Teaching animal breeding digitally in professional agricultural education

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Introduction

During the past 20 years new developments in molecular and quantitative genetics have strongly influenced the animal breeding industry. Large scale molecular screening techniques have become standard procedure and quantitative genetic methods have been developed to use this DNA information in breeding value estimation. Simultaneously, improved artificial reproduction methods were developed, which made it possible to have much larger number of offspring of elite parents and at a much earlier age. Altogether, these improvements have accelerated significantly annual genetic improvement in the animal breeding industry. Furthermore, population genetic methods to avoid inbreeding in small populations have been optimized, which, in combination with improved cryo-conservation techniques, allow for a better conservation of small and endangered populations. Ultimately, all these developments are continuously influencing the animal breeding industry, but also the work of individual people involved in breeding, data collection, and decision making such as farmers, people working in the farm and companion animal industry, or hobbyist owners of animals. It is, therefore, important that these people are aware of important developments in breeding and conservation of animal (populations) and their applications.

In the Netherlands, students go to schools for professional agricultural education to become a farmer, to work in the breeding industry, in a pet shop or as assistant of a veterinarian. Up to date teaching material is essential for successful education. In The Netherlands, however, there appeared to be a time lag of approximately 20 years between the theory taught in professional agricultural education and the developments in animal breeding research with its applications in the industry. In addition, the teaching methods are not very appealing to the students because they do not represent situations that can be easily recognized. At present, teaching methods may start with the theory of Mendel and then immediately introduce statistical formulas to estimate heritabilities and simple breeding values. Although in theory this may be correct, it is far off the daily reality and interests of the students. Nowadays, the use of laptops in the class room is customary in professional agricultural education in The Netherlands. For many courses the teaching material can be downloaded from the web, where an important source of electronic teaching material is made available by the Institute for Development of Education Material in the Agricultural Sector that schools can subscribe to. Until recently, no digital teaching material was available for animal breeding courses.

The aim of this paper is to present a digital method for teaching practical animal breeding in professional agricultural education. The method can be easily updated, to facilitate rapid

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introduction of new developments into education, and geared to the perception of the students' environment.

Material and methods

The student. Different target groups in secondary agricultural education exist: traditionally, students willing to become a farmer or employee in the (breeding) industry participate in this type of professional education. Nowadays, also many students aiming for a career in companion animals and horses join these potential farmers in the classroom. General experience is that students are only interested in one or only a few animal species. A farmer's son usually is not interested in examples from cat breeding and a typical 'horsey girl' usually is not interested in examples from commercial chicken breeding. It is important to take these differences in interest into account in the teaching to stimulate interest in the theory.

The teaching methodology. In the Netherlands a new method for education in biology in a continuous didactic route from 4 to 18 years of age is introduced: the context-concept method. It is based on the description of a practical situation and actual questions from that practice: the context. The questions in the contexts activate and stimulate the students to study relevant but short parts of the theory: the concepts. Students, especially those in professional agricultural education, are not keen on reading. The concepts, therefore, should be cut into short pieces of text, focusing on a specific detail. In our teaching material the assignments consist of brief descriptions of practical situations in animal breeding, followed by a relevant question, and digital links to relevant short pieces of theory.

Easy update. Even though it is possible on request, the teaching material generally is not made available in print because of the digital learning environment. This makes it very flexible for updates and additions. In the future new developments in animal breeding can be easily introduced into teaching.

Results and Discussion

In the opening screen the student starts by choosing the desired animal species. Then a list describing a number of assignments is presented to the student. To find the way towards the answer he/she should read and understand the linked relevant general and species specific concepts. The answers are provided in a separate document and only available to the teachers. Box 1 gives an example of the context-concept method for a student with the ambition of working in the pig breeding industry or becoming a pig farmer.

Name of the context: What is the role of a great grant parent (GGP) sow in a pig breeding nucleus system?
Description of the context: In a pig breeding nucleus system the sows in the dam line produce on average 26 piglets weaned per year. Heterosis leads to an extra piglet weaned in the crossbreds parent sows. In the dam line from each GGP sow 6 GP female offspring is selected annually. All sows in the nucleus pyramid produce two litters per year.
Practical question to be solved: What is the number of fattening pigs produced annually by a GGP sow?

Concepts to be used: General theory: cross breeding, heterosis; Species specific theory: set up of a nucleus breeding scheme

Answer (only available to the teacher): Each GGP sow produces annually 6 GP (grant parent) sows which produce each 13 (i.e. 26/2) crossbred PS (parent) sows annually. These 13 PS animals produce 27 (i.e. 26 + 1) weaned piglets per year which are used as fattening pigs. So per GGP sow 6*13*27=2106 fattening pigs are produced annually.

Box 1. An example of an assignment using context and concepts for a student with the ambition of working in the pig breeding industry or becoming a pig farmer.

Table 1 presents an overview of the concepts, divided into main subjects and the related concept subjects. Concepts can be divided into general and animal species specific theory. The general theory concepts (n = 75) can be used for teaching animal breeding in (almost) all animal species, whereas animal species specific concepts (n = 274, varying from n = 16 for cats to n = 43 for chicken and for horses), such as the structure of a breeding program, are used within an animal species.

Contexts are species specific (n = 159, varying from n = 6 for cats to n = 32 for cattle). They can be divided into the general themes health, performance, reproduction, behavior, color inheritance, cross breeding, organization of a breeding program, and conservation genetics. Contexts related to these general themes are available for each of the species when practically relevant. For example, a context about coat color inheritance is available for cats, horses, and fish, but not for cattle and goats. Contexts are available for cattle, pigs, chickens, goats, sheep, horses, dogs, cats, and fish.

Table 1. Overview of the concepts, divided into main subjects and related concepts.

Main subject	**Concepts**
Terminology	Genetics, DNA, genes, alleles, inheritance, and genetic variation
Choices related to	Domestication, adaptation, species and breed, genotype*environment interaction, heterosis, line and pedigree recording
Decisions	Breeding goal, heritability of traits, recording of performance and traits for selection purposes
Organization	Breeding program, selection paths, inbreeding, cross breeding, herd book functions, structure of commercial breeding programs
How to select	Traits, breeding value and accuracy, selection on markers, genomic selection
How to affect	Genetic improvement, selection intensity, generation interval, mating systems
How to manage	Small populations related to genetic diversity between and within breeds, conservation, gene bank

Additional information provided. In addition to the assignments the opening screen provides links to the websites of the Knowledge base Rare Breeds Farm Animals, the Animal

Breeding and Genomics Centre of Wageningen University, and the Institute for Development of Education Material in the Agricultural Sector. The website of the Knowledge base Rare Breeds Farm Animals is a web based application that offers amongst others articles from scientific and professional journals, congress proceedings, handbooks and power point presentations at seminars with relevant knowledge on the management and conservation of genetic variation in small populations. The historic and recent knowledge in this base can be used by teachers to update their knowledge and by students who perform an in depth study. The website of the Animal Breeding and Genomic Centre of Wageningen University and Research Centre website gives information on ongoing research which maybe of interest for teachers. The website of the Institute for Development of Education Material in the Agricultural Sector provides an electronic content catalogue with education material available in the relevant disciplines including animal breeding..

Conclusions

First experiences. The digital teaching material has been developed in 2008-2009. It has been tried out by 2 teachers, after which some adjustments were made. It has recently been presented to a group of 25 teachers. They were very enthusiastic about the context – concept approach and species differentiation. They concluded that the method can be used in the class room, in group learning processes and in individual training programs for students. They provided some comments based on which the number of contexts was expanded with more practical cases about farm, companion animal and horse breeding. For the species cat and fish the number of contexts and species specific concepts was considered too limited. This part of the learning method will be expanded in 2010.

Plans for the future. Apart from an annual update of, and new additions to, the contexts and concepts, there are plans to expand the material with contexts and concepts at BSc level. Financing for this expansion will be applied for in 2010. The material is available in Dutch and many contexts may be only applicable to the specific situation in the Netherlands. It would, however, be possible to translate the material into English and make it available internationally. Keeping the material updated and expanding the number of concepts and contexts in interaction with the users guarantee an up to date source of teaching material.

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References (in Dutch)

Knowledge base Rare Breeds Farm Animals: **www. http://library.wur.nl/cgn/**
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