PHILOSOPHY OF TECHNOLOGY EDUCATION: A REVIEW

Dr. R. Jayakumar
Assistant Professor
Vivekanandha College of Education,
Puducherry

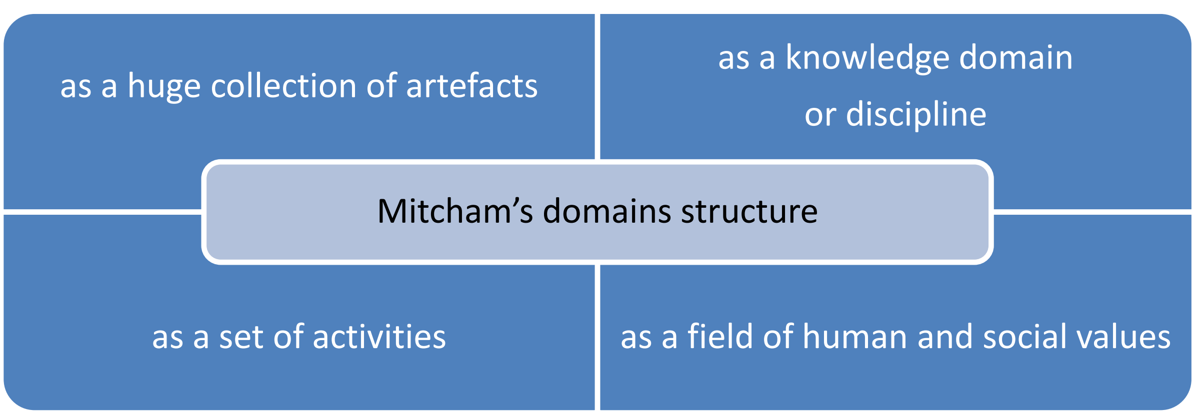
ABSTRACT

Technology education derives elements of its philosophy from statements of general education, and from those relevant sections of society and the natural world that are related to technology. Philosophy will determine how a teacher relates to students and consequent discipline structures, the content of what is to be taught, and how it is taught. For a technology teacher, philosophy will answer questions like what is technology and consequently, what is technology education, how can technology best be taught, who should be taught, what should be assessed and how, etc. Teachers do all these things and have a rationale for doing them which may be implicit or explicit. Philosophy of technology education to be explicit, then it can be debated and discussed, and can provide a logical and defensible rationale for educational activities.

DOMAINS IN THE PHILOSOPHY OF TECHNOLOGY

American philosopher Carl Mitcham has rightly pointed out the short history of the philosophy of technology and offers a survey of its current domains of interest in the book *Thinking Through Technology*. The philosophy of technology is a relatively young academic discipline. The philosophy of science, for instance, is much older. For some reason, philosophers for a long time neglected technology as a possible object for reflection. But in the past decennia the philosophy of technology has gone through a rapid catch-up operation.

Mitcham's domains structure is based on four different ways of conceptualizing technology:



PHILOSOPHY OF TECHNOLOGY EDUCATION

Traditional technology education has questioned the value of a philosophy through its approach to separate thinking and doing. This has implied a sense of inferiority to other subjects, related to technology educators and technology students. But philosophy does not lack practicality. It offers one of the best possibilities for improving technology education, a reference point for examining concepts and activities in the technological world, a foundation for evaluating and guiding decision making and a basis for speculative thinking and observation. All teachers have a philosophy about what they do and why they do it, whether it has been enunciated or not. A philosophy will determine how a teacher relates to students and consequent discipline structures, the content of what is to be taught, and how it is taught. For a technology teacher, philosophy will answer questions like what is technology and consequently, what is technology education, how can technology best be taught, who it should be taught to, what should be assessed and how, etc. Teachers do all these things and have a rationale for doing them which may be implicit or explicit. Philosophy of technology education to be explicit, it can be debated and discussed, and can provide a logical and defensible rationale for educational activities. According to Samuel Shermis (1967, 277), "all educational issues are ultimately philosophical", and what is needed is educators who understand the issues at their deepest level. Educational philosophy is generally slow to change, but society is in a continual state of flux. Given that education is a product of social demands, social changes then represent a challenge to existing educational philosophies.

A case in point is the emergence of technology as a core component of the curriculum. This curriculum decision reflects social demands, in that the nature of society has changed over time to become significantly technological, and this has represented a challenge to the prevailing technical education philosophy. Technology education is the responsive philosophical change to the social phenomena. Technology education derives elements of its philosophy from statements of general education, and from those relevant sections of society and the natural world that is related to technology. This present scenario is that education should respond to the current and emerging economic and social needs of the nation, and provide those skills which will allow students maximum flexibility and adaptability in their future employment and other aspects of life. In the derivation of a specific philosophy for technology education, these skills which will allow for maximum flexibility later in life must begin to be identified.

The other source for a philosophy of technology is those elements of society and the natural world that have to do with technology: those that design and create technology, those that use it and those that are affected by it, the raw materials used, and the effects on the natural world. Most races of society are included in these categories. This fact provides a significant rationale for the importance of technology education in that it is so pervasive, but also creates a problem in that such a study of technology would be very broad.

TECHNOLOGY EDUCATION AND THE PHILOSOPHY OF TECHNOLOGY

The ‘technology as artifacts’ approach is evident that this is one that certainly appeals to pupils. Studies in the pupils’ attitude towards technology tradition have shown that many pupils can only think of technology as the large set of artifacts that we see around us (De Vries 2005). In technology we want them to have a more balanced view on technology, but at the same time we have to acknowledge that artifacts indeed play an important role in our daily lives and that it is important that pupils have an understanding of what they are and what they do. A problem here is that there are so many and that most of them are too complicated to explain. Here the two natures of artifacts, as conceptualized in the philosophy of technology, can be a useful tool to teach about artifacts.

Rather than beginning with the complexity of many artifacts, we can start helping pupils to get a first, basic understanding of artifacts by making them reflect on the physical and the functional nature of the artifact first. The elegant simplicity of the dual nature approach is appealing for teachers as education almost by definition looks for ways in which complex things can be simplified to make them teachable and learnable. Once they have learnt to recognize the two natures in artifacts we can move on and introduce basic concepts like operation of the artifacts and the ways in which the two natures are connected in design work. This approach can be extended to systems in the next step of understanding.

In a similar way, the ‘technology as knowledge’ approach can be used to derive implications for teaching and learning technology. The normative dimension in technological knowledge, as identified by philosophers of technology, for instance, makes us aware of the need to teach not only how things are, but also about how we would like things to be. Pupils must learn to develop ideas about how things can be improved and in what aspects. They must also learn to see technology as a matter of decision making rather than a matter of necessities. That is why technological knowledge often is the outcome of decisions rather than of measurements. Using the taxonomy for technological knowledge like Vincenti's can illustrate this for pupils in a practical way. This characteristic of technological knowledge (its normativity) also brings in ethical and aesthetic (Auxiology) issues as a highly desirable component in technology education. The lessons learnt in design methodology ('technology as activities') can be used to develop design projects that do not suffer from the immature ideas people had in the early days of that discipline. In technology education, as in the world of real design, we have to acknowledge that design processes are fuzzy to some extent by nature and vary between different types of products and technologies. Still we can find simple flowcharts for design processes in course material and we have to be cautious not to let these make pupils think that design is simply a matter of following the steps one by one. Such flowcharts can fulfill a useful role in helping novice designers to learn how to become more independent of such fixed sequences of steps.

The idea of scaffolding in current educational theory supports the idea that flowcharts can serve as a useful support that gradually can be taken away when pupils become more acquainted with design work. Thereby we have to make sure that the flowcharts do not become a straitjacket when we keep using them too long. We also have to be aware of design processes in which knowledge is both used and developed. We have to build in moments in which pupils have to be conscious of potentially useable knowledge they already have, but also moments of reflection that make them aware of new knowledge that they have gained during the design process. This can be knowledge about the process of designing as well as knowledge of the content matter. Building tall structures, for instance, may have taught them about stability, but we have to make this learning explicit if this knowledge is to be useful for later design experiences. Finally there is the approach of 'technology as values'. From literature in this approach we can find lots of opportunities to help pupils develop their own normative ideas about how technology should function in society and in their own personal lives. E-learning has mentioned the option of using science fiction movies as a practical means of bringing this into the classroom.

EDUCATIONAL IMPLICATIONS OF TECHNOLOGY

In this final section, some practical implications for teaching technology are presented. After all, teachers may wonder what the relevance for these philosophical reflections could be for them. Philosophy seems to be remote from what they do anyway, and why would that be different for philosophy of technology? Teachers make day-to-day decisions continuously. Often the arguments leading to choices have a fairly pragmatic character: what is feasible in the classroom, what would keep pupils involved, etcetera. Those are all valid arguments, but it would be valuable if arguments coming from a philosophy of technology knowledge base would also play a part in these decisions. What philosophy of technology can do is to give to teachers themselves a good understanding of the nature of technology. But it is also important that pupils get a good understanding of the nature of technology. In fact, all practical choices concerning activities in classes should be made so that all the activities somehow add up to a realistic and valid image of what technology is. That means that ideally in every activity pupils are stimulated to think about the nature of the artifacts they design, make and/or use, about the knowledge that they draw from in order to do that, about the nature of the process they go through, and the values that are involved. Of course, not each and every project needs to be burdened with such a load, but the fourfold way of looking at technology (artifacts, knowledge, processes and values) can serve as a general guideline in the background for teachers to make decisions about what will be done in classes.

For instance, a teacher preparing a project in which pupils will design a simple vehicle that travels a certain distance using energy from an elastic band, could introduce this activity to pupils in such a way that they have to think about how to choose the vehicle’s properties so that function and physical realization are complementary. Furthermore, they have to consider what knowledge from Physics might be useful, as well as knowledge from technology. Thirdly, they are challenged to plan their ‘design and make’ process while considering what steps are usually in a design process and what way to go would be the best in this particular case. Finally, they can be challenged to think about values like being economical with materials, and if the project is extended a bit to include some more theoretical work on real vehicles, they can reflect on values like costs, safety, aesthetical values, etcetera. By preparing the project in this way, the teacher turns the fourfold way of looking at technology from philosophy into a practical guideline. In the example above, the emphasis is on the design and makes process and in the extended version also social aspects are considered. The list of different approaches to technology education can inspire teachers to opt for a richer activity, in which elements from other approaches are also present. Pupils could also explore the engineering concepts of systems, optimization, and resources in doing this project. They may also be stimulated to think about how the vehicles they design could be produced in a factory. In doing the project, specific opportunities for acquiring key competencies could be built in, for instance, by having the students present the end product in a well thought through manner, or have them pay explicit attention to a good division of labour in the group. This way the values of the various approaches are combined and rich learning opportunities emerge.

Apart from these types of planning activities, there are more practical decisions to be made. Let us think about the availability of resources in the classroom. What consequences may philosophy of technology have for that? It would be nice if the fourfold way of looking at technology would be mirrored in the classroom or lab. That would mean that artifacts would be available for pupils to explore and so develop an understanding of their dual nature. It would also mean that knowledge sources would be available for them to consult and involve in their work. It would mean that space for different types of activities would be available (for designing, making and testing/using/evaluating). It would also mean that values are somehow present. That sounds rather abstract, but there are various ways of incorporating values in a practical way.

Safety and sustainability as values in technology can be illustrated by posters, for instance. Maybe there are opportunities to watch DVDs or video clips online about the social and human aspects of technology. One attractive opportunity for that is to use science fiction movies and let pupils reflect about whether or not they would like to live in the world as it is presented in those movies. Finally, I would like to mention decisions regarding assessment of pupils. Quite often, what is assessed is fairly limited. In many cases the practical abilities of the pupils will be assessed, and perhaps some paper-and-pencil tests will be used to check their understanding of theory. But there is much more to be assessed if we use the philosophy of technology structure. What are not assessed, for instance, are the pupils' attitudes towards technology and their concept of it. It would be worthwhile to assess those, too. This need not necessarily be done by fancy questionnaires or other formal instruments but, perhaps, could be done better by talking about it with the pupils. Teachers could plan reflective moments in class in which individual pupils are invited to express their image of and attitude towards technology and this can give rise to a discussion, but at the same time gives the teacher an impression of the progress (or lack of that in the worst case) of the pupils' overall thinking about technology.

TECHNOLOGY CHALLENGING COUNTRIES

As Technology Education has been around in some schools and in some countries for a long time, it is surprising that there is still no consensus about what school technology should be, how pupils learn when they study it, and what are effective teaching strategies. Yet in many countries, technology is challenging a number of traditional characteristics of schooling: the decontextualization of knowledge, the primacy of the theoretical over the practical, and the organization of the curriculum along disciplinary lines.

There is a great degree of diversity throughout the world in technology education.

i. This diversity ranges from the absence of core technology education (Japan)
ii. to its compulsory study by all students (Israel),
iii. an instrumentalist approach (Finland)
iv. to a basically humanistic approach (Sweden),
v. a focus on content (USA)
vi. to a focus on the process (England),
vii. an economic rationalist philosophy (Botswana, China)
viii. to a more liberal philosophy (Canada),
ix. a staged and well supported implementation of change (New Zealand)
x. to a rushed and largely unsuccessful initial implementation (England),
xi. integrated with other subjects (science in Israel, IT in Australia) or
xii. as a discrete subject (Scotland).

While the nature of technology education developed within a country must be designed to serve that country's needs, and build upon the unique history of technical education resulting in a relevant technology education program, what happens in the technology classroom is dependent on the teachers' beliefs about technology in its broadest socially oriented context.

IMPORTANCE OF PHILOSOPHICAL TECHNOLOGY

Reflecting on and becoming aware of our philosophical orientations is important; it provides a basis for how we choose and use e-learning technologies. Education effects change, whether that change is the ability to engage in rational thought, personal growth, or to bring about political and social change (Zinn, 1990). The desired changes are based on what we believe should happen through education. This, in turn, will be reflected in how we choose and use e-learning technologies. When we are aware of our philosophical orientation, it is then possible to make informed decisions about choosing and using e-learning technology. Without knowing our philosophical orientation, other strategies are used (Zinn, 1990). Often swept up by unbridled but uninformed enthusiasm by technological advocates, many decisions by educators are based on following the latest trend. Unfortunately, these strategies often lead to incongruence and inconsistency in action between and among instructors, administrators, and students, and the ensuing disagreements that revolve around the means rather than the ends of education. Moreover, when there is incongruence between beliefs and actions, the promises of what e-learning technologies can provide will never be delivered. Unless we can systematically identify what we value in education, we cannot justify the choices we make with e-learning technologies, or deliver the promises. For these reasons, it is important to take time out from our *doing* and ask *why* it is important. “Thoughtful practitioners know not only what they do, but why they are to do it. Experience combined with reflection leads to purposeful and informed action.” (Darkenwalk & Merriam, 1982, p. 37)

CONCLUSION

Although any attempt to develop a set of standards or a curriculum framework for international use has been unsuccessful, it is to be expected that the internationalization of technology education will continue and gradually make technology education curricula look more similar than in the past when countries usually had a rather outspoken preference for a particular aspect of technology. This will certainly be to the benefit of technology education in general. It will cause an increased interest in exchanging materials and making joint efforts to develop curricula and do research. In the end teachers and pupils will have the ultimate benefit of this development. That way technology education makes its own contribution to the literacy that is needed for present world.

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