1983). *The case for animal rights*. Berkeley: University of California Press.

Regan, T. (2006). *Jaulas vazias: Encarando o desafio dos direitos dos animais*. Porto Alegre: Lugano.

Rezende, A. H., Peluzio, M. C. G., & Sabarense, C. M. (2008). Experimentação animal: Ética e legislação brasileira. *Revista de Nutrição*, *21*(2), 237–242. doi:10.1590/S1415-52732008000200010.

Rollin, B. E. (1981). *Animal Rights and Human Morality*. Buffalo, NY, USA: Prometheus Books.

Rose, M., & Grant, E. (2008). Australia's ethical framework for animals used in research and teaching. *AAWS International Animal Welfare Conference*, Queensland on 31 August to 3 September 2008.

Russel, W. M. S., & Burch, L. (1992). *The principles of human experimental techniques*: Special edition. Universities Federation for Animal Welfare. London: Herts.

Saucier, D. A., & Cain, M. E. (2006). The foundations of attitudes about animal research. *Ethics & Behavior, 16*, 117–133.

Silla, V. C. B., Arthos, S. M., & Molento, C. F. M. (2009). Descrição de dois anos de atuação da comissão de ética no uso de animais do setor de ciências agrárias da Universidade Federal do Paraná. *Ciência Rural*, *39*(7), 2093–2098. doi:10.1590/S0103-84782009000700021.

Singer, P. (2004). *Libertação Animal*. Porto Alegre: Lugano, 2004.

Sharpe, R. (1998). *The Cruel Deception: The use of animals in medical research*. Thorsons Publishing Group.

Smith, A. J., & Smith, K. (2004). Guidelines for humane education: alternatives to the use of animals in teaching and training. *Alternatives to Laboratory Animals, 32*, Suppl. 1, 29-39.

Tinoco, I. A. P. (2011). *Lei Arouca: Avanço ou retrocesso*? Recuperado em 30 maio 2012, de http://www.abolicionismoanimal.org.br/artigos/leiaroucaavanoouretrocesso.pdf

van der Valk, J., Dewhurst, D., Hughes, I., Atkinson, J., Balcombe, J., Braun H, et al. (1999). Alternatives to the use of animals in higher education. *Alternatives to Laboratory Animals*, *27*, 1, 39–52.

van der Valk, J. (2006). Animal use and alternative in education. *AATEX*, 12, 1–6.

Villiers, R., & Sommerville, J. (2005). Prospective biology teacher's attitudes toward animal dissection: implications and recommendations for the teaching of biology. *South African Journal of Education, 25*, 247–252.

Walewski, A. (2007). Importância museológica na educação ambiental em escolas: Estudo de caso. *Estudos de Biologia, 29*, 347–351

Williams, V. M., Dacre, I. T., & Elliott, M. (2007). Public attitudes in New Zealand towards the use of animals for research, testing and teaching purposes. *New Zealand Veterinary Journal,* 61–68.

Wilson, D. A. H. (2002). Animal psychology and ethology in Britain and the emergence of professional concern for the concept of ethical cost. *Studies in History and Philosophy of Biological and Biomedical Sciences, 33*, 235–261.

Zaher, H., & Young, P. S. (2003). As coleções zoológicas brasileiras: Panorama e desafios. *Ciência e Cultura, 55*, 24–26.