

Science and technology: Facing uncertainties based on ethical values



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ABSTRACT

This article aims to reflect on the uncertainties present in scientific and technological development from the perspective of ethics. Through a bibliographic research, of analytical-interpretative character, it was sought to answer the importance of ethical values to face the uncertainties present in

science and technology with a view to the sustainable survival of society. As a result, it was found that there is no certainty in any aspect of science and technology and, in the face of uncertainties, ethics and the philosophy of science contribute to the understanding of the individual, collective and global ethical dimension, in search of a transformative process with regard to the purposes of science and technology, which favors progress and the production of necessary and socially relevant knowledge.

Keywords: Uncertainties, Ethics, Science, Technology, Ethical values.

1 INTRODUCTION

Advances in science and technology provoke changes in our reality and society, such as the increasing presence of artificial intelligence and machines in the means of production of goods and services, imposing the need to broaden the debate on the social and ethical dimension of scientific and technological development in favor of the sustainable survival of humanity.

Nowadays, the insertion of technology in simple tasks is increasingly common, such as smart refrigerators, personal assistants that recognize the user's voice, machines and robots that perform household tasks and express emotions, among many examples that each year only increase.

Science and technology are also advancing more and more in medicine, biotechnology, astronomy, often creating the impression that there are no limits to the scientific and machine domain. According to Pérez (2021), we are able to create machines to perform complex tasks, but we have not yet been able to eliminate uncertainties. The relationship between machine and human generates social, ecological, political and cultural consequences, and there is no way to eliminate uncertainties, risks and vulnerabilities.

For Coeckelbergh (2013 *apud* PÉREZ, 2021, p. 3, free translation), "technology is a mechanism for eliminating vulnerabilities that automatically generates new vulnerabilities".¹ Machines based on artificial intelligence influence the autonomy of the human being and are present as opportunities in

¹ Because technology is a mechanism to eliminate vulnerabilities that automatically generates new vulnerabilities.



the means of study and work, in the quality of life in old age, in the monitoring of a disease, but they are not exempt from tensions, threats and uncertainties.

Science is surrounded by uncertainties and trends, which leads to the formulation of hypotheses and the imagination of future scenarios, in order to assist in decisions while pointing out what does not work and the future damages that can be avoided, and indicate, sometimes, the actions that best meet the desired objectives. The future survival of humanity depends on the choices made in the present moment, practicing ethics in the present to ensure the future (ANDREOLETTI et al., 2022).

This paper proposes to reflect on the uncertainties and risks arising from scientific and technological development, from the perspective of the ethical values necessary for human survival.

From a bibliographic and qualitative research, of analytical-interpretative character, having as source of research international scientific journals, the work will seek to answer the importance of ethical values to face the uncertainties present in science and technology with a view to the sustainable survival of society.

2 METHODOLOGICAL PATH

For the elaboration of this work, a systematized search of knowledge on the subject was carried out, through research in international scientific journals in the field of social studies of science, using the following keywords: "ethical values", "science and ethics", published in the period from 2017 to 2022. Articles in Spanish and English, peer-reviewed journals with free or open access were filtered. After reading the abstracts, the articles that related to the research problem were selected for review.

3 RESULTS AND DISCUSSION

The analysis of the articles selected for this work reveals that there is a difficulty in connecting research or the scientific empirical to ethics and philosophy of science, as taught by Heeney (2017), Lohse et al. (2020), MacAskill et al. (2020) and Elgabsi (2022). There is a prevalence of understanding among the authors about the uncertainties present in the field of science and technology, which are analyzed under different aspects, such as severe, normative, moral uncertainties, as explained by Andreoletti et al. (2022), MacAskill et al. (2020), Heeney (2017), Pérez (2021), Moroni and Chiffi (2022).

Recognizing the value of science and technology associated with ethical values means thinking about the future and, as Marcos (2019) proposes, it is necessary to think of the future as a task, an agenda, as a commitment to reflection, action and construction.

For Potter (2018), survival itself cannot be taken for granted, given the great difficulties that the governments of the world are facing to deal with problems that exist in the present and that impact the planning of the future. Therefore, Potter (2016) brings the concept of new wisdom as being the



knowledge of how to use knowledge for social good, which for him could be called the science of survival, to which he suggests the term bioethics.

Because research involving ethical, legal and social issues has been dominated by ethicists, with roots in bioethics, the panorama of discussions has been shaped in such a way that philosophy and ethics have come to be identified as synonymous with normative research in the life sciences (LOHSE et al., 2020).

Heeney (2017) ponders on the task of uniting the empirical and the ethical, stating that it is a challenge surrounded by enigmas, difficulties and problems. Citing Halmes (2002), Heeney (2017) reports that a moral concept such as autonomy is determined by the relationship a person has with others and, thus, it is assumed that an analyst can distinguish between observed autonomy and autonomy as it should be. In the perspective of Buchanan (2011 *apud* HEENEY, 2017, p. 10), "while 'morals' try to impose a fixed external standard, ethics is a creative and transformative process, the means of bringing something new".²

Thus, "how are ethical changes created through the production of new forms of technological coexistence?"³ (PÉREZ, 2021, p.1). According to Pérez (2021), programming, which is based on the logic of anticipation, cannot solve the problems of this new technological environment and the tendency is to create niches increasingly reserved for machines and artificial intelligence. It also ponders that there have been transformations of the ethical disposition in this increasingly technological environment, which affect notions of autonomy and creativity. According to Bryant (2014, *apud* PÉREZ, 2021, p. 2), "technological relations impose changes on our ontological maps, with results that can give rise to a *more or less inclusive or exclusive*⁴ethos".

In this dense technological environment, it is necessary to build the ethical principles of coexistence and interaction, from the understanding of how people enter the individual and collective ethical horizon, and how much this is determinant to define which ones will be excluded from an ethical relationship. The other can be included through a virtual or direct interaction, and this form of encounter capable of generating a fusion or leaving the "I" and forming the "we", is what guides the ethical action within a global dimension (PÉREZ, 2021).

Technology, according to Pérez (2021), exerts influence on the ways of managing distances, both spatial and temporal, as well as ontological, allowing to expand the world and the ethical requirement, as well as producing the "we" to the extent that it interferes in the way subjects are configured as individuals or groups and, thus, defines a new otherness.

² Therefore, while the "moral" attempts to impose a fixed external standard, ethics is a creative and transformative process, the means of bringing about something new (Buchanan 2011).

³ How are ethical shifts created via the production of new forms of technological coexistence?

⁴ Technological relationships impose changes on our ontological maps (Bryant, 2014), with results that can give rise to a more or less inclusive or exclusive ethos.



Ontological uncertainty can be approached through the empirical, since if ethics takes the empirical seriously, it will be more than principles applied in particular contexts. Actors use ethical potentialities to justify that things don't have to be as they are, but can and should be different. Analysts must get rid of ontological barriers to engage with ethics in order to explore unrealized ethical potentialities (HEENEY, 2017).

Heeney (2017) advocates that there is no certainty at any point, and ethics cannot be thought of as that found in practices, nor as a fixed, definitive and eternal ethics.

According to MacAskill et al. (2020), practicing ethics is difficult, as it often involves being sensitive to subtle distinctions to develop a correct moral view and also having the ability to keep an open mind to different views, arguments, and paying attention to intuitions. Even when one comes to a firm position on some ethical view, it still has to be considered that such reasoning may not be correct. In addition, trends must be considered, sometimes under the influence of self-interest, colleagues, culture, religion, education and social position.

In this sense, Vallverdú and Boix (2021, p.2) bring to reflection the following question: "is there a single and coherent system of ethical ideas that allows its computational implementation in a systematic, complete and efficient way?"⁵. If it existed, this would indicate a universal ethical categorization and of the human being himself, when, especially in ethics, there is no need to talk about universal forms (VALLVERDÚ and BOIX, 2021).

Vallverdú and Boix (2021, p.2) also bring a question already answered for reflection: "can we identify universals in the behavior of humans that will open the way to a universal ethics of innate behavior? The answer is clear and definitive: NO."⁶

What there are are universal ways of managing moral issues within a culture, and as social complexity increases, similar rules arise linked to human cultural evolution, which are family values, respect, property rights, collective loyalty, reciprocity, equity (CURRY, MULLINS and CASA BRANCA, 2019 *apud* VALLVERDÚ and BOIX, 2021). These universal rules, according to Vallverdú and Boix (2021), arise from the necessary cooperation and end up shaping the types of society, according to the differences between them.

There are no universal ethical theories either by nature or by reason. However hard one tries to find them, even associating them with absolute principles, they are mostly under the religious framework, both in positive versions, determining that one do something to others, and in the negative version, determining what one should not do to others. Both doing and not doing are interpreted under

⁵ Is there a single, coherent system of ethical ideas that allow for systematic, complete, and efficient computational implementation?

⁶ For all the above, let's return to the important question: can we identify universals in human behavior that will pave the way for us toward a universal ethic of innate behavior? The answer is clear and definitive: NO.



the religious and cultural discourse, with different meanings, generating divergences within one's own belief or Christian ethics (VALLVERDÚ and BOIX, 2021).

The question is how one should act in the face of moral uncertainty and what should be done. As MacAskill et al. (2020, p. 19) explains, "When we face a moral problem, we are asking what morally we should do, at the first level. In a case of moral uncertainty, we go up one level and ask about what we should do, on the second level."⁷ He further explains that one way to better understand the different senses of duty is to understand them as different levels of moral duty, as exemplified.

Andreoletti et al. (2022) clarifies that ignorance differs from uncertainty, since the former is the absence of knowledge, while the latter is incomplete knowledge, whereas extreme uncertainty is called severe uncertainty.

Severe uncertainty, according to Andreoletti et al. (2022), encompasses facts, methodologies, and normative facets of decision-making, and to deal with severe uncertainties and future risks in science and technology, philosophy can contribute to this understanding.

In the same sense, Lohse et al. (2020), when dealing with the perspectives of science, explains that there is often no connection between research and the philosophy of science, which, in their view, undermines research in the fields of life sciences, social sciences and legal studies. He further argues that the philosophy of science can make science more beneficial to society.

Lohse et al. (2020) proposes a greater integration between the philosophy of science in existing research modes, citing those that take care of legal, ethical and social issues, as well as those that deal with responsible research and innovation. This is because the philosophy of science does not have the definitive answers to problems, but manages to offer possible answers, perspectives, weightings and different ways of approaching problems, along with an analysis of the strengths and weaknesses of the answers.

Lohse et al. (2020) advocates that research teams be assembled *ad hoc*, with the participation of researchers working with different topics of the philosophy of science, in an integrated and integrative work to produce the necessary knowledge and make the philosophy of science more socially relevant. There is an effort of integration between philosophers of science and medicine, who have been expanding the work of addressing ethical, social and practical issues, presenting themselves as a good example of integrative work (LOHSE et al., 2020).

To explain the important contributions of philosophy of science to the normative analysis of the life sciences, Lohse et al. (2020) uses the case of animal experimentation as an illustrative conceptual tool or concrete example. It explains that there are unresolved ethical issues and, therefore, uncertainties, which impact on the regulation of animal experimentation. There is a dominant position

⁷ When we face a moral problem, we are asking what we morally ought to do, at the first level. Standard moral theories, such as utilitarianism, Kantianism, and virtue ethics provide answers to this question. In a case of moral uncertainty, we are moving up one level and asking about what we ought to do, at the second level.



that it is morally defensible if the benefits outweigh the harm done to animals, as well as if there is no valid alternative. According to Lohse et al. (2020), there is a strong consensus that the number of research based on animal experimentation is very high and needs to be reduced, in order to increasingly replace animal experiments with alternative methods.

However, as Lohse et al. (2020) explain, despite the development of non-animal methods, some factors inhibit the advancement of alternative experimentation, such as the lack of knowledge and experience within the scientific community, limitations of approaches for some purposes, insufficient funding for the development of new alternative methods and without the use of animals, and even scientific inertia itself.

Scientists who experiment with animals argue, as scientific resistance to alternative methods, that these are not yet well developed and that much animal research favors scientific progress, such as the use of mice used to research cancer immunotherapy (LOHSE et al. 2020).

Lohse et al. (2020) argues that the philosophy of science, through the researchers of ethical, legal and social issues, should not take any sides, to allow an independent and critical analysis of the situation and provide a useful perspective.

Animal models of experimentation for scientific purposes have become a benchmark for the success of biomedical research, for example. There is an infrastructure that surrounds these models, which includes everything from communication centers to the sharing of data on a digital platform at an international level (LOHSE et al., 2020).

According to Lohse et al. (2020), the uncertainties inherent in alternative methods and the spread of the risk of replacing animal experimentation with non-animal ones, end up giving scientists good epistemological and methodological reasons to adopt the traditionalist animal-based approach, parallel to new non-animal approaches and methodologies. Lohse et al. (2020) clarifies that there is a low level of engagement of the scientific community in the development and use of alternative methods.

Andreoletti et al. (2022), citing Royal Society 1983, explains that quantifiable uncertainties in terms of probability are called risks. He adds that risk and uncertainty, although they are often used interchangeably, have different meanings and are identified through different methodological tools and strategies. Many scientific and technological decisions about the future, according to Andreoletti et al. (2022), are due to severe uncertainties and not probabilistic risks.

Andreoletti et al. (2022), aiming to expand the aspects of severe uncertainties, cites an excerpt taken from a speech given by former U.S. Secretary of Defense Donald Rumsfeld during the invasion of Iraq, in which he organized knowledge, ignorance, and uncertainty into categories. Basically, it explains that as for uncertainty, what Rumsfeld called unknowns, "unknowns", has similarity with the



idea of Keynes (1973, *apud* ANDREOLETTI et al., 2022), that uncertainty is what is not known, it is like that fact whose chance of happening is uncertain, as well as any calculable probability.

In the understanding of MacAskill et al. (2020), an alternative way of understanding the "duty" of moral uncertainty is under the terms of rationality, that is, it has to do with what one should do, through the beliefs and preferences of each one. Thus, morally conscious agents care about doing right and refraining from doing wrong, as well as worrying more about serious mistakes than minor mistakes. According to MacAskill et al. (2020), this would be a common notion of consciousness, which can be defined as being governed by the inner sense of what is right, or according to the dictates of conscience and, in turn, a morally conscientious agent will give preference to right actions, rather than wrong actions.

Doing what is right and avoiding doing what is wrong will have to take moral uncertainty seriously. How much impact this will have depends on how strongly it cares about morality compared to other non-moral factors. What is rational for her to do will depend on her intrinsic concern with morality, which must be taken seriously, as there is no trivial answer to the question of what the agent should do when confronted with moral uncertainty (MACASKILL et al., 2020, p. 27).⁸

For ethical judgments involving uncertainties, with hypothetical retrospection, several argumentation strategies were developed (HANSSON, 2007 *apud* ANDREOLETTI et al., 2022). Thus, based on a hypothesis and looking at the past, the ethical values of decisions are evaluated as if an important future fact had materialized, requiring a morally acceptable alternative in the face of hypothetical retrospections.

When there is severe uncertainty, moral argumentation is extremely important, which is part of an emerging field with potential for new developments. Severe uncertainty affects future science, in the face of unpredictable answers to also unpredictable questions (ANDREOLETTI et al., 2022).

When there is a situation of moral uncertainty and several possible actions in relation to it, it means that the alternatives involve the risk of a big mistake. Linking error and merit to blame is not so simple, insofar as one has a valid excuse that supports the objection of culpability. In this case, one makes a minor mistake to avoid the risk of a serious or major mistake, or one makes the decision to avoid something deeply wrong by doing something that is little wrong (MACASKILL et al., 2020).

According to Andreoletti et al (2022), scientific progress involves far more uncertainties than risks. He cites as an example the medical context, in which future scenarios about the course of the

⁸ About doing what is right and avoiding doing what is wrong will have to take moral uncertainty seriously. How much impact this will have depends on how strongly she cares about morality compared to other non-moral factors. But, since what is rational for her to do depends on her preferences, which in turn depend on her intrinsic concern for morality, what is rational for her to do will depend on her intrinsic concern for morality. So, again, moral uncertainty needs to be taken seriously, for there is a non-trivial answer to the question of what the agent should do when faced with moral uncertainty.



disease and prognosis are more associated with severe uncertainty, although they still remain based on probabilistic risk. In research ethics, new studies have been justified by clinical uncertainty.

Many technological disasters occur as a result of extremely unlikely scenarios, but they have extremely serious consequences, and these are ruled out in the design of the technology. The need to design sensitive technologies, that is, those values of safety and responsibility linked to severe forms of uncertainty remains particularly challenging (ANDREOLETTI et al., 2022, p. 205).⁹

In taking a great moral hazard, there is something morally problematic in this action, for a conscientious and rational agent, and with a certain moral virtue, would not act in a less than wholly virtuous manner. It also seems impossible for a human agent to have an infinite number of uncertainties, that is, that in each and every situation he is uncertain about morality (MACASKILL et al., 2020). According to MacAskill et al. (2020, p. 35), "typically, if an agent believes that an action is morally wrong, he also believes that an alternative action is morally right."¹⁰

Based on the idea of Keynes, Shackle (1961, *apud* ANDREOLETTI et al. 2022) developed the Theory of Potential Surprise, with the aim of dealing with decision making under uncertainties, considering future scenarios. As Andreoletti et al. (2022, p. 203) explains, "another notion relevant to potential surprises is the family of approaches that explore the idea of scenario construction, also known as scenario planning."¹¹ In general, these theories influence current decisions, based on imaginative narratives about various future scenarios, being an important tool to work on imaginative capacity and avoid potentially dangerous situations and dramatic decisions (ANDREOLETTI et al., 2022).

Imaginative narratives about future scenarios function like scientific hypotheses, which, even if they are false, have their value and usefulness for weighing the evidence (ANDREOLETTI et al., 2022). In the case of imaginative scenarios, they can point out what does not work, as well as possible future damages and alternative actions to obtain results, and with this, they are indicators that uncertainties and value-based decisions are connected, as Andreoletti et al. (2022, p. 204) acknowledge, "decision-making under severe uncertainty is a value-laden activity."¹²

Andreoletti et al. (2022) distinguishes moral uncertainty from normative uncertainty, based on the rational analyses that philosophers have recently begun to present. To this end, it cites MacAskill et al. (2020, p.2 *apud* ANDREOLETTI et al., 2022, p. 204), when conceptualizing that moral

⁹ Many technological disasters occur as a result of extremely unlikely scenarios but have extremely severe consequences, and these are ruled out in the design of technology. The necessity of designing technologies sensitive to (i.e., those values of safety and responsibility linked to) severe forms of uncertainty remains particularly challenging.

¹⁰ Typically, if an agent believes an action to be morally wrong, he also believes an alternative action to be morally right.

¹¹ Another relevant notion to potential surprises is the family of approaches that exploit the idea of scenario building, also known as scenario planning.

¹² Decision-making under severe uncertainty is a value-laden activity.



uncertainty is "uncertainty about what all things considered morally should do",¹³ while the concept of normative uncertainty involves value-based decisions regarding epistemology, ethics, law and planning.

According to Moroni and Chiffi (2022), decision-making under uncertainty presents additional problems when the decision-maker is a public authority and not a private entity, especially when it involves social choice under conditions of uncertainty, as occurs with public policies.

Moroni and Chiffi (2022) point out that urban planning, for example, is surrounded by uncertainty, from which arise what they call "perverse problems", which are those that will hardly be enunciated in advance, because when they arise, they require understanding and resolution at the same time.

For Moroni and Chiffi (2022), a situation of certainty enables a list of possible events, as well as each choice has known consequences and leads to expected results. In a risk situation, in turn, the decision-maker is able to list the possible events and assign them probabilistic values. In a situation of severe uncertainty, it is not possible for the decision-maker to assign probabilities that are amenable to definition or measurement, as he may even ignore possible events or states of affairs. They conclude that, in urban contexts and decisions involving public actors, most of them occur in conditions of uncertainty.

It is possible to deal with technological uncertainty through the precautionary principle, but this is not feasible in innovation contexts, which are more complex and often involve uncertainties that go beyond science and are transscientific (SANDIN, 1999, *apud* ANDREOLETTI et al., 2022).

With regard to technology, it is feasible for the public decision-maker to create general, stable and negative rules, more focused on planning and without trying to govern or command specific technologies, because if the private actor can invent an appropriate technology to meet the objectives of the public decision-maker, uncertainty will be reduced or treated, without harming innovation and creativity (MORONI and CHIFFI, 2022).

Moroni and Chiffi (2022) point out that to reduce uncertainty, public measures are created that introduce basic rules and restrictions on human interaction, such as patterns that guide human actions. Thus, negative rules are preferable, that is, that prohibit certain actions, the formulation of specific actions, which requires more knowledge than establishing negative rules. Thus, Moroni and Chiffi (2022, p. 6) indicate three strategies to reduce uncertainties: "(i) prefer simple rules, (ii) promulgate stable rules, and (iii) provide rules that favor the emergence and proper functioning of "systems of social calculation."

Unstable rules, which are constantly revised, add uncertainty and affect the reliability of decisions, unlike stable rules, which favor socially stable environments, ensuring an overall

¹³ Moral uncertainty is "uncertainty about what we all-things-considered morally ought to do" (MacAskill et al. 2020, p. 2)



predictability and a coordination of standards (MORONI and CHIFFI, 2022). Public rules are therefore useful and necessary, as they can reduce uncertainty, if they are created and established properly, creating reliable expectations regarding the social and economic world.

Elgabsi (2022) in his studies on responsible science, emphasizes scholars who promote responsible research and innovation (RRI), pondering that the ethical concern in this case goes beyond scientific, social or legal responsibility. Elgabsi (2022, p. 306) understands that "RRI is asking for the encouragement of researchers' willingness and ability to explore value-sensitive responses to the complex questions that arise at the interfaces of science and society." Thus, for him, RRI is a continuous and conceptual reflection on the values that permeate any scientific enterprise.

When discussing the misuse of research data or scientific information, Elgabsi (2022) ponders that one should know the distinct ideas about values in science. Epistemic values delineate the goals of science and how an enterprise seeks knowledge, while ethical values are value judgments about the desirability of the consequences arising from the application of scientific evidence.

As the bioethicist Resnik (2014, p. 188 *apud* ELGABSI, 2022, p. 316) says, "the social responsibility of any scientist is to engage in activities that improve or promote the common good, which is achieved, in part, by conducting research that benefits the public."¹⁴ For Resnik, as Elgabsi (2022) explains, science is not exempt from values and certain research should not happen, if it can have harmful consequences, that is, there is a balance between benefits and potential harms when evaluating scientific research. In this sense, it is crucial to reflect in order to evaluate whether the research should continue and whether the epistemic search is ethically justifiable. (ELGABSI, 2022).

According to Pérez (2021), we live with uncertainty, there is no way to eliminate it, just as you cannot eliminate risks and vulnerabilities. Although technology is able to eliminate some vulnerabilities, it generates others, and in the uncertainty the ethical dimension and the impact of the subject's exposure to others are hidden.

Today, more and more information networks grow and the technological environment permeates the spaces. Examples range from personal assistants that recognize voice, cars that manage their own system, robots that talk, automatic systems that perform complex tasks. This relationship between machine and human generates ecological, political, social and cultural consequences, often difficult to predict. These uncertainties feed the concern with social tensions, especially arising from the consumption of electricity, and with the ethical production of artificial intelligence (PÉREZ, 2021).

According to Elgabsi (2022), scholars and proponents of responsible research and innovation (RRI) assert that responsibility in science and ethical consideration need to be tied to the large-scale political, legal, or institutional aspects of science and innovation. Ethics and responsibility, therefore,

¹⁴ The social responsibility of any scientist, says bioethicist Resnik (2014: 188), is to 'engage in activities that enhance or promote the common good', which is achieved, in part, by 'conducting research which benefits the public'.



must be anchored in concerns about what is humanly good, since assuming that scientific knowledge is a transcendent value cannot replace what is humanly good (ELGABSI, 2022).

The new forms of coexistence with machines based on artificial intelligence are changing the way of existence of the human being, as they bring effects on economic life, the opportunities for study and work, in the biological and cultural environment, since it allows privileged forms of knowledge under the logic of anticipation (PÉREZ, 2021). In addition to tensions, artificial intelligence is also loaded with threats, such as the application of algorithms that tend to suppress certain sciences, as well as customizations that can function as mechanisms of discrimination and suppression of autonomy (PÉREZ, 2021).

Artificial intelligence technologies create forms of precariousness, such as the limitation of action and the imposition of a framework of pre-established actions, and a set of rules and dependencies that reconfigure what is meant by the autonomy of the person, lacking ethical actions so that possible ways of living with machines are developed, through conditions of moral action (PÉREZ, 2021).

In artificial intelligence technologies, the limits of autonomy are confused, because the ethical subject becomes an agent of the ends that he himself proposed, directing and controlling the machine that constitutes power (PÉREZ, 2021).

Pérez (2021) cites a statement by the Vice President of the United States National Commission on Artificial Intelligence, that lethal autonomous weapons or robots would be more accurate and effective on the battlefield, which would justify the development of such technology as a moral imperative. Her discourse, according to Pérez (2021), aligns with that of some authors who argue that such arming or autonomous robots could act as supervisors of ethical behavior or moral agents, which for her is a misunderstanding of the very meaning of the ethical principle.

Another fact highlighted by Pérez (2021) is the technical obsolescence of machines, which end up displacing people, who have invested almost a lifetime in certain skills, and are equated with resources that can be discarded. It is necessary to understand how the foundations of ethics, in all its dimension, can be transferred from the human to the non-human sense, in order to understand the ethics of machines, or else to conceive that there can be no transference.

Thus, science cannot always answer all questions, since it is still necessary to know how to deal with severe uncertainty in the context of scientific and technological innovation, as well as its epistemological, ethical, social and political aspects (ANDREOLETTI et al., 2022).

4 FINAL CONSIDERATIONS

Scientific and technological development coexists with uncertainties and risks that cannot be eliminated and, in turn, require an ethical reflection on its purpose before society and the future. This



reflection is not simple, because there is difficulty in knowing what is right and what is wrong, in view of the moral uncertainty that affects decision making.

The objective of this work was achieved to the extent that, when reflecting on the uncertainties and risks arising from scientific and technological development, it was found that there is great concern with ethical issues in this environment, especially by the ability to affect the autonomy of the individual, or leave it in the background in the face of machines and artificial intelligence. Ethical values impose the need for critical reflection on the means and ends of the production of knowledge and technology, starting with the understanding of existing uncertainties and possible future and hypothetical scenarios.

Ethics does not have all the answers to uncertainties, but by the questions it instigates the analyst to ask, it leads to the understanding of the ethical potentialities in scientific and technological relations, with the aim of avoiding danger, the subjugation of the human by the machine, social and economic instability. It is in this sense that ethical values are allies in facing the uncertainties present in science and technology, supporting decisions that allow a sustainable survival of society.



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