

Students' Values and Ethical Concerns in a Biosciences' Course in Higher Education

Katerina Kedraka

Department of Molecular Biology and Genetics, Democritus University of Thrace, Alexandroupoli, Greece

Email: kkedraka@mbg.duth.gr

How to cite this paper: Kedraka, K. (2020). Students' Values and Ethical Concerns in a Biosciences' Course in Higher Education. *Open Journal of Philosophy*, 10, 469-481. <https://doi.org/10.4236/ojpp.2020.104033>

Received: September 14, 2020

Accepted: November 9, 2020

Published: November 12, 2020

Copyright © 2020 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

In this small-scale study in higher education, a good educational practice on teaching bioethics based on transformative learning and accomplished by debates, is presented. The research was carried out in June 2016 at the Department of Molecular Biology and Genetics, Democritus University of Thrace, Greece and it focuses on the concerns over their value system and moral dilemmas underground students in the field of biosciences have. Reflections occurred after the debating experience they participated in during this course. The research followed the qualitative method and data were collected through a single question posed to students, asking them to critically reflect on their debating experience. Content analysis was used for analyzing their responses. Debates seem to be a good practice for teaching bioethics, since it led them to critically think over their values and morals regarding their role as future biologists. They seem eager to reflect, question, and deal with moral dilemmas concerning the difficult ethical issue of bioethics, a key-point for every junior scientist.

Keywords

Debate, Transformative Learning, Bioethics, Values

1. Introduction

Bioethics is a field that involves critical analysis of the ethical issues that have arisen from modern advances in biology and medicine examined in the light of moral values and principles (Dopico, 2020). Bioethics is at the intersection of several different scientific fields ranging from biology, genetics, biotechnology, and biomedicine to philosophy, law, and theology. As a field, bioethics provides a framework for not only scientists but all individuals to formulate solid, verifiable scientific questions about ethical questions in biomedicine and to develop the

necessary principles and values to approach bioethical dilemmas rationally (Bostick, 2016). The aim of bioethics, then, is the development of a systematic and comprehensive approach to the complex ethical dilemmas that arise from the continued achievements of biosciences and biotechnology (Tsinorema & Louis, 2013).

Bioethics critically examines the relationship between bioscience and ethics, examining the ethical dilemmas that biologists face, as well as their social implications. This is increasingly relevant as technologies and applications related to the handling of genetic material continue to multiply. Bioethics is multifactorial: On one hand, it emphasises the social, political, economic and ideological context in which a scientific advance occurs, and on the other hand it considers the value systems, beliefs and behaviours of people who are actively involved in this science (Gordon & Levin, 2007). Decision-making and actions in the face of biomedicine-related ethical dilemmas require not only scientific and technical expertise but also critical thinking, mental sensitivity, information on current ethical issues, and a deep understanding of human nature (Katsimigas & Vasilopoulou, 2010). Bioethics intervenes in biomedicine only when the achievements of bioscience and biotechnology threaten human integrity, dignity, and autonomy or when fundamental rights are violated (Dragona-Monachou, 2002). In this way, bioethics forms a safeguard against any arrogant or thoughtless visions of genetic engineering, particularly as it relates to “anthropogenesis” and “anthropotechnics”, e.g. cloning (Jonas, 1979). Bioethics can be viewed as a set of principles and values that are used to identify and resolve ethical questions in biomedicine, with input from social, economic, political, and cultural perspectives. It can help instil a more humanitarian approach in biomedicine (Zanni, 2012).

Bioethics is an elective course offered within the Department of Molecular Biology & Genetics (Dept. MBG) at Democritus University of Thrace in Greece. The course addresses issues related to the ethical development of biologists, particularly as it relates to their roles as researchers. The aim of the course was to develop critical scientific thinking skills and to analyze and develop responsible and ethical approaches to complex scientific and social problems that arise from advances in biomedicine and biotechnology.

During the 2015-2016 academic year, 24 students were enrolled, and the 6th semester’s course had a two-hours duration per week. The design of the curriculum was set within the framework of Mezirow’s (1990, 2007) transformative learning theory. This decision was based on the need to develop students’ critical thinking on key ethical issues in the biosciences. McGonigal (2007) argued that the cognitive content of certain subjects makes some teaching strategies more appropriate than others. In the content of the Bioethics course, it is imperative to foster a critical thinking approach to complex topics in bioethics. Moreover, Cranston (2002) has argued that critical thinking should be a clear goal of all forms of education—especially education of adults—because it encourages the learner to become open to new ways of thinking.

Values are a key component of bioethical perception. By definition, a value

signifies what an individual considers important and can refer either to an individual's inner preference or to the rewards or pleasures they expect to receive from a certain behaviour (Zytowski, 1970). Some researchers consider values important elements in the general context of an individual's preferences (Pennings, 1970). Others, including Allport and colleagues (1951, cited in Elizur et al., 1991), consider values key motivators that lead to certain behaviours. Thus, an individual's value system includes all values that are used as standard criteria to judge and choose between alternative behaviours (Becker & McClintock, 1967; Kluckhohn, 1952).

Super (1962, 1970) considered values integral to an individual's personal (and professional) development and adaptation. He describes values as the rewards that people desire to acquire through their activities, efforts, and, more generally, through their whole way of life (Super, 1957). In other words, a person's values are the goals of their behaviour (Super, 1962). However, Pryor (1979) has argued that Super does not take into account that values (like perceptions and ideas) are subjective. In Pryor's (1979) framework, values depend on the characteristics of both the appraiser and the appraised, but the values themselves are neither the subject nor the object of the appraisal process. As Schiebe (1970) argued, values are derived from "evaluation processes" rather than from the characteristics of objects or individuals. Therefore, Pryor (1979) proposed that an individual's values fall into two categories: an emotional type (i.e. "I am positive about this") and an evaluative type (i.e. "This is good, therefore I have to do it).

Rokeach (1973) provided a more widely accepted definition of values. After conducting an extensive study of values, he proposed that a value is a persistent belief that a particular way of behaving or a final existential state is personally or socially preferable to an opposite (Rokeach, 1973: p 5): "A value system is an organized set of beliefs about desired behaviours or ultimate existential situations". Guttman (1968, cited in Sagie et al., 1996) considered values a subset of individuals' general behaviour, while Rokeach (1973) believed that there is a separation between values and behaviours.

Rokeach (1973) made a distinction between personal and social values, defining personal values as those that relate mainly to oneself and one's own personal behaviours and personal goals (e.g., friendship, family, and honesty) and social values as those that relate mainly to others or wider society (e.g., solidarity, equality, justice, the right to work, the protection of human dignity, freedom, democracy, the protection of the natural and cultural environment, and the protection of individual and social rights). All values—both personal and social—contribute to the shaping of an individual's profile and their "personal meaning of life" (Giannouleas, 2011; Miell & Dallos, 2007). Furthermore, Gary (n.d.) noted that values can motivate an individual to pursue positive social behaviours (e.g., solidarity, cooperation, and altruism) that favour the functioning of society (Rohan & Zanna, 2001). According to Pantaléon, Chataigné, Bonardi, & Long's (2019) results, age is a predictor of values priorities—more than the degree of self-centredness: the older the person is, the more he valorises collective values

compared to individual values.

2. Literature Review

Bioethics is increasingly incorporated into the biomedicine curriculum (Taka, 2015). Teaching bioethics helps students develop sensitivity to socio-scientific issues, preparing them to respond thoughtfully and responsibly to any scientific dilemmas that arise in their future careers (Crne-Hladnik et al., 2011; Stefani-dou, 2016; Tzampazi, 2016; Hadzigeorgiou, 2015; Malamitsa et al., 2009). Macer (2008) proposed a series of interactive exercises to teach bioethics in the classroom. Many higher education curricula emphasise the development of metacognitive skills and social skills, and this is particularly important for young biologists (Tzampazi, 2016; Hadzigeorgiou, 2015). Students need to be educated about the values and principles of bioethics, so they are able to critically examine the societal consequences of advances in biomedicine through rational argumentation and dialogue (Malamitsa et al., 2009; Crne-Hladnik et al., 2011).

A previous study of high school students in Greece indicated widespread lack of awareness and misconceptions regarding bioethical issues (Giasemmis, 2011). Furthermore, Christoforatu (2014) reported that humanitarian values such as respect and critical thinking emphasised only through rhetorical content in most secondary education curricula in biosciences. In contrast, the National Bioethics Committee notes that if the subject of bioethics is taught instead with examples and valid scientific data, university and even high school students can develop a mature and critical view of this topic (Vidalis & Molaki, 2018).

Kedraka and Kourkoutas (2018) studied the teaching of bioethics in higher education. They reported that interest in bioethics is growing within the field of biosciences because the next generation of scientists will be faced with questions of high ethical, personal, and social importance; indeed, their research may have the power to transform humanity for better or for worse. Examples of ethical questions the next generation of scientists will be faced with include cloning and commercially available genetic testing services.

Cloning raises several moral questions regarding the uniqueness of individuals and their place in work and society. This, in combination with human genome mapping, provides inexhaustible possibilities for future researchers: We now have the technical capacity to modify human genetic material to add desirable traits or remove problematic ones. This has enormous implications for the evolution of the human species. Therefore, personal genetic information should be handled with the utmost seriousness and care, and every possible precaution should be taken to ensure an ethical approach to any issues that arise (John J. Reilly Centre for Science, Technology, and Values, 2016).

Another example is commercially available or direct-to-consumer (DTC) genetic testing and services. These are genetic tests and services that consumers can purchase directly from a pharmacy, the internet, or television advertising, without any consultation from a health scientist or geneticist. These tests can be

divided into four main categories, depending on the type of information they provide: 1) Detection of monogenic disease (direct genotype-phenotype correlation); 2) Prediction of polygenic or multifactorial diseases (e.g. cancer, osteoporosis, or cardiovascular dysfunction); 3) Identification of genetic material (i.e. paternity test); and 4) Prediction of drug action or toxicity.

These commercially available genetic tests have been well-received by the general public because of their low cost, easy accessibility, and non-invasive sample collection (usually via saliva collection). However, serious ethical questions arise regarding the reliability, interpretation, and use of the results from such tests: How can people without scientific training evaluate them? How will the results be used by relatives, employers, insurance companies, or other commercial companies? Beyond bioethical concerns, the availability of these commercial genetic tests has also raised serious questions over how the use of these tools should be legislated (Zerva et al., 2017).

In bioethical theory, ethical dilemmas are framed in terms of choices between conflicting values and beliefs, and the consequent action of the individual (Braunack-Mayer, 2001). Transformative learning theory is considered the most appropriate for teaching bioethics, since it focuses on critical self-reflection and engagement in dialogue as means of facilitating learning in higher education (Badara, 2011), based on Mezirow's (1990, 2007) observation that the learning of autonomous thinking requires an individual to contemplate the interaction between personal and social ethical rules. Kedraka and Rotidi (2017) attempted to link the didactic learning environment required for the teaching of bioethical issues with Mezirow's theory of transformative learning. According to Mezirow, people express social reality through "personal constructions" that are directly linked to cultural beliefs and local moral traditions and norms in their society; these may also be linked to beliefs rooted in cultural pluralism and interculturalism (Pinto, 2016). A change in an individual's views occurs as a result of a "disorienting dilemma," defined as a situation that calls an individual's previous assumptions into question (Mezirow, 1994) and is inconsistent with the way they understand themselves and the world (Cranton, 2006). In a didactic approach based on transformative learning theory, teachers challenge students to critically evaluate their current assumptions and values in order to achieve a more rational system of principles and values (Kedraka & Rotidi, 2017). Through the educational process, teachers can pose bioethical dilemmas to students as a starting point for facilitating thoughtful and active learning. It has been argued that moral dilemmas can be a form of "mental baggage" weighing on young people (Rundgren et al., 2016). Teaching bioethics can enhance students' critical thinking abilities and decision-making skills around biomedicine-related moral dilemmas, especially when transformative forms of reasoning are mobilized through small group discussions and reflections (Kedraka & Kourkoutas, 2018; Gutierrez, 2015; Kolarova & Denev, 2012; Jarvis, 2004). As Nader, Hernández, Acosta, Hernández, and Gómez (2020) argue, a core question arises concerning Institutes of

Higher Education: what kind of biologists—individuals—members of a new generation of scientists do we want to build and what kind of professionals do we intend to train, from an ethical, legal, psychological, sociological and moral approach?

3. Methodology

Bioethics is a sophomore course at the Department of Molecular Biology & Genetics at Democritus University of Thrace-Greece. During the academic year 2015-16 the course was organized into four sections, which focused on the following topics:

Section 1: Introduction to Bioethics

- Basic concepts of ethics
- Scientific advances and management of ethical dilemmas in the modern scientific environment

Section 2: The Legal Framework

- The legal framework in Greece: development of directives and legislation
- The legal framework in Europe: development of directives and legislation
- Bioethics and international organizations

Section 3: Contemporary Bioethics Issues in Molecular Biosciences

- Reproductive biology, assisted reproduction, and designer babies
- DNA banks
- Genetic modification in the context of agricultural activity
- Challenges associated with the human genome

Section 4: The Role of the Modern Biologist

- The ethical dimension of the role of the modern biologist
- Professional ethics in the biosciences

Section 1 set the theoretical background of the course, Sections 2 and 4 featured invited professors with specialised knowledge on the topics; their expertise contributed positively to the course's comprehensive approach to bioethics.

Section 3 was taught using a debate format. Faculty members within Dept. MBG suggested various topics as possible subjects for debates. In collaboration with these faculty members, the two course leaders selected the following four topics: reproductive biology and assisted reproduction, DNA banks, genetic modification in agriculture, and challenges associated with the human genome. The selected topics were described to the class and students were instructed to form four groups of three to research one of the topics (with the help of a list of relevant literature). After some negotiation, each group chose whether they were for or against the chosen topic. The debate process included the following stages: First, 10-minute presentations of each group's position took place presenting either for or against position, based on scientific data and arguments; Next, 5 minutes were used for response arguments to the points raised by the opposing team; Finally, there was a 3 minutes time for each group's closing arguments and concluding positions. Students and teachers then voted on which group had

“convinced” them, and the lesson ended with an extensive open plenary discussion on the presented topic.

At the end of the semester, students who participated in the course were asked to send (via email) their opinion on various aspects of the course, describe their experiences with the course, and provide feedback on the implementation of this course. A small-scale study was conducted to analyse the ethical issues raised by students during debate section of the Bioethics course at Dept. MBG. Also, we tried to figure out the students’ opinions regarding the debate process they have taken part in. To evaluate the debate process including we posed the open question: “What have I kept from my participation in the debate process?”. Of the 24 students who took part in the course, 19 provided full responses to the end-of-semester email and were included in the study. Data collection took place at the end of the Bioethics course in June 2016. To control for bias and potential inter-rater differences in the content analysis, students’ responses were blinded, and students were informed their results would be anonymous and would be used for a small study. Since the responses were originally in Greek, translation to English was an issue to resolve and in some cases the translation focused on the meaning rather than on the exact word-to-word translation.

The research methodology follows a qualitative approach. This was considered most appropriate because it allows deeper analysis and interpretation of the data. Taylor (2007) argues that since focus is set around critical reflection, relationships, and context, as catalysts of transformative learning in Science higher education teaching, qualitative research designs are most likely to be used in relevant studies. To analyse students’ opinions in the debate session, we used the free associative recording of students’ opinions, therefore we encouraged them to feel free to report their thoughts and feelings. Research suggests that this is most revealing of each individual’s personal philosophy, because what (and how much) the respondents choose to say indicates what they consider important and reveals the “truths” they want to share (Atkinson, 1998). Precisely because it is based on free and open communication, this technique ensures the collection of genuine and substantial experiences and emotions.

To analyse student’s written email narratives (including their responses to the open question: “What have I kept from my participation in the debate process?” presented at the current paper) we used the content analysis method. This method involves classifying responses into thematic categories; this allows the content of the students’ narratives to be converted into concise findings, which are then interpreted in qualitative terms. Content analysis is considered the most appropriate method “for searching and evaluating messages in print, especially when it comes to issues of opinion” (Verma & Mallick, 2004: p. 224).

4. Findings

After thoroughly analysing the content of the students’ views, student opinions were divided into three categories: social values, ethical roles, and critical reflec-

tion concerning the junior biologists' own ethical dilemmas.

Narratives of students revealed several concerns regarding students' social values that they became aware of through the debates in the Bioethics course. They found it was difficult to determine what is morally right for people. They wondered whether scientific advances have helped societies evolve for the better and improve living and working conditions, and if they finally led to equality between people.

“I did not consider whether all these scientific discoveries have led to the elimination of any discrimination between people in terms of their rights.”

Students also focused on the ethical role that biologists should play in balancing the drive for more scientific research with the consequences of this research for society. Their considerations concern not only the economic dimension of research but also how it affects the human beings and the environment. They wonder if they should focus more on humans and less on research techniques, since they find very difficult to make decisions that affect people. They seem to realize that success in research has many facets: if what a scientist find with his research is not good for society, they seem uncertain whether a scientist should have discovered it in the first place. They pose the core question when a biologist is considered successful, if instead of helping people, his scientific discovery falls into the wrong hands and, moreover, in this case, who is to blame.

“Profit is not a good motivator for biologists, but should they not consider this at all?”

Students expressed critical reflection on their prior assumptions concerning the ethical dilemmas of the modern biologist. They seem to realize that biologists must be fully aware of their responsibility and take full responsibility whether their research results will be used for good or for bad. They confess that this educational experience struck them to realize how many exclusions or problems the results of genetic research can create for people, since it is not clear what do we mean by good for humanity and science.

“From the debates, I understand that it is important to have my own views on what is morally right because there are no easy answers.”

5. Discussion

This study revealed the emergence of ethical concerns among participating students after participating in a bioethics debate exercise in the Bioethics course at Dept. MBG. This finding was not expected and arose from the application of the debate technique in the course, which encouraged students to deeply explore important ethical issues in the fields of biomedicine and biotechnology.

In this course, students explored the value system of the biologist, a standard criterion for judging and choosing between alternatives choices of professional behaviour (Becker & McClintock, 1967; Kluckhohn, 1952; Nader et al., 2020). In particular, students expressed concern over the moral role of the modern biologist, given the tension between research (and its achievements) and the social

values the biologist must uphold. It is critical for students to develop their own principles and values so they can engage in independent, unbiased logical reasoning when faced with ethical dilemmas in their future careers (Bostick, 2016). The values to which the students referred highlight their concerns about whether biologists should focus solely on their research or instead take into account the rewards or satisfaction they expect to receive from their research activities. This issue has also been raised by Zytowski (1970) and Elizur and colleagues (1991), who consider satisfaction and reward the main motivations that lead individuals to choose specific behaviours.

Throughout the course, students became familiar with critical and scientific argumentation and analysis and presentation of data, thereby developing reflection and critical thinking skills (Islas & Cortés, 2020). This supports the findings of Goodwin (2003) and Scott (2008), who studied the development of critical thinking through debates and concluded that students acquire new knowledge and critical thinking skills through the process of debate. Similarly, Walker and Warhust (2000) argued that classroom debates increase critical thinking since they require analytical problem-solving, communication, presentation, and the ability to work in teams. Moeller (1985) proposed that although many students were initially anxious about whether they would succeed in a debate exercise, the process proved valuable and helped them expand their critical thinking skills.

Through this investigation, it seems that Mezirow's (1994, 1998, 2007) theory of transformative learning is fully applicable in a didactic teaching approach to bioethics focused on concerns over moral dilemmas in terms of designing moral education strategies (Pantaléon, Chataigné, Bonardi, & Long, 2019).

Junior biologists in training seem eager to begin the revision of their assumptions about ethical issues in biosciences, and, in fact, reflect on the very existential question of whether scientific advances have positive or negative consequences for society, on the basis of promoting the union between the scientific interest in their training and the need to achieve an understanding of ethical values (Nader et al., 2020). It is also important that this course encouraged students to examine their values, the roles and responsibilities of bioscience researchers through the lens of ethics. Despite their young age, students in this study felt the need to consider ethical, social, and personal values alongside the importance of continued scientific progress. Indeed, Mezirow (1990, 2007) stressed that the learning of autonomous thinking requires a critically contemplative interaction between personal and social ethical rules.

6. Conclusion

We acknowledge that the generalisability of these findings is limited given the small study population and the use of qualitative analysis based on specific students' descriptions of their views. While these results may not be generally reflective of all junior biologists, they highlight concerns about the moral dimension of the biosciences as perceived by students in Dept. MBG of the Democritus

University of Thrace in Greece.

It seems, therefore, that this bioethics curriculum can encourage biology students to critically evaluate their assumptions in the rapidly developing field of biosciences, leaving them better equipped to deal with the modern ethical dilemmas they are likely to face on a personal, professional, and social level in the future.

As one student put it, “*I believe that this is a course that every student in Dept. MBG should attend. Through the experience, you develop the critical ability to think both as a scientist and as a human.*”

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- Atkinson, R. (1998). *The Life Story Interview*. Sage University Papers on Qualitative Research Methods. Thousand Oaks, CA: Sage. <https://doi.org/10.4135/9781412986205>
- Badara, I. A. (2011). *Using Transformative Learning Theory to Investigate Ways to Enrich University Teaching: Focus on the Implementation of Student-Centered Teaching in Large Introductory Science Courses*. PhD Diss., Tennessee: University of Tennessee. http://trace.tennessee.edu/utk_graddiss/945
- Becker, G. M., & McClintock, G. G. (1967). Value: Behavioral Decision Theory, *Annual Review of Psychology*, 18, 239-286. <https://doi.org/10.1146/annurev.ps.18.020167.001323>
- Bostick, M. (2016). *Teaching with Technology: AP® Biology Bioethics*. <http://www.carolina.com>
- Braunack-Mayer, A. J. (2001). What Makes a Problem an Ethical Problem? An Empirical Perspective on the Nature of Ethical Problems in General Practice. *Journal of Medical Ethics*, 27, 98-103. <https://doi.org/10.1136/jme.27.2.98>
- Christoforatu, T. (2014). *Biology, Bioethics and Education*. Unpublished Master's Thesis: School of Philosophy, Department of Philosophical and Social Studies. <http://elocus.lib.uoc.gr/dlib/6/5/1/metadata-dlib-1458738810-994034-23089.tkl>
- Cranton, P. (2002). Teaching for Transformation. *New Directions for Adult and Continuing Education*, 93, 63-71. <https://doi.org/10.1002/ace.50>
- Cranton, P. (2006). *Promoting Transformative Understanding Learning: Workshop Overview, July 29, 2006*. <https://www.unisa.edu.au>
- Crne-Hladnik, H., Hladnik, A., Javornik, B., Kosmelj, K., & Peklaj, C. (2011). Is Judgment of Biotechnological Ethical Aspects Related to High School Students' Knowledge? *International Journal of Science Education*, 34, 1277-1296. <https://hal.archives-ouvertes.fr/hal-00712368> <https://doi.org/10.1080/09500693.2011.572264>
- Dopico, E. (2020). Pedagogical Debates on Educational Innovation. *American Journal of Education and Learning*, 5, 62-71. <https://doi.org/10.20448/804.5.1.62.71>
- Dragona-Monachou, M. (2002). *Ethics and Bioethics—Science and Society. Review of Political and Ethical Theory, Vols. 8-9*, 1-27.
- Elizur, D., Borg, I., Hunt, R., & Beck, I. M. (1991). The Structure of Work Values: A Cross

- Cultural Comparison. *Journal of Organizational Behavior*, 12, 21-38.
<https://doi.org/10.1002/job.4030120103>
- Giannouleas, M. (2011). *Behavior and Interpersonal Communication in the Workplace*. Athens: Pedio.
- Giasemmis, H. (2011). *Study of Knowledge and Attitudes of Lyceum Students towards Biotechnology and Genetics Issues*. Doctoral Thesis, Patras: University of Patras, School of Humanities and Social Sciences, Department of Early Childhood Education.
- Gordon, E. J., & Levin, B. W. (2007). Contextualizing Ethical Dilemmas: Ethnography for Bioethics. In L. Jacoby, & L. A. Siminoff (Eds.), *Empirical Methods for Bioethics: A Primer (Advances in Bioethics, Volume 11)* (pp. 83-116). Bingley: Emerald Group Publishing Limited. [https://doi.org/10.1016/S1479-3709\(07\)11004-9](https://doi.org/10.1016/S1479-3709(07)11004-9)
- Gutierrez, S. B. (2015). Socio-Scientific Issues to Enhance the Bioethical Decision-Making Skills of High School Students. *International Education Studies*, 8, 142.
<https://doi.org/10.5539/ies.v8n1p142>
- Hadzigeorgiou, Y. (2015). A Critique of Science Education as Sociopolitical Action from the Perspective of Liberal Education. *Science & Education*, 24, 259-280.
<https://doi.org/10.1007/s11191-014-9728-4>
- Islas, C., & Cortés, V. (2020). Presencia de la bioética en la investigación de la Universidad Autónoma Metropolitana. *Perfiles Educativos*, 42, 42-59.
<https://doi.org/10.22201/iissue.24486167e.2020.168.59039>
- Jarvis, P. (2004). *Continuing Education and Training: Theory and Practice*. Athens: Me-taichmio.
- Jonas, H. (1979). *The Principality Guarantee. Versucheiner Ethik fur die Technologische Zivilisation*. Frankfurt: Suhrkamp.
- Katsimigas, G., & Vasilopoulou, G. (2010). Basic Principles of Bioethics and Orthodox Ethics. *The Step of Asclepius*, 9, 158-170.
- Kedraka, K., & Rotidi, G. (2017). Bioscience and Bioethics in Light of Adult Education: The Approaches of P. Jarvis and C. Rogers Used within the Training Regarding Biosciences. *Educational Cycle*, 5, 48-68. <http://www.educircle.gr>
- Kedraka, K., & Kourkoutas, Y. (2018). Debates in Teaching Bioethics. *Journal of Curriculum and Teaching*, 7, 32-41. <https://doi.org/10.5430/jct.v7n1p32>
- Kluckhohn, C. (1952). Values and Value Orientations in the Theory of Action. In T. Parsons, & E. A. Shils (Eds.), *Towards a General Theory of Action* (pp. 338-433). Cambridge, MA: Harvard University Press.
- Kolarova, A. T., & Denev, I. T. (2012). Integrating a Bioethics Course into Undergraduate Biology Education. *Biotechnology & Biotechnological Equipment*, 26, 2801-2810.
<https://doi.org/10.5504/BBEQ.2011.0089>
- Macer, D. (2008). *Moral Games for Teaching Bioethics*. UNESCO Chair in Bioethics.
- Malamitsa, K., Kasoutas, M., & Kokkotas, P. (2009). Developing Greek Primary School Students' Critical Thinking through an Approach of Teaching Science which Incorporates Aspects of History of Science. *Science & Education*, 18, 457-468.
<https://doi.org/10.1007/s11191-008-9150-x>
- McGonigal, K. (2007). Teaching Transformation: From Learning Theory to Teaching Strategies. *Adult Education*, 12, 12-15.
- Mezirow, J. (1990). *How Critical Thinking Activates Transformative Learning*. In J. Mezirow, & Associates, *Fostering Critical Reflection in Adulthood*, San Francisco: Jossey-Bass.
- Mezirow, J. (1994). Understanding Transformative Theory. *Adult Education Quarterly*,

- 44, 222-232. <https://doi.org/10.1177/074171369404400403>
- Mezirow, J. (1998). On Critical Reflexion. *Adult Education Quarterly*, 48, 185-198. <https://doi.org/10.1177/074171369804800305>
- Mezirow, J. (2007). Learning to Think like an Adult: Central Concepts of Transformative Theory. In J. Mezirow, & Co. (Eds.), *Transformational Learning* (pp. 43-72). Athens: Metaichmio.
- Miell, D., & Dallos, R. (2007). *Interpersonal Relationships: A Continuous Social Interaction*. Athens: Greek Letters.
- Moeller, T. (1985). Using Classroom Debates in Teaching Developmental Psychology. *Teaching of Psychology*, 12, 207-209. https://doi.org/10.1207/s15328023top1204_5
- Nader, J. E. D., Hernández, A. M., Acosta, A. C., Hernandez N, M., & Gómez, X. C. (2020). Biosocial Focus and Current Salubrity of Bioethics. *International Journal of Research—GRANTHAALAYAH*, 8, 105-110. <https://doi.org/10.29121/granthaalayah.v8.i1.2020.257>
- Pantaléon, N., Chataigné, C., Bonardi, C., & Long, T. (2019). Human Values Priorities: Effects of Self-Centredness and Age. *Journal of Beliefs & Values*, 40, 172-186. <https://doi.org/10.1080/13617672.2018.1554880>
- Pennings, I. M. (1970). Work Value Systems of White-Collar Workers. *Administrative Science Quarterly*, 15, 397-405. <https://doi.org/10.2307/2391330>
- Pryor, R. (1979). In Search of a Concept: Work Values. *Vocational Guidance Quarterly*, 27, 250-258. <https://doi.org/10.1002/j.2164-585X.1979.tb00993.x>
- Rohan, M. J., & Zanna, M. P. (2001). Values and Ideologies. In A. Tesser, & N. Schwartz (Eds.), *Blackwell Handbook of Social Psychology: Intraindividual Processes* (pp. 458-478). Malden, MA: Blackwell Publishers. <https://doi.org/10.1002/9780470998519.ch21>
- Rokeach, M. (1973). *The Nature of Human Values*. New York: Free Press.
- Rosário Pinto, M. (2016). Bioethical Dilemma in Emergency and Critical Care. A Multi-cultural Perspective. *Journal of UIIPS*, 4, 45.
- Rundgren, C.-J., Eriksson, M., & Rundgren, S.-N. C. (2016). Investigating the Intertwinement of Knowledge, Value, and Experience of Upper Secondary Students' Argumentation Concerning Socioscientific Issues. *Science & Education*, 25, 1049-1071. <https://doi.org/10.1007/s11191-016-9859-x>
- Sagie, A., Elizur, D., & Koslowsky, M. (1996). Work Values: A Theoretical Overview and a Model of Their Effects. *Journal of Organizational Behavior*, 17, 503-514. [https://doi.org/10.1002/\(SICI\)1099-1379\(199612\)17:1+<503::AID-JOB820>3.0.CO;2-Q](https://doi.org/10.1002/(SICI)1099-1379(199612)17:1+<503::AID-JOB820>3.0.CO;2-Q)
- Schiebe, K. E. (1970). *Beliefs and Values*. New York: Harper & Row.
- Stefanidou, C. (2016). History and Philosophy of Science for Citizenship: The Case of "Life of Galileo" by B. Brecht. *Abstracts 1st European Regional IHPST Conference*, Flensburg, 22-25 August 2016, 25.
- Super, D. (1957). *The Psychology of Careers*. New York: Harper.
- Super, D. (1962). The Structure of Work Values in Relations to Status, Achievement, Interests and Adjustment. *Journal of Applied Psychology*, 46, 231-239. <https://doi.org/10.1037/h0040109>
- Super, D. (1970). *The Work Values Inventory*. Boston, MA: Houghton Mifflin. <https://doi.org/10.1037/t01584-000>
- Taka, M. X. (2015). *Educational Leadership and Administration: A Bioethical Approach*. Unpublished Master's Thesis: School of Philosophy, Department of Philosophy and Social Studies.

<http://elocus.lib.uoc.gr/dlib/5/9/c/metadata-dlib-1449576817-411817-14704.tkl>

- Taylor, E. W. (2007). An Update of Transformative Learning Theory: A Critical Review of the Empirical Research (1999-2005). *International Journal of Lifelong Education*, 26, 173-191. <https://doi.org/10.1080/02601370701219475>
- The John J. Reilly Center for Science, Technology & Values (2016). <http://reillytop10.com/2016/09/19/reillytop-10-in-the-classroom>
- Tsinorema, S., & Louis, K. (2013). *Bioethics Issues. Life, Society and Nature in the Face of the Challenges of the Biosciences*. Heraklion: University Publications of Crete/Greece.
- Tzampazi, A. (2016). Teaching Science in Second Chance Schools: Two Case Studies Inspired by Philosophy of Science. *Abstracts 1st European Regional IHPST Conference*, Flensburg, 22-25 August 2016, 26.
- Verma, G., & Mallick, K. (2004). *Educational Research*. Athens: Typothito.
- Vidalis, T., & Mollaki, B. (2018). *What Do I Know about Bioethics?* Athens: National Committee on Bioethics.
- Zanni, A. (2012). *Biotechnological Challenges in the Field of Philosophy and Education and the Role of Bioethics Price*. Unpublished PhD Thesis: National and Kapodistrias a Party University of Athens (UOA), Faculty of Philosophy, Department of Philosophy, Pedagogical j Treaty and Psychology, Philosophy Department. <http://hdl.handle.net/10442/hedi/29716>
- Zerva, S., Lahana, O., Bourazani, E., Papoutsaki, E., Petropoulos, K., Christofidi, M., Katsila, Th., & Patrinos, G. P. (2017). Exploring the Limits of Bioethics: D TC Genetic Testing. *Bioethics*, 3, 5-14. <https://doi.org/10.12681/bioeth.19862>
- Zytowski, D. G. (1970). The Concept of Work Values. *Vocational Guidance Quarterly*, 18, 176-186. <https://doi.org/10.1002/j.2164-585X.1970.tb00231.x>