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The teaching of food technology in secondary schools

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This paper presents findings from a recent Australian study that investigated perceptions of 'food technology' by teachers in secondary schools compared to a wider professional view. While 'food technology' has been well established in most Australian secondary school curricula, a contradiction has emerged between the 'school view' of the Food Technology label and the 'professional view' of the same. The use of identical language to describe different approaches is causing a significant problem for the food profession. A framework known as Technacy Genre Theory was used to analyse data from a survey of 382 relevant stakeholders to define the nature of the extent of agreement between the two forms of technological practice. The results confirmed that the label Food Technology is perceived significantly and substantially differently between school teachers and the wider food profession.

Food Technology is a field that has advanced enormously in knowledge as part of the wider technology profession, accelerating in its own science base, and is identified as a key to meeting food security issues and rising world hunger. In the supply chain of effectively building human capability in food technology studies and innovation, a key foundational link is the quality and accuracy of food technology education in schools. There is a need to accurately identify the content being taught under the label of Food Technology in schools as this has been brought into question by sectors of the wider food profession (personal communications[1]).

The AIFST Education Providers Working Group has stated: "AIFST members from the food and related industries and teaching institutions have expressed their concern that the national skills base in food science and technology in Australia is decreasing and the future of food science and technology education of graduates for the Australian food industry is threatened" (AIFST 2008).

Data for the present study was collected during 2009 as part of a doctoral thesis, *A Critique of Food Technology, Innovation and Teacher Education: A Technacy Perspective on Curriculum*. The summary of findings presented in this paper has been taken from a larger report made available to AIFST and the Department of Education and Training library (Turner 2010). The study sought to identify what the label 'Food Technology' means and thus 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 food profession represents the 'demand' side of the process that starts with receiving students 'supplied' by the school 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 academic culture and knowledge in food technology and innovation, technical systems and equipment used, and relevant material ingredients involved in food technology practice. Questions from the study aimed to gauge relative attention given to sustainability, economic trends and innovation capacity building as these areas remain topical in the wider context of food science and technology research and emerging world concerns. The key question this study sought to clarify was: Do state secondary education providers and teachers share the national vision of knowledge and innovation with the wider profession of food technologists?

Method and framework

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 curricula and the food science discipline. This sought to understand in particular the purpose of the subject area over time and from an economic context.

A scoping exercise explored contemporary knowledge and understanding of teachers through fieldwork that involved school visits, class observations and informal teacher discussions. Personal interviews were undertaken with the New South Wales Department of Education and Training (NSW DET) curriculum personnel, while 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 teaching and the food technology field. Sampling involved the use of hard copy and online media.

The survey instrument collected respondent profiles, dispositions and affect, and technological understandings. Analysis was conducted on data from 382 survey returns with the aim to clarify what the state of play is in schools, what the state of play is beyond school and what alignments and ideas there might be for a common future for the subject Food Technology.

The main school system sampled was the NSW Department of Education and Training in Australia, partly because of accessibility, but also because this school system is generally regarded as one of the biggest 'centralised education systems' in the world, and so has a significant mass impact on society both in Australia and internationally where other large centralised education systems have emerged (NSW DET 2010).

An adaptation of a perception grid method used by Provost & others (2007) was used to help clarify a dispute between school-based teacher views of what constitutes Food Technology, and the wider food profession view of the same expression. The point of difference tested was framed to detect the degree of difference between two forms of food technology genre to isolate the cause of confusion in the sector. The data analysis was arranged under three core sections: Demographics, Food Technology and Innovation, and

Food Technology and Associated Technology Education. The research was modelled upon an existing critical theory known as Technacy Genre Theory (Seemann 2009). As a conceptual framework, the theory was tested empirically to determine if it could identify and measure interrelationships and subtle differences between genres of technology practice for food technology. The fundamental praxis of technacy considers access and equity and ensures that social and environmental inputs are considered equally valid parts in decision-making processes for technological activities (ASTEC 1996). Perceptions were gathered around contextual and goal-oriented aspects of practice, with a specific interest in the:

- Human elements of practice, eg agency, knowledge, techniques, values, social organisation,
- Tool elements of practice, eg enabling technical devices, equipment and systems, and
- Material or ecological elements of practice, eg consumable ingredients, properties, aesthetics, impact on ecology.

These three elements represent, according to technacy theory, both resources and constraints evident in all forms of technological practice (Seemann 2003, 2009). 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 the food technology curriculum, the food profession, and innovation as an economy agenda were each framed as follows:

- The purpose of food technology given the contemporary context of economic and lifestyle drivers,
- Knowledge, concepts and techniques in food technology,
- Tool elements for technical production systems and devices used in food technology, and
- Material and environmental factors including ingredients, data or ecological resources used in food technology practice.

Summary of findings

The key outcome of this research clarifies that, under the label of 'Food Technology', two domains of practice are at play. Two themes emerged that suggest that food professionals are mostly goal-oriented towards valuing innovation, research and development (depicting a culture of science). Accordingly the corollary theme was that the food profession expects high school leavers entering their field to be grounded in similar skills and values. In comparison, the research found that schools are mostly goal-oriented towards valuing life skills and are vocational in purpose (depicting a culture of the humanities). The corollary theme was that teachers of food in schools expect high school students to perceive the subject as a life skills and vocational field of study. Farlex (2010) concluded that the humanities place less emphasis on the study of a discipline and more on a general education in the "study of languages and literatures, the arts, history, and philosophy", whereas the sciences are largely driven through "investigation, systematic knowledge or practice", drawing upon uncompromised scientific content and methods. It is this contrast in disciplines that may explain the differing perceptions between the two sectors as to what ought to 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 wider professional community of food scientists and technologists[2]. For Knowledge and Techniques: Food teacher index = 0.315 (n = 78); Area other than Food Technology index = 0.259 (n = 58); General secondary index = 0.369 (n = 55); Food technologist index = 0.808 (n = 191); (df = 3, F = 191.774, $p < 0.000$). For Tools and Equipment: Food teacher index = 0.197 (n = 78); Area other than Food Technology index = 0.145 (n = 58); General secondary index = 0.289 (n = 55); Food technologist index = 0.817 (n = 191), (df = 3, F = 279.008, $p < 0.000$). For Materials and Ingredients: Food teacher index = 0.1333 (n = 78); Area other than Food Technology index = 0.1052 (n = 58); General secondary index = 0.2055 (n = 55); Food technologist index = 0.6497 (n = 191), (df = 3, F = 121.993, $p <0.000$). On the issue of evidence for coherence in genre co-relationships existing between food knowledge, techniques, ingredients and tools, the results of a Pearsons 3 x 3 correlation matrix showed a very strong three-way interdependent pattern, as predicted in Technacy Genre Theory: Knowledge-Tools (n = 382, r = 0.823, $p < 0.000$, 2-tailed); Knowledge-Ingredients (n = 382, r = 0.742, $p < 0.000$, 2-tailed); and Tools-Ingredients (n = 382, r = 0.790, $p < 0.000$, 2-tailed) (Figure 1).

This significant finding also provides a possible reason why many Australian Food Science and Technology (FST) undergraduate degrees have expressed concern at a drop in enrolments in FST courses (AIFST 2009). This situation has also been compounded by the dropout rate in the first university year of high school leavers who have come from a 'food technology' course in their secondary studies but, upon commencement of the course, have often expressed the view that it is incorrectly described, and should conform to the school form of its name (KPA 2003). The data presented in this report validate that students have been presented with a practice for Food Technology in schools that is dislocated from the wider professional practice of the field.

Further analysis reveals contradictions amongst the teachers as to where the subject is currently located in the curriculum (as a life-skills vocational subject) and where the subject would be better located (where it can thrive as a field of innovation, research and development). An unexpected result shows that 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) has better agreement with the wider professional community of food technologists than the Food Technology teachers surveyed. This may mean that most Food Technology teachers perceive the subject in a vocational education domain, but also 'see' from their other teacher peers that the subject should be more science driven. Figure 2 compares Food Technology teachers to their colleagues in the same faculty. The food teachers do not present as a culture engaged in evolving their subject matter, or evolving as a science-based discipline[3]. Food teacher mean score 2.80 (n = 69); Areas other than food technology mean score = 3.27 (n = 42); General secondary mean score = 2.72 (n = 47); Food technologist mean score = 3.32 (n = 157); (df = 3, F =

5.709, p < 0.001).

Figure 3 reveals that teachers viewed the subject as offering a relevant pathway into hospitality whereas the food profession views the subject as a pathway via a science discipline. Teacher Training: Food teacher mean score = 3.75 (n = 64); Areas other than Food Technology mean score = 4.02 (n = 41); General secondary mean score = 4.32 (n = 47); Non-Teacher Training: Food technologist mean score = 3.31 (n = 114); (df = 3, F = 13.926, sig = 0.000). We conclude that the concept of Food Technology in schools competes with Food Hospitality, and that not only are the two genres of food studies presented as meaning the same thing but Food Technology in years seven to ten is the foundation study that prepares students into the food hospitality form rather than the science form. There is evidence to support this assessment at the Department level of the subject area. The 2009 archived statistics from the NSW Board of Studies show that only 3477 students studied Food Technology in their Higher School Certificate compared to 6584 students who studied Hospitality with an exam and 7628 students who undertook Hospitality without an exam. This is also compounded by the NSW Institute of Teachers (NSWIT) course content for teacher training registration that reinforces vocational operational skills under the label of Food Technology as a major in Technology and Applied Studies (TAS) teaching degree accreditation rather than a dominant set of food science skills.

This current scenario where the school curriculum, the form of practice in schools and the NSWIT teacher degree accreditation reaffirming the established view of the discipline back into those schools, suggests a tightly aligned and self-referencing relationship between the school, the curriculum and the teaching accreditation standards. This self-referencing relationship may offer insight into the conservative system of how 'Food Technology' is presented. It also appears to offer insight as to why school 'Food Technology' studies favour a vocational-operational view of the subject at the expense of evolving the wider professional view as a field of science and innovation.

We suggest that this discord may pose a real problem for the profession of food technologists while it relies upon the secondary school's sector to be a key supplier of emerging food technology talent. Teacher Training (n = 152; Teacher mean score = 4.00) vs. Non-Teacher Training (n = 114; Food technologist mean score = 3.31); (Alpha = 0.05, n = 266, df = 1, t = 5.633, p < 0.000, 2-tailed).

Our study also found that teachers perceived the junior Food Technology Years 7–10 syllabus as a platform for learning self-sustainable life skills. Figure 4 shows a dominant view toward end-user cooking skills by the teaching collegiate. Teacher Training: Food teacher mean score = 4.09 (n = 68); Areas other than Food Technology mean score = 4.00 (n = 48); General secondary mean score = 4.25 (n = 48). Non-Teacher Training: Food technologist mean score = 3.06 (n = 125); (df = 3, F = 25.061, sig = 0.000). This suggests that the NSW Food Technology 7–10 syllabus may not provide an adequate lead-in to the senior Food Technology syllabus as well as what it was designed to do or perhaps that teachers are misinterpreting the syllabus; Teacher Training (n = 164; Teacher mean score = 4.11) vs. Non-Teacher Training (n = 125; Food technologist mean score=3.06); (Alpha = 0.05, n = 289, df = 1, t = 8.593, p < 0.000, 2-tailed).

Food technology sources

Qualitative results fundamental to this study revealed that even though food teachers may aspire to be science driven, practice was life skills orientated. It is asserted that the tools and methods (to a slightly less extent, the ingredient resources) used ultimately determine genre practice. In curriculum design and subsequent tool choice in schools, the equipment used is primarily vocational education-oriented, while in the food technologist's genre of practice the methods, tools and much of the ingredients used are experimental laboratory-oriented. The teaching collegiate demonstrated a weakness in sourcing new knowledge externally to their school sector, but were strong in networking within their school sector with other teachers. For their professional development, their sources were mostly school workshops, school-based textbooks or food and Vocational Education Training (VET) trade magazines advocated by their school networks. The wider professional group, however, 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, sources of knowledge other than pure food science (Figure 6). The only common relationship between the two groups for sourcing information was the internet.

School 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 mean score = 3.68) vs. Food Technologist Training (n = 115, Food technologist mean score = 2.99); (Alpha = 0.05, n = 234, df = 232, t = 4.428, p < 0.000, 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 rigour in content (Figure 7). Given that teachers favoured textbooks most highly, particularly food teachers, and that 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 mean score = 3.93 (n = 60); Areas other than Food Technology mean score = 3.65 (n = 26); General secondary mean score = 3.24 (n = 33). Non-Teacher Training: Food technologist mean score = 2.99 (n = 115); (df = 3, F = 9.137, sig < 0.000).

Strong science and mathematical skills were perceived by the teaching collegiate as largely irrelevant for the study of Food Technology compared to the wider professional community of food technologists who perceived maths and science skills as essential (Figure 8); Teacher Training (n = 116, Teacher mean score = 3.01) vs. Food Technologist Training (n = 124, Food Technologist mean score = 3.85); (df = 1, F = 37.778, p < 0.000). The teaching collegiate does not appear to perceive Food Technology as a scholarly subject but rather a soft subject that at best offers vocational operational skills. Teacher Training: Food teacher mean score = 2.93 (n = 55); Areas other than Food Technology mean score = 3.14 (n = 29); General secondary mean score= 3.03 (n = 32). Non-Teacher Training: Food technologist mean score =

3.89 (n = 124), (n = 240, df = 3, F = 12.779, p < 0.000).

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 mean score = 2.53) vs Non-Teacher Training: (n = 182, Food Technologist mean score = 3.16); (Alpha = 0.05, n = 266, 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 9 suggests that the school culture as a whole does not present as a culture engaged in evolving their subject matter, or evolving as a discipline through research and networking with peers. Teacher Training: Food Teachers mean score = 2.51 (n = 75); Areas other than Food Technology index = 2.58 (n = 55). Non-Teacher Training: Food Science Technologist mean score = 3.16 (n = 182); (df = 3, F = 11.271, p < 0.000).

When asked to rank the academic demands of Food Technology relative to other subjects, the teaching collegiate ranked it last (Figure 10). In comparison, the wider professional group ranked Food Technology fourth (Figure 11), 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 and innovation as commonly practised in the wider food profession.

A high proportion of undergraduates from both groups appeared dissatisfied with the lack of school practicum (in the case of teacher courses in food technology for schools) or industry internships (in the case of professional Food Technology courses) offered in their undergraduate degrees. For the undergraduate teachers, school placements were noted as the most preferred compared to industry placements, suggesting that pedagogy (teaching method) is more valued than understanding discipline content. On the other hand, undergraduate food science students sought more science industry placement or internship time. Written responses indicated that this would make them more confident in the discipline and therefore 'lab bench ready' for the food profession upon graduation. However, our investigations suggest that there appears to be some resistance from food manufacturing industries to collaborate with universities, and visa versa. It was beyond the scope of this study to follow up the detail of why this may be the case.

Recommendations

It is proposed that school curriculum designers change the label from Food Technology to a more generic term such as 'Food Studies' and that this new syllabus be designed and positioned under the vocational strand in school offerings, that is, for 'Food Studies' to remain focused on food as primarily a life-skills, vocational and humanities field of study.

Teachers appear to be maximising internal, localised referencing rather than wider, out-of-education reading, which has produced an internal closed feedback of refinement drivers to the curriculum rather than drivers of evolution, genuine refreshment and innovation. This cycle has had a significant undesirable impact on both school leavers entering the food science and technology profession, and the supply of next generation food scientists. It is therefore recommended that the professional development for secondary food teachers involve mandatory food science and technology workshops targeting the research and development laboratories of food science industries.

Conclusion

This paper concludes that the teaching profession and the wider community of food science and technology professionals practice two very different forms of technology, even though they both use the same label Food Technology. This was made transparent through Technacy Genre Theory. Our study highlights the need to make changes to the school curriculum in order to resolve issues concerning expectations of secondary school students undertaking Food Technology and pathways into university offerings for the wider profession of food science and technology. It is proposed that the knowledge gained from this research will inform and better align educational services towards the national priority in innovation and sustainability and thereby stimulate research concerning food education and associated teacher capital.

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Footnotes

1. Drawn from a series of discussions between 2008–2011 with members from the Australian Institute Food Science and Technology Incorporated; Food Technology Association of Australia and research scientists and academics from the Commonwealth and Scientific and Industrial Research Organisation; Program Leader Undergraduate Food Science, NSW University; Program Leader Postgraduate Nutrition and Food Science, University South Australia; Bri Research; Program Leader Food Science and Technology, Curtin University.

2. Based on Perception Grid responses where 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.
3. Likert Scale from 1–5 where an average high mean score of 4–5 suggests a strong science, innovation and food design orientation. A low average score of 1–2 suggests strong vocational, cooking-skills, conservative orientation to the purpose and practice of Food Technology. Alpha = 0.05, n = 315.

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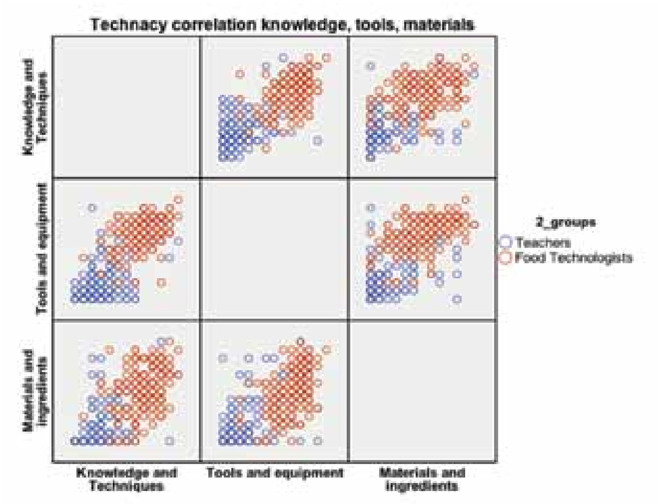

Figure 1. Correlation matrix for food technology knowledge and techniques, tools and equipment, material and ingredient priority systems.

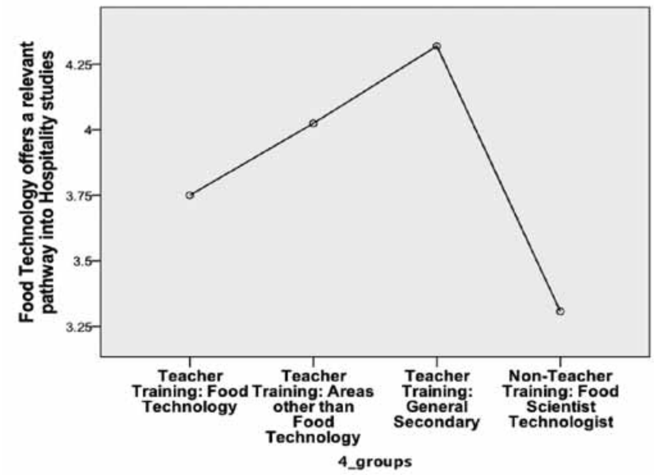

Figure 3. Food Technology offers a relevant pathway for Hospitality.

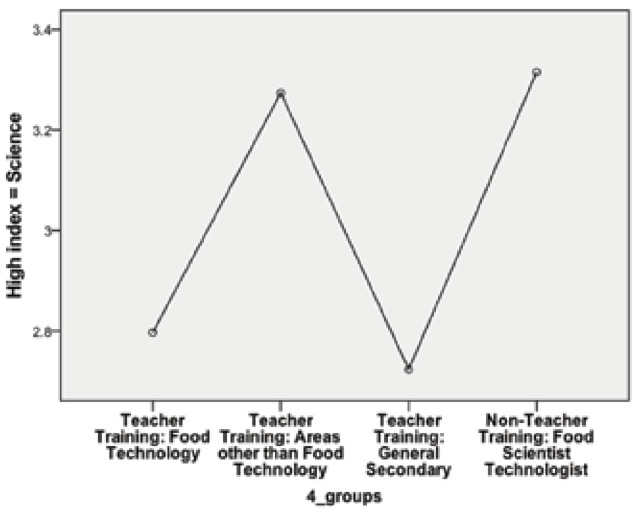

Figure 2. Teacher Training and Non-Teacher Training science mean score.

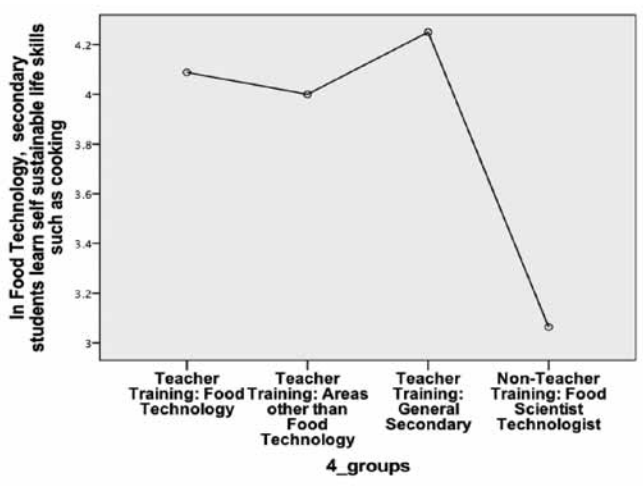

Figure 4. Food Technology focuses on practical cooking skills.

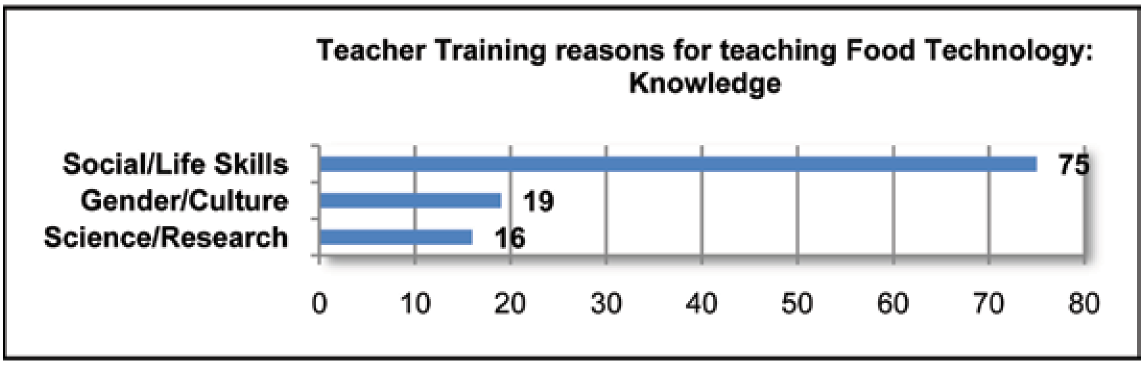

Figure 5. Teacher Training reasons for teaching Food Technology: Knowledge (n = 110).

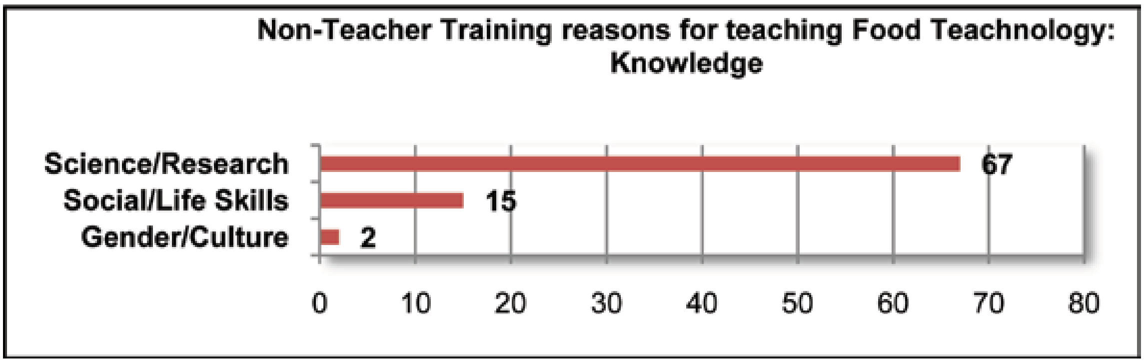

Figure 6. Non-Teacher Training reasons for teaching Food Technology: Knowledge (n = 84).

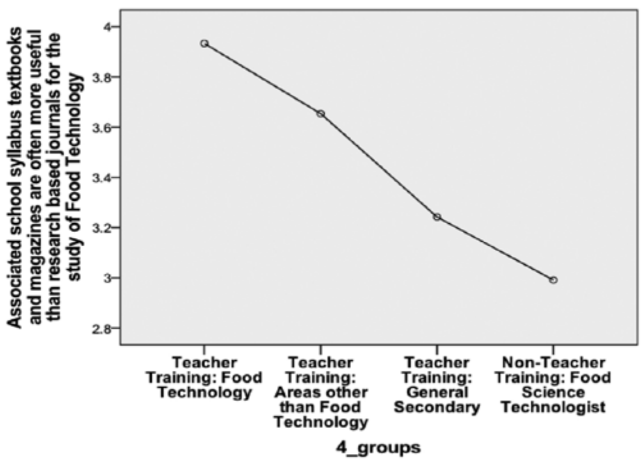

Figure 7. School textbooks are more useful for the study of Food Technology rather than journal articles or research-based literature.

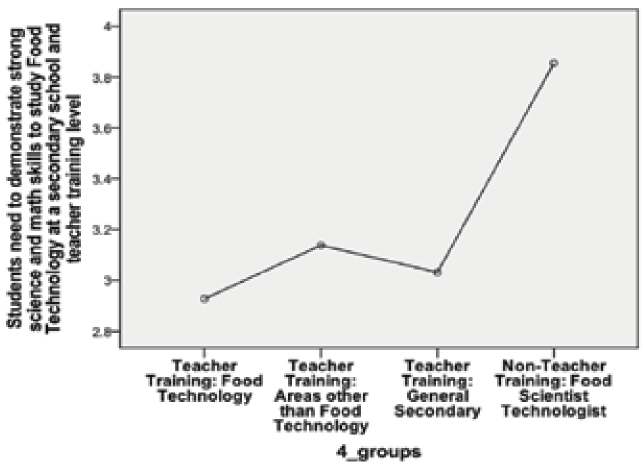

Figure 8. Mathematics and science skills are essential to study Food Technology.

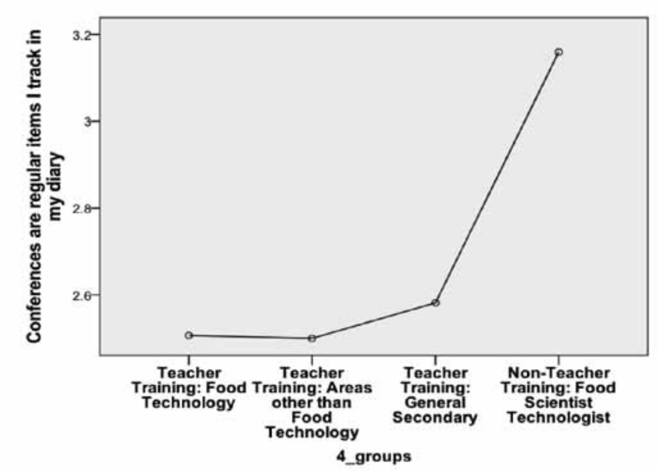

Figure 9. Conference tracking.

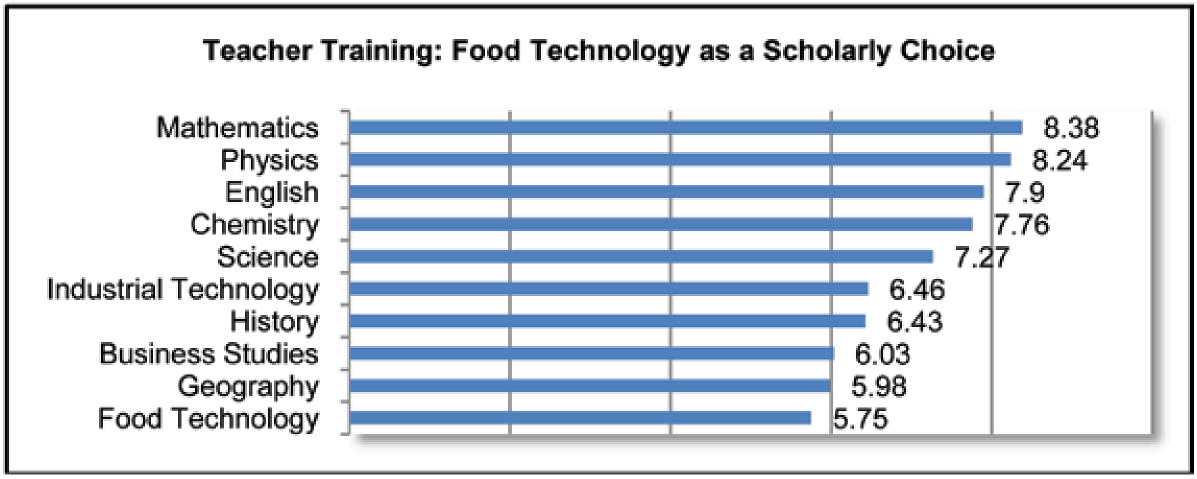

Figure 10. Teacher Training: Food Technology as a scholarly choice (n = 165).

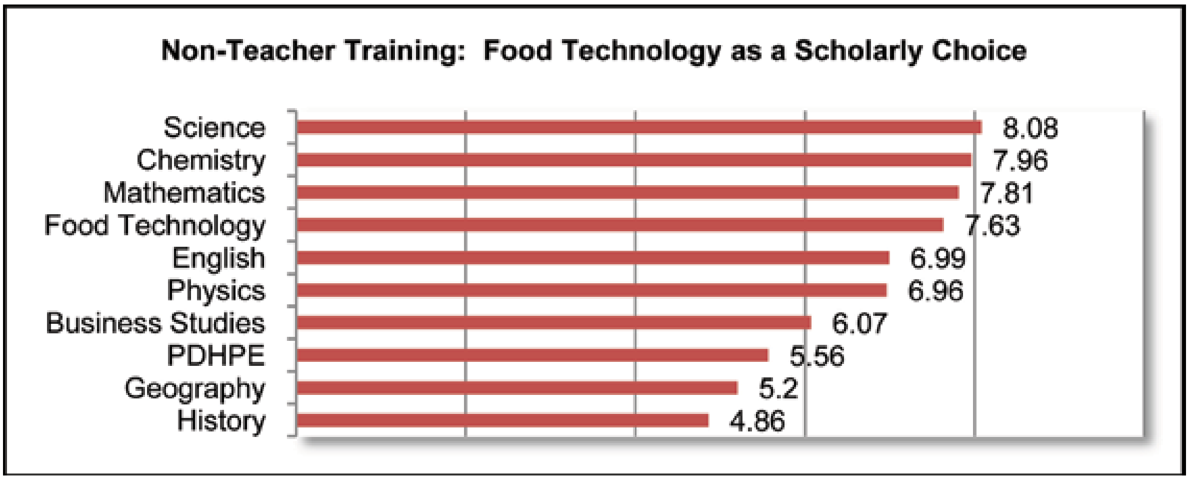

Figure 11. Non-Teacher Training: Food Technology as a scholarly choice (n = 158).