Chapter 16
A Curriculum Developer's Perspective on the Place of Food in the Secondary School in England

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Abstract This chapter begins by considering the importance of food education in secondary schools in England in the context of the obesity crisis and the role of meat production in contributing to global warming. It continues with a discussion on how young people might be taught to cook and eat well. This is extended to a consideration of the role of science learning in meeting these objectives. Then the chapter discusses the possible content of secondary school food technology courses. Finally, there are concluding remarks which comment briefly on each of the previous sections in the light of possible curriculum development.

Keywords Curriculum development · Food education · Food science and technology · Healthy eating · Planetary stewardship

Introduction

This chapter will be in five parts. The first part will explore the importance of food education in England from the government's perspective. The second part will explore what young people might need to be taught in order to be able to cook for themselves (now) and for their families (in the future). The third part will explore the role of science understanding in learning how to cook. The fourth part will explore the possible content of food technology courses. The fifth part will consist of concluding remarks.

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The Importance of Food Education

The government in England has been exercised about the teaching of food in schools as part of its concern with regard to the nation's health and the impact of poor dietary choices on the cost of the National Health Service (NHS). As early as 2007, Foresight reported that the predicted increase in obesity was a ticking time bomb as far as health service costs were concerned (Department for Innovation, Universities and Skills (DIUS), 2007a).

These extracts from the summary of key messages (DIUS, 2007b) indicate the seriousness of the situation:

- In recent years, Britain has become a nation where overweight is the norm. The rate of increase in overweight and obesity, in children and adults, is striking. By 2050, Foresight modelling indicates that 60% of adult men, 50% of adult women and about 25% of all children under 16 could be obese. Obesity increases the risk of a range of chronic diseases, particularly type 2 diabetes, stroke, coronary heart disease, cancer and arthritis. The NHS costs attributable to overweight and obesity are projected to double to £10 billion by 2050. The wider costs to society and business are estimated to reach £49.9 billion per year (at today's prices).
- The obesity epidemic cannot be prevented by individual action alone and demands a societal approach.
- Tackling obesity requires a far greater change than anything tried so far, and at multiple levels: personal, family, community and national.
- Preventing obesity is a societal challenge, similar to climate change. It requires a partnership between government, science, business and civil society.

Written over ten years ago this provides a stark warning, and now prescriptions for type 2 diabetes caused to a large extent by lifestyle choices leading to being overweight and obese are costing the NHS in England more than £1 billion a year (Ives, 2018). Research has indicated that the number of fast-food outlets can double the chances of becoming obese (Briggs, 2014), and the UK's high streets currently have the highest concentration of fast-food outlets since 2010 (Homer, 2018). The following data from the Office for National Statistics are worrying:

- The UK has seen a 34% increase in fast-food outlets from 2010 to 2018.
- In 2010, the average number of fast-food outlets per 100,000 people was 47. It had risen to 61 by 2018.
- In nearly every area (204 out of 215), the rate of takeaways per 100,000 people was higher in 2018 than in 2010.

Hence, it is not difficult to see why the government wants young people to be able to eat well and do this by cooking for themselves. There have been several government interventions in the curriculum to achieve this in recent years.

In 2013, the government introduced a new National Curriculum, and within the design and technology programme of study, there was a section devoted to Cooking and Nutrition (Department for Education (DfE), 2013). For pupils aged 11–13, this reads as follows:

- Understand and apply the principles of nutrition and health.
- Cook a repertoire of predominantly savoury dishes so that they are able to feed themselves and others a healthy and varied diet.
- Become competent in a range of cooking techniques (for example, selecting and preparing ingredients; using utensils and electrical equipment; applying heat in different ways; using awareness of taste, texture and smell to decide how to season dishes and combine ingredients; adapting and using their own recipes).
- Understand the source, seasonality and characteristics of a broad range of ingredients.

The difficulty with this situation is that the time available to meet these requirements is limited, as the teaching would have to take place within the time allocated to design and technology.

In 2016, the government withdrew food as a material to be used within all design and technology specifications and replaced this with a new General Certificate of Education (GCSE) Food Preparation and Nutrition (DfE, 2015). The subject content is divided into four sections as follows:

- Nutrition
- Food
  - Food provenance
  - Food choice
- Cooking and food preparation
  - The scientific principles underlying the preparation and cooking of food
  - Preparation and cooking techniques: how and when the skills and techniques can be applied and how they relate to the knowledge and understanding requirement listed above
- Skills requirements: preparation and cooking techniques
  - This includes an extensive section on skills required to demonstrate and apply skills when planning, preparing, cooking and presenting a selection of recipes, modifying recipes or creating new recipes to meet particular requirements.

For all young people aged up to the age of 14 years the teaching of Cooking and Nutrition within design and technology is compulsory, but the Food Preparation and Nutrition GCSE course is an elective subject and the number of young people taking this is significantly lower.

Other Approaches to Health Eating

Whatever one may think about these actions, it is clear that they can be explained as part of the government's drive to improve the health of the nation and to reduce NHS costs. However, it is not just diet that contributes to well-being.

Physical activity also plays a key role, and in addition to influencing what we eat, the government promotes school sporting activities, which it sees as being linked to, and in synergy with, its Childhood Obesity Plan (Hinds, 2018). But there are mixed messages. The call for people to eat less meat in a bid to cut carbon emissions (Harrabin, 2018) led the climate minister Claire Perry to opine that it is not the government's job to advise people on a climate-friendly diet. Eating less meat, especially processed meat, would be beneficial health-wise (BBC news, 2018), so whilst it is appropriate to advise people on their diet with regard to avoiding obesity, it is not appropriate to give similar advice with regard to climate change.

This is at odds with the Foresight report (DIUS, 2007a) that indicated strongly that to be effective, government strategies required cross-ministry collaboration. At the time of writing, the Eat-Lancet Commission has published the report 'Food Planet Health Healthy Diets From Sustainable Food Systems' (Eat-Lancet Commission, 2019), which argues that the data concerning the impact of current food production and consumption are both sufficient and strong enough to warrant immediate actions. It identifies five strategies required to radically transform the food system, shown in Table 16.1. These strategies indicate that government attempts to promote healthy eating are justified, but in fact do not go far enough in that they do not consider the impact of food production on planet Earth and the need for a move to a much more plant-based diet. This has significant implications for the teaching of young people to cook and eat well – the topic under consideration in the next section.

Teaching Young People to Cook and Eat Well

An immediate question is where in the school curriculum might such teaching take place? We have already noted that the time available to teach cooking in design and technology lessons is limited. In a design and technology course for pupils aged 11–14, it is quite likely that the amount of time spent on food-related matters would be between 12 and 18 h in each of the three-year courses and that within this time a wide range of other matters would need to be considered. For example, the designing and making of food products, as opposed to simply following recipes; the nutritional content of food; the way food is produced, processed, distributed and sold; the impact of these processes on climate change; the competition between biofuel and food production for human consumption; and food hygiene. Given this wide-ranging agenda it might make sense to place teaching to cook in personal, social and health (PSHE) education, and to teach other aspects in other subjects such as science and geography. If one wants young people to design and make food products in design and technology, then the learning taking place in PSHE, science and geography would support this endeavour. Such cross-curricular learning would of course need to be coordinated in the secondary school if it was to be effective.

Young people do not have much control over the food they eat. Parents and carers usually buy and cook the food, and the food available at school is limited to that

Table 16.1 Strategies for transforming the food system on planet Earth

Strategy	Intention
Strategy 1 Seek international and national commitments to shift towards health diets	The scientific targets set out by this Commission provide guidance for the necessary shift, recommending increased consumption of plant-based foods – including fruits, vegetables, nuts, seeds and whole grains – while in many settings substantially limiting animal source foods. This concerted commitment can be achieved by making healthy foods more available, accessible and affordable in place of unhealthier alternatives, improving information and food marketing, investing in public health information and sustainability education, implementing food-based dietary guidelines, and using health care services to deliver dietary advice and interventions
Strategy 2 Reorient agricultural priorities from producing high quantities of food to producing healthy food	Agriculture and fisheries must not only produce enough calories to feed a growing global population but must also produce a diversity of foods that nurture human health and support environmental sustainability. Alongside dietary shifts, agricultural and marine policies must be reoriented toward a variety of nutritious foods that enhance biodiversity rather than aiming for increased volume of a few crops, much of which is now used for animal feed. Livestock production needs to be considered in specific contexts
Strategy 3 Sustainably intensify food production to increase high-quality output	The current global food system requires a new agricultural revolution that is based on sustainable intensification and driven by sustainability and system innovation. This would entail at least a 75% reduction of yield gaps on current cropland, radical improvements in fertilizer and water use efficiency, recycling of phosphorus, redistribution of global use of nitrogen and phosphorus, implementing climate mitigation options including changes in crop and feed management, and enhancing biodiversity within agricultural systems. In addition, to achieve negative emissions globally as per the Paris Agreement, the global food system must become a net carbon sink from 2040 and onward
Strategy 4 Strong and coordinated governance of land and oceans	This implies feeding humanity on existing agricultural land i.e. by implementing a zero-expansion policy of new agricultural land into natural ecosystems and species-rich forests, aiming management policies at restoring and reforesting degraded land, establishing international land use governance mechanisms, and adopting a "Half Earth" strategy for biodiversity conservation (i.e. conserve at least 80% of preindustrial species richness by protecting the remaining 50% of Earth as intact ecosystems). Moreover, there is a need to improve the management of the world's oceans to ensure that fisheries do not negatively impact ecosystems, fish stocks are utilized responsibly, and global aquaculture production is expanded sustainably
Strategy 5 At least halve food losses and waste, in line with UN sustainable development goals	Substantially reducing food losses at the production side and food waste at the consumption side is essential for the global food system to stay within a safe operating space. Both technological solutions applied along the food supply chain and implementation of public policies are required in order to achieve an overall 50% reduction in global food loss and waste as per the targets of the SDGs. Actions include improving post-harvest infrastructure, food transport, processing and packing, increasing collaboration along the supply chain, training and equipping producers, and educating consumers

Taken from 'Healthy Diets From Sustainable Food Systems' produced by the EAT-Lancet Commission

provided by the school kitchen. Recent criticism of school meal provision in secondary schools has suggested that it does not support healthy eating behaviours (Jamie Oliver Food Foundation, 2017). So, one does wonder if teaching young people to cook in such an environment when they are aged 11–14 will pay much dividend when they are required to cook for themselves, i.e. when they move away from home which will probably not be until they are 18 years old or older. Some schools run short intensive programmes about learning to cook for their students as part of a sixth form programme preparing them for life at university (Lewis, personal communication, 2010).

However, given some schools in England are required to teach the National Curriculum, which includes teaching to cook, how might they decide what to teach? Several questions arise:

- What sort of facilities will young people have access to when they start cooking for themselves?

Most flats have a kitchen, which will be equipped with a cooker that features a grill, a hob (a surface with either hot plates or gas rings) and an oven. The kitchen may also to have a microwave oven. A fridge and freezer are likely to be available for a short- and long-term storage of perishable foods, and cupboards will be available for the storage of dry and tinned goods. A variety of pots, pans and cooking trays, plus cooking utensils, are also likely to be available, but limited to few sizes only. Any program in school to teach cooking must make some of these facilities available and teach how best to use them.

- What sorts of ingredients and food products will they have access to?

Most families in England live within easy travelling distance of large supermarkets, which sell a very wide range of food, drinks and food products. Young people cooking for themselves for the first time are likely to be on a low budget. Fruit and vegetables are available at low prices, as well as staples such as potatoes, rice and beans and bread and pasta. Eggs too are inexpensive. Fresh fish is relatively inexpensive, as is chicken and minced meat. Processed meat products such as bacon and sausages are inexpensive, although large consumption especially if fried is not healthy. With that range of ingredients it should be possible to create a varied, healthy diet at a low cost. It should be noted that this range may well need to be modified in attempts to move towards a more plant-based diet as recommended by the ‘EAT-Lancet Commission’. However, within the walls of large supermarkets, there are large numbers of food products that require little in the way of cooking other than heating in a microwave oven, and these are generally high in fat, salt and sugar and are calorie intensive and inexpensive.

The availability of ingredients and ready meals at supermarkets also needs to be seen in the context of the advertising that is currently taking place to encourage people both young and old to ‘just eat’ (see for example https://www.just-eat.co.uk/explore/magicisreal and https://www.youtube.com/watch?v=dvRrh8NOTbM).

The message underlying these adverts is that time spent preparing your own food is time wasted when you could be doing other things. Thus, young people are encouraged to dial up fast food for home delivery so that they can get on with much more exciting activities. In the small town where I live, the 'Just Eat' website (https://www.just-eat.co.uk) identified 93 different restaurants from which I could order takeaway meals to be delivered to my door.

- *What sorts of meals should we be teaching them to cook*?

This might change in the light of a move to a more plant-based diet, but the following would seem to be appropriate in the light of healthy eating from a perspective that does not focus strongly on the environmental impact of meat production:

– Packed lunches – salads and sandwiches
– Simple quick-to-cook meals – baked potatoes plus fillings, pasta plus various sauces, rice dishes
– Simple fruit desserts
– Soups and stews

This list is a bit on the worthy side, and I wonder if I should include cakes and biscuits as possible tasty treats. Of course, the cooking methods should involve boiling, steaming and baking and should promote grilling as opposed to frying.

- *What are the influences that will shape their willingness and ability to cook for themselves*?

The food that is cooked and eaten at home by youngsters as they grow up will have a large influence on what they might cook when they leave home. The role of parents and carers in enabling their children to cook either by example of what they themselves do or through deliberately teaching them will be significant. There will be a cultural influence at play here both in terms of what is cooked and eaten (for example, Afro-Caribbean cuisine is different from Chinese cuisine, which in turn is different from Indian cuisine, and within these there may be regional or religious preferences) and whether there is a cultural tradition of home cooking. The availability of ready meals, takeaways, fast-food outlets and delivered meals will be a disincentive to cooking at home. One is left wondering whether learning to cook at school between the ages of 11 and 14 will influence young people to actually cook for themselves as they get older and leave home given the range of other influences.

Note that this development of a cooking programme of study is based on what would be useful for them when they have to fend for themselves once they have left home and what would likely be available to them in terms of ingredients and equipment. It has not been developed as a cookery course, and it should not be seen as preparation for an examination course. As to who would teach such a course, it would need to be taught by those who have the necessary expertise; for example, those who might already be teaching about food within D&T.

The Role of Science Understanding in Learning How to Cook and Eat Well

It is possible to teach young people a wide range of cooking skills that enable them to follow the instructions in recipes successfully but not necessarily understand why such recipes are successful, or the contribution they make to a healthy lifestyle. It is a scientific understanding of the principles of cooking and the role of ingredients within the cooking process and the nutritional properties of ingredients that is needed to overcome this limited skills agenda.

Farrimond (2017) has produced an interesting and comprehensive book, *The Science of Cooking*. It is organised into the cooking of different sorts of food: meat and poultry, fish and seafood, eggs and dairy, rice and other grains, pasta, vegetables and fruits, nuts and seeds, herbs and spices, oils and flavourings, and baking and sweet. Dorling Kindersley books are generally very visual and are laid out in a highly attractive manner; in short, they delight the eyes. The book is full of useful practical advice, and there is no shortage of technical information; scientific facts and explanations are also embedded throughout the book. It is a font of information but to my mind is overwhelming and does not present any 'Big Ideas' or key concepts that might be useful across the piece in making sense of the wealth of content presented.

Mary Myatt (2018) has written compellingly about the importance of 'Big Ideas' in achieving curriculum coherence and here we have an example of a publication that fails to take this into account. Given the limited time there is for any subject in the school curriculum, it is important to identify and teach such 'Big Ideas' or key concepts so that learners are in a strong position to make sense of the knowledge and skills they are expected to acquire. Below are some suggestions for these 'Big Ideas', but the author welcomes readers' views regarding their merits or otherwise and whether there are any other important omissions:

A. Big Ideas useful for understanding cooking:

- Particulate nature of matter: atoms, ions and molecules, including polymers
- Properties: all materials, including food, have properties according to their composition and the way the atoms, molecule or ions are arranged
- Property modification through the application of heat and a combination of other materials, including the formation of colloids and emulsions
- The difference between heat and temperature
- The role of heat transfer, via radiation, conduction and convection, in property modification
- Reversible and irreversible changes
- The composition of food in terms of fats, proteins and carbohydrates and the structure of these types of substances

B. Big Ideas for understanding healthy eating:

- The role of food in providing energy, in maintenance and repair of the body and in enabling growth

- The role of fats, proteins and carbohydrates in diet
- The energy provided by different foods
- The role of vitamins and minerals in diet
- Digestion, transportation and respiration: the breakdown of large molecules into smaller ones, their movement into the bloodstream and transportation into cells throughout the body where respiration takes place to provide energy
- The balance between the food eaten, the energy obtained from that food and the energy expended in exercise and maintaining body processes

For the teacher charged with teaching the skills needed to prepare the healthy food listed in the previous section relating this to the science Big Ideas will almost certainly be a challenge, particularly in respect to the time likely to be available. Collaboration with science and PE teachers will be required to ensure that these concepts have to some extent been taught in these subjects so the cookery teacher is not 'starting from scratch'. The cookery teacher can then build on this teaching in a way that helps learners appreciate the reasons for using particular ingredients, cook them in ways suggested by recipes and understanding how they contribute to healthy eating. Requiring the cookery teacher to teach the Big Ideas as well as the cookery will almost certainly lead to an overcrowded and rushed curriculum with the acquisition of skills, knowledge and understanding in the process. It is worth emphasising that there is a significant chemistry embedded in cooking, as exemplified by the inclusion of cookery in chemistry degree courses taught at Imperial College London through a Culinary Practice module (Samadder, 2019). Professor Alan Spivey, Assistant Provost (Learning and Teaching), said: 'The Chemical Kitchen will offer an amazing experience for all 1st year chemistry students at Imperial to kick-start their practical training in an unconventional and provocative way. Whether you want to be a chemist or a chef, skills such as meticulous planning and detailed observation and recording are vital. The plan is to encourage safe experimental practice, practical reproducibility and appreciation of the often overlooked parallels between the practice of chemistry and myriad other activities which require manual dexterity so as to inspire our students to excel as experimental scientists.'

The Possible Content of Food Technology Courses

Any possible content of a food technology course must reflect the nature of technology (a) to achieve intellectual coherence and (b) to avoid confusion with other food courses, for example, a food science course. De Vries (2007) suggests four ways of reflecting about the nature of technology:

- Technology as an artefact
- Technology as knowledge
- Technology as a process
- Technology as a property of humans

It may be unusual to view food and food products as technological artefacts, but this might be helpful in that we can separate food into two components: first, the composition of a particular food or food product and, second, the purpose of that food or food product, i.e. what it is in the food (its physical nature) and what it is for (its functional nature). Consider a birthday cake, made up from a list of ingredients (its physical nature) and its use as a food product to be eaten at a celebration (its functional nature). If we change its physical nature, we are almost certain to change its functional nature.

There is clearly a lot of technological knowledge in food technology, and there is an important difference between this and the scientific knowledge, which food technologists also use. Scientific knowledge is declarative, e.g. the calorific value of a set of ingredients can be measured and is a specific number of calories. This value is neither good nor bad; it just is. Whether these ingredients are 'good' for people who might eat them is a matter of judgement. This is normative knowledge and will depend on the effect that the ingredients have on those people. This will vary according to the lifestyles adopted by particular people.

Technology can be seen as a particular way of acting or doing things.

In general terms, this process may be seen to have three phases:

- Envisaging how things might be
- Envisaging what is needed to achieve this
- Creating this reality

It is not difficult to apply this process to food technology as follows:

- Envisaging how things might be – all people in a particular community are well fed.
- Envisaging what is needed to achieve this – the community identifies the types and amounts of food needed.
- Creating this reality – members of the community cooperate in growing, harvesting, storing and distributing the food.

Jacob Bronowski (1973) captures how technology is a unique property of humans in his seminal work *The Ascent of Man* as follows:

Man has a unique set of gifts which make him unique among animals … so that unlike them, he is not a figure of the landscape His imagination, his reason, his emotional subtlety and toughness make it possible for him not to accept the environment but to change it … (man has) the ability to visualize the future, to foresee what might happen and plan to anticipate it and represent to ourselves in images that we project and move around inside our head … Every animal leaves traces of what it was; man alone leave traces of what he has created (pp. 19, 20 and 42).

Through food technology humans have left significant traces of what they have created in that they have changed landscape as the result of agriculture, erected huge facilities for food storage, developed a host of ever more complicated machinery devoted to planting and harvesting and processing food, and devised a range of

techno science devoted to increasing food production. Individual communities have, throughout history, devoted significant energy and resources to the task of feeding themselves, and now we are challenged with the task of using food technology to feed a growing and increasingly hungry world population. Naughton (in Banks, 1994) adds further weight to the idea of technology as a property of humans when he wrote that technology always involves 'ways of doing things … a complex interaction between people and social structures on the one hand and machines on the other' (p. 12).

We should not, however, let the difference between scientific knowledge and technological knowledge makes us to ignore the important relationship between science and technology. Arthur (2009) argues that technology can be viewed as the exploitation of phenomena revealed by science. He rejects a simplistic view that 'technology is applied science' but is adamant that it is from the discovery and understanding of phenomena that technologies spring. He notes that:

> It should be clear that technologies cannot exist without phenomena. But the reverse is not true. Phenomena purely in themselves have nothing to do with technology. They simply exist in our world (the physical ones at least) and we have no control over their form and existence. All we can do is use them where usable. Had our species been born into a universe with different phenomena we would have developed different technologies. And had we uncovered phenomena over historical times in a different sequence, we would have developed different technologies (p. 66).

Hence, in exploring the possible content of food technology courses, it will be important to acknowledge the scientific phenomenon on which the technology is predicated.

Considering Production

The narrative of food in the world starts with its production through agriculture and moves on to include its storage, processing, sales and distribution at individual, local, regional, national and global levels and ultimately its consumption. The production of some food on a global scale plays a significant role in global warming, and there is concern that the combination of rising population and the impact of climate change may significantly impair our ability to produce enough food to feed the world (Berners-Lee, 2019). There is competition between growing food for human consumption and producing biofuels (Nuffield Council on Bioethics, 2011). Some see the development of genetically modified foods as a solution to the world food problem and some see it as potentially harmful, whilst others object to the way it might be used to exploit farmers (Preston, 2018). A food technology course may focus on one or more parts of this narrative, and the associated issues and the depth of treatment would vary according to the ages of the learners. For the purposes of this chapter, I will consider only food production in some detail, but I hope to

develop a more complete picture involving storage, processing, sales, distribution and consumption of food in a future publication. In considering production, I will try to be true to the nature of technology, identify the underlying Big Ideas, discuss appropriate pedagogy and consider the role that new and emerging technologies might play.

The most basic form of food production is subsistence farming by which a family or a community grows just enough food for them, with little amount to eat and a surplus if possible. Any disruption of this activity quickly leads to hunger and starvation. In 2015, about two billion people (slightly more than 25% of the world's population) in 500 million households living in rural areas of developing nations survived as 'smallholder' farmers, working on less than 2 ha (5 acres) of land (Rapsomanikis, 2015). A step up from subsistence farming is the production of sufficient food for own needs and a surplus which they can sell to others through local markets. A further increase in the scale of food production involves farmers producing food for sale only and using their earnings to buy food from other food producers or from shops and business that sell food. This sort of farming can feed into regional, national and global markets. This sort of farming can grow produce thatis sold into regional, national and global markets. The Food and Agriculture Organization of the United Nations (2009) predicts that the world population will reach over nine billion by 2050 from the current population of 7.4 billion. This will place a significant burden on food production. For example, the report estimates that by 2050, the net import of cereals of developing countries will more than double from 135 million metric tonnes in 2008/2009 to 300 million in 2050.

What experiences of food production might we wish young people to have? Is it unrealistic to expect young people to acquire the experience of growing and harvesting food for themselves? Perhaps schools that teach food technology should have one or more allotments on which young people can grow and harvest a variety of crops according to season. For the moment I am ruling out rearing and subsequently slaughtering livestock, although I could certainly make a case for keeping chickens and harvesting eggs and raising goats for milk, which could be used to produce cheese and yoghurt. There could be arrangements for some of their produce to be sold at a local market or a school shop. Some of the produce could be used in cooking lessons, and some could be further processed through preservation, e.g. jam or pickle making or in the case of wheat producing flour, which might be used for simple baking. This is in no sense a trivial endeavour. It would require funding, organisation and commitment, but its educational potential is high. The activities of planting, growing, tending and harvesting are underpinned by an understanding of the following Big Ideas concerning the needs of plants:

- Fertile soil to grow; for some soils, fertilisers might be needed.
- Appropriate weather conditions to supply sunlight and water at temperatures that do not harm the plants. In adverse conditions, additional water and protection from sunlight and cold might be required.
- Protective measures against pests and disease affect yields.

- Drainage to prevent the soil becoming waterlogged and preventing growth.
- Appropriate planting to maximise yields and enable harvesting.

None of these ideas are particularly difficult to understand, but unless each is considered in the teaching and the way the allotment is managed then the learning achieved by the young people will be limited. It is worth noting that this experience can be seen in the light of the four ways of thinking about technology suggested by Marc de Vries (2007). They are technology as an artefact – the use of tools, materials and equipment to plant, grow and harvest food as well as to produce food; technology as knowledge – the application of Big Ideas to grow and harvest food; technology as a process – the entire activity of planting, growing and harvesting can be seen in this light; and technology as a property of humans – the entire endeavour can be seen as a technological activity carried out by humans. Hence, this learning activity is true to the nature of technology.

The learning associated with school-based food production can act as a springboard for considering food production in the world outside the confines of the school allotment with particular reference to the way technologies, particularly new and emerging technologies, are being utilised. Consider vertical farming (as opposed to the horizontal farming used in the school allotment). According to some, this innovation is set to revolutionise food production (see (http://www.bbc.com/future/story/20170405-how-vertical-farming-reinvents-agriculture) and https://vertical-farming.net/), but others argue that it can only be successful if it meets a range of stringent criteria (see, for example, https://university.upstartfarmers.com/blog/9-reasons-why-vertical-farms-fail).

The cultivation of leafy greens, easily carried out in the school allotment, is the focus of a vertical farming initiative (see https://aerofarms.com). The key technologies are summarised in Table 16.2. It would be instructive for young people to compare the way the needs of plants were met when growing and harvesting food on the allotment with the way these needs were met in the vertical farming approach. Such a comparison would provide insight into the way food technology is developing by embracing new and emerging technologies.

Despite the concern that has been raised as to the impact of automation on the way people might be able to work in the future (Carr, 2015) in many areas of farming, automation is seen as a boon as it enables large amounts of work to be done with little human labour and, in some cases, is required because human labour is not available. The use of driverless tractors to help harvest wheat is already available (see https://agfax.com/2018/11/26/driverless-tractors-are-closer-than-you-think-dtn/). Machines that can autonomously seed and weed are already available (see https://www.machinedesign.com/motion-control/farm-robotics-are-taking-giant-automated-leap-forward). And in response to shortages in farm labour, a variety of autonomous fruit-picking machines are being developed (see https://www.cnbc.com/2018/03/08/wave-of-agriculture-robotics-holds-potential-to-ease-farm-labor-crunch.html).

Table 16.2 Technologies for the vertical farming of leafy greens developed by Aerofarms®

Smart aeroponics	Aeroponics is used to mist the roots of greens with nutrients, water and oxygen. The aeroponic system is a closed loop system using 95% less water than field farming and 40% less than hydroponics.
Smart light	LED lights are used to create a specific light recipe for each plant, giving the greens exactly the spectrum, intensity and frequency they need for photosynthesis in the most energy-efficient way possible. This engineered lighting allows control of size, shape, texture, colour, flavour, and nutrition with razor-sharp precision and increased productivity.
Smart nutrition	Constant monitoring all of the macro- and micronutrients for our plants to provide them with everything that they need to thrive. Taking the exact same seed from the field and it grows in half the time as a traditional field farmer, leading to 390 times more productivity per square foot than a commercial field farm.
Smart data	Some 130,000 data points are monitored every harvest, constantly reviewing, testing and improving the growing system using predictive analytics to create a superior and consistent result. With remote monitoring and controls in place, the typical risks associated with traditional agriculture are minimised.
Smart substrate	A patented, reusable cloth medium is used for seeding, germinating, growing, and harvesting. The growing cloth medium is made out of BPA-free, post-consumer recycled plastic, each taking 350 (16.9 oz) water bottles out of the waste stream. The cloth can be fully sanitized after harvest and reseeded with no risk of contamination, acting as a barrier between the mist and the plants.
Smart pest management	Every aspect of our growing process has been optimized to minimize and mitigate pest proliferation. In addition to our controlled, indoor environment, our growing methods disrupt the normal life cycle of common indoor pests so that they never get started.
Smart scaling	The size and configuration of the system are highly customizable. The systems are comprised of modules that serve as building blocks that can be stacked vertically or lengthwise. This allows us to grow in varied locations and achieve ultimate yield per square foot, no matter the space, with quick installation.

And now drones (unmanned aerial vehicles) with sensors are being applied to farming in order to help increase crop production and monitor crop growth. Sensors and digital imaging capabilities can give farmers a richer picture of their fields. This information may prove useful in improving crop yields and farm efficiency. The report 'Drones for Agriculture' (Sylvester, 2018) from the Food and Agriculture Organization of the United Nations provides a wide-ranging and up-to-date set of case studies indicating the increasing significance of this technology in agriculture.

In short, food production is becoming 'smart', and such methods are on the increase. Hence, this should surely feature in a food technology course alongside an understanding of the traditional methods of farming and how these are being adapted in this light. The depth and extent of treatment would depend on the age of the learners.

Concluding Remarks

What are we to make of this curriculum developer's perspective? There can be little doubt that the government in England sees education in food as important at least through the lens of healthy eating and cooking healthy meals in response to the obesity crisis facing the nation. Whether the interventions in terms of a revised National Curriculum and the new GCSE qualification in Food Preparation and Nutrition will have the desired effect is still open to question. Time will tell. Teaching young people to cook and eat well is, like many initially appealing ideas, not as simple as it seems.

The curriculum is crowded, and there are other aspects of food education to be considered. This has jeopardised attempts to teach all young people to cook. I have suggested that such teaching might take place as a separate part of the curriculum unencumbered by other aspects of food education. Clearly this has risks. Would it have the necessary status or resources, for example? Would such an approach be possible? Would it be successful? Also, many of the factors that influence young people with regard to their ability and willingness to cook for themselves are outside the control of schools. It is clear that science understanding has a role to play in learning how to cook and eat well, but such understanding is not achieved through teaching cooking skills alone. Collaboration between those teaching cookery and those teaching science will be important here if young people are not to get mixed and confusing messages.

A discussion between science and food colleagues about the Big Ideas identified above and how best they can be utilised in teaching young people how to cook and eat well might be a useful starting point. In 2016, the government in England removed the A level qualification in Food Technology and with it the opportunity for young people aged 16–18 years to continue an academic study of food. The new qualification in Food Preparation and Nutrition for young people aged 14–16 resulted in the removal of food as a material to be considered in Design and Technology. The place of food within the Design and Technology National Curriculum (for young people aged 11–14) places high emphasis on Cooking and Nutrition alongside the opportunities for some food product development. Where do these experiences and the lack of opportunity 16–18 put the study of food technology for young people?

My consideration of the possible content of food technology is admittedly a very curtailed discussion, but I think it indicates that there is very little in the way of food technology as such being taught to young people aged 11–18. Devising a food technology course that the government might consider worthwhile as an A level will be challenging and needs to involve a range of stakeholders: school teachers, university lecturers and food and farm industry representatives, awarding organisations, professional associations and learned institutions. I hope that my discussion of the possible content of food technology courses goes some way to showing that such a course would be interesting, worthwhile and useful and that the effort required from the stakeholders to achieve this would not be a waste of time.

Developing a set of food technology courses for young people aged 11–18 would require buy-in from key stakeholders, in particular the learners and senior leadership teams (SLTs) in schools. The justification for such courses, given the importance of food in the world across a range of interrelated and significant issues such as health, combating global warming and feeding a growing population, gives the courses both relevance and urgency, and one would hope that SLTs would see them as an important if not essential component of general education for all young people up to the age of 16, if not beyond. In terms of learner buy-in, there is always a pedagogical challenge in dealing with content that is conceptually demanding and perhaps not what they are used to learning about. This is not insurmountable but does rely on teachers developing approaches that are appealing to learners. The argument that dealing with matters that are not immediately to the taste of learners because they are 'beyond their ken' is weak in that it denies learners the opportunity to expand their horizons.

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