

Chapter 1

Philosophy of Technology: What and Why?

What do we mean by ‘philosophy’ of technology, and why would educators want to know about it? Those are the two questions that will be addressed in this introductory chapter.

The answers to these questions are by no means self-evident. The word ‘philosophy’ in the first question is used in different ways. A teacher could, for example, state that his or her ‘philosophy’ in dealing with classes is based on making humans do what they are good at. In that case the word ‘philosophy’ does not refer to a scientific discipline, but rather to a certain ‘approach’. If the word is used in that sense, there is often an interest to get to know this ‘philosophy’. If, however, we take ‘philosophy’ in the sense of a scientific discipline, it is certainly not to be taken for granted that educators would be interested in it. Educators tend to be concerned primarily with day-to-day and down-to-earth types of questions. Why would they take a book like this one other than for personal interests that are not directly related to their teaching profession?

The second question cannot be answered properly without having answered the first one. So let us first consider the meaning of the term ‘philosophy’ of technology. What is meant by that word in this book?

1.1 What Is Philosophy?

In general, philosophy is the scientific discipline that aims at systematic reflection on all aspects of reality. In philosophy we try to gain insight into the real nature of those aspects. We can do this by asking the following question: “what do you mean when you say ?” This can be called the *analytical function* of philosophy. Asking such a question can have a practical purpose. It can, for example, help us to get out of dead-ends in debates, in particular when these are caused by naïve use of terms. An example of such a dead-end is the following. For many years people have debated about the issue of whether or not technology can be properly called ‘applied

science'. Such debates were often frustrated because both for the 'technology is applied science' opinion, as well as for the opposite opinion, examples could easily be found. Seemingly there was a paradox: the 'technology is applied science' opinion could be supported by evidence and falsified by evidence at the same time. The example of the transistor could be used as evidence for the 'technology is applied science' claim, but at the same time the steam engine could be used to falsify it. However, the paradox appears to be a fake one only when one asks the question: what did we mean when we said 'science' and what did we mean when we said 'technology' in our debate? It is only then that we start realizing that the paradox is the result of our limited use of the terms. Thanks to that consideration, we are now aware that we have to be careful not to make too general claims about science and technology, because there are different types of sciences and different types of technologies. Because we used a particular type of science and technology to support one opinion and a different type of science and technology to support the other opinion, but failed to be explicit about the different use of the terms, we were not able to reach a consensus. The example illustrates how useful it can be to reflect carefully about what we mean by the words we use. This is where philosophy comes in to help us.

Apart from the analytical function of technology there is a *critical function* of technology. By using the proper language and concepts that were developed by means of the analytical function of philosophy, we can now reflect on things in such a way that we can make value judgments.

Because there are many aspects of reality, there are many 'philosophies'. In this book we will deal with philosophy of technology. That is a relatively young discipline compared to another 'philosophy' that deals with a related aspect of reality, the philosophy of science. In the philosophy of science one deals with questions such as: how does scientific knowledge emerge, what criteria do we use to determine whether or not we are prepared to reckon a certain activity to be 'scientific', what is a scientific theory and how does it relate to reality, what different types of sciences can be distinguished? A third example of a philosophy is the philosophy of mind. This type of philosophy focuses on various aspects of the mental aspect of reality. Some questions that are discussed in the philosophy of mind are: what do we mean by 'intentions', by 'desires', by 'beliefs', what do we mean by 'rationality', and how do intentions, beliefs and desires relate to one another in rational minds? As rationality plays a role in science, there are relationships between the philosophy of science and the philosophy of mind. Likewise, there are relationships with the philosophy of technology. That is evident when we realize that technology is not only a matter of our hands, but also of our minds. When in philosophy of mind literature we read about general concepts such as 'rationality' of 'agents' that have 'intentions' and 'desires', and by 'reasoning' about 'means-ends relationships' 'plan' their 'actions'; these are all concepts that play a role in technology too. Therefore, when in later chapters we study the various aspects of the philosophy of technology, we will come across such concepts again.

Within the discipline of philosophy several fields can be distinguished. Just as in physics we have solid-state physics, nuclear physics, optics, and mechanics

(classical and quantum); we can also identify different parts of philosophy, each with its own focus. Let us now see what the main fields in philosophy are that we will recognize when a survey of the philosophy of technology is presented in the remaining chapters of this book.

One field in philosophy is *ontology*. It deals with being, with what *is*, what *exists*. At first sight it may seem trivial to ask the question what do we mean when we say that something *exists*, and many people will wonder what the relevance of asking such a question might be. Yet, there can be situations in which the answer to this question does make a difference. For example, one could ask if technological products really have a systems nature or if this is just something that we have ‘invented’ to make sense of them. Ontology also asks for the *essence* of things. For example: what makes technology different from nature? When do we call something ‘technological’ or ‘artificial’, and when do we call it ‘natural’?

Epistemology is a second field in philosophy. It focuses on the nature of knowledge. What, for example, do we mean when we say that we ‘know’ that the moon circles around the earth? Or what do we mean when we say that we ‘know’ that the object in front of us is a CD player? In our time, knowledge is seen as an important issue in society. We often speak of a ‘knowledge economy’, and many people nowadays are interested in what is called ‘knowledge management’. What, then, do we mean when we use the term ‘knowledge’ in those expressions? In education, knowledge of course plays a vital role too. For a long time we have considered education to be the transfer of knowledge. Now our view on education is more varied. Knowledge is not always transferred, but sometimes has to ‘grow’ in individuals. Related to this field is the *philosophy of mind*, in which we reflect on how minds function and can have knowledge and other types of intentions.

In the third place we have *methodology* as a field in philosophy. Here confusion can easily arise. Methodology is often associated with methods. But that is only part of the truth. The word ‘methodology’ is composed of three Greek words. ‘Metha’ means ‘through’, ‘hodos’ means ‘way’ and ‘logos’ means ‘word’, but also can have the meaning of ‘study’. Literally methodology, or meth-hodo-logy, means: study of (logos) the way (hodos) through which (metha) something happens. When we think of ‘methods’, such a way is well paved and straightforward. But things do not always come about in such a well-organized manner. Often that way is crooked and rough. Methodology deals with all sorts of ways.

A fourth field in philosophy is *metaphysics*. Metaphysics deals with our vision of reality, and the way we try to make sense of reality. An important issue here is the question of the purposes of our activities. Reflections on purposes are called: *teleology*. This term is not to be confused with ‘theology’, which is a discipline in its own right. Teleology deals with aims and purposes. For what purpose, for example, do we live, work, play, eat, think, etcetera? The answers to such questions are usually closely related to one’s worldview. This worldview can be a religion, but it need not be so (hence we should be careful not to confuse teleology and theology). Of course teleology assumes that there are aims and purposes for life. For that reason lots of philosophers consider teleology to be a theory rather than a field of study in philosophy. For non-philosophers, though, the issues that are debated in teleology are

probably what they think of in the first place when they hear the word ‘philosophy’. It deals with very fundamental questions. For technology it means that we try to understand what drove – and drives – humans to develop and use technologies. Is it just a matter of survival? Or are there other possible motives for behaving like a ‘homo technicus’?

In the fifth place, there are *ethics* and *aesthetics* as fields in philosophy. They are taken together here because they both deal with the issue of values. Ethics is concerned with the issue of what is good to do and what should not be done. Ethics not only deals with specific ethical guidelines, such as those that have been derived from religions (and people sometimes shy away from because they fear indoctrination), it also deals with logical analyses of ethical dilemmas. *Logic* is a field in philosophy that plays a role in ethics, but also in the other fields of philosophy. It helps people make proper arguments when reasoning for or against certain decisions with ethical aspects. So ethics is both a field in which specific ethical opinions are discussed, and also provides logical tools for ethical reasoning. Aesthetics deals with values of beauty. What does it mean for something to have beauty? Here logic also plays a role. A popular saying is that beauty cannot be argued about. That suggests that reflecting on beauty is just a matter of feelings. But in philosophy it is more, and logic can be used to support rational reasoning about beauty as much as about other issues.

All of these fields can be recognized in the philosophy of technology. There is, for example, a growing amount of literature on the ‘ontology of technological artifacts’. In that literature philosophers try to get to grips with the nature of technological artifacts. When can we say that a certain object *is* a technological artifact? Teleology also features in the philosophy of technology. We can be interested in the question: for what different purposes human beings do technology. In this book, Chaps. 2, 3, 4, 5, and 6 will deal with each of these five fields in the philosophy of technology.

One more way of splitting up the whole field of philosophy into subsections is by dividing this field into analytical and Continental philosophy (Continental because most authors in this strand were German or French, while most of the ‘analytical’ authors were from the UK or the USA). Although nowadays these two philosophical streams are not as separated as they used to be in the past, and certainly the geographical terms like Continental are now inappropriate. However, many contemporary philosophers can still be recognized as belonging to one of these two. The difference between the two is roughly that in analytical philosophy the main aim is to conceptualize, and that continental philosophers are more interested in making value judgments about (aspects of) reality. Sometimes the same difference is described as philosophy of language on the one side (because conceptualization to a large extent has to do with the way we use language – words and expressions – to define concepts), and philosophy of culture on the other side (because the value judgments in most cases refer to developments in culture and the role technology has in that). In fact this means that the two functions of philosophy (the analytical and the critical) have been dealt with by separate streams in philosophy. Probably most people get to know the philosophy of technology by reading books in the

second strand (the Continental philosophy, or cultural philosophy), because it often appeals more to people to think about social and cultural aspects of technology than to think about how technological concepts can be defined and understood properly. Hopefully the remaining chapters of this book will show that both strands can be equally exciting. And for educational purposes, searching for clear and well-defined concepts is certainly of no less importance than to discuss value aspects of technological developments.

So far we have dealt with philosophy in general. Let us now focus on the philosophy of technology to see the status of that particular field.

1.2 What Is Philosophy of Technology?

The difference between the continental and analytical traditions is also found in the philosophy of technology. In the early days of the philosophy of technology, most authors wrote about the social impacts of technology and the impacts of society on technology. One could call this way of reflection, in which the focus is on the relationship between technology and its social context: ‘philosophy *about* technology’. Mitcham uses the term ‘humanities philosophy of technology’ for this category. The philosophers we find in this category often did not have an engineering or natural science background. Many of them were philosophers ‘*pur sang*’. Perhaps that explains why they did not reflect so much on what technology is, but rather on the effects it had on culture and society: they did not have the expertise to make such reflections. Although this is not necessarily an effect of the humanities approach, somehow the authors in this category tend to focus on the negative impacts of technology on society and often warn us to be careful. The alternative way of reflecting on technology, ‘philosophy *of* technology’ is then characterized by the fact that it tries to describe technology itself. Here we find philosophers of whom several have both a philosophical and an engineering background. This combination does not occur very frequently, and perhaps that explains why this second type of reflection of technology emerged much later and slower than the first-mentioned type. Mitcham uses the term ‘engineering philosophy of technology’ for this other category. Although here too there is no necessary relationship with the engineering background of the philosophers in this category, these people tend to be much less critical about technology than their colleagues in the ‘humanities philosophy of technology’. In this strand we also find what is called the *empirical turn* in the philosophy of technology. This term indicates an interest in letting one’s philosophical agenda be led at least partially by taking notice of the practice of technology. The idea is that this is helpful in developing appropriate concepts and ideas in philosophy. It does not turn philosophy into an empirical science (philosophers still have the freedom to make statements that have no direct reference to practice) but it does stimulate philosophers to develop ideas that make sense to practitioners. For education too, this empirical turn is of interest. In education we like to teach about technology as we can see it being practised. A philosophy that has no relationship to

practice would be less useful than a philosophy that has seriously taken that into account.

What is also reflected in the philosophy of technology as a general feature of philosophy is the distinction between the fields of ontology, epistemology, methodology, metaphysics (and in that field teleology), and ethics. In his survey of the development of the field of philosophy of technology, titled 'Thinking Through Technology', Carl Mitcham has identified four main approaches. According to him reflections on technology have focused on four ways of conceptualizing technology: as objects, as knowledge, as actions, and as volition. In the first way of conceptualizing technology, we find mainly ontological considerations. Philosophers then ask for the essence of technological artifacts. In the second case, technology as knowledge, of course epistemological studies can be expected. In actions as a viewpoint, methodology is the field of philosophy that is addressed, and in the volition approach, the teleological, ethical and aesthetical considerations are found. In this book Mitcham's division will be used to describe philosophy of technology for technology educators. This division roughly matches the division in the fields of philosophy that we have identified. But as we will see, sometimes the discussion of a field in the philosophy of technology in Mitcham's division will have elements of more than one of the fields of philosophy.

Mitcham, in his book, makes clear that the philosophy of technology is a pretty young discipline, much younger than, for example, the philosophy of science. As a result, many fundamental issues are still debated quite heavily. On the one hand, one can, of course, say that such debate is inherent for philosophy in general, and in the philosophy of science also there are still very fundamental debates. But on the other hand, the philosophy of technology does not have as clearly crystallized positions in these debates as in the philosophy of science. There are no 'schools' in the philosophy of technology with a well-established tradition like one can find in the philosophy of science, where we have Popperians, Kuhnians, Lakatosfollowers, or Feyerabendians. The philosophy of technology is more like a mosaic of many different ideas and suggestions. Yet, there is a lot that one can learn from this mosaic. Mosaics anyway do have their charm.

1.3 Why Would Technology Educators Want to Know About Philosophy of Technology?

It is certainly not self-evident that educators would like to know more about philosophy of technology. For many people philosophy in general is regarded as something that does not have a clear usefulness. Even famous people have made statements that reflect this attitude. In his book 'Philosophy for dummies', Tom Morris quotes some of these statements. Voltaire once wrote: "When he who hears doesn't know what he who speaks means, and when he who speaks doesn't know himself what he means – that's philosophy". The only thing philosophers seem to

do is disagree with each other, or in William James' words: "There is only one thing that a philosopher can be relied on to do, and that is to contradict other philosophers." The results of that can only be negative, according to Jonathan Swift, who wrote: "The various opinions of philosophers have scattered through the world as many plagues of the mind as Pandora's box did those of the body; only with this difference, that they have left no hope at the bottom."

This does not sound very positive about philosophy. Why then would technology educators spend any time on studying philosophy of technology? Is it perhaps what Socrates said: "The unexamined life is not worth living" (again, quoted from Tom Morris)? Or, applied to technology education: "The unexamined technology is not worth teaching"? Wouldn't it be a poor situation if technology is taught without any kind of reflection, just as a collection of bits and pieces of knowledge and skills? Would that not easily result in a fairly random choice of what is taught and what is not taught? And would that really contribute to what (future) citizens need to live in a technological world?

Let us consider what those who teach about technology could gain from the philosophy of technology. There are at least four reasons for technology educators to get acquainted with this discipline. The philosophy of technology can be a source of inspiration for determining the content of a curriculum, it can yield insights into how to construct teaching and learning situations, it can provide a conceptual basis and proper understanding of technology which can help technology educators respond to unforeseen situations while teaching about technology, it can help to position the teaching of technology among other subjects, and it can help identify the research agenda for educational research in technology education. All of those will be discussed in this section.

Teaching technology can have several aims. It may be because people need specific knowledge and skills to be able to function in an environment in which technology plays an important part. Another aim may be that people acquire a good, balanced perception of what technology is. One could defend the statement that in fact that is a prerequisite for all functioning in a technological world. Developing a good perception of technology can be important in different cases. For future engineers it is important to know what characterizes the field that they will work in, in order for them to be able to think and act consciously and responsibly. But also for those who will never become engineers but will be constantly confronted with technology in their lives, it is important that they are able to make good, well-informed judgments about the way technology should be approached. Either when the teaching of technology takes place as a professional or academic program, or when this teaching is part of the general education of all people, the question that educators are faced with is: what should be the content of teaching that will help the learners to acquire a good perception of technology? In other words: what should be the content of the curriculum? Philosophy of technology can help answer that question as it provides ideas about what are important features of technology that are inherent in a balanced perception of technology.

Once the content of the curriculum has been determined, the next question is: how can we construct situations that will enhance the acquisition of such a balanced

perception of technology in learners? Here too, the philosophy of technology can be a useful resource for consideration. Philosophy of technology can, among other things, provide insights into what makes technological knowledge and skills different from other sorts of knowledge and skills. These differences may be important for determining how technological knowledge and skills can be taught and learnt. One of the characteristics of technological knowledge, for instance, appears to be its normative component. The philosophy of technology, in particular the epistemology of technology, has shown that technological knowledge is often related to judgments. Part of the knowledge of engineers has to do with the functions of artifacts, and those can be fulfilled well or badly. Another normative aspect in technological knowledge is that some materials are better suited for usage in a particular artifact than others. The normative knowledge about the relationship between the material properties and the functions that need to be fulfilled in the artifact is another example of the normativity in technological knowledge. Scientific knowledge does not have this kind of normativity. There is normativity in science as well, but mainly with respect to the norms for what we accept as scientific knowledge or not, and not with respect to the objects of the knowledge. One cannot say that an electron is bad or good. As soon as one starts making statements about its suitability to do something, one has already passed the border to technology, because a practical purpose or application is then at stake. This difference between scientific and technological knowledge, no doubt, has its consequences for teaching those different types of knowledge. A good insight into what characterizes the normativity in technological knowledge can help those who teach technology to make sophisticated decisions when setting up educational settings and situations for the teaching and learning of technology. Later on in this book we will see how.

Teaching and learning is always a matter of interaction. Whatever the teacher has prepared for, the learner also has an influence on what is taught. Often it cannot be foreseen what influence this will be. No one can tell beforehand what questions learners will ask as a response to certain content presented in the educational situation that has been prepared by the teacher. An educator who has no good perception of technology, but entirely relies on a curriculum that has been designed by others who had such a perception, will soon find himself or herself in trouble when learners start to ask questions that are not directly and/or explicitly addressed in the curriculum content. It is simply not possible to help other people acquire a good perception of technology in educational situations when one self does not hold such a perception.

Reflections on the specific features of technology can also help to position the teaching of technology among the teaching of other subjects. Perhaps the most important example of this is the ever-recurring question of how to find a proper relationship between science and technology education as two elements in general education. As we will see in Chap. 4, the development of scientific knowledge and that of technological knowledge have often gone hand in hand. Yet scientific and technological knowledge are different and have distinct characteristics (the normativity in technological knowledge has already been referred to). This justifies that teaching technology should be separated from teaching science, yet the two should

closely co-operate in order to do justice to the relationship between them. There are different options for this to be realized in educational practice. Philosophical insights into technology, and in science, can help to find proper ways of positioning the teaching of technology among the teaching of science and other subjects.

The development of education about technology ideally should be supported by educational research. Alas, this is often not the case.

Sometimes a lack of interest is the cause for that. Technology is considered to be such a practical subject that one feels no need to develop any kind of theory about its teaching, not even through empirical research into what happens in educational practice. In other cases a lack of funding is the cause of an absence of educational research in the development of technology education. But fortunately there are other situations in which educational research does have a function in the development of curricula and teaching practice. If, however, it is unclear what characterizes technology itself, it will be equally unclear what is to be researched in terms of teaching technology. The philosophy of technology here too can serve as a source of inspiration. In this philosophy the use of the concept of systems has been brought forward as an important feature of technology and engineering. For educational research this raises the question of what pre-concepts pupils and students might have about this. Do they have an intuitive sense that a washing machine is a set of co-operating parts that transform a certain input to a certain output through a certain process? Or do they regard it as just a large collection of nuts and bolts? The philosophy of technology has shown the usefulness of regarding the functional and the physical nature of an artifact. Do pupils and students have that kind of understanding already before they enter our classrooms? How would they describe a knife in the first place? As an object that has a sharp part and a blunt part that fit together (the physical nature)? Or would they describe it as a means for cutting bread or meat (the functional nature)? Such insights would be useful to have for those who try to teach about those artifacts. Likewise, philosophical reflections on design processes (in design methodology) can help us determine what would be important to get to know about the way pupils and students design in project work.

It is useful to make a remark about my use of the terms 'technology' and 'engineering'. I have abstained from any effort to give a definition of technology. For those who are looking for a definition: there are thousands out there to choose from and I do not think I can come up with the one that beats them all. Throughout the book I will use the term 'technology' in the broad sense of the human activity that transforms the natural environment to make it fit better with human needs, thereby using various kinds of information and knowledge, and various kinds of natural (materials, energy) and cultural resources (money, social relationships, etc.). I will use engineering in the same broad sense, only distinguishing it from technology in that engineering is when professionals called 'engineers' do the human activity described above. The term includes not just mechanical and electrical engineers, but also architects and textile designers (in general: all those professionals who develop and make new technological devices, systems and processes). The term 'technology' also includes the users as humans who are involved in this activity. In my description of the philosophy of technology the terms 'technology' and 'engineering'

both apply, and I will let my choice between the terms be led by the literature that I refer to in a particular case.

Now that we have a first impression of what philosophy of technology deals with and in what sense it can be useful to educators, we now turn to the various fields of the philosophy of technology in order to get a more in-depth view on the ideas that have been developed so far. We will start with the issue of technological artifacts.