# Chapter 6
# The Theoretical-Practical Cake

## Linking Theory and Practice in Food Industry Education

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## 6.1 Background

The Central Asian countries differ significantly in their economic development, as shown in the following overview (cp. Table 6.1, Germany Trade and Invest 2013, 53f).

While Kazakhstan shows a rather per capita high income, mainly due to oil and gas production, the other countries in the area score significantly lower. Those discrepancies also transfer to the food supply. As early as 2009, Kazakhstan joined the ranks of the world's largest exporters of wheat and flour, achieving self-sufficiency with those foods, even though the yield per hectare is drastically lower than the worldwide average (Belaya and Mykhaylenko 2010, 4). In Turkmenistan, Uzbekistan, and Kyrgyzstan, however, the supply situation with wheat is considerably below 100% (Perekhozhuk et al. 2013, 9), with Tajikistan having imported two thirds of its wheat in 2010 (Geppert and Oppeln 2011, 3). This dependence is especially important considering the elevated wheat consumption per capita in the country, being two to three times the German level (Perekhozhuk et al. 2013, 10).

Overall, due to the vast north-south extension of Central Asia, the area is characterized by very different climate conditions, allowing the production of a broad range of goods, including grains, fruits, and vegetables, as well as milk and meat. Due to the lack of modern refining processes, too little of these goods are used for providing food to the domestic population and for export. The meat production in Kazakhstan is a current example: The country exports slaughtered meat while importing large amounts of processed meat products (Belaya 2016, 3). Overall, the Central Asian countries import more refined foods such as canned meat and fruit,

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**Table 6.1** Comparison of economic development

| | GDP per capita in US $ 2013 (rounded) | Main contributors to GDP |
|---|---|---|
| Germany (Statista) | 46.000 | Service sector, production industry, construction |
| Tajikistan | 955 | Agriculture, trade, service sector |
| Turkmenistan | 7.000 | Fuels, energy, manufacturing sector (data from 2011) |
| Uzbekistan | 1.950 | Mining, manufacturing sector, public administration (data from 2011) |
| Kazakhstan | 13.000 | Mining, industry, trade |
| Kyrgyzstan | 1.200 | Mining, industry, agriculture |

dairy products, processed meats, confectionery, and infant food (Belaya and Mykhaylenko 2010, 4). The value lost to the country due to imports further increases the dependency. Food production and processing is therefore of immense importance to the development of Central Asia.

Despite the overall high educational standard, the region still lacks specialists and managers "…trained in economically efficient, technologically up-to-date and ecologically sustainable technologies" (Zöbisch 2012, 1). It subsequently became inevitable to structurally redesign the current education in the food industry for specialists, engineers, and instructors. A prototype training course for food technology had to be developed, and an educational framework for the academic programs Bachelor of Science in Food Technology and Master of Science in Food Technology was created. The prototype training course required specific preparation and training for the instructors. The Master of Education in Food Technology program is based on the technical Bachelor of Science in Food Technology.

## 6.2 Prototype Training Course for Food Technician/College

Since the academic programs are described elsewhere, this section focuses solely on the interlinking of theory and practice in the prototype training course for food technician, i.e. food processing and production technician.

The structure of the prototype training course for food technicians is based on the vocational college concept. In the past, dual vocational training has not achieved the best results (Euler 2013, 12); the training of instructors for food technology and food processing and production consequently differs from the German approach. A 3-year or 6-semester full-time classroom-based education was deemed the best fit considering the educational system of all participating countries, resulting in a qualification equal to that of a dual vocational program.

Education in Central Asia is heavily based on traditional, instructor-centered teaching, with little interlinking between theory and practice (Stehling 2015). Accordingly this challenge had to be overcome with the newly designed prototype

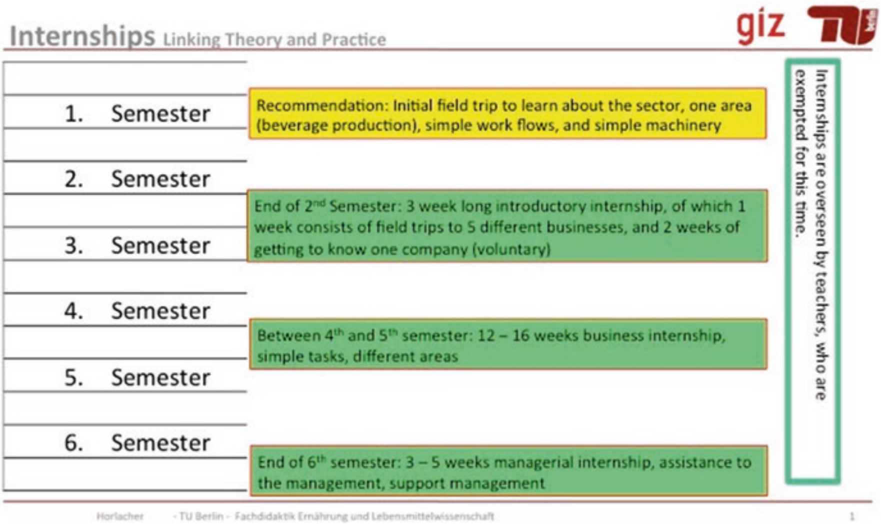


**Fig. 6.1** Linking theory and practice in the prototype training course for food technology

training course. The curriculum provides numerous links by including a high percentage of practical working periods, some of which will be presented in this paper.

### *6.2.1 Internships*

As of right now, practice plays an insignificant role in college education, a nuisance to be addressed by integrating business internships, which remotely resemble the concept of dual vocational training. As an important prerequisite for this approach, strong ties between the colleges and participating companies have to be developed and maintained. During the five internships integrated into the training, it is of great importance to allow the college students to handle tasks of increasing difficulty to gradually develop their responsibility for food production (see Fig. 6.1). The tasks will range from merely observing different production methods to supporting the management toward the end of the training. The instructing teachers must closely advise and oversee the students during the internships and develop a close relationship between school and businesses.

### *6.2.2 Food Sensory Technology*

For the subject sensory technology, several groups of teachers from Central Asia were educated at seminars by a vocational school teacher specially trained for the assignment. To help the students develop the competencies in a theory-practice

**Fig. 6.2** Sensory technology lab in Bishkek (Photo: Franz Horlacher)

module, sensory technology labs with several training spots were established with the German experts, using available resources at the University of Bishkek, Kyrgyzstan (see Fig. 6.2); the Technical University Dushanbe, Tajikistan; and the Agricultural University Almaty, Kazakhstan. The only sensory technology lab established at a college as of now exists in Kara-Balta, Kyrgyzstan. Here, German experts qualified additional instructors. This allows a consistent linking of theory and practice for the vocational college for food technicians.

### *6.2.3 Technical Drawing*

Technical drawing is taught in the first semester of the 3-year college program. A potential problem consists in the subject being taught on a rather abstract level and the conventional introduction into technical drawing offered does not correspond well with the expected tasks of a future food technician. To avoid such issues, the following approach was proposed: Technical drawings (or parts thereof) of food processing machines from the field trips prior to the program are to be included in the lessons. During the field trips, the students are asked to take pictures with their mobile phones. The parts shown in the pictures are later to be discussed in class. The students are supposed to develop an understanding of technical drawings without having to create technical drawings themselves. This approach can teach students how correctly interpreting a technical drawing may reveal more and deeper knowledge than pictures. The acquired skills are also the foundation for process engineering and hygiene, both taught at a later time, to establish an understanding of potential cleaning tasks during food production.

### *6.2.4 Practice-Oriented Food Technology, Food Processing, and Production*

To bridge the gap between theory and practice in the core subject of food processing, the ratio of theoretical training to practical work at the technical center was established at 1:2. The technical special subjects of the electives (part IV) are sorted into seven food groups, three of which are to be chosen for each college based on country-specific and regional demands. For a corresponding specialization, an appropriately equipped technical center must be available. For those teaching tasks, the current teachers must receive additional training to more closely link practice and theory.

### *6.2.5 Example of Linking Theory and Practice in the Technical Center*

During a workshop in spring 2016 in Almaty (Kazakhstan), the following approach of linking theory and practice was demonstrated to the participating teachers and educational delegates with a task to be detailed further in this paper, since it presents a possibility to realize this way of teaching using limited resources.

## 6.3 Curricular Anchoring

The presentation started with the prototype training course for food technicians. Under 6.4.6, the program's curriculum lists the subjects 21a and 21b, Technology of Bakery Production. Among others, the presentation listed the following competencies as aspired learning outcomes:

- The college graduates apply specialized technological understanding in monitoring production workflows.
- They choose appropriate methods to solve pending technological tasks.
- They evaluate advantages and disadvantages of critical methods.
- In particular, the development of new methods.

The following contents are to be taught in the section "Pastry Goods":

- Production methods and production technology for pastry goods
- Discovering the production processes for certain pastry goods

**Table 6.2** Specification of workflow and potential transfer

| Brief specification of workflow | Potential transfer |
|---|---|
| Students correctly prepare devices for the experiment | Students autonomously organize experiments at the technical center and comply with hygiene regulations |
| Students perform the experiment according to the instructions | Students design experiments at the technical center and execute them |
| Pastries produced are evaluated appropriately | Students evaluate products produced by themselves appropriately and according to self-developed schemata (sophisticated sensory technology) |
| Equipment and materials are cleaned hygienically and put away | Students maintain equipment according to the HACCP concept |
| Results of the different groups are diligently logged | Students discriminately record their results and the results of others |
| Theory on foam formation is worked through in teams | Students establish the theoretical foundation from texts |
| Upcoming questions are answered and assessed with the instructor | … and self-critically reflect on their established findings |
| Different results are interpreted with the gathered information | Students interpret newly established insights in new situations |

### *6.3.1 Comparative Work Test*

These specifications served as the foundation for the design of the following tasks for a workshop, created in Almaty in cooperation with German experts. One focal point was a simulation of work with students in the technical center. The concept was based on the comparative work test (Rösch 1987).

**Task:** Compare the listed methods of whisking eggs for foam egg batter using the example of the sponge cake mixture. Based on the test results and theoretical texts, deduct rules for the production of foam egg batter.

This task requires a small technical center. Each group needs a sturdy food processor, a work area, sufficient small appliances, and raw materials (eggs, flour, and sugar). The work sheets needed are provided online (Table 6.2).[1]

[1] http://forum.eduinca.net/

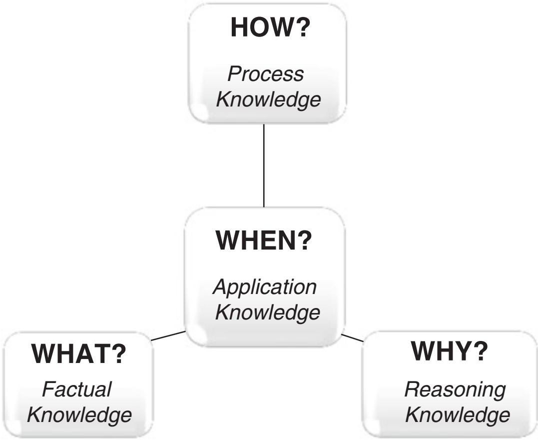


**Fig. 6.3** Action knowledge according to Schelten (2011)

### 6.3.2 *Intended Learning Outcomes*

The learning process can be divided into two levels: On the one hand, students mainly learn manual methods at stations 1–5. Simultaneously, they learn about different processes during pastry production (“Discovering the production processes for certain pastry goods”) while “assessing advantages and disadvantages of crucial methods…” by comparing results. Subsequently, they can “…choose appropriate methods to solve pending technological tasks…” and potentially develop new methods. Up to this point in the learning process, the students only learn different methods without addressing the deeper reason for the action and/or interpreting the results. Within the concept of action knowledge (Schelten 2011, 3; see Fig. 6.3), the students’ comprehension level up to this point is merely process knowledge, amended by factual knowledge. For a sophisticated vocational training that links theory and practice, reason knowledge is needed to replenish the other types of knowledge to form application knowledge.

However only application knowledge allows for a “…specialized technological understanding in monitoring production workflows….” It is crucial for the students to understand the theoretical foundation of their actions, i.e. develop the so-called reasoning knowledge. In this example reasoning knowledge is gained by the foam formation of egg protein. The students understand the theory of foam formation using the work sheet and subsequently assessing their understanding. It is very important that the results of the experiment cannot be interpreted directly from the offered text. The work materials merely prepare the “next developmental zone” according to Vygotskij (2002). Interpreting the results from the experiments is only possible after the taught theory is thoroughly understood. This allows the students to develop a broadened understanding of the interconnections between theory and practice.

## 6.4 Conclusion

A modern and promising education in food production and food technology can only be achieved by permanently linking theory and practice on all levels of the educational process. The examples illustrated present one possible approach. The comparative work experiment, deducting its conceptual formulation from professional practice and achieving its results using scientific methods (Horlacher 2015), is particularly suitable for implementation in a technical center. The skills achieved constitute action knowledge (Schelten 2011), representing the constitutive element of professional self-conception.

In general, these approaches have to be refined according to regional specifications which are rather diverse in the states of Central Asia and as well differ in comparison to the situation of TVET in Germany. The conception of appropriate experiments reflecting regional peculiarities is very important for vocational colleges.

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