Food technology, innovation and teacher education: summary of survey findings

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<td>BTechEd</td>
<td>Bachelor of Technology Education</td>
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<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
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<tr>
<td>D&amp;T</td>
<td>Design and Technology</td>
</tr>
<tr>
<td>DET</td>
<td>Department of Education and Training</td>
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<tr>
<td>FST</td>
<td>Food Science and Technology</td>
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<tr>
<td>HSC</td>
<td>Higher School Certificate</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<tr>
<td>NSW</td>
<td>New South Wales</td>
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<tr>
<td>NSWIT</td>
<td>New South Wales Institute Teachers</td>
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<tr>
<td>TAFE</td>
<td>Technical And Further Education</td>
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<tr>
<td>TAS</td>
<td>Technological and Applied Studies</td>
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<tr>
<td>VET</td>
<td>Vocational Education and Training</td>
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<td>VOCED</td>
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EXECUTIVE SUMMARY

This report presents a summary of findings from data collected during 2009 as part of a doctoral thesis entitled: A Critique of Food Technology, Innovation and Teacher Education. The survey instrument collected information that sought to establish contemporary perceptions about the study of Food Technology in Australia and the role secondary education may play in ‘supplying’ people into professional studies towards a career as a food technologist. In this arrangement, the industry and profession of food technologists represent the ‘demand’ side of the process that starts with receiving students ‘supplied’ by the schools sector into undergraduate food science and technology courses. The survey questions aimed to compare the degree of alignment between the ‘supply’ side (secondary teacher perceptions) with the ‘demand’ side (food profession perceptions) of what is meant by the label ‘Food Technology’ and its practical manifestation. The areas being compared included: academic culture and knowledge in food technology and innovation; technical systems and equipment used, and relevant material ingredients involved in food technology practice. The study also aimed to gauge relative attention given to goals concerning sustainability, economic trends and innovation capacity building as these areas remain topical in the wider context of the field of food technology research and emerging world concerns. The study was not based on a critical analysis of NSW Food Technology syllabi, although syllabi are referred to where responses or comment are relevant. The key question this study sort to clarify is: Do state secondary education providers and teachers share the national vision of knowledge and innovation with the wider profession of Food Science and Technologists?

The study was guided by Technacy Genre Theory, which provided the conceptual framework to identify and measure inter-relationships and subtle differences between typologies (genre) of technology practice for Food Technology. Perceptions were gathered around contextual and goal oriented aspects of practice, with a specific interest in the:

1. Human elements of practice (e.g. agency, knowledge, techniques, values, social organisation)
2. Tool elements of practice (e.g. enabling technical devices, equipment and systems)
3. Material or ecological elements of practice (e.g. consumable ingredients, properties, aesthetics, impact on ecology)

The above three elements represent, according to Technacy Theory, both resources and constraints evident in all forms of technological practice (Seemann, 2009; 2003). Each element exists in a dependent relationship with the other elements of practice, and is defined via the purpose and context of application. Thus, the purpose and context of Food Technology curriculum, the Food Profession, and Innovation as an economy agenda were
each framed as follows:

1. The purpose of Food Technology given the contemporary context of economic and lifestyle drivers
2. Knowledge, concepts and techniques in Food Technology (school teachers vs. wider profession of food technologists)
3. Tool elements for technical production systems and devices used in Food Technology
4. Material and environmental factors including ingredients, data or ecological resources used in food technology practice

The key outcome of this research clarifies, under the label of ‘Food Technology’, that two domains of practice (aka two forms of Technacy Genre) are at play. Further, two themes emerging from the findings suggest that the Food Technologists are mostly goal oriented and expect of high school leavers entering their field to value innovation, research and development (a culture of science), while the school’s are mostly goal oriented and expect of their high school student to view the subject as life-skills and vocational in purpose (a culture of the humanities). Where the humanities place less emphasis on the study of a discipline but more about experiencing a general education in the “study of languages and literatures, the arts, history, and philosophy (Farlex, 2010)”, the sciences are largely driven through “investigation, systematic knowledge or practice (ibid, 2010),” and where explicit scientific content and methods are not sacrificed. It is this contrast in disciplines that may help explain the differing perceptions between both sectors for what ought constitute the study of Food Technology.

A key finding identified that the teaching collegiate as a whole perceived priority systems of Food Technology knowledge/techniques, tools/equipment and ingredients/materials significantly differently to the food profession. This significant finding also explains a likely reason why many Australian Food Science Technology undergraduate degrees have expressed concern for a drop in enrolments in Food Science and Technology (FST) courses (Education Providers Working Group, p.16, 2009). This situation has also been compounded by the dropout rate in the first year of high school leavers who have come from a ‘food technology’ course in their secondary studies but upon commencement in their university degree, have often expressed that the degree in food technology is incorrect, and should convey the school form of its name (KPA, 2003). The data presented in this report validates that students have been presented with a different practice for Food Technology in schools that is dislocated from the wider professional practice of the field.

Other results fundamental to this study reveal that even though food teachers may aspire to be science driven, the genre of practice was found to be life skills orientated. It is asserted that the tools and method (to a slightly less extent, the ingredient resources) used, ultimately determines genre practice. In the case of curriculum design and subsequent tool choice in schools, the equipment used is primarily vocational education
(VOCED) orientated. This situation is compounded by technology education degrees offering advanced standing as ‘fast tracked’ pathways by reinforcing trade skills for those entering the teaching profession with prior VET qualifications, particularly in Hospitality. In contrast, the food technologist genre of practice for the methods, tools and much of the ingredients used, are clinical experiment laboratory oriented. Congruent to this finding, when asked to rank the academic demands of ‘Food Technology’ relative to other subjects, the subject was ranked last by the teaching collegiate but fourth highest by the wider professional group, while Mathematics, Science and English were recorded as the top three scholarly subjects by both groups. At best Food Technology is seen as a soft subject by the teaching collegiate that offers vocational operational skills rather than a scholarly subject driven through science, maths and innovation as commonly practiced in the wider food science and technology profession.

The data revealed that the teaching collegiate were weak in cross-referencing externally for knowledge, but were strong in networking within their fold with other teachers, sourcing mostly in-school workshops for their professional development, reading school based textbooks or food and VET trade magazines. On the other hand, the wider professional group were strong in networking across and outside their fields of discipline, attending and publishing into research based conferences and industry based workshops, and reading peer reviewed journals or books for sources of knowledge. The most common relationship between the two groups for sourcing information was the Internet as a tool choice. Where the teachers viewed mental visualization and abstract thinking as strong considerations to better inform teaching practice and important to develop cognitive abilities, the food profession did not see any relevance. However, mental visualisation tasks may further inform the teaching and learning for innovations in food science enhanced through computer applications. This presents a need, particularly for the Non-Teacher Training group to consider extension activities or laboratory in-service training where the recording for procedures, workflow and instrument identification is better accessed in a lab environment. There is also reason to suggest the need to also explore the CAD environment that may be aligned to laboratory work. The use of CAD may further inform new ways for learning and understanding around molecular structures of food nutrients, particularly in food science undergraduate degrees.

Food Technology as an area of study revealed confusion among Technology and Applied Studies (TAS)¹ teachers for where the subject is currently sitting and where it needs to go i.e. vocational vs. science. However, the teachers who teach core areas such as Maths, Science and English were more aligned with the wider professional group who saw or expected the subject to be more orientated towards the science domain. Where TAS teachers perceived social and life skills, cooking and food processing as core to the study of Food Technology (as was the case with the type of professional development sought);

¹ Technological and Applied Studies (TAS) is an elective area of study in NSW secondary schools
the wider professional group perceived science and research, food experiments and processing for product development as the foundations to the study of Food Technology (as was the case with the type of professional development sought). The only relationship common between the two groups concerned nutrition, but the teachers displayed a highly skewed lean toward nutrition compared to 1) the FST professionals and 2) other elements of technological practice. This trend for nutrition studies appears to have impacted on the quality of undergraduate degree content offerings in FST courses, and as a result has marginalised food engineering and other food science skills required for the food profession (Education Providers Working Group, p.16, 2009). Additionally, both groups noted eco sustainability extremely low compared to other elements of technological practice. This trend for nutrition studies appears to have impacted on the quality of undergraduate degree content offerings in FST courses, and as a result has marginalised food engineering and other food science skills required for the food profession (Education Providers Working Group, p.16, 2009). This result is an uneven distribution in technological knowledge as a basis for rounded judgement in the respective genre of practice. Both sides appear to be in need of increasing their respective understanding of the ecological aspect to their forms of practice.

A high proportion of undergraduates from both groups appeared dissatisfied with the lack of school practicum or industry internships offered in their undergraduate degrees. For the undergraduate teachers, and where only school placements were noted as the most preferred, compared to showing an interest for industry placements, suggests that pedagogy (teaching method) is more valued than understanding discipline content. On the other hand, the non-teacher undergraduate food science students expressed the need for more science industry placement or internship. Written responses indicated that this would make them more confident in the discipline and therefore ‘lab bench ready’ for the food profession upon graduation, but there appears to be some resistance from food professionals in the industry to collaborate with universities. It was beyond the scope of this study to follow up the detail of why this may be the case.

In summary, this report has identified that schools and the wider professional community of food science technologists practice very different forms of Technacy Genre, even though they both use the same label for their practice. It is recommended that school curriculum designers change the label from Food Technology to a more generic form such as ‘Food Studies’ and that a new syllabus be designed that allows for more depth of learning in nutrition, given food teachers strong interest in this area, and positioned under the VOCED strand of subjects if current practice in schools are seen to be sufficiently important to the main as is. Conversely, teachers appear to be maximising internal, localised referencing rather than wider contextual (out of education sector) scoping which has produced an internal closed feedback cycle of refinement drivers to the curriculum rather than drivers of evolution and innovation in the curriculum. This confusion has had a significant undesirable impact on both school leavers entering into the Food Science and Technology industry, and the supply of next generation food scientists. It is recommended professional
development involve mandatory FST industry workshops targeting the laboratories of the food science industries. With regard to eco-sustainability, there is a need to raise the bar in training to link eco-footprint more deeply into teaching and learning and the expertise and purpose of food research. Technacy Genre Theory offers a framework to do this for not only ‘Food Technology and associated technology genre’ in secondary schools and teacher education, but also for the FST profession in that it allows for sustainable and effective understandings and learning of technological practice and innovation. There is an opportunity for the FST profession and schools to be champions in food sustainability and new science research in design. This would raise the knowledge and market agency of Australian expertise in food sustainability and security. A way forward for this message to be heard is for school curriculum designers, in collaboration with food science technology professionals and university academics, to design a new Food Science syllabus that is positioned under the sciences strands for national curriculum consideration and run as a curriculum alternative in addition to the abovementioned shift to ‘Food Studies’ and existing Food Hospitality offerings in schools. Food Science and Innovation Studies would be a potential “strand” in science to maximise laboratory devices, contexts and cultures of practice.
INTRODUCTION

The research design for this study drew on a mixed method approach where historical literature was reviewed around the evolution and understanding of food technology curriculum and the food science technology industry. This sought to understand in particular the purpose of the subject area over time and in an economic context. Contemporary knowledge and understanding of teachers (secondary in service or undergraduate teachers) and non-teachers (food science professionals and food science undergraduates) were identified through fieldwork that involved school visits, class observations and informal teacher discussions. Personal interviews were undertaken with the New South Wales Department and Education and Training (NSW-DET) curriculum personnel and informal phone conversations were undertaken with food technologists and academics. Questions were formulated and a pilot survey tested. The population was chosen through a confidential stratified random sample of stakeholders associated with the food technology field. Sampling included the use of hard copy and online media. The survey instrument collected respondent profiles, dispositions and affect, and technological understandings. Empirical analysis was conducted on data from 382 survey returns during 2009. The data aimed to clarify what the state of play is in schools for the subject Food Technology, what the state of play is beyond school, and what alignments and ideas there might be for a common future.

The main school system sampled was the NSW Department of Education and Training (NSW DET) in Australia, partly because of accessibility, but also because this school system is generally regarded as one of the biggest ‘centralized education systems’ in the world, and so has a significant mass impact on society both in Australia and internationally (NSW Government, 2010). Statistical analysis was performed on the quantitative data using SPSS, and of particular interest was the use of perception grids. These were framed using Technacy Genre Theory, and were used to compare professional food technologists’ responses with schoolteacher responses. The perception grid method is an adaptation from similar work used by Provost, Lipp, Bath & Hannan (2007), designed to discern psychology student views about the nature of human knowledge. This work drew on Sperandeo-Mineo’s earlier studies (cited in Martin, Provost, Lipp, Bath & Hannan, 2007) that investigated the epistemological beliefs of schoolteachers about the nature of science and the relationship beliefs had with teaching expertise and academic background. Thematic analysis of text was undertaken from the qualitative survey sections using Technacy Genre headings.
This report presents data analysis arranged under three core sections:

1. **Demographics**

   Participants involved teachers in secondary TAS and Non-TAS schooling; TAS and non-TAS academics in higher education; TAS and non-TAS undergraduates studying to be teachers; food science technologists; academics and undergraduates studying to be food science technologists. The food profession present as the reference group, while the teachers present as the comparative group. The data findings also refer to participants as Teacher Training and Non-Teacher Training and are used interchangeably. The demographic profiles examined their area of expertise; state of employment; gender; age; teaching or working years; employment type; qualifications and educational background; areas of teaching qualified to teach and areas taught but not qualified to teach; undergraduate year level and postgraduate study.

2. **Food Technology and General Education**

   This section sought to identify academic culture for knowledge and techniques, tools and equipment and materials and ingredients (inclusive of ecology) for the teaching of Food Technology; Food Technology as an area of study and scholarly choice; various technologies that may support the teaching and learning for Food Technology; Professional development; Secondary curriculum and knowledge sources to inform the area of study. The term ‘General Secondary’ was used to include participants in teaching areas such as Mathematics, Science, English, History or Geography. The term ‘Areas other than Food Technology’ was used to include participants in teaching areas such as Industrial Technology or Information and Software Technology. These teachers often teach Food Technology in the junior years.

3. **Innovation, Food Technology and Technology Education**

   Directions for an innovation climate have been evident since 1996, when the Federal Government endorsed the Australian Science, Technology and Engineering Council for its first comprehensive foresight review that identified essential priorities for the national interest of technology and science. This section sought to identify participant perceptions and values for intellectual capital and to what degree there is a culture of continuous innovation through design, technology and food science based education. This section is largely based on reports and peer reviewed papers from the Australian Science, Technology, Engineering Council (ASTEC,1996); Slaughter (1999); Innovation, Summit, Implementation Group (2000); NSW Department of Education, Training Youth & Affairs (NSW-DET, 2000); Fee & Seemann (2002); Commonwealth of Australia (2003); Department of Education, Science and Training (DEST, 2003); KPA (2003);

The expected benefit from this research aims to improve school-based pedagogy in the teaching area of Food Technology that is more aligned with the Food Science and Technology profession. It is proposed that the knowledge gained from this research will inform and better align educational services with the food science and technology profession and nurture culture towards the national priority in innovation and sustainability.
SECTION 1: DEMOGRAPHICS

Area of expertise

The population represented participants from two main groups Teacher Training (n=191) and Non-Teacher Training (n=191). (Figure 1). These were collated into four different subgroups:

A) Teacher Training: Food Technology (n=78);
B) Teacher Training: Areas other than Food Technology (n=58);
C) Teacher Training: General Secondary (n=55) and
D) Non-Teacher Training: Food Profession2, such as members of the Australian Institute of Food Science and Technology Inc. (n=191).

The Food Profession present as the reference group, while the Teachers present as the comparative group (Figure 2). Participant types for each subgroup were identified under categories as Undergraduate student; Postgraduate student; Teacher; Academic or Food Scientist Technologist (Figure 3).

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2 Food profession is used interchangeably with Food Scientist Technologist; Wider professional group; Wider community of Food Technologists
Food Technology, Innovation and Teacher Education: Summary of Survey Findings: By Angela Turner, 2010

Employment by state

NSW has the largest education system and biggest population therefore dominates both at State and National levels (Figures 4 and 5). The Non-Teacher Training group represent science and innovation from an Australian professional view nationally. This group also has a high proportion of International students inclusive of NSW. These students offer an insight from an International perspective for the field of study (n=191).

![Particpant Types](image)

![Teacher Training by State](image)

![Non-Teacher Training by State](image)
Age

Both groups display a similar age distribution in Figures 6 and 7, therefore the interpretation of responses are comparative as to whether age influences particular perceptions about Food Technology as a subject area (n=382). A bi-modal figure exists between 30-49 years for the Teacher training group. This suggests that the teaching profession has a strong middle age continuum. However a sharp rise for 20-29 years signifies a new cycle in the teaching profession (n=191, M=30-39 years, median=32 years, SD=1.652). The same sharp rise is evident for the Non-Teacher Training 20-29 year age group, which also signifies a new cycle in the food industry profession, which also includes an influx in international students. The age spread between 30-59 years in Figure 7 shows a steady middle age, but lower continuum for the food industry (n=191, mean=20-29 years, median=20-29 years, SD=1.257).

Gender and age

Figures 8 and 9 present a dominant female gender grouping across both groups (Teacher Training n=116 and Non-Teacher Training n=141), particularly for 20-29 years. A higher male grouping spread is evident across the Teacher Training group, particularly for the 30-39 years (n=75) compared to the Non-Teacher Training group (n=50). This gender in-balance may influence particular perceptions about Food Technology as a subject area.
Teaching or working years

Undergraduate students were not included in this question given they had not worked professionally in their chosen field (n=241). The Teacher Training group displays multimodal data sets in Figure 10. This bi-modal figure for 5-10 years and 26-30 years presents a similar pattern in Figure 11. The data suggests a twenty-year cycle revival into both the teaching profession and the food profession. Figure 10 shows bi-modal figures of 21-25 years and 31-35 years for the Teacher Training group. This suggests a fifteen-year generational decline in teachers entering or staying in the profession, with retirement years being taken up after a thirty-year period. The Non-Teacher training group present a bi-modal figure of 11-15 years and 36+ years in Figure 11. This suggests a five-year generational gap of industry employees and may be associated with job opportunities nationally. (Teacher Training: n=53, M=16-20 yrs, median=20-21 yrs, SD=1.938; Non-Teacher Training group: n=78, M=16-20 years, median=20-21 years, SD=2.282).

![Teacher Training Working Years](image1)

**Figure 10**: Teacher training length of working years

![Non-Teacher Training Working Years](image2)

**Figure 11**: Non-Teacher Training length of working years
Employment type

In the case for both groups, Figure 12 displays the majority of participants were in full time employment (Teacher Training group 85.5% and Non-Teacher Training group 92.4%). The nature of the respondents’ full time employment brings practicing currency and an experienced view to the survey (n=141). Undergraduate students were not included in this question given they had not worked professionally in their chosen field (n=241).

![Employment Type Chart](Image)

Completed or enrolled in a full degree and degree name

Sixty-one degree types containing various specialisations were recorded (Figures 13 and 14). These were categorised broadly into the Humanities and the Sciences. This question sought to frame whether the type of educational background influences particular perceptions about Food Technology as a subject area (n=371).

![Teacher Training Degree Type](Image)

![Non-Teacher Training Degree Type](Image)

3 Normally a 3-4 year degree
Disciplines were grouped into common themes representing areas of study for the Humanities (blue) and the Sciences (red). Figures 15 and 16 present two contrasting themes, which signify implications for the study of Food Technology given the opposing disciplines for the educational background of participants. Where the humanities place less emphasis on the study of a discipline but more about experiencing a general education in the “study of languages and literatures, the arts, history, and philosophy (Farlex, 2010)”, the sciences are largely driven through “investigation, systematic knowledge or practice (ibid, 2010),” and where explicit scientific content and methods are not sacrificed. It is this contrast in disciplines that may help explain the differing perceptions between both sectors for what ought constitute the study of Food Technology. Teacher Training group (n=180). Non-teacher Training group (n=191).

Figure 15: Teacher Training disciplines

Figure 16: Non-Teacher Training disciplines

TAFE/university combined qualification with a Food Technology focus

A very small proportion of participants had undertaken a TAFE–University combined qualification. These included two participants with a Food Certificate qualification, one Teaching Certificate qualification and one participant having completed an Accelerated Teacher program (n=4).
4 year Technology Education degree with a Food major

Although a larger proportion of participants with no Food major presents for the Teacher Training group (Figure 17), it is important to highlight while those who are not trained in Food Technology often teach Food Technology in schools. Their view of the subject area is important as they offer a perception of their colleagues work (n=191). Figure 18 presents Humanities based degrees predominate in education, while Figure 20 presents science-based degrees predominate in the food profession. This data presents opposing background disciplines between the participants and may present disagreement due to generalist knowledge rather than specialist knowledge for discipline content.

4 May be called D&T, BTechEd or TAS with ‘NO’ TAFE embedded training
Knowledge of lecturer’s qualification if studying under a Food Technology related university degree

The Teacher Training group demonstrate a weak interest in the qualification of their lecturer’s discipline (Figure 21). The data suggests that because of the strong Humanities view, the culture of teachers may have a diminished view for discipline content importance. Figure 22 however presents a strong interest in explicit knowledge required for the sciences and background understanding of their lecturer qualification.

Undergraduate student’s year level

Figure 23 presents a similar profile for undergraduate students’ experienced study in the subject. In particular, the 3rd year students predominate for both groups, so it is assumed they should know the subject well in their respective field (n=198).

If yes, note area of expertise
**VET or university background for undergraduate students**

The Teacher Training group presents a higher VET background compared to the food profession (Figure 24). It is this strong identity for vocational operational skills that changes the perception of the subject matter and where some language may be closely aligned, but the practice being different. The data also suggests a closed loop culture for trade skills being reinforced by those entering the teaching profession and as such may prevent the subject area evolving to its full potential in a science domain (n=53).

![Figure 24: Teacher Training and Non-Teacher Training undergraduate prior qualification](image)

**Original qualification prior to TAS teaching qualification**

Figure 25 shows a high proportion of participants were qualified in Hospitality prior to entering study for the teaching profession. The contemporary trend for universities to offer articulated pathways from TAFE has also increased the trend in NSW to quickly push into schools briefly trained mature age industry graduates, particularly VOCED Hospitality as ‘fast tracked’ pathways. This emphasis is also driven by the current move toward Trade Training Schools (NSW Department of Education and Training, 2006) and the current New South Wales Institute of Teachers (NSWIT) course content document for Food Technology as a major and teaching degree accreditation. The phrasing: “practice of design and production/manufacture in food and hospitality contexts” (New South Wales Institute of Teachers, p.33) presents the interpretation of “food” as reinforcing vocational operational skills. This presents a real problem for the Food Science and Technology industry as a discipline area of study in science and innovation (n=36).

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6 This question was posed only to Technological and Applied Studies (TAS) teachers
TAS qualification educated to teach

Although this question sought to locate two main areas that participants were qualified to teach in, many responded with multiple answers. The top two results in Figure 26 show predominately gender response groupings as they are favoured teaching areas commonly taught in schools. For example, Food Technology, Textiles and Hospitality are common female teaching subjects, while Industrial Technology, Metal, Engineering, Construction and Graphics are common male teaching subjects. A small proportion noted only ONE area of teaching, even though they may be qualified to teach in other areas under the TAS stream. This suggests a resistance to teach outside of their area of expertise (n=55).

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7 This question was posed only to Technological and Applied Studies (TAS) teachers
Teaching areas taught not formally educated in\textsuperscript{8}

Figure 27 shows that there is an emphasis for TAS teachers to teach in the Family Studies and Early Childhood subjects that traditionally has had a strong relationship with cooking and sewing skills. This reinforces a vocational and soft subject view concerning teacher capabilities in TAS (n=24).

![Figure 27: TAS Teachers: Subject areas non-TAS teaching without a formal qualification](image)

Original qualification prior to Non-TAS teaching qualification\textsuperscript{9}

A poor response rate was evident for this question, which could be due to misinterpretation given the assumption most participants would have had a first degree. One participant each had prior qualifications in Visual Art and Music, with one participant each in administration (n=4).

Non-TAS qualification educated to teach\textsuperscript{10}

A larger proportion of non-TAS teachers were qualified to teach science. This may be a factor why this group interpreted the Technacy genre questions as science based. Visual Art also presents strongly and may be due to competitive employment positions in this field (n=25).

![Figure 28: Non-TAS Teachers: Subject areas qualified to teach](image)

\textsuperscript{8} This question was posed only to Technological and Applied Studies (TAS) teachers

\textsuperscript{9} This question was posed only to Non-Technological and Applied Studies (Non-TAS) teachers

\textsuperscript{10} This question was posed only to Non-Technological and Applied Studies (Non-TAS) teachers
Teaching areas taught not formally educated in

The participants for this group were largely students and had not engaged in teaching as a profession. For those that did respond, one participant each were identified as teaching in an area they did not have formal qualifications to teach in, such as Computer Applications/Graphics; Software Development/Textiles; Engineering Science; Agriculture; Textiles and Graphics (n=6).

Postgraduate study undertaken

Figure 29 shows that Innovation and research does not emerge as a strong pattern for post teacher training (n=12). Where the non-teacher training group present as strongly engaged in research and scholarship in subject discipline orientation and pursuit for further study in Figure 30 (n=46), the teacher-training group present as minimal to non-existent. The data is projecting that school culture is not engaging or evolving in their discipline areas and because of this lack of research capacity, reinforces their own socially constructed view.

![Teacher Training Post Graduate Study](image1)

**Figure 29: Teacher Training group postgraduate study**

![Non-Teacher Training Group Post Graduate Study](image2)

**Figure 30: Non-Teacher Training group postgraduate study**

11 This question was posed only to Non-Technological and Applied Studies (Non-TAS) teachers. i.e. general secondary subject areas
SECTION 2: FOOD TECHNOLOGY and GENERAL EDUCATION

Participants were asked to circle phrases or terms in three perception grids that sought to identify and clarify the degree of technology genre agreement between the two groups: 1) Teacher Training and 2) Non-Teacher Training. Between the four groups:

1. Teacher Training: Food Technology
2. Teacher Training: Areas other than Food Technology
3. Teacher Training: General Secondary and
4. Non Teacher Training: Food Profession

The research framework draws on Technacy Genre theory (Seemann, 2003), which offers a way of identifying and measuring degrees of agreement between typologies of technology practice. The genre framework is designed to detect inter-relationships and subtle differences between combinations of materials, tools and techniques to include:

- Human factors (e.g. knowledge, techniques, values, social organisation)
- Tool factors (e.g. technical inputs and output [device systems])
- Material factors (e.g. ingredients, data or ecological resource factors [properties, aesthetics, impact on ecology]).

Knowledge and techniques used in Food Technology

The research found that teachers perceived priority systems of Food Technology knowledge significantly differently to the wider professional community of food technologists in Figure 31. Knowledge: Teacher index= 0.31 vs. Technologists Index= 0.81 (both n=191, t=-23.614, df=380, p<.000, 2-tailed). Teacher Training: General secondary index=.37 (n=55); Food teacher index=.32 (n=78); Areas other than food technology index=.26. Non-Teacher Training: Food Scientist Technologist index=.81 (n=191); df=3, F=191.774, sig.<.000).

![Figure 31: Priority systems for Food Technology knowledge](image)

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12 A high Technacy Genre Index approaching 1.0 suggests a strong science, innovation and food design orientation; a low index approaching 0.0 suggests strong vocational, cooking-skills, conservative orientation to the purpose and practice of Food Technology. Alpha = 0.05, n=382.
Tools and equipment used in Food Technology

Teachers perceived priority systems of Food Technology tools significantly differently to the wider professional community of Food Technologists in Figure 32. Tools: Teacher index=0.21 vs. Technologists Index=0.82 (both n=191, t=-28.284, df=380, p<.000, 2-tailed). Teacher Training: General secondary index=.29 (n=55); Food teacher index=.20 (n=78); Areas other than food technology index=.15 (n=58). Non-Teacher Training: Food Scientist Technologist index=.82 (n=191); (df=3, F=297.008, sig.<.000).

Figure 32: Priority systems for Food Technology tools and equipment

Materials and ingredients used in Food Technology

Teachers perceived priority systems of Food Technology ingredients and materials significantly differently to the wider professional community of food technologists in Figure 33. Ingredients: Teacher index=.15 vs. Technologists Index=.65 (both n=191, t=-18.947, df=380, p<.000, 2-tailed). Teacher Training: General secondary index=.21 (n=55); Food teacher index=.14 (n=78); Areas other than food technology index=.11 (n=58). Non-Teacher Training: Food Scientist Technologist index=.65 (n=191); (df=3, F=297.008, sig.<.000).

An unexpected result showed that, despite the sub-group of general secondary teachers with no training in either Food Technology or any other technology field, their overall Technacy Genre index shows better agreement with the genre practiced by the food profession compared with food technology teachers and teachers who teach in Areas other than Food Technology in schools: For Knowledge: Secondary teachers index=.37, Food teachers index=.32, Food Technologist index=.81; For Tools: General secondary index=.29, Food Teachers index=.20, Food Technologist index=.82;

13 A high Technacy Genre Index approaching 1.0 suggests a strong science, innovation and food design orientation; a low index approaching 0.0 suggests strong vocational, cooking-skills, conservative orientation to the purpose and practice of Food Technology. Alpha = 0.05, n=382.

14 A high Technacy Genre Index approaching 1.0 suggests a strong science, innovation and food design orientation; a low index approaching 0.0 suggests strong vocational, cooking-skills, conservative orientation to the purpose and practice of Food Technology. Alpha = 0.05, n=382.
For Materials and Ingredients: Secondary teachers index=0.21, Food Teachers index=0.14, Food Technologist index=0.65. On all measures, food teachers and ‘other field’ technology trained teachers scored the lowest in their perceptions of what Food Technology education entails compared to the rest. This poses a real problem for the food profession for how food technology is portrayed in schools: Knowledge index=0.26, Tools index=0.15, Materials index=0.11.

Figure 33: Priority systems for Food Technology materials and ingredients

**Technacy correlation for knowledge, tools and materials**

On the issue of evidence for coherence in genre co-relationships existing between food knowledge, techniques, ingredients and tools (Figure 34), the results of a Pearson’s 3x3 correlation matrix shows there is a very strong three-way interdependent pattern, as predicted in Technacy Genre theory. Knowledge-Tools (n=382, r=.823, p<0.000, 2-tailed); Knowledge-Ingredients (n=382, r=.742, p<.000, 2-tailed); and, Tools-Ingredients (n=382, r=.790, p<.000, 2-tailed).

Figure 34: Correlation matrix for Food Technology knowledge and techniques, tools and equipment, material and ingredient priority systems
**Food Technology as an area of study**

A Likert Scale of twelve questions asked respondents for degrees of agreement for the purpose and practice of Food Technology as an area of study. A Technacy Genre Index score of 4-5 for six of the questions suggests a strong science, innovation and food design orientation theme, with the other 6 questions suggesting a strong vocational cooking-skills and conservative orientation theme. One independent question sought to clarify whether schools offered Food Technology for the senior years with a view to detect teacher willingness to teach the subject. Alpha=.05, n=325. In summary the questions included:

- Depth and breadth of sourced literature
- Creative enterprise through visualisation and mental imagery
- Food Technology syllabus representation and educator interpretation
- Food Technology as a valued and scholarly subject area in education
- Perceived practical learning activities for the study of Food Technology
- Educator technology genre values and willingness to promote / teach the subject

The research found that teachers perceived the educational value of Food Technology as substantially and significantly different to the food profession. For science: Non-Teacher Training index=3.32 (n=157) vs. Teachers index=2.90 (n=158); (df=313, t=-3.250, p<.001, 2-tailed). For VET: Teacher Training index=3.16 (n=171) vs. Non-Teacher Training index=2.29 (n=154); (df=323, t=7.064, p<.000, 2-tailed). Figures 35 and 36 suggest confusion amongst the teachers but not the food technologists. The data suggests contradictions amongst the teachers for where the subject is sitting currently and where the subject needs to go. An unexpected result shows that, despite the sub-group of teachers who teach in Areas other than Food Technology (and who may not be trained in Food Technology but may teach the subject), show better agreement with the wider professional community of Food Technologists (Figure 35). This may mean that they see the subject currently in a vocational education domain, but also see the subject should be more science driven. The Food Technology teachers compared to their colleagues in the same faculty do not present as a culture that are engaged in evolving their subject matter, or evolving as a science based discipline (Figure 36). For science: Food technologist index=3.31 (n=157); Areas other than food technology index=3.27 (n=42); Food Teacher index=2.80 (n=69); General secondary index=2.72 (n=47); (df=3, F=5.709, p<.001). For VET: General secondary index=3.39 (n=48); Food teacher index=3.23 (n=75); Areas other than food technology index=2.84 (n=48). Non-Teacher Training: Food technologist index=2.29 (n=154); (df=3, F=18.908, p<.000).
Further analysis of the fourteen questions from the Likert Scale reveal that teachers viewed the subject as *offering a relevant pathway into Hospitality* compared to the food profession who view the subject as a science discipline (Figure 37). Teacher Training (n=152; Teacher index=4.00) vs. Non-Teacher Training (n=114; Food Technologist index=3.31); (df=1, t=5.633, p<.000, 2-tailed). Food Technology competes with Hospitality. For example, the current 2009 archived statistics from the NSW Board of Studies where only 3,477 students studied Food Technology in the Higher School Certificate year compared to 6,584 students who studied Hospitality with an exam and 7,628 students who undertook Hospitality without an exam. This is also compounded by the New South Wales Institute of Teachers (NSWIT) course content that reinforces vocational operational skills for Food Technology as a major in TAS teaching degree accreditation rather than food science. This further pushes the vocational operational skills theme and one that poses a real problem for the food profession. Teacher Training: General secondary index=4.32 (n=47); Areas other than Food Technology index=4.02 (n=41); Food teacher index=3.75 (n=64). Non-Teacher Training: Food scientist technologist index=3.31 (n=114); (df=3, F=13.926, sig=.000).
The teachers view the junior **Food Technology Years 7-10 syllabus as learning for self-sustainable life skills that focuses on practical cooking lessons**. Teacher Training (n=164; Teacher index=4.11) vs. Non-Teacher Training (n=125; Food Technologist index=3.06); (df=1, t=8.593, p<.000, 2-tailed). Figure 38 shows a teacher view dominates toward end-user cooking skills. This suggests the NSW Food Technology 7-10 syllabus does not provide an adequate lead into the senior Food Technology syllabus as well as what it was designed to do or perhaps that teachers are misinterpreting the syllabus. Teacher Training: General secondary index=4.25 (n=48); Food teacher index=4.09 (n=68); Areas other than Food Technology index=4.00 (n=48). Non-Teacher Training: Food scientist technologist index=3.06 (n=125); (df=3, F=25.061, sig.=.000).
The following data did not show significant responses at alpha set to .05, but shows a trend towards alpha consistent in theme with the significant data presented thus far. Food teacher perceptions are that students do not take up the subject because they see it as a _job pathway to become a food technologist_. If students take the subject, it is because of their interest to be a nutritionist or dietician. This is also compounded by another view from many student’s that the syllabus was too theory laden and preferred to take Hospitality instead because it is easier. Teacher Training (n=124, Teacher index=3.23) vs. Non-Teacher Training (n=122, Food scientist technologist index=3.32); (df=244, t=-.54, sig.=.589, 2-tailed). A pattern of responses shown in Figure 39, suggest that Food Technology is not greatly supported by food teachers as much as it could be. Again, this trend aligns with current 2009 archived statistics from the NSW Board of Studies previously stated, and one that reinforces the vocational operational skills theme rather than nurture student interest in food science. Teacher Training: Areas other than Food Technology index=3.48 (n=33); General secondary index=3.41 (n=37); Food teacher index=2.96 (n=54). Non-Teacher Training: Food scientist technologist index=3.32; (df=3, F=1.655, sig=.177).

A marginally significant response rate was evident for studying _eco-sustainability, synthetic foods, naturopathy and bush food nutrition_. Teacher Training (n=122, Teacher index=3.81) vs. Non-Teacher Training (n=113, Food Technologist index=3.52); (df=233, t=2.063, p<.040, 2-tailed). An unexpected result showed that the food teachers and food profession possibly undervalue this area and is perhaps more ‘mainstream’ market driven (Figure 40). The data suggests that carbon footprint transparency could be better utilised with regard to technological actions and perhaps should be given more importance in teaching and learning and food processing/manufacturing industries. Teacher Training: Areas other than food index=4.06 (n=34); General secondary index=3.91 (n=33); Food teacher index=3.60 (n=55). Food Technologist Training: Food technologists index=3.52 (n=113); (df=3, F=2.848, p<.038).
Controlled research and hypothesis testing showed no statistical significance at alpha set to .05, but shows a trend towards alpha consistent in theme with the significant data presented thus far. Teacher Training (n= 124, Teacher index=2.76) vs. Food Technologist Training (n=122, Food Technologist index=2.56); (df=244, t=1.287, sig.=.199, 2-tailed). Food Technology curriculum in its current format in secondary schooling does not accommodate controlled research and hypothesis testing. Perhaps more science based food experiments could be given more importance in the syllabus that would give weight to research and hypothesis testing as it pertains to the food profession (Figure 41). Teacher Training: Areas other than Food Technology index=2.83 (n=30); General secondary index=2.75, (n=36); Food teacher index=2.72 (n=58). Non-Teacher Training: Food technologist index=2.56 (n=122); (df=3, F=.601, sig=.615).

Whether students choose to study food technology in years 11 and 12 in NSW is a decision largely driven by syllabus representation and teacher interpretation, teacher popularity and their willingness to teach the subject. The data did not show significant responses at alpha set to .05, but further analysis could be undertaken between food teachers and school regions (Figure 42). Teacher Training (n=54, Teacher index=2.96) vs. Non-Teacher Training (n=122, Food Technologist index=3.32); (df=174, t=-1.819,
sig=.071). Teacher Training: General secondary index=3.84 (n=19); Food teacher index=3.51 (n=53); Areas other than Food Technology index=3.37 (n=30). Non-Teacher Training: Food technologist index=3.07 (n=68); (df=3, F=1.851, sig=.140).

Figure 42: Students choose to take Food Technology in years 11 and 12

Associated school syllabus textbooks and magazines were seen to be more useful than journals for the study of Food Technology by the teaching collegiate. Teacher Training (n=119, Teacher index=3.68) vs. Food Technologist Training (n=115, Food Technologist index= 2.99); (df=232, t=4.428, p<.000, 2-tailed). There was a significant statistical difference between the teachers and the wider professional group and this suggests an academic divide for scholarship and rigor in content (Figure 43). Given teachers favoured textbooks the highest, particularly food teachers, and teachers write the textbooks for schools, this suggests a highly constructed internal view of the subject matter rather than drawing on external knowledge through scholarly journals or networked links with food professionals. Teacher Training: Food teacher index=3.93 (n=60); Areas other than Food Technology index=3.65 (n=26); General secondary index=3.24 (n=33). Non-Teacher Training: Food technologist index=2.99 (n=115); (df=3, F=9.137, sig<.000).

Figure 43: School textbooks and magazines are more useful than journals to study Food Technology
Whether students choose Food Technology in senior years because they want a career as a food technology teacher is a decision largely driven by teacher interpretation of Food Technology, teacher popularity and teacher willingness to teach the subject. Teacher Training (n=122, Teacher index=3.04) vs. Food Technologist Training (n=99, Food Technologist Index=2.58); (df=1, t=2.9444, p<.004, 2-tailed).

Although there is some confusion amongst the teachers whether students take the subject to enter the teaching profession, or to teach Hospitality, a closed loop cycle is implied (Figure 44). That is, this loop starts, proceeds and finishes back in the school teaching environment. A student’s perception at school often leads to a career choice as a food technology schoolteacher, and this in-turn results in ‘food technology’ schoolteacher graduates returning and reinforcing the original school perceptions developed about what constitutes the study of Food Technology. Teacher Training: General secondary index=3.26 (n=35); Areas other than Food Technology index=3.00 (n=31); Food teacher index=2.93 (n=56). Non-Teacher Training: Food technologist index=2.58 (n=221); (df=3, F=3.469, sig<.017).

**Figure 44: Students choose Food Technology to enter a career as a Food Technology school teacher**

**Food Technology years 7-12 should include creative graphic design such as CAD**
did not show significant responses at alpha set to .05. Teacher Training: index=2.91 (n=124) vs. Non-Teacher Training index=2.58 (n=101); (df=223, t=1.868, p<.063, 2-tailed). However, there was a significant difference in responses between the teachers. The food teachers and those who teach in areas other than Food Technology displays a higher mean score in Figure 45. This may be due to the packaging component in the NSW junior Food Technology syllabus that lends itself to a more creative aspect in the design of food products and labelling, although not heavily emphasised as a design ‘learn to’. An unexpected result shows general secondary teachers more aligned with the wider professional group of Food Technologists who may see this as a graphic design profession rather than associated food technology product development. However design and communication are closely aligned to physiological problem solving and CAD has the ability to provide science based visuals for molecules, and associated food components.
This may inform new ways for learning and understanding molecular structures of food nutrients in food science that is more aligned to laboratory work. Teacher Training: Areas other than Food Technology index=3.28 (n=40); Food teacher index=2.84 (n=55); General secondary index=2.55 (n=29); (df=3, F=3.038, sig=.030).

![Figure 45: Creative graphic design should be included in junior Food Technology curriculum](image)

There was a significant difference between both groups concerning the importance to undertake experiments for Food Technology students compared to chemistry and biology subjects. Teacher Training (n=156, Teacher index=4.04) vs. Non-Teacher Training (n=159, Food Technologist index=4.28); (df=313, t=-2.527, p<.012, 2-tailed). An unexpected result in Figure 46 shows the teachers who teach in areas other than Food Technology are more aligned with the food profession. Often other schoolteachers not trained in Food Technology teaching, respond on items more in agreement with the wider professional view of food technologists. This signals confusion amongst the inside world of the teaching profession between food technology teachers and their teaching collegiate for where the subject is sitting currently and where the subject needs to go. The food and general secondary teachers view Food Technology differently to chemistry and biology subjects, therefore see no relevance for students to undertake science based experiments. This pattern gives weight to anecdotal concerns by the food profession that the school view is not evolving at the natural pace of the subject’s evolution in the wider profession, a problem already identified as negatively affecting first year enrolment patterns into undergraduate Food Technology courses targeting the wider career of food technology and innovation (Education Working Group, 2009, p. 16). Teacher Training: Areas other than Food Technology index=4.26 (n=43); Food teacher index=4.01 (n=70); General secondary index=3.88 (n=43); (df=3, F=3.631, p<.013).
Paradoxically, ‘food teachers’ were aware of the National Food Industry study compared to the wider professional community of Food Technologists. Teacher Training (n=131, Teacher index=2.05) vs. Non-Teacher Training (n=125, Food Technologist index=2.30); (df=254, t=-1.710, sig=.088). This poses an interesting conundrum that although the food teachers may have been aware of the study which offered knowledge and insights to the contemporary knowledge and practice in the field of study, the data presented suggests that they have ignored the findings (Figure 47). Teacher Training: Food teacher index= 2.47 (n=57); Areas other than Food Technology index= 1.95 (n=39); General secondary index=1.46 (n=35). Non-Teacher Training: Food technologists index= 2.30 (n=256); (df= 3, F= 6.965, p<.000).

Teacher participants responded that the study of Food Technology provided an excellent foundation to learn food science and technology compared to the wider professional group of food technologists. Teacher Training (n=98, Teacher index=3.73) vs. Non-Teacher Training (n=99, Food Technologist index=3.28); (df=195, t=2.951, p<.004, 2-tailed).
However, both group responses contradict a previous question. Where the food teachers felt the subject ‘Food Technology’ did not offer a pathway to become a Food Technologist but more so as a pathway to become a nutritionist or dietician, they perceive the syllabus as an excellent foundation to learn food science. Whereas the food profession noted previously that students took the subject to become a Food Technologist, but do not perceive the syllabus provides an adequate foundation to learn food science in Figure 48. The data suggests a need to include food science content in both the junior and senior syllabus. Teacher Training: Areas other than Food Technology index=3.93 (n=30); General secondary index=3.74 (n=19); Food teacher index=3.61 (n=49). Non-Teacher Training: Food technologist index=3.28 (n=99); (df=3, F=3.450, p<.018).

![Figure 48: Food Technology provides an excellent foundation to learn Food Science and Technology](image)

**Students need to have a sound knowledge base in controlled research and hypothesis testing to study Food Technology at secondary and undergraduate levels.** The teaching collegiate shows confusion and contradiction to a previous question similar in phrasing. Teacher Training (n=122, Teacher index=3.59) vs. Non-Teacher Training (n=139, Food Technologist index=3.87); (df=259, t=-2.259, p<.026, 2-tailed). Figure 49 shows deep confusion, or misperception amongst the teachers for what constitutes the study of Food Technology compared to the wider professional community’s understanding of it. The data in Figure 49 contrasts the difference between secondary and tertiary study content for Food Technology and also implies syllabus representation and teacher interpretation have prevented the subject area evolving to its full potential as a science discipline. Teacher Training: Areas other then Food Technology index=4.00 (n=32); General secondary index=3.62 (n=39); Food teacher index=3.31 (n=51). Non-Teacher Training: Food Technologist index=3.87; (df=3, F=4.938, p<.002).
The teachers did not see a need for students to demonstrate strong science and mathematic skills to study Food Technology at secondary school or at a teacher training level, but the wider professional community of Food Technologists perceive it otherwise. Teacher Training (n=116, Teacher index=3.01) vs. Food Technologist Training (n=124, Food Technologist index=3.85); (df=1, F=37.778, p<.000). It is clear from the data presented in Figure 50 and data presented thus far that teaching collegiate do not perceive Food Technology as a scholarly, science and innovation subject but rather a soft subject that at best offers vocational operational skills. Teacher Training: Areas other then Food Technology index=3.14 (n=29); General secondary index=3.03 (n=32); Food teacher index=2.93 (n=55); (df=3, F=12.779, p<.000).
Drawing and mental visualisation tasks enhance Food Technology studies

Design and communication are closely aligned to physiological problem solving. The data in Figure 51 did not show significant responses at alpha set to .05, but showed a trend towards alpha consistent in theme with significant data thus far. Teacher Training (n=184; mean=3.55); Non-Teacher Training (n=183; mean=3.35); (t=2.028; df=365; p<.043, 2-tailed). The teachers view mental visualization and abstract thinking as strong considerations to better inform teaching practice and important to develop cognitive abilities but the food profession do not see any relevance. However, mental visualisation tasks may further inform the teaching and learning for innovations in food science enhanced through computer applications. Teacher Training: General secondary index=3.60 (n=55); Food teacher index=3.54 (n=74); Areas other than food technology index=3.53 (n=55) and Non-teacher Training: Food Science Technologist index=3.35 (n=183). (n=55; mean=3.60); (df=3; F=1.42; sig.=.236).

Figure 51: Drawing and mental visualization tasks would enhance the study for Food Technology

Computer Aided Design has relevance for Food Technology tasks

This question aimed to expand on the concept of design and communication and the relevance of digital 2D and 3D design with regard to physiological problem solving. Although the mean was higher for the Non-Teacher Training group in Figure 52, there was no significant statistical difference between the two groups. Teacher Training group: (n=160; mean=3.16; Non-Teacher Training group: (n=183; mean=3.28. (n=343; t=-1.110; df=341; sig.=.268, 2-tailed). A bi-modal score presents for food teachers and secondary teachers and this may provide an insight into technology genre relevance. However, the results for this question from the Non-Teacher Training group contradict a previous question under Food Technology as an Area of Study where this group saw no relevance for creative graphic design such as CAD for Food Technology Years 7-12. However the higher mean score for the Non-Teacher Training group suggests an interest
to explore the CAD environment that may be aligned to laboratory work rather than creative aspects for packaging design for example. The use of CAD may further inform new ways for learning and understanding around molecular structures of food nutrients in food science undergraduate degrees. Teacher Training: Food teacher index=3.15 (n=67); General secondary index=3.15 (n=39); Areas other than food index=3.17 (n=54). Non-Teacher Training: Food technologist index=3.28 (n=183); (df=3; F=.412, sig.=.745).

Figure 52: Relevance for Computer Aided Design in Food Technology

It is easy to integrate Information Communication Technology skills into lessons

The skill set to integrate ICT into teaching practice presents a significant difference between the two groups with the capacity being significantly higher in the Teacher Training group compared to the Non-Teacher Training group. Teacher Training index=3.76 (n=186) vs. Non-Teacher Training index=3.32 (n=178); (df=362; t=4.891, p<.000, 2-tailed). Food teachers and those who teach in areas other than Food Technology present slightly higher index scores compared to general secondary teachers. However, the teacher group show a significantly higher index score compared to the wider professional community (Figure 53). This presents a need, particularly for the Non-Teacher Training group to consider extension activities or laboratory in-service training where the recording for procedures, workflow and instrument identification is better accessed in a lab environment. Teacher Training: Areas other than food index=3.82 (n=55); Food teacher index=3.75 (n=76); General secondary index=3.73 (n=55) and Non-Teacher Training: Food technologist index=3.32 (n=187); (df=3,F=8.050, p<.000).
The FOODWORX CD proved to be a useful teaching resource

As part of the National Food Industry Study, a CD was sent out to all schools inclusive to an initiative to promote the food industry sectors. This question sought to determine what value the CD posed for teaching and learning in secondary schools and tertiary institutions. There was no statistical significant difference evident in the responses at alpha set to .05. Teacher Training index=3.24 (n=184) vs. Non-Teacher Training index=3.30 (n=179); (df=361; T=–818, p=.414). However the food teachers display a considerable value in the educational purpose of the CD in Figure 54. Given the consistent analysis theme has leaned toward vocational training by most teachers thus far, the data suggests that not enough emphasis may have been placed on the content as a discipline. Teacher Training: Food teacher index=3.37 (n=76); Areas other than food index=3.19 (n=53); General secondary index=3.13 (n=55) and Non-Teacher Training: Food technologist index=3.30 (n=179); (df=3, F=1.810, sig=.145).

Figure 53: Integration of Information Communication Technology skills

Figure 54: The Foodworx CD was a valuable teaching resource
Conferences are regular items I track in my diary

The Food Technologists’ emerge as more engaged in research and scholarship in their discipline area compared to the teachers who present as minimal to non-existent. Teacher Training: (n=184, Teacher index=2.53) vs. Non-Teacher Training: (n=182, Food Technologist index=3.16); (df=364, t=-5.810, p<0.000, 2-tailed). Although the general secondary teachers show a higher score compared to the other teachers, Figure 55 suggests that the school culture as a whole do not present as a culture engaged in evolving their subject matter, or evolving as a discipline through research and networking with peers. Teacher Training: General Secondary index=2.58 (n=55), Food Teachers index=2.51 (n=75); Areas other than Food Technology index=2.50 (n=54). Non-Teacher Training: Food Science Technologist index=3.16 (n=182); (df=3, F=11.271, p<.000).

Figure 55: Conference tracking

Expectations or experiences for professional development

Seventy two percent responded no to this question, with twenty seven percent noting they had sufficient access to professional development (n=382). Figure 56 shows that the Teacher Training group had the highest score for insufficient access to professional development, with the Food Technology teachers displaying the highest score amongst teachers, shown in Figure 57. This high score suggests a lack of culture for research and in-service training within the educational system. The Non-Teacher Training group also present a high score for a lack of sufficient access to professional development. This could be due to the large proportion of written responses by the undergraduate students for more industry access during their undergraduate degree years. Sufficient access is noted to be adequate for food professionals in paid employment. Those that did update their knowledge through workshops, although small in response rate, ranged from 3, 6 or every 12 months. (n=276).

15 Do you feel that you have sufficient access to professional development? How often would you update your knowledge and skills from a food science workshop? * State what type of professional development you would like to receive

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Food Technology, Innovation and Teacher Education: Summary of Survey Findings: By Angela Turner, 2010
Thematic analysis of text was undertaken from the qualitative survey section, using the Technacy Genre headings: Human Agency (knowledge), Tools and Equipment, Materials (ingredients, data or ecological resources), sought to identify philosophy levels for the type of professional development preferred, how it is obtained and participant generic aspirations, if any. Participants from country regions (dominantly teachers) noted geographic location as an obstacle that also involved accommodation expense if attending in a city area. The Teacher Training group noted the beginning of school term workshops as the most common professional development available. These consist of inter-school workshops within each region. While many teachers noted never attending a workshop outside of the in-school term workshops, other participants responded that in lieu of physically attending a workshop, knowledge was updated through online sources. Responses from the Non-Teacher Training group consistently noted that the AIFST offered regular and up to date conferences, symposiums and workshops that nurtured networking between students, academics and food professionals. However, there was a clear pattern to suggest that the ability to attend these as in-service training was largely driven by employer support.
Participants from country regions noted geographic location as an obstacle that also involved accommodation expense if attending in a city area. Undergraduate food science technology students strongly noted an inability to attend professional development due to budget constraints as well as a strong desire for more industry work experience as noted in the following sections for this question.

From the category of knowledge, identifiable themes were:
1. School: internship
2. Industry: Internship
3. Workshops or courses
4. Networking through conferences

Figure 58 presents a high proportion of undergraduates from both groups appeared dissatisfied with the lack of school practicum or industry internships offered in their undergraduate degrees. For the undergraduate teachers, and where only school placements were noted as the most preferred, compared to showing an interest for industry placements, suggests that pedagogy (teaching method) is more valued than understanding discipline content. On the other hand, the non-teacher undergraduate food science students expressed the need for more science industry placement or internship. Written responses indicated that this would make them more confident in the discipline and therefore 'lab bench ready' for the food profession upon graduation, but there appears to be some resistance from food professionals in the industry to collaborate with universities. It was beyond the scope of this study to follow up the detail of why this may be the case. The data also suggests that the Non-Teacher Training group value conferences as a platform for knowledge networking compared to the Teacher Training group who prefer (according to the written responses), in-school workshops (n=101). Figure 55 validates the qualitative responses.

![Figure 58](image.png)

*Figure 58: Teacher Training and Non-Teacher Training professional development: Food knowledge*
For tools and equipment, two identifiable themes evident were:

1. Practical VET skills (cooking, computers, metal)
2. Practical science skills (laboratory, industry processing, engineering)

Figure 59 presents a contrast in technology genre for the types of professional development sought for tools and equipment between the Teacher Training and Non-Teacher Training groups. Where the teachers favour cooking and culinary skilling (under the guidance of a chef in an industry setting), and to a minor degree computer applications, the Non-Teacher Training group preference was for learning more science based practical applications. However, the teachers presented a strong interest for science-based content such as laboratory, processing and food engineering and this suggests a need to provide industry links with food professionals (n=52).

![Figure 59: Teacher Training and Non-Teacher Training professional development: Food tools and equipment](image)

For Materials (ingredients, data or ecological resources), two identifiable themes evident were:

1. Nutrition and naturopathy
2. Food industry standards, legislation, product development

Figure 60 displays a closer alignment between the Teacher Training and Non-Teacher Training group for food industry standards, legislation and product development, but the Non-Teacher Training group present as being less interested in nutrition and naturopathy compared to the teachers (n=34).

![Figure 60: Teacher Training and Non-Teacher Training professional development: Food ingredients and materials](image)
Expectations or experiences for exploring new ways of learning

The motivation to explore new ways in learning can be attributed to internal or external factors and may determine the amount of effort a person may expend on particular activities in the future. This includes the ability to engage in research and apply abstract thought; adaptability and entrepreneurial skills to further inform teaching practice. The top three mean scores for both groups listed as barriers to their professional development included a lack of resources, time constraints and inadequate in-service training (Figures 61 and 62). Both groups point to external and employer based barriers to their professional development. This external rather than personal capability constraint suggests that human agency for innovation tendencies is strained by tool and material offerings and that the classroom or workplace environment possibly lacks the ability to nurture and develop multi-faceted attributes. Although ranked low, multiple-modes exist for a lack of confidence and classroom facilities for the Non-Teacher Training group (Figure 62). This personal capability could be associated with the undergraduate student responses for the desire to imbed more industry experience into their undergraduate degree for 'lab bench readiness' (n=276). Overall, the Teacher Training group present as having more difficulty engaging in new ways of learning compared to the Non-Teacher Training group.

Figure 61: Teacher Training: Difficulties exploring new ways of learning

Figure 62: Non-Teacher Training: Difficulties exploring new ways of learning


**Food Technology as a scholarly choice**

This question aimed to identify what ranking Food Technology has as a scholarly area of study and what subjects are perceived the most value to teaching and learning for post school job uptake. From a list of fifteen subject areas, ten were ranked in order of preference. The subject was ranked last by the teaching collegiate but fourth highest by the wider professional group, while Mathematics, Science and English were recorded as the top three scholarly subjects by both groups. At best Food Technology is seen as a soft subject by the teaching collegiate that offers vocational operational skills rather than a scholarly subject driven through science, maths and innovation as commonly practiced in the wider food science and technology profession. This is consistent with data thus far and anecdotal evidence to suggest the subject is still not being taught or promoted as a serious science within schools and has continued to deliver the subject along the lines of an upgraded Home Economics or food service program, home science view, particularly for the junior years (KPA, 2003, p.156). (n=323).
Reasons why Food Technology should be taught in schools

Thematic analysis of text was undertaken from the qualitative survey section for understanding the reasons why Food Technology should be taught in schools. These were framed using Technacy Genre headings: Human Agent (knowledge), Tools and Equipment, Materials (ingredients, data or ecological resources) to identify knowledge, values and attitude toward job pathways associated with Food Technology and how well sustainability issues are valued. If we can read anything into the following graphs, there is a significant and substantial difference between the Teacher Training and Non-Teacher Training groups. This view is validated statistically in the Pearsons correlation index for the perceptions of knowledge, tools and materials used in Food Technology.

From the category of knowledge, three identifiable themes were evident:
1. Social life skills
2. Gender and culture
3. Science and research

For knowledge, two domains of practice are evident: social and life skills, and science (Figures 65 and 66). Although the Non-Teacher Training group (n=84) listed social and life skills the second highest, this may suggest a portion of this group see life skills as a self-sustaining practice, or perhaps how the subject is currently taught. The teachers (n=110) listed gender and culture as the second important reason for teaching Food Technology, whereas the food profession noted little relevance. It would be interesting to undertake further study to identify the contrast in values for this response as it is beyond the scope of this research for now.

Figure 65: Teacher Training reasons for teaching Food Technology: Knowledge

![Teacher Training reasons for teaching Food Technology: Knowledge](image)

Figure 66: Non-Teacher Training reasons for teaching Food Technology: Knowledge

![Non-Teacher Training reasons for teaching Food Technology: Knowledge](image)
For tools and equipment, two identifiable themes were evident:
1. Cooking and food processing
2. Experiments and food processing

Figure 67 shows the Teacher Training group (n=54) present strongly for cooking and food processing. This heavy emphasis for cooking is evidence of Technacy Genre Theory revealing an uneven distribution of technological practice. In comparison, the Non-Teacher Training group (n=19) display a small mean score for cooking. This overlap suggests not all food industry processes occur in a laboratory or processing plant, but often cooking is a process undertaken during preliminary food design and development in a domestic style kitchen. The small response for food experiments by the teachers suggests that a few in the teaching collegiate engage in the science of food through experiments to better understand food-processing outcomes.

![Figure 67: Reasons for teaching Food Technology: Tools and Equipment](image)

For Materials (ingredients, data or ecological resources), three identifiable themes were evident:
1. Nutrition
2. Food safety and quality
3. Ecology and Food sustainability

Figure 68 shows an uneven distribution of technological practice by the teachers and this suggests a heavily skewed view for what constitutes the teaching and learning of Food Technology. Although nutrition is an important element, marginalising other elements constitutes an uneven outcome in technological learning, thinking and practice. Closer parallels were evident for food safety and quality and food sustainability, but given much less importance (n=92). The food profession also valued nutrition the highest (n=56) and for both groups this shows an interest to maintain healthy food choices. However, ecology and food sustainability were noted as the lowest for both groups and this
suggests the importance to raise the bar in training to link eco-footprint more deeply into teaching and learning and the expertise and purpose of food research.

Reactions to the NSW 7-10 TAS Syllabus advice for programming

This question aimed to establish how well syllabus conventions have affected change, or re-enforced the status quo for old syllabus content and practice. Although this question was designed for the NSW Teacher Training group specifically, both teachers (n=70) and non-teachers (n=10) responded. There is a clear pattern to suggest the advice for programming was viewed to be on a backward sliding or at least confused agenda given the negative responses from participants (Figure 69).

Thematic analysis of text was undertaken from the qualitative survey section to identify associations between Human agency (knowledge), Tools and Materials (ingredients,

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<sup>16</sup> Most of the 7-10 NSW Technological and Applied Studies syllabi were accompanied with advice that “some/many existing units of work will form the basis of effective programs”. What is your reaction to this?
Responses reveal an uneven distribution between knowledge, tools and material elements. The responses present a relatively even distribution for knowledge, however the positive comments largely noted by undergraduate Food Technology student teachers and areas other than Food Technology, were very scant in description for the type of knowledge evident and as such provided little scope to analyse any explicit value other than, “if it works, then keep doing the same”.

For the negative comments in reference to knowledge, largely noted by Food Technology teachers, the data suggests there has been no cultural change in the syllabi to enable teaching practice toward innovation, foresight and a futures orientated view of the world for the study of Food Technology. It also suggests that the 7-10 syllabus do not provide an adequate lead into the senior Food Technology syllabus. Figure 70 aimed to capture the scale of negative and positive comments.

From the category of knowledge, negative and positive comments were listed:
Negative (n=32):
- Re-inventing the wheel
- Low intellectual content
- Not moving with the times
- Isn’t good to rehash old stuff
- What’s new? Same old thing
- New is best, get rid of the old
- Time for a shift in programming
- Lacks defined, measurable tasks
- Little scope or desire for innovation
- Reassures existing teacher knowledge
- Not up to date with society and the future
- Not enough depth for knowledge capacity
- Is this wasn’t so serious, it would be funny
- Historical stuff does not grow new knowledge
- Unrealistic in terms of time to learn knowledge
- Poor understanding of Food Technology by board
- Not good enough to lead into higher order thinking skills
- This has promoted the status quo that existed before 2005
- Needs to be interdisciplinary study, not separate areas of study
- There is no connection between the junior syllabus and the senior syllabus for Food Technology. They are poles apart.
Positive (n=30)
- Fine
- True
- Agree
- Logical
- Positive
- Support this statement
- If it works, keep doing it
- Base to expand on is useful
- Scope and sequencing is doable for timing
- Manipulating/rearranging existing units OK
- Only the better elements have been reused
- Good basis if Food Technology is not a major
- All subjects in secondary school have their foundations

For tools and equipment, negative and positive comments were listed:
Negative (n=14)
- Needs new resources
- Doing skills is for dummies
- Old equipment is being used
- Heavy lean toward doing skills
- It comes back to $’s and resourcing
- More specific resources are required
- Saves money by using same equipment
- How to cook is not going to help sustainability

Figure 70: Teacher Training: Agreement/disagreement for knowledge for the 7-10 Technological and Applied Studies syllabi
• New developments in technology and equipment required
• Need to develop more relevant and contemporary resources
• Clearly a cost factor for equipment if a new syllabus is written
• Focus on skills rather than design and intellectual development
• New equipment will not be purchased as it is the same old stuff
• New manufacturing processes cannot be taught with old equipment
• Focuses on practical nature which doesn’t address up to date needs for students

Positive (n=3)
• Skills are important
• Assessment tasks and demonstrations still relevant
• Inclusion of computers good

Negative comments for tools and equipment were recorded from Food Technology teachers and, undergraduate students of the same. Undergraduate students training in Areas other than Food Technology, and academics of the same, show a negative response to the quality of equipment in their technology genre area. This may be due to a dislocation between school equipment and that used in industry settings.

Materials (ingredients, data or environmental resources) recorded one negative response from a food technology teacher declaring new developments in products were vague (n=1). There were no positive responses. The lack of responses for materials points to a skewed perception for technology practice, and that largely constitutes knowledge as separate to tool and equipment skilling, and that ecology and material use has no consideration. Based on the technical effort, and where there is too much emphasis on particular lobes, and not enough on another, the focus on the purpose or context becomes lost and the capacity to synthesise is reduced. Therefore technology judgement becomes flawed. These comments and graphs evidence the need for a robust
framework such as Technacy to guide curriculum designers and teachers to ensure an even balance in technological practice is strengthened.

**Understanding the subject matter**

Thematic analysis of text was undertaken from the qualitative survey section for the type of sources drawn on for teaching. It is possible that the question should have been worded to ‘understanding subject matter for teaching and the workplace’ and requires re-appraisal. As a result, the legitimacy concerning response rate in-balance is declared between the Non-Teacher Training group (n=76) and the Teacher Training group (n=141). The essence of this question aimed to identify the type of data that is used to inform knowledge and practice and what industry associations, training or curriculum support is utilised to inform teaching or work practice. The responses were framed using Technacy Genre headings: Human agency (knowledge), Tools and Equipment and Materials (ingredients, data, ecological resources).

From the category of knowledge as human agency three identifiable themes were evident:

1. Networking
2. Life and industry skills
3. Self directed research

Figure 72 shows that teachers’ drew on other teacher’s knowledge, primarily through shared resources or school development days. Undergraduate students drew on lecturers, teachers during practicum placement or other students (n=61). Life skills involved trade industry experience that largely constituted the Hospitality industry for the Food Technology teachers or Carpentry and Building from the teachers who teach in Areas other than Food Technology (n=39). A small proportion cited self-directed research (n=15). The Non-Teacher Training group largely interacted with colleagues through networking at conferences, interactions with industry, seminars or workshops or informed knowledge through experiments and laboratory practice (n=38). The data suggests that school culture knowledge is largely driven ‘in-house’, with no cross-reference to the wider professional world.
For tools and equipment, two identifiable themes were evident:

1. Media
2. Internet

It is clear from the data in Figure 73 that the main tool of choice to source knowledge is through the Internet for both groups (given the ratio of responses previously noted: Teacher Training: n=102; Non-Teacher Training: 28). The data suggests that there has been a move away from traditional modes of sourcing information through hardcopy in libraries, to online books and journals. Discerning between what constitutes an academic website and a non-academic website poses educational issues for both sectors. The Teacher Training group show a preference for media compared to the Non-teacher Training group, however this is consistent with the Teacher Training group use of media such as video, DVD or visual slides as teaching resources in class for example, compared to the Non-Teacher Training group.
For materials (ingredients, data, ecological resources), six identifiable themes were evident:

1. Books
2. Syllabus
3. Journals
4. Textbooks
5. Magazines
6. Newspaper

The data in Figure 74 presents a strong reliance on textbooks by the Teacher Training group (n=68). The Food Technology teachers also accessed magazines and books for recipes, while the teachers who teach in Areas other than Food Technology accessed woodworking books and magazines to inform knowledge. On the other hand, the Non-Teacher Training group’s preferences were for journals, and to a lesser extent, textbooks and books. This suggests an academic divide for scholarship and rigor in content previously presented in Figure 43. Teachers, particularly food teachers, favoured textbooks the highest. Given teachers write the textbooks for schools, this suggests a highly constructed internal view of the subject matter rather than drawing on knowledge through scholarly journals or textbooks written by academics for the food profession.

Figure 74: Teacher Training and Non-Teacher Training: Materials information source
SECTION 3: INNOVATION, FOOD TECHNOLOGY and TECHNOLOGY EDUCATION

Learner attributes

In order to develop attributes that foster student’s social, cultural and environmental sustainability awareness, curriculum requires a standard classification scheme to describe innovation attributes in universal terms, and in stages of development. This question sought to detect inter-relationships and subtle differences between group trends connected with expressions associated with innovation as they pertain to federal government reports and industry needs and what types of attributes are perceived accordingly.

Key Results: a high Technacy Genre Index approaching 1.0 suggests strong human agency (tacit knowledge) for innovation and food design orientation; a low index approaching 0.0 suggests strong tool focus (physical equipment) or ingredient/ecology (ethical and cultural appropriateness) focus for innovation and food design orientation. Alpha = 0.05.

The research found that Teachers perceived learner attributes significantly differently to the food profession. Teacher Training index=.55 vs. Non-Teacher Training index=.42 (both n=191, t=5.753, df=380, p<.000, 2-tailed).

The top ten expressions that aligned with federal government reports and food industry needs included:

1. Technical precision
2. Adaptability to change
3. Apply practical common sense
4. Safe use of tools and equipment
5. Acceptance of failure for success
6. Ethical and cultural appropriateness
7. Imaginative, enterprising and resourceful
8. Able to follow a detailed blueprint or manual
9. Able to find solutions to problems as they occur
10. Proficiency at using a variety of tools and equipment

Figure 75 shows the sub-group of secondary teachers display the highest index for innovation attributes compared to the food teachers and those who teach in areas other than Food Technology.

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17 Circle up to 10 phrases that you think best describe the learner attributes you feel are important to foster in students.
Results for the food profession shows a strong index toward physical equipment for innovation and food design orientation. Although these attributes are consistent with vocational operational skilling, they are also consistent with laboratory applications and food processes in the food industry. Teacher Training: General secondary index=.61 (n=55); Food teacher index=.53 (n=78); Areas other than Food Technology index=.52 (n=58). Non-Teacher Training: Food Scientist Technologist index=.42 (n=191); (df=3, f=13.086, sig.<.000). A closer examination between the teachers and the food profession only were analysed (Figure 76), as their experience may provide a better interpretation for attributes required post schooling. Although the teachers present a strong perception for human agency (tacit knowledge) as essential learner attributes for innovation and food design orientation, the food profession perceive both human agency (tacit knowledge) and tool focus (physical equipment) as essential learner attributes for innovation and food design i.e. tools and equipment fundamentally drive innovation and knowledge development. This ‘codifiable and transmittable knowledge’ view is consistent with anecdotal evidence as essential drivers for economic input that stimulates creativity and innovation (Fee and Seemann, 2002, p.5; Department Education Science and Training, 2003b; Collins, 2001; Nonaka & Von Krogh, 2009). Teacher index=.575 (n=53) vs. Food Technologist index=.379 (n=75). (t=5.417, df=126, p<.000, 2 tailed).
Food Technology, Innovation and Teacher Education: Summary of Survey Findings: By Angela Turner, 2010

Innovation as an area of study

Historically, the conventional approach in technology education has been to develop student mastery of methods and techniques but it is argued a deeper level of learning is required to “prepare people with the skills and knowledge needed to identify and shape the quality of the world we share with others” (Gruenewald, 2004, p. 2). A Likert Scale containing nineteen questions asked respondents to rate statements according to innovation as an area of study.

A Technacy Genre Index score of 4-5 for six of the questions suggests a strong science and innovation theme, with the other ten questions suggesting a strong vocational and conservative orientation theme. Three independent questions sought to clarify the difference between creative and innovative, the value of design within the educational institution and whether Food Technology syllabi fostered attributes needed in the modern economy. Alpha=.05, n=382.

In summary the statements for innovation included:
- The changing nature of technology
- Sustainability of vocational education
- Perceptions of design as a creative enterprise
- Perceptions of innovation as economic enterprise
- Teaching pedagogy and assessment frameworks in education
- Educator willingness to teach design and innovation as a discipline
- Media influence, public opinion and global reality for skills: trades or professions

There was no significant difference between the Teacher Training and Non-Teacher Training groups. For Innovation: Teacher Training index=2.72 (n=191) vs. Non-Teacher Training index=2.58 (n=191); (df=380, t=1.192, p=.234, 2-tailed). For Vocational skills: Teacher Training index=2.85 (n=191) vs. Non-Teacher Training index=3.01 (n=191); (df=380, t=-1.367, sig=.172, 2-tailed). Data presented in Figures 77 and 78 did not show significant responses at alpha set to 0.5, but shows a trend towards alpha consistent in theme thus far. The data suggests confusion amongst the inside world of the teaching profession between food technology teachers and their collegiate for what the study of innovation should constitute. However, the Non-Teacher Training group displays a higher lean toward practical based skills (Figure 78). This is consistent with data thus far for the importance of equipment and technical tool skilling required in laboratory work and food processing. For Vocational skills: Teacher Training: General secondary index=3.04 (n=55), Food teacher index=2.81 (n=78), Areas other than Food Technology index=2.74 (n=58); Non-Teacher Training: Food Technologist index=3.01 (n=191). (df=3. F=1.372, p=.251). For Innovation: Teacher Training: General secondary index=2.85 (n=55), Food teacher index=2.70, Areas other than Food Technology index=2.61 (n=58); Non-Teacher Training: 2.58 (n=191); (df=3, f=.946, sig=.418).
Assessment value ranking

This question builds upon learner attributes and aimed to identify values assigned to assessment, and in doing so identify problems understanding innovation in order to assess it. Participants were asked to provide a ranking out of ten, in order of importance from a list of 15, for the attributes they would choose as the most value when assessing students in school or the workplace.

There was a significant difference between groups. For Vocational Training: Teacher index=6.53 (n=183) vs. Non-Teacher index=6.69 (n=166); (df=347, t=-2.148, p<.032, 2-tailed). Food Innovation: Teacher index=6.87 (n=183) vs. Non-Teacher index=7.18 (n=166); (df=347, t=-1.830, p=.068). Although both groups appear to share similar associations for innovation, the technical aspects weigh more importantly for the food scientist technologists in Table 1. This suggests the purpose and context are important considerations in technological practice.
Teacher Training median score=6.86; Non-Teacher Training median score=7.1. Both groups’ median score presented as collaborative skills.

<table>
<thead>
<tr>
<th>Teacher Training group</th>
<th>Non-Teacher Training group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vocational values</strong></td>
<td><strong>Innovation values</strong></td>
</tr>
<tr>
<td>1 OH&amp;S</td>
<td>Technical Skill</td>
</tr>
<tr>
<td>2 Learning new knowledge</td>
<td>Learning new knowledge</td>
</tr>
<tr>
<td>3 Cognitive skill</td>
<td>OH&amp;S</td>
</tr>
<tr>
<td>4 Critical reflection</td>
<td>Innovative idea</td>
</tr>
<tr>
<td>5 Innovative idea</td>
<td>Critical reflection</td>
</tr>
<tr>
<td>6 Good behaviour</td>
<td>Proficiency at using a variety of tools and equipment</td>
</tr>
<tr>
<td>7 Technical skill</td>
<td>Follow a detailed blueprint or manual</td>
</tr>
<tr>
<td>8 Collaborative skill</td>
<td>Collaborative skill</td>
</tr>
<tr>
<td>9 Task purpose</td>
<td>Task purpose</td>
</tr>
<tr>
<td>10 Consideration contexts</td>
<td>Finished product</td>
</tr>
</tbody>
</table>

Table 1: Assessment values for innovation attributes

Although the data for innovation did not show significant responses at alpha set to .05, a trend toward alpha consistent in theme is evident. The food teachers show a high index for innovation assessment values, which contradicts data thus far, and may mean that although they may aspire to the importance of these attributes, syllabus requirements and assessment criteria at a senior level are possible constraints (Figure 80). On the other hand, the teachers who teach in Areas other than Food Technology show a high index for vocational training assessment values, which also contradicts the previous question. Additionally, the food scientist technologists were more closely aligned to this group, which again is consistent with their preference for technical expertise in laboratory settings and processing procedures (Figure 80). However, they also show a high index for innovation attributes in accordance with cognitive ability and this suggests that this group perceives both practical skills and knowledge as key drivers for innovation and therefore share equal consideration as assessment values. The general secondary teacher group display confusion for assessment values in Figures 79 & 80. For the food teachers, an aspiration gap is evident given the data thus far. Vocational Index - Teacher Training: Areas other than Food Technology index=7.16 (n=55), Food Teachers index=6.28 (n=74), General secondary index=6.22 (n=54). Non-Teacher Training: Food Technologist index=6.97 (n=166); (df=3, F=4.547, p<.004). Innovation index – Teacher Training: Food teacher index=7.05 (n=74), Areas other than Food Technology index=6.85 (n=55), General secondary index=6.66. Non-Teacher Training: Food Technologist index=7.18 (n=166); (df3, F=1.748, sig=.157).
Assessing innovation is easy

The Teacher Training group noted it was easy to assess innovation (n=67) compared to the Non-Teacher Training group (n=52) (Figure 81). Given the contradictions and confusion with data thus far, but with the aspiration to do better being evident, a solid framework is needed to provide an assessment guideline that is able to identify an even balance of attributes.
Important ‘generic skills’ for the current and emerging Australian economy

The relevance for manufacturing skills and the ability to practice, teach and assess human adaptability skills have long been a point of debate between industry and educational institutions. Historically, society experienced a stable, slow pace of change and simply designed technologies with limiting impact on society. Today’s society however, experiences rapid change with technologies superseding themselves within months. Therefore a necessary shift is required away from a “materialistic, short-term, high-impact, rapid growth outlook to one that is post-materialist, long term, low impact and low-medium growth” (Slaughter, 1999, p. 151). School leavers seeking jobs will increase their employability if they can show a capacity for sustainable, long-term decision-making, utilise tools and equipment, and ingredients and materials choices that leave a low carbon footprint on the environment.

A Likert scale of statements was designed around this government agenda using innovation attributes typically found in government reports and policies. These included:

- Adaptable to change
- Think originally and critically
- Capacity for abstract thinking
- Capacity for technical applications
- Creative individuals able to communicate well
- Capable of finding solutions to problems as they occur and
- Able to remain motivated when faced with difficult situations.

Common vocational attributes included skill and application in one area of manufacturing, technical proficiency and experience in an area of expertise.

There is a significant difference between both groups for innovation skills and vocational training skills. For Vocational Training: Teacher Training index=3.46 (n=182) vs. Non-Teacher Training index=3.42 (n=180); (t=.988, df=299, p=.324, 2-tailed). For Innovation: Teacher Training index=4.39 (n=182) vs. Non-Teacher Training index=4.09: (t=5.197, df=354, p<.000, 2-tailed). The food teachers noted highly toward innovation. The data suggests for food teachers an aspiration gap in their capacity to deliver these skills given data thus far (Figure 82). Teachers who teach in Areas other than Food Technology display a heavy emphasis for vocational skills that is consistent with teacher preference for teaching trade skills and syllabus requirements (Figure 83). However, teachers who teach in core areas such as Maths, Science and English show both practical and cognitive skills as important. Given a high percentage of these participants hold science degrees it is reasonable to suggest that this group has aligned across a number of questions with the food profession (Figures 82 & 83). Additionally, the Non-Teacher Training group, although noted generic skills needed for the Australian economy as vocational, displays a re-occurring pattern consistent with data thus far for the importance...
placed on skill application and technical precision in food product development, and therefore identifies the importance of purpose and context for technological applications.

Training: Teacher Training: Areas other than Food Technology index=3.72 (n=43), General secondary index=3.69 (n=35), Food Teachers index=3.25 (n=51). Food scientist technologist index=3.42 (n=3, f=3.011, sig<.030). Innovation: General secondary index=4.51 (n=55), Food Teacher index=4.37 (n=70), Areas other than Food Technology index=4.36 (n=53). Food scientist technologist index=4.09 (n=178); (df=3, f=9.786, sig<.000).

![Figure 82: Teacher Training and Non-Teacher Training: Innovation generic skills](image)

![Figure 83: Training and Non-Teacher Training: Vocational generic skills](image)

**Government “innovation” reports in education and business**

Figure 84 presents data comparisons between teachers and undergraduate teachers only. This question aimed to identify the depth and breadth of sourced literature and aimed to identify how well practice is a manifestation of theory. The Environmental Education policy shows a fairly even distribution between the two groups and presents as the most widely read document. This poses an interesting conundrum that although the teachers may have been aware of the study which, offered knowledge and insights to the contemporary knowledge and practice in the field of study for sustainability, the data

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presented thus far suggests that they have ignored the importance of imbedding eco-sustainability in their teaching practice. Additionally, the undergraduate students did not display an interest in materials, ingredients and eco-sustainability as Technacy Genre Theory framework identified these key, missing factors through many questions in the survey. Overall, the undergraduate students present as being more informed and aware of government reports around new knowledge and economic directions, it is questionable what the teachers are assessing the undergraduate students in: best practice in knowledge and learning or traditional pedagogic practice such as classroom management strategies? Encouragement for any new pedagogy or new knowledge content in discipline areas a student chooses can only be encouraged but not assessed. This question is beyond the scope of this research and requires further research.

**Figure 84: Teacher Training: Awareness of Innovation reports**

- Australia’s teachers, Australia’s future. Advancing innovation, science, technology and mathematics (2003).
- Ministers joint statement on education and training in the information economy (2000).
- Frontier technologies for building and transforming Australian industries (2003).
- Hospitality policies and regulations.
- Adelaide declaration on national goals for schooling
- NSW safe and supportive schools

- Teachers □ Undergraduate Teachers

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Food Technology, Innovation and Teacher Education: Summary of Survey Findings: By Angela Turner, 2010
**Brain Bender: Knowledge, abstract thinking and vivid imagery are essential for excellence in skill development and should be given more attention in learning and assessment in technology subjects**

Thematic analysis of text was undertaken from the qualitative survey section to determine participant values for learning and assessment. These were framed using Technacy Genre headings: Human Agency (knowledge), Tools and Equipment, Materials (ingredients, data, ecological resources). Initially, responses were tallied to identify positive and negative reactions. For knowledge, a clear pattern is evident that a larger proportion of participants from both groups felt knowledge, abstract thinking and vivid imagery are essential in skill development (Figure 85). However for the Teacher Training group, particularly for the food teachers, this agreement suggests an aspiration versus reality context exists given the consistency in theme thus far for vocational training. An unexpected result shows the Non-Teacher Training group display a higher disagreement with this statement. It could be argued that mental visualisation tasks may further inform the teaching and learning for innovations in food science enhanced through computer skill applications. Teacher Training group (n=66). Non-Teacher Training group (n=83).

![Core skills for learning and assessment in technology subjects: Knowledge, abstract thinking and vivid imagery](image)

**Figure 85:** Teacher Training and Non-Teacher Training core skills for learning and assessment in technology subjects: Knowledge, abstract thinking and vivid imagery

For tools and equipment, two themes were evident:
1. Skills develop knowledge
2. Skills are more important than knowledge

It is clear from the responses in Figure 86, that the term ‘skill’ appears to constitute different interpretations from the Teacher Training and the Non-Teacher Training groups. The majority of teacher responses were from the food teachers and teachers who teach in Areas other than Food Technology. Many felt that skills should be taught without
engaging in creativity or design as this approach offered more scope for slow learners, and for those who were creative, would naturally blend the two. Another theme emerged that students are ultimately working toward a test or exam that does not constitute the need for abstract thinking and vivid imagery, but rather occupational, health and safety contexts associated with using tools. At a senior level, the teachers did not appear to make a connection with the language in this statement and the similarities of language used in the NSW Higher School Certificate e.g. innovation and creative enterprise. A strong theme around assessment figured prominently but it was noted that these attributes were too hard to teach and assess. For those teachers who were former trade persons’, skill was the number one priority and that abstract thinking and vivid imagery could be added on later.

However, for the Non-teacher Training group, tools and equipment shaped knowledge. A strong theme throughout the responses from this group offered that through the use of tools, creative thinking is stimulated and leads to inventions and innovations. Some responses felt that all are important, i.e. practical skills, knowledge and abstract thinking, as one cannot exist without the other, they were seen as interrelated.

For Materials, only two themes were evident by six participants:
  1. Meal plating
  2. Food safety and hygiene

The lack of responses for materials suggests a very weak association from both groups between knowledge, tools and materials in technological practice. The lack of responses also suggests there is a need to raise the bar in training and objectives to link eco-footprint more deeply into teaching and learning and the expertise and purpose of research. It is suggested undergraduate degrees and industry direct research talent and resource more to "Food Innovation towards a lighter touch on the earth".
Figure 87: Teacher Training and Non Teacher Training core skills for learning and assessment in technology subjects: Materials.
CONCLUSIONS

The data revealed deep confusion and contradictions between participants around the national vision of knowledge and innovation, particularly for food technology. Confusion in the sense that although it is healthy to have different perceptions, the subject has become stagnant due to multiple opinions and as such has not generated a curriculum high in status. While it could be argued the differences are that great and not in agreement, the point of debate and issues of concern is that the teachers appear to have formed their own acculturated view of the subject, and as a consequence, the subject has not evolved in line with the wider professional view of food technologists. The findings suggest that this is due to a lack of research culture in the school sector of the subject area. Furthermore, the two key characteristics that distinguish the teachers and the food professionals are their respective orientations for the humanities and the sciences. Where the humanities encompass a certain orientation toward social development and life skills for the subject matter, the sciences contain an orientation toward deep discipline knowledge.

Where teacher training undergraduate degree accreditation course content for Food Technology education is concerned, a strong pattern emerges as being strongly skewed toward vocational operational skills (Hospitality), with little to no acknowledgement for food science technology profession qualifications. This has allowed for fast track teacher degrees to be formed via a TAFE entry and rarely by a first-degree entry. This scene translates to the NSWIT structures for teacher accreditation for ‘Food Technology’ that is largely targeted at chefs and those working in retail food operations, and rarely targeted at food science technology innovation development. Aside from the extensive range of professional development available to teachers in relation to food processing as it relates to Hospitality for VET in schools, little professional development is apparent which enables teachers to develop a detailed understanding of the food profession. Professional development is not just about learning how to apply the curriculum or learning how to work within the confines of the current education system. It is also very much about seeking out new ways of doing things that lead to innovative thinking, acting and doing.

Additionally, the participation rates for the senior secondary Food Technology subject are low and compete against vocational subjects that are more heavily promoted. For example, approximately double the number of students completed Hospitality in 2009. The inadequate ‘lead-in’ has exacerbated this problem by the junior years 7-10 Food Technology syllabus and the vocational operational skilling focus conveyed that promotes both a misrepresentation in the syllabus and a skewed interpretation by teachers for what the study of Food Technology ought constitute.
In conclusion, it makes sense for curriculum designers to change the label from Food Technology to Food Studies, and that this new syllabus provide a deeper level of learning in nutrition, and be positioned under the VOCED strand of subjects. Additionally, curriculum designers, in collaboration with academics and food professionals, design a new Food Science and Innovation Studies syllabus that is positioned under the sciences strands for national curriculum consideration.
References


