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Integrated and interactive workbook for fostering the visibility of interconnectivity of disciplines in food science

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Abstract

Food science explores the fundamental relationships between the quality of food and its processing, as well as the effects of diet on health. Food chemistry and food analysis are two core disciplines needed to understand the complexity of food science. The integrated und interactive workbook developed at ETH helps to make the interconnectivity of disciplines visible. With theory texts, interactive videos, electronic dictionaries and quizzes for each individual chapter, the workbook promotes students' active engagement and participation in the learning process inside and outside the lecture hall. Three different formats of the workbook, namely an e-textbook, a web-based platform and a mobile application, will be developed. These digital technologies create flexible learning spaces, can be used in flipped classroom settings, and support students' academic learning process.

1   Introduction

Food chemistry and food analysis are two closely related fields central to food science. Both are essential for understanding the composition, properties, and safety of foods, and they provide basic knowledge that is important for the understanding of other disciplines in food science. At ETH Zurich, the Laboratory of Food Biochemistry of Professor Laura Nyström is responsible for lectures in food chemistry and food analysis. During their Bachelor's degree studies, food science students attend the lecture series Food Chemistry I & II and Food Analysis I & II as well as the basic Food Chemistry Laboratory Course. Unfortunately, students often find individual lecture courses to be isolated entities and do not immediately see links between the different lecture series. The integrated and interactive workbook presented here aims at supporting students' learning in several consecutive semesters, offering several opportunities to link their newly learned content to concepts and themes learned in previous semesters and associated lectures.

2   Workbook structure and content

The workbook will be structured similarly to the lectures in the different disciplines during the semester. For food chemistry, this structure draws on themes involving the main food components, namely lipids, proteins and carbohydrates. Additional topics, e.g. aroma substances, vitamins and food additives, are also included. Food analysis will be structured according to the different analytical methods that are discussed, including multiple spectroscopic and chromatographic techniques and enzymatic analysis methods. The advantage of the workbook structure is that the entry portal of the workbook can be designed

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separately for each course so that the sections are organized and arranged according to the mental logic needed for that topic.

The workbook contains independent thematic modules, where individual text parts can be combined in a tailored order to fit specific needs. Written theory parts are combined with topic related videos, whenever possible in an interactive format. These videos are either self-made or from open access resources. Additionally, the workbook includes multiple choice questions after each individual thematic chapter. These questions lead the students through the whole field and emphasize the most important points. The developed resource of teaching materials guides students throughout the semester and can be used to prepare for exams.

3   Instructional design

Multiple formats of the workbook will be developed. Its content, with all relevant theory parts, exercises and additional material such as interactive videos, schemes and figures, will be collected first in two e-books (in ETH PolyBook format). There is a debate about students' preferences regarding the materials they use to learn scientific content. Studies have shown that students still prefer textbooks to e-books and only accept e-books if there is an additional benefit (Sieche, Krey & Bastiaens, 2013; Allred & Murphy, 2019). Therefore, the e-book developed here contains not only theory text, but combines text with interactive videos, schemes and figures. It also includes vocabulary assistance, i.e. text narration and dictionary/glossary searches, as well as relevant quizzes. It therefore profits from all the advantages an electronic book has over a traditional textbook. To adapt to the modern technologies that are available today, the e-book content will in the future be further transformed into a web-based e-learning platform and, if possible, into a mobile application.

3.1   E-book

The Educational Development and Technology group at ETH Zurich offers various digital learning tools directly linked to Moodle, the learning management system at ETH Zurich. Using PolyBook, long documents like lecture scripts etc. can be created in a digital and attractive form. With existing lecture material on food chemistry and food analysis, two PolyBooks will be created. For each chapter, exercises with multiple choice questions and excursus to related fields (e.g. organic chemistry) will be added. Thematically connected topics will be linked within the PolyBooks Food Chemistry and Food Analysis; this will help the students to understand important links and relationships.

3.2   Web-based platform

Even though the use and the acceptance of e-books and other mobile devices in higher education is increasing, there are some disadvantages to e-books (Waller, 2013; Fojtik, 2015). The major disadvantage is the reluctance of both students and faculty to switch from printed books to e-books (Waller, 2013). To overcome the possible disadvantages of e-books, the content of the two PolyBooks will be transferred to a web-based e-learning platform. The idea is to create two different entry pages for Food Chemistry and Food Analysis, respectively. From there, topics can be selected and students will be guided through related fields. In this format the links between the two disciplines can be made even more visible, and will be a great resource which helps students to become experts in food chemistry and food analysis.

3.3   Mobile application

If the web-based e-learning platform is well accepted by the students, it will be further developed into a mobile application. This will give students the opportunity to use the material on their mobile devices, including mobile phones and tablets, and make the resource even more flexible than the web-based platform in terms of studying time and location.

4   Expectations

4.1   Didactics

The workbook supports independent and self-directed learning (Rockinson-Szapkiw et al., 2013; Henderson, Selwyn & Aston, 2017; Gray and DiLoreto, 2016; Pinto & Leite, 2020). Students can decide on their own how much they want or need to use the workbook. With all the material provided, including interactive videos and quiz questions, the workbook facilitates active learning, because the students need to critically evaluate their own needs and will therefore evolve into independent and confident learners.

4.2   Students' view

Students can use the workbook at any time and place, also offering them flexibility when studying outside of the lecture hall. The workbook will include short summaries of theory and explanations of the most important terms and concepts; exercises to be carried out as part of interactive sequences in lectures or as homework; and self-study material for use during the semester and for exam preparation. All this material will support the students in active learning. Furthermore, the students will be able to reflect on their performance at any given time during the course via self-study materials, and via assessment using graded tasks and quizzes.

4.3   Lecturers' view

The workbook serves as an additional resource for students during the semester. Lecturers can use the content in class, or just refer to it and advise their students to use it for independent study. The main advantages of the teaching material resource developed are that it can be utilized in several ways; be assembled in different combinations for various purposes; and be updated easily, facilitating the preparation of study material for lecturers. This also guarantees the use of the workbook over multiple years.

5   Conclusions

Food chemistry and food analysis are two highly interconnected disciplines in food science. The links between these two subjects are not always visible to students, particularly because they are taught as individual lecture series. The workbook presented here can be used to illustrate the connections between these two disciplines and help students to better understand and follow the lectures. Overall, the integrated and interactive workbook supports food science students in learning the key concepts of food chemistry and food analysis by providing them with inspirational and high-quality study material which facilitates active learning.

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