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Pharmacology Students' Perception of the Use of Animals Prior to Laboratory Practice

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Authors' contributions

This work was carried out in collaboration among all authors. Author LAGG designed and evaluated the application of instrument, and did data capturing. Author OGA designed the questionnaire, did data analysis and prepared the manuscript. Author RSV prepared the manuscript and did data analysis. Author MTCO reviewed and analyzed the data and did data discussion. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Technological development in computing and biochemistry has allowed the development of teaching tools that are useful in the teaching-learning process. In this descriptive-inferential work, the perception of Pharmaceutical Biological Chemistry (QFB) degree regarding the use of animals in their laboratory practices was evaluated, taking as a reference the practice of testing drugs with hypoglycemic effect.

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Study Design: The design of the study was descriptive inferential.
Place and Duration of Study: The study was realized in FES Zaragoza, UNAM, with Biology Pharmaceutical Chemist student careers between february to may in 2024.
Methodology: In this work, an evaluation instrument was designed and developed and that was validated by expert criteria and that was applied to 132 students prior to carrying out the practice in the laboratory. The applied evaluation instrument contained 3 questions aimed at knowing this perception of the students.
Results: The results present a binomial distribution probability greater than 0.99 in favor of reducing or replacing research animals with computer simulators.
Conclusion: The students consider that is possible to replacement or to reduce the animal research in teaching laboratory.

Keywords: Laboratory practices; laboratory animals; teaching systems; practical skills development.

1. INTRODUCTION

Laboratory practices are an essential part of teaching. In the areas of chemical, biological and health sciences they are a formative nature in the sense that they allow students to acquire skills in handling situations near to the reality in the professional life. However, the development of the field of bioethics, pressure from non-governmental organizations and some governments have limited the use of experimental animals in teaching practice, affecting mainly developed and developing countries. In the public higher education institutions in Mexico, the use of murines and rats in teaching laboratory remains as a common practice, and resistance to their use by students is increasing. It is important to note that the global trend is to eliminate their use and limit it as much as possible in research.

For many years, the use of experimental animals such as rats and mice in higher education institutions for carrying out laboratory learning activities has been a constant as part of the professional training of students (Weeler, 1993). The use of experimental animals in laboratory practices has been of great relevance in health science courses and subjects, including the pharmaceutical area. Some experts consider that the use of experimental animals in these areas of knowledge allows the acquisition of necessary skills in certain areas of professional development, including research, development, evaluation of drugs and treatments in traditional medicine, as well as in alternative medicine (Badyal et. al., 2009; Ranganatha, 2012; VanLangen et al., 2023).

Along with pressure from civil associations against the use of animals in experimentation, the use of computers and advances in the area of computing and biochemistry have led the most economically and technologically developed countries, as well as those considered to be developing, to manage and implement laws that limit or restrict the use of animals in both research and teaching, also affecting industries such as the pharmaceutical and cosmetic industries in the performance of preclinical and toxicological tests that guarantee, as far as possible, the safety of the use of these products in humans and animals for human consumption, companion animals or animals of interest to humans (Hughes, 1990; Elhajji and Basheti, 2018).

The COVID-2019 pandemic changed the teaching system in many countries from face-to-face (especially in university studies in the area of chemical, biological and health sciences) to an online system, including practical laboratories, which on the one hand allowed the review of the curricular content to be advanced and on the other to incorporate the online system for teaching the practical part for its evaluation and acquisition of knowledge, although not necessarily of the skills necessary in the professional field, a question that will have to be answered in the not-so-distant future, when and pharmacologists trained in this online system will need to perform surgeries in an operating room or validate the safety of a new drug to treat a condition in humans or in animals of interest to humans. The above is reported in multiple studies (Dujaili et. al., 2023), and this has driven more than before the pressure from students to suppress laboratory practices that involve the use of animals.

Regarding the use of animals for research, Senior in 1995, noted that 75% of people accepted the need to use animals for medical research, and 16% were completely reluctant to

do so (Senior, 1995). In 2020, 56% of survey participants considered the use of animals for research morally acceptable, but in 2023 only 51% did (The Gallup Organization, 2022). In a survey conducted by Finnie et al. (2023) of Veterinary students, 78% of respondents accepted that the use of animals for teaching and research is necessary.

In some educational systems, the implementation of computer technologies for teaching pharmacology laboratories without the use of animals for research appears to be an alternative for the teaching process (Entringher et al., 2024).

The objective of this study was to know the appreciation regarding about of use of experimental animals before carrying out the practical activity in the teaching laboratory of pharmacy, and their interest for replace the use of animals in the practice for a model computational model for the demonstration of the effect of hypoglycemic agents of fourth-year students of a course with a profile in pharmacology.

2. METHODOLOGY

This research has a non-experimental, descriptive-inferential design. Through the quantitative treatment of the data obtained by applying the evaluation instrument (questionnaire), it aims were to investigate the perception on the use of experimental animals and their preference for alternative methods for practical activities in a pharmacology teaching laboratory, taking as a reference the practice of evaluation of hypoglycemic effect drugs.

2.1 Participants

This study involved 132 fourth-year Pharmaceutical Biological Chemistry (QFB, Química Farmacéutico Biológica) degree from FES Zaragoza, UNAM, with a professional profile in pharmacology prior to the practice of drugs with hypoglycemic effect. This university degree is studied in 5 years and by the fourth year the students have already carried out activities in laboratories with experimental animal and computer simulators.

2.2 Instruments

An evaluation instrument was designed with 10 questions, the first one collected information concerning the practical learning expectations of the students with the realization of the practice using experimental animals, the answer was open in short text. Reagents 2 to 5 inquired about the participants' experience in handling animals and their opinion on the possible substitution of the live model for a computer simulator. The evaluation was carried out on an ordinal scale (yes, no). Reagent 6 collected information on the characteristics that participants consider a computer simulator should have based on the experience they have accumulated throughout their university studies. The response was open in short text. Reagents 7 to 9 had the objective of knowing the bioethics and moral aspect regarding the sacrifice of experimental animals. They were evaluated on a Likert scale. Finally, Reagent 10 allowed knowing the knowledge of the local regulations for the sacrifice of experimental animals, as well as the degree of confidence that participants have in sacrificing experimental animals in compliance with current regulations. The response was evaluated on a Likert scale.

2.3 Procedure

The evaluation instrument was designed and validated by expert criteria prior to its application (questionnaire, the questionnaire is described in the instruments section). For the validation of the instrument, the collaboration of an expert in veterinary medicine and animal management, an expert and researcher in education, and an expert in information technology and online educational platforms was requested. The instrument contains in its presentation the objective of the study and indicates the confidentiality with which the data collected will be handled. Prior to the application of the questionnaire, a brief presentation was made to the participating students, and they were invited to participate voluntarily, with the requirement of not having carried out the practice of hypoglycemic agents. The participants are mostly between 21 and 22 years old, which is the age at which they take the corresponding module or subject.

2.4 Data Analysis

A frequency analysis was performed on the data collected. Questions 2 and 5, aimed at obtaining information on whether they believe learning is possible without the use of experimental animals in laboratory practice, and the willingness to change an animal model for a computer

simulator in the practice of evaluating drugs with hypoglycemic effect, were calculated with the probability of binomial distribution of the affirmative answer to each question. The rest of the questions were only subjected to a frequency analysis.

3. RESULTS AND DISCUSSION

3.1 Results

The evaluation instrument (questionnaire) was answered for 132 students of QFB in FES Zaragoza, UNAM, the 79% consider that they have adequate animal handling skills (restraint and administration routes), 36% have bioethical conflicts with animal euthanasia, 27% are unsure and 37% do not have any. In other hand, 40% of the students agree to be involved in the handling and sacrifice of laboratory animals (to a greater or lesser extent), while 26% are unsure and 34% do not wish to do so.

In the evaluation instrument, question 2 investigates the students' perception regarding the possibility of meeting the objectives of the hypoglycemic practice without the use of research and teaching animals, question 4 on the possible decrease in the number of animals used in the teaching laboratory practices, and question 5 on their willingness to use simulators in carrying out the practice.

The Table 1 presents the frequencies obtained from the application of the evaluation instrument, as well as the result of the binomial distribution probability corresponding to the questions focused on the perception of the participants regarding the use of laboratory animals in pharmacology practices, taking as a reference the practice of hypoglycemic drugs (questions 2, 4 and 5).

3.2 Discussion

The frequency and probability of distribution obtained show that university students questioned who participated in this survey have a predilection for reducing the number of experimental animals in laboratory practices, as well as for replacing animal models with computer simulators, since they consider that the same practice objectives can be achieved through of the use of simulators. The above coincides with what was reported by Senior (1995), Finnie et al. (2023) and The Gallup Organization (2022). However, it is necessary to highlight that from 1995 to date there has been an increase in this trend of reducing or eliminating the use of animals in research, the result of this study is even higher than that reported by The Gallup Organization (2022) where they report for 2023 only a general approval of the use of animals for research of 51%. In the case of Finnie et al. (2023), the acceptance of the need to use animals was 78%, which suggests that pressure from students may be due more to misinformation from the moment of choosing a career regarding what is addressed and how it is addressed in a pharmacology or pharmacy program.

The application of computer technologies (simulators) can support the teaching process in the health area, where pharmacy is found (Entringher et al., 2024), however, although the use of these technologies has been well received by students and a part of the labor field

Table 1. Observed frequencies and probability of distribution of the evaluation instrument focused on the use of experimental animals in teaching practices

Question 2. Do you consider it possible to meet the objectives of the practice without the need to use laboratory animals? (frequency, %)	
Yes	No
106 (80.30%)	26 (19.70%)
Question 4. Do you think that the use of laboratory animals in undergraduate studies should be reduced? (frequency, %)	
Yes	No
89 (67.42%)	43 (32.58%)
Question 5. Would you be willing to use a simulator as a replacement for the animal model in laboratory practices?	
Yes	No
104 (78.78%)	28 (21.22%)

Question 2 $p(Yes \leq 106) = 0.99$; Question 4 $p(Yes \leq 89) = 0.99$; Question 5 $p(Yes \leq 104) = 0.99$; $p_{(si)}=0.5$, $p_{(no)}=0.5$

in pharmacy, the impact of this education, without the manipulation of experimental animals and without the necessary studies, can have an impact on the lack of development of practical skills necessary in some areas of professional development as pharmacologists.

As pointed out by Elhajji and Basheti (2018), and Entringher et al. (2024) The development of computational technologies, as well as biochemical techniques and methodologies, have become important tools for the instruction of future professionals who are today in classrooms and laboratories in university education centers. What should not be overlooked is the importance of acquiring skills in areas of pharmacology such as the development and evaluation of drugs, as well as toxicological studies aimed at ensuring the safety and efficacy of treatments and cosmetologically products, among others. The experience reported by Finnie et al. (2023) in veterinary school should be taken up again and through information campaigns, the development and application of technologies, together with policies for more bioethical care and handling of research animals, can help, more than reversing this trend towards the reduction or elimination of research animals, to better see the justified need for the use of animals for research and teaching in the health area. Also, in 2023 an evaluation on perception of students of nursing science about use of animals in the course of pharmacology remark the importance of use of animals in courses as pharmacology in the heathy sciences (García et al 2023).

The ethic use of animals and the knowledge about normative are essential skills in the health sciences in the professional field, the ethic norms complement the work in the professional and teaching laboratories (García et al, 2023; Zhang et al, 2024).

4. CONCLUSION

The students of the Biological Pharmaceutical Chemistry career (132) that responded the evaluation instrument consider themselves to have good animal handling skills (in restraint and administration routes), however, they express bioethical conflicts respect to the performance of euthanasia on animals, which is why they consider that the use of animals for research in some pharmacology laboratory practices can be reduced, or they can be replaced by simulators without affecting the learning process.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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