This edited book on ethics represents the outcomes of an international collaborative project that examined the role and place of bioethics in science and technology curricula. As science and technology advance, ethical issues increasingly are brought to the fore not only both for scientists and technologists but also for the general public. Science and technology education also reflects this shift and thinking and teaching about ethics in the school curriculum has increased. A greater emphasis is being placed on society's general scientific and technological literacy and this includes an understanding of socio-scientific issues including ethical decision-making. Although this book has a focus on ethics in the school science and technology curriculum, we believe it will also prove useful for those thinking about ethical decision making in a range of contexts outside of the school sector. The book will prove useful for University lecturers, teachers, curriculum developers and policy makers and those that are involved in science and technology decision making more broadly.
Ethics in the Science and Technology Classroom
Ethics in the Science and Technology Classroom

A New Approach to Teaching and Learning

Edited by

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PREFACE

This edited book on ethics represents the outcomes of an international collaborative project that examined the role and place of bioethics in science and technology curricula.

As science and technology advance, ethical issues increasingly are brought to the fore both for scientists and technologists but also for the general public. Science and technology education also reflects this shift and has expanded what it means to learn science and technology. A greater emphasis is being placed on society’s general scientific and technological literacy and this includes an understanding of socio-scientific issues including ethical decision making.

Although this book has a focus on ethics in the school science and technology curriculum, we believe it will also prove useful for those thinking about ethical decision making in a range of contexts.

We have considered it a privilege to work with a group of people who are committed to exploring research-informed ways of including and enhancing students’ ethical thinking in areas of the curriculum, particularly science and technology. We trust that this book will extend the thinking on the place of ethics in the school curriculum and more broadly be of benefit to those who read it.

Alister Jones, Anne McKim and Michael Reiss
Editors
1. TOWARDS INTRODUCING ETHICAL THINKING IN THE CLASSROOM: BEYOND RHETORIC

INTRODUCTION

In the past, school science was predominately a precursor to further study for those who would progress in the broader area of science, whether as a career in science or in a science-related field such as engineering or medicine. In the last twenty years there has been the increasing recognition of the importance of socio-scientific aspects within science education. There are expanding notions of what it means to learn science and of the reasons for learning science. These expanding notions emphasise the practical utility of science and the potential of science and technology education to allow students to participate as effective citizens who are scientifically and technologically literate. This literacy includes being discerning, knowledgeable and responsible in understanding science in its political, environmental, historical, social, cultural and economic settings. In this socio-cultural milieu moral and ethical issues are embedded in the scientific decision-making process. As science advances, moral and ethical dilemmas are increasingly to the fore, both in the media and in scientific endeavour itself. Ethics has always been an important part of science and in particular medicine. In teaching socio-scientific issues science teachers can make a unique contribution to developing citizenship as well as increasing students’ motivation and enjoyment of science. Learning about socio-scientific issues is therefore an important component of scientific literacy (Jorde & Mark, 2007).

Scientific and technological literacy which includes understanding of socio-scientific issues is seen as crucially important in science and technology education and indeed has become a curriculum goal in many curricula internationally in the last 10 years. Included in such curricula there is often rhetoric about ethical issues in science and technology. However, such inclusion is usually found principally in the introduction to the curriculum and all too often moves little beyond the rhetoric in the actual learning outcomes or classroom approaches. This book is an attempt to move beyond the rhetoric of socio-scientific issues, frequently restricted to the margins of classroom practice, and examines how we might include ethical thinking in science and technology curricula and classrooms for the benefit of students. There is of course still debate about the extent to which ethics should be taught within school science and technology and this book contributes to that debate.
This book is the result of a research and development project, funded by the New Zealand Bioethics Council which brought together researchers from both within New Zealand and internationally to consider ways to include ethical thinking in science and technology classrooms. Ethical frameworks can provide a powerful approach to thinking about teaching and learning in science and technology, enhance student engagement through connections to real controversial issues and empower students to contribute to informed debate about our future. It is argued that engagement with socio-scientific issues as part of their formal science education assists young people to explore positive, negative and interesting applications of scientific ideas and the development of new technologies, recognise reliable evidence and data, analyse issues in real world contexts which helps make science more relevant to their everyday lives, participate in argumentation, and develop the ethical reasoning and decision-making skills needed to face current and future bioethical controversies.

STRUCTURE OF THE BOOK

In Chapter 2 Michael Reiss sets out to define ethics and ethical thinking and provides a framework for the other chapters in the book. Ethics is set out as a branch of knowledge just as other disciplines, such as science, mathematics and history are. Thinking in ethics is not completely distinct from thinking in other areas but it cannot simply be reduced to such thinking either. For example, critical thinking, whilst important in ethical thinking, cannot be equated to it. Indeed, teaching critical thinking does not lead automatically to thinking ethically. Michael highlights that there can be confidence about the validity and worth of an ethical conclusion if three criteria are met. Firstly, if the arguments that lead to a particular view are supported by reason; secondly, if the arguments are conducted within an established ethical framework; finally, if a reasonable consensus exists about the validity of the conclusions, arising from a process of genuine debate. As Michael indicates, much of ethics still boils down to views about right and wrong informed more about what seems ‘reasonable’ than what follows from formal reasoning. This chapter introduces the concepts of consequences, intrinsic rights and wrongs, virtue ethics and consideration of widening the moral community.

Progression in ethical thinking is a fundamental if we are successfully to teach ethical thinking within science and technology classes. Too often in education little work is done on developing indicators of progression. Chapter 2 provides a framework to assist classroom teachers and other educators in thinking how we might enhance student ethical thinking and proposes indicators of progression in ethical thinking from novice to advanced. Finally, although this chapter advocates the teaching of ethics within school science and technology classes, it also indicates that this should only be a small part of the science and technology curriculum.

Chapter 3 provides a justification for the introduction of ethics into science and technology education and, in particular, curriculum statements. The rationale and reasons for teaching ethics in the classroom are linked to notions of scientific and technological literacy including an introduction to socio-scientific issues.
Anne McKim reviews a number of curriculum and classroom approaches and introduces a range of web-based resources. The benefits of introducing ethical thinking in the classroom are highlighted as well possible barriers and constraints. These benefits include helping students to understand the value-laden nature of science and technology as well as introducing concepts and processes and enhancing students’ scientific and technological literacy.

The introduction of ethics can cause difficulties for teachers, particularly those who perceive science and technology as being value-free. It also can challenge teachers’ views of science teaching as being just the effective transfer of facts and introduction into a narrow understanding and practice of ‘the scientific method’. Although science and technology curricula may specify the introduction of ethical thinking there is often little practical guidance on how to do this in the classroom. Throughout this chapter Anne emphasises the importance of students having a good conceptual understanding of the science behind ethical decision making. At the conclusion of this chapter a new approach to building a conceptual framework for bioethical thinking is presented as well as an interactive thinking tool which supports ethical thinking for teachers and students.

It is often assumed that younger students in school, particularly primary ones (aged 5 to 11 years), would not normally be introduced to aspects of ethical thinking in their science and technology classrooms. Indeed, much of the published literature on ethics in classrooms focuses on the secondary/high school level rather than the primary/elementary level. In Chapter 4, Cathy Bunting and Barbara Ryan present a series of case studies that demonstrate that children from 5 years of age through to 12 years can and do engage in ethical thinking. These case studies also indicate the way in which ethical thinking strategies can be embedded in a classroom science and technology programme. These case studies involved professional development for teachers as well as researching the planning and implementation of classroom programmes. The case studies centred around the use of river resources for younger children through to conservation and the use of animals in research for children aged 11 and 12. The resulting accounts provide rich insights into the teachers’ planning, lesson structure and children’s ethical thinking. This chapter provides empirical evidence of how students make progress in their ethical thinking. The teachers used a consequentialist approach for younger children and a mix of consequentialism, rights and responsibilities for the older children. Cathy and Barbara stress that making the ethics component about relevant issues engages students in their learning, increases ethical knowledge and improves ethical sensitivity. Teacher knowledge is again fundamental to the success of student learning in this area.

Older students such as those in the senior secondary school can be introduced to a wider range of concepts concerning ethical thinking. Lindsey Conner in Chapter 5 indicates the complex nature of teaching and learning in bioethical contexts and examines the number of variables that have to be considered, including new and emerging knowledge, incomplete information, diverse opinions, the influence of media, probability and risk. In discussing the introduction of ethics to senior students at secondary school Lindsey highlights the rapid nature of the scientific
discoveries and technological developments that may challenge their beliefs, values and social responsibilities. The notion that ethical problems are culturally determined provides an added dimension, since what is an acceptable solution may well be different in different places for different people and at different times.

A number of approaches to teaching and learning about bioethics for senior students are outlined in this chapter. Given that the introduction of ethics in school science may challenge notions of what is important in school science means that science teachers’ notions of the nature of science and technology may also be challenged. This highlights the importance of thinking about what support is required for teachers if ethics is to be effectively introduced into school science and technology.

Vaille Dawson in Chapter 6 examines the outcomes of bioethics education in secondary school science through two case studies in Australia. Vaille highlights the importance of argumentation skills in enabling students to be aware of the need to provide evidence to support their decisions and to evaluate evidence and the claims of others. This chapter provides insights into bioethics education in action in the secondary classroom and highlights issues that arise. For example, although a rationale for introducing ethics into the classroom can be to enhance the relevance of science for students, not all students may think that ethics is relevant to them. The explicit teaching of bioethical principles and decision-making processes is also crucial. Teachers are also not necessarily always aware of current developments in science and are not likely to be aware of some of the ethical dilemmas in science and technology developments.

Rosemary De Luca in Chapter 7 argues that bioethics can be seen as a potential contributor to teachers’ pedagogical knowledge in science and technology classrooms. Rosemary argues for a widening of the ‘lens’ of bioethics from a Western philosophical tradition to a notion of ‘cultural bioethics’ and makes the case for a narrative approach to ethics. For example, consideration of genetic modification and cosmology is explored through a Maori lens. Other narrative approaches to topics that include IVF and embryo research are used to explore such an approach to teaching and learning ethics.

Throughout this book a background theme is the importance of teacher knowledge in relation to introducing ethical approaches into science and technology classrooms. Another emerging theme is that a range of classroom approaches will be required for effective teaching and learning. In Chapter 8, Kathy Saunders works from these themes to develop an effective professional learning programme for science teachers around controversial issues in science. The programme that was developed assisted teachers to build a more effective pedagogical knowledge base that engaged and motivated students. The programme not only assisted teachers but resulted in more positive outcomes for students.

**CONCLUSION**

There is still debate about the extent to which ethics should be taught within school science and technology. This debate is considered throughout this book through the development of theoretical frameworks for ethics in science and technology, the
examination of possible curriculum and classroom approaches and the discussion of models of professional learning that can enhance outcomes for teachers and students.

REFERENCES


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2. ETHICAL THINKING

INTRODUCTION
Ethics is the branch of philosophy concerned with how we should decide what is morally wrong and what is morally right. Sometimes the words ‘ethics’ and ‘morals’ are used interchangeably. They can, perhaps, be usefully distinguished though some languages do not allow for a distinction to be made. We all have to make moral decisions daily on matters great or (more often) small about what is the right thing to do: Should I continue to talk to someone for their benefit or make my excuse and leave to do something else? Should I give money to the Kakapo Recovery Programme, to Oxfam or to cancer research charities? Should I stick absolutely to the speed limit or drive 10% above it if I’m sure it’s safe to do so?

We may give much thought, little thought or practically no thought at all to such questions. Ethics, though, is a specific discipline that tries to probe the reasoning behind our moral life, particularly by critically examining and analysing the thinking which is or could be used to justify our moral choices and actions in particular situations (Reiss, 2002).

THE WAY ETHICS IS DONE
Ethics is a branch of knowledge just as other intellectual disciplines, such as science, mathematics and history, are. Ethical thinking is not wholly distinct from thinking in other disciplines but it cannot simply be reduced to them. In particular, ethical conclusions cannot be unambiguously proved in the way that mathematical theorems can. However, this does not mean that all ethical conclusions are equally valid. After all most philosophers of science would hold that scientific conclusions cannot be unambiguously proved, indeed that they all remain as provisional truths, but this does not mean that my thoughts about the nature of gravity are as valid as Einstein’s were. Some conclusions – whether in ethics, science or any other discipline – are more likely to be valid than others. It is a common fault in ethics courses to assert that there are no rights or wrongs in ethics.

One can be most confident about the validity and worth of an ethical conclusion if three criteria are met (Reiss, 1999). First, if the arguments that lead to the particular conclusion are convincingly supported by reason. Secondly, if the arguments are conducted within a well established ethical framework. Thirdly, if a reasonable degree of consensus exists about the validity of the conclusions, arising from a process of genuine debate.
It might be supposed that reason alone is sufficient for one to be confident about an ethical conclusion. However, there are problems in relying on reason alone when thinking ethically. In particular, there still does not exist a single universally accepted framework within which ethical questions can be decided by reason (O’Neill, 1996). Indeed, it is unlikely that such a single universally accepted framework will exist in the foreseeable future, if ever. This is not to say that reason is unnecessary but to acknowledge that reason alone is insufficient. For instance, reason cannot decide between an ethical system which looks only at the consequences of actions and one which considers whether certain actions are right or wrong in themselves, whatever their consequences. Then feminists and others have cautioned against too great an emphasis upon reason. Much of ethics still boils down to views about right and wrong informed more about what seems ‘reasonable’ than what follows from formal reasoning.

The insufficiency of reason is a strong argument for conducting debates within well established ethical frameworks, when this is possible. Traditionally, the ethical frameworks most widely accepted in most cultures arose within systems of religious belief. Consider, for example, the questions “Is it wrong to lie? If so, why?”. There was a time when the majority of people in many countries would have accepted the answer “Yes, because scripture forbids it”. Nowadays, though, not everyone accepts scripture(s) as a source of authority. Another problem, of particular relevance when considering the ethics of contemporary science and technology, is that while the various scriptures of the world’s religions have a great deal to say about such issues as theft, killing people and sexual behaviour, they say rather less that can directly be applied to the debates that surround many of today’s ethical issues, for example those involving modern biotechnology. A further issue is that we are more conscious nowadays that we live in multicultural or pluralist societies. Within most countries there is no longer a single shared set of moral values.

Nevertheless, there is still great value in taking seriously the various traditions – religious and otherwise – that have given rise to ethical conclusions. People do not live their lives in ethical isolation: they grow up within particular moral traditions. Even if we end up departing somewhat from the values we received from our families and those around us as we grew up, none of us derives our moral beliefs from first principles, ex nihilo, as it were. In the particular case of moral questions concerning contemporary biology, a tradition of ethical reasoning is already beginning to accumulate. For example, many countries have official committees or other bodies looking into the ethical issues that surround at least some aspects of biotechnology. The tradition of ethical reasoning in this field is nothing like as long established as, for example, the traditions surrounding such questions as war, abortion, euthanasia and trade protectionism. Nevertheless, there is the beginning of such a tradition and similar questions are being debated in many countries across the globe.

Given, then, the difficulties in relying solely on either reason or any one particular ethical tradition, we are forced to consider the approach of consensus (Moreno, 1995). It is true that consensus does not solve everything. After all, what does one do when consensus cannot be arrived at? Nor can one be certain that
consensus always arrives at the right answer – a consensus once existed that women should not have the vote and that beating was good for children.

 Nonetheless, there are good reasons both in principle and in practice in searching for consensus. Such a consensus should be based on reason and genuine debate and take into account long established practices of ethical reasoning. At the same time, it should be open to criticism, refutation and the possibility of change. Finally, consensus should not be equated with majority voting. Consideration needs to be given to the interests of minorities, particularly if they are especially affected by the outcomes, and to those – such as young children, the mentally infirm and non-humans – unable to participate directly in the decision-making process. At the same time, it needs to be borne in mind that while a consensus may eventually emerge there is an interim period when what is more important is simply to engage in valid debate in which the participants respect one another, so far as is possible, and seek for truth through dialogue (cf. Habermas, 1983; Martin, 1999).

Is it enough to look at consequences?

The simplest approach to deciding whether an action would be right or wrong is to look at what its consequences would be. No one supposes that we can ignore the consequences of an action before deciding whether or not it is right. This is obvious when we try to consider, for example, whether imprisonment is the appropriate punishment for certain offences – e.g. robbery. We would need to look at the consequences of imprisonment, as opposed to alternative courses of action such as imposing a fine or requiring community service. Even when complete agreement exists about a moral question, consequences may still have been taken into account.

The deeper question then is not whether we need to take consequences into account when making ethical decisions but whether that is all that we need to do. Are there certain actions that are morally required – such as telling the truth – whatever their consequences? Are there other actions – such as betraying confidences – that are wrong whatever their consequences? This is about the most basic question that can be asked in ethics and it might be expected by anyone who is not an ethicist that agreement as to the answer would have arisen. However, this is not the case. There still exists genuine academic disagreement amongst moral philosophers as to whether or not one needs only to know about the consequences of an action to decide whether it is morally right or wrong.

Those who believe that consequences alone are sufficient to let one decide the rightness or otherwise of a course of action are called consequentialists. The most widespread form of consequentialism is known as utilitarianism. Utilitarianism begins with the assumption that most actions lead to pleasure (typically understood, at least for humans, as happiness) and/or displeasure. In a situation in which there are alternative courses of action, the desirable (i.e. right) action is the one that leads to the greatest net increase in pleasure (i.e. excess of pleasure over displeasure, where displeasure means the opposite of pleasure, i.e. harm).
Utilitarianism as a significant movement arose in Britain at the end of the eighteenth century with the work of Jeremy Bentham and J. S. Mill. However, its roots are much earlier. In the fifth century BCE Mo Tzu in China argued that all actions should be evaluated by their fruitfulness and that love should be all-embracing. In Greece, Epicurus (341-271 BCE) combined a consequentialist account of right action with a hedonistic (pleasure-seeking) theory of value (Scarre, 1998).

Utilitarianism now exists in various forms. For example, preference utilitarians argue for a subjective understanding of pleasure in terms of an individual’s own conception of his/her well-being. What all utilitarians hold in common is the rejection of the view that certain things are right or wrong in themselves, irrespective of their consequences.

Consider the question as to whether or not we should tell the truth. A utilitarian would hesitate to provide an unqualified ‘yes’ as a universal answer. Utilitarians have no moral absolutes beyond the maximisation of pleasure principle. Instead, it might be necessary for a utilitarian to look in some detail at particular cases and see in each of them whether telling the truth would indeed lead to the greatest net increase in pleasure.

There are at least two great strengths of utilitarianism. First, it provides a single ethical framework in which, in principle, any moral question may be answered. It doesn’t matter whether we are talking about the legalisation of cannabis, the age of consent or the patenting of DNA; a utilitarian perspective exists. Secondly, utilitarianism takes pleasure and happiness seriously. The general public may sometimes suspect that ethics is all about telling people what not to do. Utilitarians proclaim the positive message that people should simply do what maximises the total amount of pleasure in the world.

However, there are difficulties with utilitarianism as the sole arbiter in ethical decision making. For one thing, an extreme form of utilitarianism in which every possible course of action would have consciously to be analysed in terms of its countless consequences would quickly bring practically all human activity to a stop. Then there is the question as to how pleasure can be measured. For a start, is pleasure to be equated with well-being, the subjective experience of happiness or the fulfilment of choice? And, anyway, what are its units? How can we compare different types of pleasure, for example sexual and aesthetic? Then, is it always the case that two units of pleasure should outweigh one unit of displeasure? Suppose two people each need a single kidney. Should one person (with two kidneys) be killed so that two may live (each with one kidney)?

Utilitarians claim to provide answers to all such objections (e.g. Singer, 1993). For example, rule-based utilitarianism accepts that the best course of action is often served by following certain rules – such as ‘Tell the truth’, for example. Then, a deeper analysis of the kidney example suggests that if society really did allow one person to be killed so that two others could live, many of us might spend so much of our time going around fearful that the sum total of human happiness would be less than if we outlawed such practices.
Intrinsic rights and wrongs

The major alternative to utilitarianism is a form of ethical thinking in which certain actions are considered right and others wrong in themselves, i.e. intrinsically, regardless of the consequences. Consider, for example, the question as to whether a society should introduce capital punishment. A utilitarian would decide whether or not capital punishment was morally right by attempting to quantify the effects it would have on the society. Large amounts of empirical data would probably need to be collected, comparing societies with capital punishment and those without it with regard to such things as crime rates, the level of fear experienced by people worried about crime and the use to which any money saved by the introduction of capital punishment might be put. On the other hand, someone could argue that regardless of the consequences of introducing capital punishment, it is simply wrong to take a person’s life, whatever the circumstances. Equally, someone could argue that certain crimes, for example first degree murder, should result in the death penalty – that this simply is the right way to punish such a crime.

There are a number of possible intrinsic ethical principles and because these are normally concerned with rights and obligations of various kinds, this approach to ethics is often named ‘deontological’ (i.e. ‘rights discourse’). Perhaps the most important such principles are thought to be those of autonomy and justice.

People act autonomously if they are able to make their own informed decisions and then put them into practice. At a common sense level, the principle of autonomy is why people need to have access to relevant information, for example, before consenting to a medical procedure.

Autonomy is concerned with an individual’s rights; justice is construed more broadly. Essentially, justice is about fair treatment and the fair distribution of resources or opportunities. Considerable disagreement exists about what precisely counts as fair treatment and a fair distribution of resources. For example, some people accept that an unequal distribution of certain resources (e.g. educational opportunities) may be fair provided certain other criteria are satisfied (e.g. the educational opportunities are purchased with money legally earned or inherited). At the other extreme, it can be argued that we should all be completely non-egoistic or nepotistic. However, as Nietzsche and others have pointed out, it is surely impossible to argue that people should (let alone believe that they will) treat absolute strangers as they treat their children or spouses. Perhaps it is rational for us all to be egoists, at least to some extent.

Rights are accompanied by duties but the relationship between rights and duties is often misunderstood. It is typically supposed that if I have rights then I also have duties – as in the political slogan that rights need to be accompanied by responsibilities. To see the logical error in this, consider a newborn baby. If ever a creature had rights it is surely a newborn baby. It presumably has the right to be fed, kept warm, protected and loved. But what duties does it have? Surely none. A newborn baby is simply too young to have duties. It is not yet responsible for its actions. However, others have duties to it – namely to feed it, keep it warm, protect it and love it. Normally such duties are fulfilled by the child’s parent(s) but if neither parent is able to undertake these duties, for whatever reason, the duties pass
to others, for example other relatives, foster parents, adoptive parents or social
services. In general, if A has a right, there is a B who has a duty to ensure that A’s
rights are met.

If it is the case that arguments about ethics should be conducted solely within a
consequentialist framework, then the issues are considerably simplified. Deciding
whether anything is right or wrong now reduces to a series of detailed, in depth
studies of particular cases. As far as modern science and technology are concerned,
ethicists still have a role to play but of perhaps greater importance are those who
know about risks and safety, while sociologists, psychologists, policy makers and
politicians who know about people’s reactions and public opinions also have a
significant role.

Much energy can be wasted when utilitarians and deontologists argue. There is
little if any common ground on which the argument can take place, though some
philosophers argue that there can be no theory of rights and obligations without
responsibility for consequences, and no evaluation of consequences without
reference to rights and obligations. The safest conclusion is that it is best to look
both at the consequences of any proposed course of action and at any relevant
intrinsic considerations before reaching an ethical conclusion.

Virtue ethics

A rather different approach to the whole issue of ethics is provided by virtue
ethics. Instead of starting from particular actions and trying to decide whether
they fail to maximise the amount of happiness in the world, are divinely
forbidden or infringe someone’s rights, virtue ethics focuses on the moral
characteristics of good people. For example, think about a good teacher. What
characteristics might we expect them to manifest? We might want them to know
their subject, to treat all students fairly, to be able to maintain order in the
classroom, to maximise students’ chances of doing well in any examinations, to
be able to communicate clearly, to have a sense of humour and so on. Some of
these are skills – for example the ability to maintain order – but some are
personality traits that we call virtues – notably treating all students fairly, rather
than, for example, favouring males, Asians, high attaining students or All
Blacks supporters.

Virtue ethics has an ancient pedigree – receiving considerable impetus from
Aristotle – and has undergone something of a revival since the 1970s. Part of the
reason for this may be connected with a somewhat instrumental tendency in much
of the training of such professionals as doctors, nurses, lawyers, accountants and so
on, in which the idea of moral goodness features little. And yet many people who
have to deal with such professionals (as patients and clients) want them to be
morally good as well as technically skilled. Indeed, a number of recent notorious
disasters involving professionals (e.g. involving Harold Shipman, Exxon Mobil,
Bernard L. Madoff Investment Securities) have far more to do with moral badness
than lack of skilled know-how.
Traditionally, ethics has concentrated mainly upon actions that take place between people at one point in time. In recent decades, however, moral philosophy has widened its scope in two important ways. First, intergenerational issues are recognised as being of importance (e.g. Cooper & Palmer, 1995). Secondly, interspecific issues are now increasingly taken into account (e.g. Rachels, 1991). These issues go to the heart of ‘Who is my neighbour?’: The term ‘bioethics’ is often used when such interspecific questions are being considered, though in the USA and some other countries ‘bioethics’ often simply means ‘medical ethics’.

Interspecific issues are of obvious importance when considering biotechnology and ecological questions. Put at its starkest, is it sufficient only to consider humans or do other species need also to be taken into account? Consider, for example, the use of new practices (such as the use of growth promoters or embryo transfer) to increase the productivity of farm animals. An increasing number of people feel that the effects of such new practices on the farm animals need to be considered as at least part of the ethical equation before reaching a conclusion. This is not, of course, necessarily to accept that the interests of non-humans are equal to those of humans. While some people do argue that this is the case, others accept that while non-humans have interests these are generally less morally significant than those of humans.

Accepting that interspecific issues need to be considered leads one to ask ‘How?’. Need we only consider animal suffering? For example, would it be right to produce, whether by conventional breeding or modern biotechnology, a pig unable to detect pain and unresponsive to other pigs? Such a pig would not be able to suffer and its use might well lead to significant productivity gains: it might, for example, be possible to keep it at very high stocking densities. Someone arguing that such a course of action would be wrong would not be able to argue thus on the grounds of animal suffering. Other criteria would have to be invoked. It might be argued that such a course of action would be disrespectful to pigs or that it would involve treating them only as means to human ends and not, even to a limited extent, as ends in themselves.

Intergenerational as well as interspecific considerations may need to be taken into account. Nowadays we are more aware of the possibility that our actions may affect not only those a long way away from us in space (e.g. pollutants produced in one country affecting another) but also those a long way away from us in time (e.g. increasing atmospheric carbon dioxide levels may alter the climate for generations to come). Human nature being what it is, it is all too easy to forget the interests of those a long way away from ourselves. Accordingly, a conscious effort needs to be made so that we think about the consequences of our actions not only for those alive today and living near us, about whom it is easiest to be most concerned.

PROGRESSION IN ETHICAL THINKING

Jean Piaget was perhaps the first person carefully to investigate the subject of moral development, i.e. how individuals progress over time in their ethical thinking. In the 1920s he studied the ways in which children viewed the rules of
the games they were playing (Nucci, 2008). He concluded that morality was a developmental process. To a young child, morality is all about obeying rules. So telling lies is wrong because a child has been told not to tell lies. I can still remember my father’s surprise when, as a young boy, I confessed to him that biting my nails was a terrible thing to do and that if I continued I should be punished. With hindsight, it was clear that I viewed biting my nails as being morally reprehensible along with other things I had been told not to do (stealing, telling lies, hitting my younger sister and so on). In time, I came to appreciate that biting my nails might transgress rules of etiquette but not principles of morality.

Piaget observed that as children age, and in interactions with others, they move to a more autonomous and less rule-bound view of morality (Piaget, 1932). Piaget’s conclusions were developed further by Lawrence Kohlberg who, while also accepting that moral reasoning proceeded in stages, argued that it can continue throughout our lives and that very few of us ever reach its ultimate conclusion. Kohlberg viewed the moral reasoning and practice of individuals as falling into one of six stages (Kohlberg, 1958). Stage one, as for Piaget, is characterised by the acceptance of moral teaching because of a fear that one will be punished if one transgresses. At the other extreme, stage 6, rarely found in empirical studies, is characterised by abstract principles of moral reasoning in which the acceptability or otherwise of actions is judged against principles of ethical fairness that are established as such not merely because the majority agrees with them but because they result from universal, logical argument (as in Kant’s The groundwork of the metaphysics of morals or Rawls’ A theory of justice).

**Indicators of progression in ethical thinking**

It is rather difficult to allocate children (or adults) to Piaget’s or Kohlberg’s stages of moral development. In the research that led to this book (Jones et al., 2007) we developed a range of indicators of progression in ethical reasoning (Figure 1). Figure 1 should not be read rigidly. It is not the case that individuals progress uniformly from left to right, nor would it be altogether surprising to find individuals who in some cases were situated at the left and in others at the right of the figure. Furthermore, any individual’s position on Figure 1 will be affected by the individuals around them, the particular scientific or technological issue being considered, their motivation and a range of other factors. Nevertheless, we suspect that many teachers will find it convincing to argue that good teaching in this area should help individuals move from the left to the right of Figure 1. Such movement, indicating progression in ethical thinking, entails the following:

- An individual moving from viewing an ethical issue (e.g. eating meat from intensively farmed animals) in terms of its effects for oneself (e.g. the meat tastes delicious) to one’s peers (e.g. how does the rest of one’s family feel about this?) to others in one’s country (e.g. consequences for national employment) to people globally (e.g. effect on world trade).
– A shift from seeing oneself as the moral universe (egocentrism) to following social rules (e.g. one should stick to the speed limit) to holding reasoned principles (e.g. one should adjust one’s car speed for the benefit of other road users even in the absence of a speed limit).

*Figure 1. Indicators of progression in ethical reasoning.*
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- A progression from only being able to use one ethical framework (e.g. consequentialism) to using two to using three or four to evaluating the usefulness of the frameworks for different situations (e.g. considering the frameworks of consequentialism, rights and virtues when considering whether or not to terminate a 20 week-old fetus with Down syndrome).
- Moving from considering humans only (e.g. when determining how to manage a park) to considering all sentient animals to considering whole ecosystems.
- A progression from considering ethical issues (e.g. climate change) solely in terms of the ‘now’ to the long-term.
- A development from relying solely on existing knowledge (e.g. when discussing how to deal with animal pests) to using taught knowledge to researching new knowledge.
- Moving from a situation where scientific knowledge and ethical principles (e.g. about whether money should be spent conserving endangered species) are considered in isolation to one where they are drawn together.
- A shift from considering socio-ethical issues only within one’s own set of values to considering them within others’ too.
- A progression from simply accepting standard ethical frameworks to being able to critique them.
- A development from needing to consult frameworks before using them to remembering them to internalising them.

CONCLUSION

There is still debate about the extent to which ethics should be taught within school science and technology. This debate is considered elsewhere in this book along with specific suggestions about how bioethics, in particular, might be taught. What this chapter has sought to do is, first, to review the ways in which ethical judgements can be made and, secondly, to suggest how teachers of school-aged students might hope to see their students’ ethical reasoning progress. My own belief is that while teaching about ethics should be only a small part of the science and technology curriculum, in terms of the time allocated to it, it constitutes, nevertheless, an important part. Such teaching is desired by many students and can help both to motivate them and to locate science and technology teaching in ‘the real world’.

REFERENCES


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