

Bringing Science Fiction into teaching of Bioethics

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Abstract

This article questions science fiction might be considered as a pedagogical tool for teaching bioethics in higher education. One can stress that science fiction narratives can stimulate critical thinking and provide a lens for understanding complex ethical dilemmas. It can be highlighted that science fiction has the ability to illustrate abstract bioethical concepts, provoke in-depth debates about scientific and ethical implications, and support students to develop judgment and practical reasoning skills. Potential methodological pitfalls are addressed, such as oversimplification, scientific inaccuracies, and cultural biases. A structured approach is proposed for selecting and integrating science fiction works into teaching, emphasizing the importance of scientific accuracy, thematic relevance, and educational value. A practical pedagogical framework for using science fiction in bioethics courses, including a proposed course design for bachelor-level students that encourages active learning and critical analysis, is presented and discussed.

Keywords: *bioethics; science fiction; Critical thinking; decision-making skills, evaluation grid*

1. Introduction

Students are exposed to an increasing amount of information, which necessitates the use of a set of tools and knowledge to navigate and orient themselves in order to distinguish facts from interpretations, as well as truth from error. Managing this critical mass of information disrupts the relationship to knowledge and has become a particularly pressing issue in the context of socially sensitive questions. Among these, the ethical challenges associated with advances in medicine and biology are regularly debated and result in legislative frameworks or the creation of practical guides by research ethics committees. Ethical issues related to the environment translate into a climate of eco-anxiety among young adolescents and young adults (Costello et al., 2009). Addressing bioethical questions has become a major challenge in higher education.

This challenge can be linked to other questions: How do we learn and how do we teach in a context where there is immediate access to a multitude of contents, mixing knowledge, pseudo-knowledge, beliefs, and opinions? What resources and cases should be analyzed with students? How can we evaluate their understanding of ethical questions?

Training in critical thinking and practicing critical thinking appear as viable options to explore tools and methods for addressing bioethical questions. Students can adopt these tools and apply them in other domains. Critical thinking transcends disciplines: it engages students in an active, inter-relational stance, teaching them to position themselves as citizens through skills that will develop both professionally and personally. The development of critical thinking aligns with societal demands for upholding democratic values (Lecointre, 2018).

By nature interdisciplinary, bioethics requires significant investment from teachers. While bioethics is sometimes perceived as being limited to medical questions, where teachers may feel a lack of legitimacy, a broader conception can be mobilized. The term "bioethics" emerged in the U.S. in the 1970s, originating in Wisconsin and Georgetown (Potter, 1970). Van Rensselaer Potter in Wisconsin envisioned bioethics as a "science of survival" integrating biology and human values, while André Hellegers in Georgetown focused on medical ethics for clinical problem-solving. Potter's broader vision addressed humanity's existence over time and space, contrasting Georgetown's traditional medical ethics. Milestones include the 1979 Belmont Report's principles of autonomy, beneficence, non-maleficence, and justice, foundational for research ethics following the revelations of the scandal of the Tuskegee study's on syphilis.

Based upon feedback from teaching bioethics in higher education (Bodart and Poteaux, 2022; Canu et al., 2022), the article addresses the use of science fiction as a pedagogical tool for teaching bioethics and proposes a scheme and criteria of an evaluation grid.

2. How Science Fiction may contribute to Bioethics teaching?

2.1. Science Fiction as a Multifaceted Tool for Bioethics Education through defamiliarization, and critical thinking

Science fiction offers multiple dimensions that enrich understanding and stimulate critical thinking. Its narratives provide (1) a mirror to comprehend the present, (2) a warning through extrapolation of current trends, and (3) a way to challenge immutable assumptions, proposing alternative "realities". One notable concept is the *mooreffoc effect*, created by G.K. Chesterton and popularized by C.S. Lewis. This "defamiliarization" effect reframes familiar ideas or objects through an unusual lens, reigniting a sense of wonder. Such reframing challenges student's habits of perception, prompting them to reassess ingrained mental frameworks. This re-evaluation mirrors the cognitive shifts achieved through ethical thought experiments, like the *trolley problem* created by P. Foot. These methods can promote ethical reasoning.

Science fiction novels and movies can be effectively integrated into pedagogical alignment and contribute to teach bioethics in different manners (Gordijn and Have, 2017). Learning activities can be built according to the aims of the pedagogical alignment. First, *science fiction novels and movies may act as intuition pumps to illustrate concepts and dilemmas*; they can illustrate complex concepts and therefore they may increase the accessibility of potential abstract bioethical concepts (1) through engaging narratives and plausible situations, and (2) through contextualization and familiarization with ethical dilemmas by exploring future scenarios. Indeed, science fiction scenarios constitute spaces to explore our fears, hopes, and ideals related to biomedical advances or socio-economic choices. Second, *science fiction novels and movies can stimulate critical thinking*. They can provoke in-depth debates and reflections on the ethical implications of scientific advances. Students can exercise practical reasoning by analyzing the situations presented and study the ethical decisions of characters in various situations and analyze moral choices made by the characters. Yazici and colleagues (2010) noted in their study that debates on bioethical issues with the benefit of science fiction presentation were observed to be most effective method for student to develop their judgment towards bioethical issues, grasping both theoretically and experimentally aspects with positive attitudes.

To be efficiently used, one might be cautious by carefully selecting works based on their relevance (nature of the bioethical issues involved) and scientific quality. Moreover, the selected works shall be integrated into a structured pedagogical framework, complementing other academic resources, such as historical cases. Proposed teaching shall enhance student engagement through narrative immersion, transcending traditional theoretical frameworks such as thought experiments (e.g., the trolley dilemma), and employing the Moore effect to potentially create socio-cognitive conflict. Nevertheless, one shall not forget to encourage students to develop a critical perspective on the representations proposed.

2.2. Pitfalls of using science-fiction novels and movies

Several methodological pitfalls and challenges have to be considered, therefore leading the choice of science-fiction presenting a scientific accuracy or at least, an accuracy that can be easily discussed. As discussed above, academic articles shall be provided to complete the analysis of the ethical issues. Context and background information will be of use to enable the students to distinguish between speculative elements and current scientific realities. First, science fiction works may provide oversimplification of complex issues, by presenting bioethical dilemmas in a simplified manner, or they may offer a limited scope, not covering all the relevant bioethical issues, or focusing in a disproportional manner on certain topics, neglecting the others. Second, students must be aware that not all science fiction works are based upon accurate scientific facts, which could lead to misconceptions about technologies. It may raise difficulties to distinguish fiction from reality: students may struggle to distinguish between speculative elements and real scientific possibilities, potentially leading to misunderstandings

about current biotechnological abilities, for therapeutic purposes for example. Third, several works of science fiction may exhibit bias. In one hand, they are often products of their time and cultural context, which may limit their relevance or suitability for use in bioethical debates. On the other hand, other works may rely on emotional manipulation rather than logical reasoning. Such cases shall not be included in a pedagogical scenario, unless being used as an example to exert critical thinking and expose with clarity the bias. For example, works like *Westworld* or *Black Mirror* shape cultural perceptions of technology and ethics, yet their suspension of disbelief can lead audiences to accept fictional premises uncritically. Fourth, dystopias rely on worst-case scenarios, which may instill undue fear or pessimism about scientific advancements, and therein, hinder a balanced discussions about the potential benefits and risks within an ethical dilemma. One shall find the references associated with these analysis within table 1.

3. How to choose an appropriate science-fiction work?

Science fiction bridges fiction, theory and reality, and may provide contents preparing students to navigate through complex ethical landscapes with imagination, empathy, and critical insight. The selection of science fiction works depends on various criteria :

- Thematic Relevance shall resonate with the purpose of illustrating or analyzing bioethics principles, like ethical dilemmas (e.g., AI, genetic engineering), societal issues (e.g., dystopian futures, climate change), or philosophical questions about humanity and existence.
- Scientific Accuracy and Plausibility : scientific elements should be logical and align with known facts or theories commonly shared in the scientific community. Beyond the consistency or science, hard science fiction works focus on accurate scientific details and plausible technological advancements (e.g., physics, astrophysics) while soft science fiction works may focus more on societal or philosophical themes, with less emphasis on scientific rigor.
- Educational value. Selected works can provoke critical thinking and debates about ethical or scientific issues. It is necessary to ensure the work aligns with educational goals, such as introducing values (figure 1) and/or scientific concepts.

Narrative quality, consistency and character development are also of interest by providing in depth understanding of moral choices made by the characters. Cultural and contextual relevance ought not to be neglected since they are factors of immersion. Science fiction masterpieces create a cognitive reservoir of imagined experiences that examine potential applications and consequences of scientific and social developments. Emerging genres like climates fiction highlighted environmental ethics, blending imaginative storytelling with urgent real-world concerns. Table 1 groups together, in a non-exhaustive manner, novels, films or television series that can be employed, as well as references where these resources have been analysed. These works of fiction might be used alone, in the multiple dimensions that they expose. Alternatively,

the understanding of a single principle, such as that of human dignity, can be illustrated through the mobilization of several works like Brave New World, Gattaca, The Parable of the Sower, The Handmaid's Tale or Flowers for Algernon.

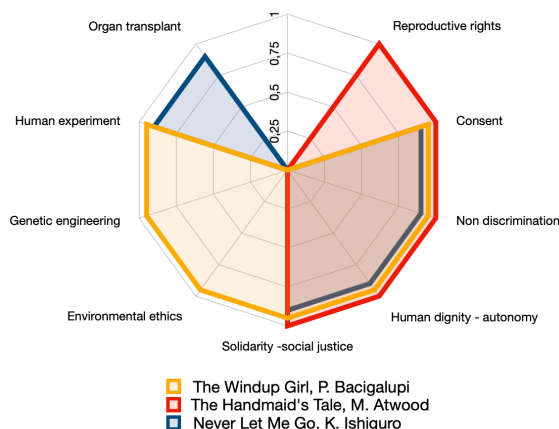


Figure 1. Comparison of the use of three different science fiction works to study values raised in bioethics (arbitrary unit).

Table 1. Works of fiction and anticipation that can be used to discuss and analyze ethical issues.

Fiction's name	Fiction's format	Principles and values	References
Brave new world, A. Huxley	Novel (1932)	Genetic manipulation, social control, non-discrimination and eugenics	Chan, 2009; Rumpala, 2015,
Dune, F. Herbert	Roman (1965), Movie (2021)	Ecological crisis, environmental ethics	Rumpala, 2015
The Handmaid's tale, M. Atwood	Novel (1985), Television (2017)	Reproductive rights, non-discrimination and eugenics, consent, human dignity and social justice.	Magee, 2018
Gattaca, A. Niccol	Novel (1997)	Genetic manipulation, non-discrimination and eugenics.	Ogbunugafor et Edge, 2022 ; So et al., 2022
Never let me go, K. Ishiguro	Novel (2005), Movie (2010)	Human cloning, exploitation of bodies, human dignity	Chan, 2009
The windup girl, P. Bacigalupi	Novel (2009)	Genetic modification, slavery of modified creatures, ecological crisis.	Rumpala, 2015
Black Mirror	Television (2011-14 ; 2016-24).	Artificial intelligence, privacy, autonomy, human dignity, mental manipulation	Chan, 2009

4. Building up a pedagogical script integrating science-fiction works in a bachelor course for introduction to bioethics

A course fostering critical thinking and reflection has been part of our bioethics teaching since 2020. Two formats were developed to fit Bachelor architecture constraints, referred to as L2 and L3 courses. Since some students attend both years, we adapted the teaching to maintain L3 engagement while considering constructive alignment. For 2024–2025, we added science fiction analysis. The course includes a 2-hours session and two student presentation sessions (Canu et al., 2022). The first session focuses on: (1) reviewing the course's reflective framework and critical thinking goals, (2) selecting science fiction works tied to specific bioethical principles, and (3) choosing real cases linked to those themes.

Students who created evaluation grids the previous year will be able to reuse these grids to evaluate their presentation work as well as the presentations of their peers' work. However, these grids must be modified to include new criteria: relevance of the film or novel to illustrate a bioethical issue, contextualization and analysis of the scientific accuracy and plausibility, critical analysis of values and ethical dilemmas within science fiction and relation to real cases.

Between the two presentation sessions, students receive informative feedback from the teacher on their performance. At the end of the first session, students fill out a self-assessment sheet of their work. They are asked to respond on several dimensions: quality of their group work organization, work atmosphere, distribution of the workload in the group. They must also comment on the contribution of fiction to the work on bioethical issues, the strong points of their presentation performance, and areas for improvement.

An evaluation of the courses will be performed, including (i) an analysis of students' evaluation grid productions by the teachers (clarity of criteria, clarity and relevance of descriptor, use of the grid by the students), (ii) an analysis of the student's self-assessment sheets, (iii) an anonymous questionnaire carried out using a Socrative platform (made up of 23 closed questions organized as follows: (1) general appreciation, (2) lessons, (3) animation of the lesson and interactions, (4) activities and (5) evaluation; and open-ended questions focused on the relevance of teaching in their training, on the three strengths of teaching and the last question invited students to provide suggestions for improving teaching) and (iv) group interviews.

In the context of a case analysis, several expectations must be met. Students must demonstrate an understanding of the narrative framework of the novel or movie, and the ability to identify the values related to bioethics present in the work, as well as the evidence that shows the tension between these values; students must also demonstrate the ability to scientifically contextualize the resource (plausibility, factual errors, confrontation with current techniques, theories not taken into account). As an example of case analysis, *Gattaca*, a 1997 science fiction film by Andrew Niccol, serves as a powerful tool for exploring bioethical issues (Ogbunugafor et al, 2022; Greenbaum and Gerstein, 2022). Set in a dystopian future, it depicts a society divided

between genetically engineered "valids" and naturally conceived "in-valids." It encourages critical thinking about the long-term consequences of genetic technologies and the balance between scientific progress and ethical considerations. Together with Aldous Huxley's *Brave New World*, *Gattaca* offers a context to remind students of milestones in molecular biology concepts. Molecular biology emerged in the 1930s when genetics and biochemistry converged. Major advancements occurred in the 1940s-50s, including the discovery of DNA's structure through X-ray diffraction. In 1953, the identification of DNA's double helix was a key milestone, and by the 1960s, decoding the genetic code revealed how DNA sequences code for proteins. The 1990s Human Genome Project revolutionized DNA sequencing, while recent breakthroughs like genetic engineering using CRISPR-Cas9 and synthetic biology continue to open new perspectives, from fundamental research to therapeutic purposes. Many of the core concepts mentioned in the movie are anchored in scientific reality, with limits to be considered: (1) the film's portrayal of genetic prediction is somewhat exaggerated but not entirely implausible. Current research has made significant advances in predicting traits and disease risks based on genetic information. Students shall note that if epigenesis was neglected in the movie, its importance is crucial and can be discussed with students, in a debate on genetic determinism; (2) practice of selecting embryos based on genetic traits, as shown in the film, is already a reality (pre-implantation diagnosis), though not to the extent depicted in *Gattaca*. (3) while not as overt as in the film, concerns about genetic discrimination in employment and insurance are very real in today's society. It offers the opportunity to expose that, being enforced in the European Union in 2016, the GDPR (General Data Protection Regulation) classifies genetic data as personal data, imposing strict requirements regarding its collection, processing, and storage. Individuals must provide explicit and informed consent for the use of their genetic data, which must be handled transparently. Finally, several key bioethical principles have to be identified by the students in their analysis of *Gattaca*: (1) eugenics and human enhancement (2) equality and non-discrimination (3) genetic determinism (4) privacy and genetic information (5) consent and autonomy.

5. Conclusion

In exploring the integration of science fiction as a pedagogical tool for bioethics, the aim was to highlight its unique potential to inspire critical thinking and ethical reflection. Science fiction bridges the gap between theoretical bioethical concepts and their real-world implications. Works such as *Gattaca* serve as both a cautionary tale and engages students emotionally, facilitating deeper exploration of bioethical dilemmas. To maximize its educational impact, careful selection of science fiction works is essential, prioritizing thematic relevance, scientific plausibility, and cultural resonance. These narratives provide a cognitive framework that complements traditional teaching methods, fostering empathy and enabling students to navigate complex ethical dilemmas with greater nuance.

Ultimately, the use of science fiction in bioethics education not only enriches the learning experience but also provides students with the tools to critically assess the balance between scientific innovation and ethical responsibility in shaping our collective future.

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