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Food technology on the school curriculum in England: Is it a curriculum for the twenty-first century?

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Abstract In England, food technology is part of the curriculum for design and technology but the purpose of food technology education is not clear. Over the years, food on the school curriculum has generally been seen as a practical, learning to cook, activity initially for girls to prepare them for domestic employment or housewifery. As society has developed many aspects of design and technology teaching have also developed, to include teaching about new materials, new equipment and new processes but we argue that food technology has developed less slowly than other areas of design and technology. We question whether the current food technology curriculum provides an appropriate education for pupils in the twenty-first century. The research involved interviews with stakeholders to develop a conceptual framework for a modern food curriculum. School schemes of work and examination specifications were then analysed against this conceptual framework, and teachers and pupils were surveyed about their experiences of teaching and learning in food technology. The findings indicate that the main purpose of food technology on the school curriculum is still linked to developing pupils' practical food-making skills as a 'life skill', although one which is now available to boys and girls. We suggest that food technology education should serve a different and more sophisticated purpose in the twenty-first century; it could help pupils to develop their understanding of the underlying scientific principles, broaden their general knowledge of food-related issues and better prepare them for citizenship and employment.

Keywords Design and technology · Food technology education · Conceptual framework · Scientific understanding · Twenty-first century curriculum · Citizenship · Employment

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Introduction

The tale of the sabre-toothed tiger curriculum (Benjamin 1939) describes how one (imaginary) Palaeolithic tribe developed a useful curriculum for its children, including sabre-tooth-tiger-scaring, which helped the tribe to thrive. Over time the sabre-tooth tigers died out and sabre-tooth-tiger-scaring was no longer relevant, but the curriculum for the children remained unchanged as it was seen as 'traditional' and successful. The tale provides a valuable lesson about maintaining a school curriculum so that it is relevant and meaningful to pupils.

We are concerned that the food technology curriculum in England is in danger of becoming a 'sabre-toothed tiger' curriculum, not fit for the twenty-first century, and in this research project we investigated this concern. Design and technology, or technology, is a relatively new subject on the school curriculum and does not have the corpus of research literature of other subjects. Previous research has reported on philosophical approaches to design and technology (Jones et al. 2011) but there has been little research into food technology. Over 20 years ago, Rutland (1993) looked into the place of food in the school curriculum and examined three key issues: food and gender, food and status and food and the less able. The findings indicated that, though attitudes were slow to change, it was considered appropriate to teach food to both girls and boys, that where food was taught as food technology within design and technology it had a higher status and the study of food was appropriate for all abilities, though there may be difference in the actual course content. Following this, Bielby (2005) researched why food education changed from home economics to food technology, and the impact of this shift on teachers' work. She commented that some researchers (Atherton 1990; Paechter 1993) had noted organisational tensions and the need to adapt to new teaching styles following the introduction of food technology in design and technology but she had found no concern about teaching pupils about the food industry. However, Bielby commented that research into the food curriculum is scarce and that the emphasis by examination boards on designing, with less opportunities to develop food preparation knowledge and skills, have had a significant influence on food education. She concluded that, in her view, food technology has retained many important aspects of food education, including the origins of food and the scientific principles related to food preparation, but that there has been an overemphasis on industrial food production rather than a critical overview of the food industry. However, there is little further research which focuses on food technology within design and technology and we are unaware of recent research in this area.

Over a period of time we have explored what should comprise a modern food technology curriculum, what was taught in food technology, in England, prior to the 2014 programme of study and whether this is appropriate for the twenty-first century and properly preparing pupils for citizenship and employment. The research involved interviews with stakeholders to develop a conceptual framework for a modern food curriculum. School schemes of work and examination specifications were then analysed against this conceptual framework, and teachers and pupils were surveyed about their experiences of teaching and learning in food technology. The research has been reported separately elsewhere (see Rutland 2009, 2010a, b, 2011; Rutland and Owen-Jackson 2012a, b, 2013) but this article draws together all the findings to present an overview of current practice, and asks if this is relevant and meaningful to pupils.

Food technology on the school curriculum

Practical food lessons or cookery have been on the school curriculum since the 1840s (Gordon and Lawton 1978; Rutland 1997, 2006). The purpose of the subject was to provide girls, mainly from lower social classes, with cookery skills to prepare them for domestic employment or housewifery.

The 1870 Education Act, which introduced mass schooling in Great Britain, emerged as a result of the 1851 Great Exhibition in Crystal Palace which showed that Britain was falling behind other European countries in its technical and technological development. Following this, woodworking and metalworking were developed on the school curriculum to prepare boys to contribute as educated workers to the manufacturing enterprises growing up in Britain. These opportunities were not, however, offered to girls, who continued to be taught cookery and sewing in preparation for domestic work, whether paid or in the home. In selective grammar schools, for more academically able girls, food was taught as domestic science with more emphasis on nutrition and science, although the most able pupils were guided away from this and towards academic subjects such as Latin and foreign languages.

In the post war era of 1945 and onward secondary modern schools, for the less academically able, offered girls a ‘housecraft’ curriculum, with a practical bias and a vocational slant towards catering and the food trades, as a preparation for adult life (DES 1963; Geen et al. 1988). However, these occupations were relatively low paid and considered low status. In this period of food austerity, it was also thought important to teach girls to cook nutritious meals (Rutland 2006).

During the second half of the twentieth century ‘housecraft’ evolved into home economics and the teaching broadened to encompass not only cooking skills but also food science, nutrition, fibres and fabrics and people and homes, with more emphasis on the principles underlying the craft skills (Nuffield Home Economics 1982). Despite this it remained a subject taught mainly to girls as preparation for domestic life.

Over the same period boys’ subjects, woodwork and metalwork, were further developed. As industry became more technological and the need for manual craft skills in industry declined, along with changing thinking about the nature of education, these subjects changed. There was increasing emphasis on the design and technological aspects, although the practical craft aspects never disappeared they became part of something bigger. In 1967, Project Technology declared as one of its objectives ‘to help all children to get to grips with technology as a major influence in their lives, and as a result, to help more of them to lead effective and satisfying lives’ (Schools Council 1967, p. 5). This project focused mainly on engineering and electronics as technology but also acknowledged the role played by science-based work in domestic science, and it does suggest a broader purpose to these subjects than simply preparing pupils for employment.

The Sex Discrimination Act 1975 led to schools opening up curriculum opportunities, with girls able to study craft, design and technology (CDT) (as woodwork and metalwork were now named) and boys able to study home economics and textiles. There were a number of initiatives, such as Women in Science and Engineering (WISE), Girls and Technology Education (GATE) and Girls into Science and Technology (GIST), to encourage girls to study science, engineering and related subjects but there were no initiatives to encourage boys to study home economics or textiles. This is an indication that the subjects were perceived differently; CDT seemingly useful and worthwhile for all pupils whilst home economics and textiles seemingly had value for girls but not for boys (see Bell et al. 2013).

In 1976 James Callaghan, then Prime Minister of the UK, made a speech which paved the way for the introduction of the National Curriculum and greater government intervention in schools. In this speech, he said that education should prepare young people not only as active citizens but also as workers, and that schools should prepare young people with the knowledge and skills required by industry, emphasizing the utilitarian value of education and suggesting that all subjects on the school curriculum should contribute to preparing pupils for employment.

The National Curriculum was introduced in the UK with the Education Reform Act 1988 and implemented in schools in 1990 (DES 1990). This curriculum introduced 'Design and Technology' into the school curriculum and brought together the previously discrete subjects of art, business studies, craft, design and technology (CDT), home economics and information technology (IT). There had been some consideration, in the National Curriculum discussions, that the subject content of home economics should merge with science or remain as a separate part of the curriculum but when teachers were consulted nationally, in 1989 through their professional organization The National Association of Teachers of Home Economics (NATHE), it was feared that both these options would see the subject wither away and overall teachers supported the view that food's best future was within design and technology. The teachers of home economics, both individually and through the professional organization The National Association of Teachers of Home Economics (NATHE), fought a long and successful battle to retain food as part of design and technology (see Knight 1996). This indicates the importance of a Subject Association generating change and an ability to broker accounts of sustainable classroom practice within that framework. This is a salutary thought for the Design and Technology Association regarding the proposals for food teaching for pupils aged 14–16 years (DfE 2014).

The purpose of design and technology on the school curriculum was initially described as to allow pupils to develop 'capability to operate effectively and creatively in the made world. The goal is increased competence in the indeterminate zones of practice' (DES/WO 1988, p. 3). This is at odds with the purpose of education as suggested by Callaghan, but was widely accepted—even if not fully understood. The introduction of design and technology was not an initial success; there was a lack of understanding and confusion about its purposes and aims (see McCormick 2002; Wakefield and Owen-Jackson 2013) and teachers were unsure about what they should be teaching, or how. Many home economics teachers were confused and alienated by the terminology used in the National Curriculum documents. True, they could find some examples related to home economics in the programmes of study but the knowledge, understanding and skills related to home economics were not clearly identified. Though home economics was named as part of the framework, few examples were cited that directly related to food or textiles. Typical terms used, for example systems, structures, mechanisms, were unfamiliar to home economists. As Atherton (1990) commented, many home economics teachers felt ill prepared and 'de-skilled' when they considered the implications for them of the Design and Technology National Curriculum document.

The early experiences of design and technology, with food technology, did not quell the discussions. Some food teachers thought that the focus on industry, rather than the family, was detrimental. Some suggested that food should be taught through cross curricular themes, for example health education and personal and social education, while others thought that this was not a secure position for the practical aspects of the subject (see Jackson 1992). Some, however, welcomed the change as they saw it as a way of raising the profile and value of home economics (Jackson 1992). Smithers and Robinson's (1992, p. 15) view was that 'being able to cook, use a computer and word processor to fill in forms are affected by technology but are not necessarily part of it' and that 'cooking' should be given its own slot in the curriculum, indicating that little had changed regarding perceptions of the general educational value of teaching food. It was, and still is, seen by some as learning 'how to cook', developing practical skills, and little else, reflecting a lack of understanding of the nature of food technology and food product development as distinct from 'cookery'.

Over the first 5 years of the National Curriculum design and technology was revised three times and in its final version comprised only CDT and home economics, with areas described as electronics and systems, food technology, resistant materials and textiles technology. In the 25 years since its introduction the subject has continued to develop. There have been changes in the materials used, a growth in electronics and smart materials, the equipment available in many schools now includes computer-aided manufacturing technologies, laser cutters, computerized sewing machines and some are introducing 3D printers. Design work often makes use of design software. The developments in food technology have been less remarkable, although electric kitchen equipment is used this is often domestic standard not industry standard. Our observations, as food technology teacher educators visiting numerous schools across England and in conversation with colleagues visiting other schools, are that in many schools there is little or no reference to smart ingredients or modern food processing technologies and that food product development (design work) does not always include computer-based nutritional analysis, spreadsheet costing or experimental work. The food technology seen in many schools could have been taught 20 years ago with little discernible difference—is this a curriculum fit for the twenty-first century?

In the twenty-first century there are increasing sales of 'fast foods' and ready-made meals (Hucker 2013) and food preparation in the home takes 20–40 min per day, compared to 2 h in the mid-twentieth century (Popkin 2008). There are concomitant high levels of childhood obesity (Public Health England 2013) and adult food-related illnesses (Rayner and Scarborough 2005). On this measure these data suggest that food technology teaching has had little impact on the behavior of individuals, leading to questions of how effective or valuable this education has been. In response to these concerns, in 2008 the UK government introduced an initiative in schools called 'Licence to Cook'. This gave all pupils aged 11–14 years an entitlement to 8 h each year to learn to cook basic, nutritious, recipes and the principles of diet and health. A range of resources was produced and teachers, not all of them food technology teachers, trained to teach the programme. This programme offered a limited, and in our view impoverished, learning experience for pupils and did little to improve childhood health (see Rutland 2008 for a critique of Licence to Cook).

In 2012 the government announced a review of the National Curriculum in England and in 2013 published proposals for all subjects for pupils aged 5–14 years. The proposal for design and technology was rejected by many, with its focus on repair, maintenance, recycling and growing plants for food and decoration it was considered old-fashioned, regressive and lacking in academic rigour. After further discussion the government published a revised version, which was widely accepted as modern, innovative and rigorous, for implementation in September 2014.

Whilst there is much support for the new curriculum, which requires pupils to develop creativity and imagination, risk-taking and technical expertise and to learn about modern materials and technologies, there are concerns over the place of food technology. Although pupils should be to 'select from and use a wider, more complex range of materials, components *and ingredients*, taking into account their properties' (DfE 2013, our emphasis) there is little reference to food technology within the details of the curriculum.

This is exacerbated by a separate section within the design and technology curriculum which requires pupils to 'understand the principles of nutrition and learn how to cook'. Cooking is described as a 'crucial life skill', but the curriculum document does not make clear how this requirement aligns with the nature of design and technology as a whole. Nor is it clear how learning to cook, without an understanding of ingredients, food science and modern food technologies will prepare pupils for citizenship or employment in the twenty-first century.

This research has investigated food technology on the school curriculum, prior to the 2014 programme of study, to explore what should comprise a modern food technology curriculum and whether the current food technology curriculum is appropriate for the twenty-first century and properly preparing pupils for citizenship and employment.

Research methods

The research has evolved through different phases; it has been mainly qualitative with some elements of quantitative. An initial research project, supported by the Design and Technology Association (Rutland 2009), investigated what secondary school pupils in England should learn in a modern food technology curriculum. Data were gathered from two conferences on nanotechnology and interviews with five informants, although the individuals were an opportunity sample they were selected to be representative of both education and the commercial world with specific interest in food teaching in schools.

The outcome was a conceptual framework to modernise the food technology curriculum, consisting of:

a. designing and making food products
b. underpinned by an understanding of the science of food and cooking and nutrition
c. an exploration of both existing, new and emerging food technologies in
d. the context of the sustainable development of food supplies locally, nationally and globally and
e. an appreciation of the roles of consumers, the food industry and government agencies in influencing, monitoring, regulating and developing the food we eat (Fig. 1)

This project was followed by research based on semi-structured interviews with a number of stakeholders: two teacher educators preparing secondary school teachers of food technology, a curriculum developer for an independent, not-for-profit organisation, four secondary school food technology teachers with various levels of teaching experience, a university lecturer teaching on food related degree courses, two food technology examiners from a national examining body and a researcher from the food industry. This sample of interviewees was selected on the basis that they represented a range of stakeholders interested in food technology in schools, including teachers; teacher educators; design and technology and science in-service providers; external examination bodies; higher education lecturers and food researchers in industry, and provided complementary perspectives. Each interview was tape recorded and transcribed. The interviews explored what secondary school pupils in England should learn, understand and be able to do as a result of a modern food technology curriculum and led to a refined version of the conceptual framework for food technology in schools, see Rutland (2009, 2010a, b, 2011).

The next phase of the research was documentary analysis of the curriculum for pupils in lower and upper years of secondary schools. The content of lower secondary school teaching was collected from schemes of work (SoW) for pupils in years 7, 8 and 9 (aged

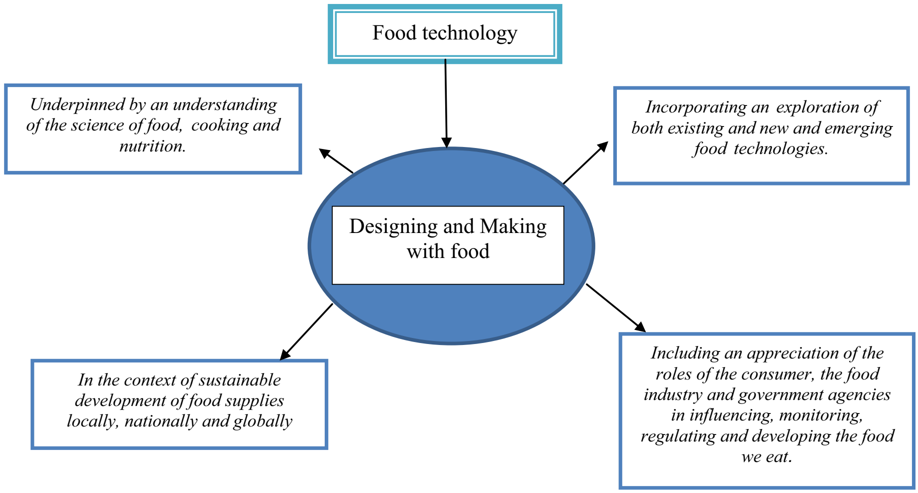

Fig. 1 Conceptual framework for a modern food technology curriculum

11–14 years) from nine schools across England, in the West Midlands, London Region and Oxfordshire. The schools varied in size and socio-economic context and, we believe, are generally representative of the range of state secondary schools. This was an opportunity sample, initial teacher education colleagues were asked to submit schemes of work from their partner schools, with the school's permission, and the ones analysed were all those received. Seven schools provided Year 7 SoW, nine schools Year 8 SoW and six schools Year 9 SoW. Although the number of SoW analysed is small this was a random sample and, in our experience, the schemes would 'resonate' with teachers in schools. As the SoW were produced by each school independently there was no common template for presentation, although most contained similar information the level of detail varied.

The curriculum for pupils in upper secondary schools was drawn from the examination specifications for food technology, which tend to drive teaching in schools. We looked at specifications for GCSE Food Technology from Assessment and Qualifications Alliance (AQA), Edexcel, Oxford, Cambridge and RSA Examinations (OCR) and Welsh Joint Education Committee (WJEC).

The SoW for lower secondary school pupils and the examination specifications for upper secondary school pupils were all read through carefully by each researcher independently and analysed against the conceptual framework for food technology devised and developed in the earlier phase of the research. The findings from this phase of the research are reported in Rutland and Owen-Jackson (2012a, b).

The most recent phase of research comprised questionnaires completed by teachers and pupils to gather their views on food technology currently taught in schools and their views for future developments (Rutland and Owen-Jackson 2013). A random and self-selecting sample of 15 teachers was drawn from those schools in partnership with two universities engaged in initial teacher education of food technology students. The teachers were selected on the basis of availability and willingness to participate and were from the larger teaching population of state, private, mixed and single sex secondary schools of 780–2,000 pupils from the north, midlands and south of England. The teachers were of varying ages and different years of teaching experience. The questionnaires were given personally to 15 teachers and a 100 % response rate was obtained, although three questionnaires were not fully completed. These three teachers' views were analysed but not their response to the aspects of the food technology in the conceptual framework. The teachers were also asked to look at a list of topics based on the conceptual framework for food technology and respond to the questions.

The pupils surveyed were drawn from the schools of the participating teachers, these schools represented a range of types of secondary schools including comprehensive, selective grammar and private. The teachers were asked to distribute questionnaires to their pupils within class, which provided a 100 % response rate. Each teacher was asked to survey a specific year group in order to ensure data were obtained from pupils in each of the year groups. Questionnaires were completed by 202 pupils aged 11–14 years across all schools, with 62 from Year 7 pupils, 38 from Year 8 and 102 from Year 9 pupils.

Research findings

Developing a conceptual framework for food technology

The initial phase of the study provided a conceptual framework for use in later phases. This framework is shown in Fig. 1 and has been discussed elsewhere (Rutland 2010a). All of those interviewed in the initial phase agreed that the conceptual framework provided a good basis for developing a food technology curriculum, with the teachers expressing some concerns about the current curriculum and its appropriateness.

These initial findings, reported fully in Rutland (2010b), showed that the teacher educators and curriculum developer acknowledged that in some schools the teaching of food technology does involve science teachers or has links with personal, social and health education, but that this is not a common feature. They also thought that 'designing' through food was misunderstood and too often involved sketching rather than experimentation and food product development. All of those interviewed in the initial phase agreed that there was a place in food technology for the teaching of nutrition and food science, in order to help develop both an understanding of food and of scientific concepts, although there was no agreement over the amount and depth of knowledge required. Similarly with new technologies, the importance of these was acknowledged but the amount and depth of knowledge required was disputed. The university lecturer, examination body representatives and food technology researcher put forward the view that food technology in schools does not adequately prepare pupils for studying the subject at a higher level or develop their understanding of modern food production. However, the teachers also highlighted that the limited time available for teaching food technology led to many constraints on what could be taught.

The content of food technology teaching: lower secondary school

The second phase of the research, reported in Rutland and Owen-Jackson (2012a, b), showed that in lower secondary school schemes of work for food technology schools were attempting to engage pupils in 'designing' through food but that the strategies used for this were limited, mainly using only evaluation of existing products, sensory evaluation and modification of existing recipes. The focus of the design development was aesthetic with little or no reference to other aspects, such as conceptual, technical, constructional, consumer needs or marketing. There was evidence of lots of practical work taking place, to develop pupils' making skills as well as their familiarity with tools and equipment, knowledge of safety and hygiene and safe working practices. However, in the first 2 years most of the dishes undertaken were simple, such as soup, fruit crumble, scones, muffins and flapjack, with occasional references in individual schools to roux sauces, whisking method of cake making and choux pastry. There was more variety in dishes cooked in the final year of lower secondary school (Year 9).

All the schemes of work indicated that pupils were taught the principles of nutrition and healthy eating, although not at a detailed level. Three schools taught food science to Year 9 and two schools taught it in Year 8, through consideration of yeast in bread-making, gelatinization in a roux sauce, coagulation of meat protein and the function of eggs in cooking.

The analysis showed that, in Year 7, no pupils were taught about new and emerging technologies. In Year 8 and Year 9 although there was no evidence of schools exploring with pupils new and emerging technologies in relation to food there was teaching about existing food production. In Year 8, one school taught pupils about mass and batch production, one taught food marketing and two schools taught about Hazard Analysis and Critical Control Points (HACCP). In Year 9, two schools taught about food preservation and one school about manufacturing processes, although only in relation to one-off, batch and mass production methods. One school taught HACCP in Year 9 and another taught about 'quality control'.

The analysis also showed that pupils in Year 7 were not taught about sustainable development in relation to food. In Year 8, one school taught the issues of food imports, eating meat and fish, sustainable fish stocks and meat alternatives and another school taught a project on 'ethical food' which covered fair trade, ethical business and the issues of local produce and food miles. In Year 9 one school taught a project based on 'local produce' which looked at food sources and food miles.

In all the schemes of work there was little or no reference to the roles of government, food industry and the consumer.

The content of food technology teaching: upper secondary school

In the analyses of the examination specifications for older secondary pupils there was considerable difference amongst the specifications from the different examination bodies, making general findings difficult. In relation to 'designing' in the main there was a reliance on 'drawing' as a designing strategy and an expectation pupils would 'draw' design ideas for food products. However, one specification did ask pupils to develop food products through trialling and testing, two cited nutritional analysis as a design strategy and three referred to user needs or target groups.

Overall, in relation to designing and making with food, the key issues which emerged were a lack of clarity and consistency required in the depth and breadth of knowledge, understanding and skills for combining food materials. There was also a lack of clarity and consistency across the specifications of the concepts of food product development, product testing, packaging, making design decisions and food choices.

All the specifications required knowledge of nutrients and the nutritional content of foods, but none made reference specifically to nutritional requirements such as Reference Nutrient Intake (RNI), though dietary reference values (DRVs) were mentioned in one specification. There was some reference to aspects of food science in all the specifications, in two pupils were required to know about the properties, functions and characteristics of ingredients and foods in order to make appropriate design decisions. One of these two specifications also required knowledge of raising agents, a range of cooking methods, heat transference and the effect of heat on foods. Another specification required pupils to select ingredients/foods for their organoleptic qualities, be aware of the scientific principles underpinning a range of functions of ingredients and cooking methods and the effect of cooking on foods. The fourth specification expected pupils to know the functional properties of starch, sugar, protein and fats and the structure of colloids, solutions, suspensions and gels, and about the impact of functional properties on desired outcomes and terms such as gelatinisation, elasticity, shortening, aeration, emulsifying and coagulation. Despite this, there was a lack of consistency and clarity across the Awarding Bodies in the depth and rigour of knowledge expected of the science of food, understanding of the functions of ingredients, impact of cooking on foods and depth of nutrition knowledge and understanding.

In relation to existing, new and emerging technologies, two specifications required pupils to understand most aspects of the food technologies outlined in the framework. Three of the specifications made particular reference to nanotechnology and nanomaterials and three, different, specifications referred to genetically modified (GM) foods. Two of the specifications required pupils to know about trends in food manufacture, industrial food production methods and CAD/CAM processes used in food manufacture with one-off, batch and high volume production, the use of industrial equipment such as tunnel ovens, blast freezers, silos and vats and quality control and the legal requirements for quality assurance. A third specification required pupils to know about designing to manufacture in quantity, producing work schedules, legislative issues in relation to British Standards Institute (BSI) and International Organization for Standardization (ISO) and detailed aspects of commercial manufacturing, including the use of just-in-time (JIT), scaling up quantities, parameters and tolerances, the use of pre-manufactured and standard components, manufacturing specifications and systems and processes. All the specifications required knowledge of storage methods and extending shelf life of foods. Only one specification required an awareness of how new technologies are used to produce new foods and ingredients.

Sustainable and environmental issues were present in all the specifications to some extent. Two of the specifications required pupils to be aware of sustainability and environmental issues, with specific reference to sustainability, recycle, reduce, reuse, refuse, repair and rethink (6Rs) and life cycle analysis. One of these specifications also required pupils to know about food sources, food growing, transport of food, food waste and national and local sustainable food issues. A third specification required pupils to be aware of the use of scarce resources, transport costs religion, cultural preferences, organic and free range foods, fair trade, farm assured on food production and the environment. The fourth specification referred to moral, environmental and cultural issues within the food industry including factory farming, GM, Fair trade, organic. This specification also had a section on analysing products which included a list of terms including GM ingredients, Fair Trade, irradiated and food miles. However, there was little clarity in this specification about what pupils should actually know in relation to these issues.

The roles of the consumer, the food industry and government agencies were dealt with inconsistently and inadequately in all of the specifications. They all required pupils to understand and practice health, safety and hygiene in relation to food, tools, equipment and the relevant legislation. One asked pupils to look at trends in consumer preferences and media influences on food choice. Another required pupils to know about Electronic Point of Sale (EPOS) technology and barcodes use in supermarkets.

Teachers' and pupils' views of food technology

The latest research, reported in Rutland and Owen-Jackson (2013), explored the views of teachers and pupils on the current food technology curriculum. It revealed huge variations in the time available for studying the subject. In Years 7 and 8 curriculum time ranged from 2.5 to 69 h per school year, with most around 15–18 h. In Year 9 it varied from 2.5 h minimum to 114 h maximum.

All the teachers and the majority of pupils (87 %) agreed that food technology should be studied by all pupils, mainly because it is seen as a 'life skill', although 91 % of pupils thought that 'designing and making' with food helped to develop creativity. Five teachers cited because it teaches about 'nutrition or healthy eating', three cited 'to tackle obesity' and only one cited because it develops creativity, independence and team work skills. Year 9 pupils also made references to learning about 'nutrition and healthy eating' and both Year 7 and Year 9 pupils thought that it was 'fun'. The small number who thought that it should be optional stated that it was not enjoyed by all pupils or that they were not good at it.

The majority of teachers indicated that design strategies were important, citing the use of product evaluation, sensory analysis, nutritional analysis and modifying recipes. The use of image boards was considered 'not important' by all teachers. A smaller majority (57 %) of teachers agreed that pupils should 'design and make' with food, mainly because it helped them to be creative with food, understand food and utilise their knowledge and skills. Those who disagreed (29 %), did so because they thought that there should be more emphasis on developing pupils' practical skills. Two teachers were ambivalent, seeing that 'designing' with food encouraged pupils to be creative but believing that the focus should be on developing knowledge and skills.

There was high agreement by the teachers and pupils that the development of practical skills and nutrition are key aspects of food technology (71 and 64 %). Similarly, most teachers considered 'guidelines of a healthy diet' and 'properties of food', which were taught across the Year groups, to be important. Aspects of 'nutrition' were also considered important by teachers and whilst there was evidence for basic nutritional knowledge and the nutritional content of foods being taught, there was less evidence for the teaching of nutritional intake measures and the implications of eating highly processed food. Other key aspects being taught were health and safety (57 %), understanding ingredients and the effect of cooking on ingredients (43 %), designing/developing ideas (21 %), understanding food labelling and the social, moral, environmental dimensions of food (14 %) and one teacher (7 %) citing each of developing knowledge for food choice, sensory analysis, food source/seasonality, wise food shopping and pupils having fun.

Teachers also gave importance to pupils 'understanding what ingredients can do' but there was little evidence of this being taught to the majority of pupils until they were 14 years old. The responses from teachers showed that they considered aspects of 'food technologies' to be important, particularly 'ways of preserving food' and 'emerging food technologies' but again there was little evidence of these aspects being taught to the younger age range. The picture is similar for 'the context of sustainable development of food supplies' and 'roles of the consumer, food industry and government agencies'.

Pupils gave a variety of responses as to the knowledge they thought was needed to design and make but none mentioned design strategies and only one pupil mentioned 'research skills'. The majority, across all year groups, cited knowledge of food or ingredients (39 %); many cited knowing how to cook or use equipment (26 %). In Year 7, 13 pupils (21 % of Year 7) mentioned 'health and safety' which is often a focus of Year 7 teaching and in Year 9 there were several mentions of 'target market' and healthy eating, again likely to be a reflection of the focus of the teaching they had encountered. All pupils regarded learning how to cook as an important feature of food technology with some mentioning specific skills they had learnt, for example 'rubbing in and chopping'.

Teachers were asked what was missing from food technology teaching and responses varied. The highest number of responses (36 %) referred to a lack of curriculum time, with two mentions of funding and one of technician support. Some teachers mentioned skills (29 %) and nutrition/healthy eating (21 %) and there were single mentions of idiosyncratic responses such as 'creativity with leftover food', 'links with farming', 'the enjoyment/ appreciation of food' and the contribution of food technology to pupils' literacy and numeracy. Each of these is a reflection of the individual teacher's own interests or, in the case of developing literacy and numeracy, whole-school teaching focus.

Pupils were also asked what was missing from food technology and 80 of the 202 (40 %) reported 'nothing'. However, like the teachers, pupils highlighted the lack of 'time' and many said they wanted more variety in what they cooked (15 %) and more choice over what to cook (11 %).

Finally, teachers were asked how their food technology curriculum would develop and improve over the next academic year and, again, responses varied considerably and were reflections of local concerns rather than any national or subject foci. Individual responses included:

- focusing more on skills, one teacher mentioned introducing sugar craft
- introducing more social, moral, cultural and environmental issues
- trying to obtain more outdoor growing space
- integrating more with Science, Technology, Engineering and mathematics (STEM)
- less designing work
- moving their focus away from technology.

Pupils were asked how they thought food technology could be improved and their responses included more practical work (17 %), more curriculum time (16 %), particularly in Year 7, recipes which are more interesting, complex or challenging (13 %) and more choice over what they cooked (11 %), particularly in Year 9.

Discussion

Drawing together the findings from all phases of this research gives a reasonably clear picture of the teaching of food technology in schools in England prior to the introduction of the new National Curriculum in September 2014.

The research developed a conceptual framework for the teaching of food technology that would prepare pupils for citizenship and employment in the twenty-first century. The evidence from teachers, pupils and examination specifications is that, although some aspects of the framework are present in the curriculum, current teaching does not match what might be considered appropriate for a modern food technology curriculum.

The findings indicate that, amongst food technology teachers, there appears to be a lack of understanding of the range of strategies available to 'design' with food as most teachers reported that they ask pupils to draw and sketch ideas but not that they ask them to work with ingredients to develop ideas. The influence of other areas of design and technology, where drawing or sketching design ideas is an effective approach, and the influence of examination requirements has not helped food technology teachers develop appropriate strategies for enabling pupils to engage in food product development. There is much scope within schools to improve pupils' ability to develop food products, through introducing them to a wider range of design strategies, and teachers could be encouraged to teach approaches used in the food industry, such as target markets, specifications, product development and product testing.

However, in order to undertake appropriate food product development activities pupils require technical knowledge and understanding related to the physical, chemical and nutritional properties of ingredients and aesthetic factors such as flavour, odour, texture and colour. The research found that, although there was some consideration of some of these aspects, pupils were not taught food science in depth and their technical knowledge of food is therefore likely to be limited.

The research also found that pupils in lower secondary school were being taught about healthy eating guidelines and basic nutrition but that, again, this was not in depth. At upper secondary school, although more detailed nutrition was taught, this was still at a relatively low level. The high levels of obesity and food-related illness in England suggest that previous years of teaching about nutrition has not impacted on food intake and that it is important to find ways to teach pupils effectively about nutrition and healthy eating. It could be considered that pupils' interest in food science, or their ability in relation to it, is under-estimated and their understanding of healthy eating guidelines could be greatly enhanced by developing further the teaching of these aspects of food technology.

It was clear from these findings that pupils do enjoy the practical aspect of food technology but the evidence showed that most practical work in schools involves pupils in making only simple dishes, such as soup and fruit crumble, which is likely to develop only low-level skills, and many pupils would welcome more challenge in their practical work with the opportunity to prepare more complex dishes. There are constraints on what can be done, due to teaching time available, economic constraints, as most pupils are required to provide their own ingredients, and social constraints as there remains an expectation that pupils will make food products that can be taken home and eaten. If these constraints could be addressed, particularly the time available, there would be more opportunities to develop practical work which would support pupils' learning not only of practical skills but also of food science and nutrition, food sustainability issues and food product development.

The research showed that pupils are taught little about food technologies, the environmental issues around food or the role of government and food agencies in food matters. These are topics which are likely to be of interest to young people and teachers should be prepared to teach some of these more difficult issues. If pupils were taught about the technologies used by the food industry this would help to develop their awareness of the implications of eating highly processed food on their health and future well being. In order to be informed consumers they should be enabled to make decisions on the foods they eat based on knowledge of where they come from. Misunderstandings by the public on important issues, such as genetically modified foods and nanotechnology in food production, could be discussed by older pupils in an informed manner. This would help to develop their understanding of modern food production and the role of government and food agencies. Sustainability, in relation to food production, food availability and food use, is already taught in many schools and could provide a relevant and interesting context for pupils to discuss a range of issues.

Food technology has much to offer pupils in schools as it is directly related to their future lives as healthy, confident and capable members of a technologically advanced society, who have an understanding of the potential impact of these developments on themselves and the environment in this country and the wider world.

Conclusion

There are different schools of thought, still, about the nature and purpose of design and technology on the school curriculum. In 1997, the *International Journal of Technology and Design* published a special edition (Volume 7, issue 1–2) which addressed aspects of the philosophy of technology, the links between technology and science and technology and society and research into the learning of technological concepts and processes. In reviewing progress, Jones et al. (2011) found that the philosophy of technology had developed considerably and could make an effective contribution to the teaching of the subject, although we found it is rare to find in practice that it does. They also found that the teaching of technology was beginning to move away from the purely crafts-based approach to one which took account of the wider aspects of technology and aimed to develop technological literacy in pupils, although there were still aspects of 'vocational education' in the subject. This review, however, focused on 'technology' in general and did not consider food technology.

Our view of the purpose of food technology sits alongside the view Jones, Bunting and de Vries (ibid) have of design and technology. Food technology should not just be about learning to cook, although many teachers and pupils regard its purpose as developing a 'life skill' rather than contributing to pupils' general education. Although, there was some acknowledgement of the academic learning it develops this was not the focus for teachers or pupils and it has been noted that design and technology is seen by some pupils as not intellectually challenging (Ofsted 2011; Miller 2011). This is a position which is unsustainable and which, in the longer term, could have a detrimental effect on food technology in schools.

We would argue that the potential of food technology to enhance pupils' understanding of food, food science and food-related issues is under-valued. The impact of a modern food technology curriculum would be to strengthen the links with science, especially chemistry. Encouragement to study chemistry alongside food technology at GCSE and Advanced Level would increase the number of pupils studying chemistry, particularly girls. It could further be suggested that the current teaching about nutrition has not been effective but that engaging pupils with a deeper understanding about food, and food-related issues, would help to develop their understanding of the relationship between food consumption and health. Introducing pupils to aspects of modern food materials, and the issues surrounding food access and food production, would develop the subject in the same way that other aspects of design and technology have been developed to respond to changes in society and industry.

A more modern food technology curriculum would also better prepare pupils for employment, if that is deemed to be the purpose of food technology on the school curriculum. The food and drink industry is the largest manufacturing sector in the UK and accounts for 18 % of manufacturing output; it employs over 400,000 staff, 16 % of manufacturing employment (Food and Drink Federation 2014). There are careers available at all levels within the industry and it is likely that opportunities will grow rather than decline.

The conceptual framework developed in this research provides a framework for the development of a food technology curriculum which would be authentic and meaningful for pupils, engage and motivate them and raise the standard of their learning. They would, of course, still learn to cook as the framework needs to be taught through engagement with food, handling it, experimenting with it, cooking with it and tasting it. It is these practical experiences which help pupils understand the higher level thinking required to really understand food science and nutrition. Additional opportunities can be provided by school to enable pupils to develop and extend their practical skills to a higher level, for example though vocational courses such as catering and enhancement and enrichment activities with a cross-curricular curriculum focus. These include Science, Technology, Engineering and Mathematics (STEM) clubs, challenges or careers sessions (Banks and Barlex 2014) and cooking and gardening clubs. Practical skills based learning alone within design and technology would be a greatly impoverished experience for pupils whilst practical work underpinned by wider learning opportunities would provide pupils with a much richer, worthwhile and sophisticated educational experience.

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