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STATISTICS IN BRITISH AND CZECH BIOLOGY TEXTBOOKS

Abstract:

The Czech biology textbooks contain almost no graphs, tables and figures, despite the fact that biology is an exact science. In contrast to British textbooks that include this interdisciplinarity. British textbooks are full of charts, tables, and even contains some statistical tests. This fact points to the diversity of approaches of Czech and British teachers to teach biology and the interdisciplinary. The aim of this article is to determine the differentiation between the approach of teaching biology in the Czech Republic and Great Britain. At the conclusion will be drawn several proposals to change the Czech approach to teaching biology.

Keywords:

Statistics, teaching biology, interdisciplinarity

JEL Classification: I21

Introduction

Objectives of the education approach are becoming more or less uniform. The achievement of the objectives is tested by various international comparison methods as PISA, TIMSS, etc. One would assume that if European countries have similar objectives of education and learning outcomes are tested by means of the same tests, then their approaches to learning and even textbooks look similar. But at first glance British and Czech textbooks differ significantly.

This brief comparative study aims at highlighting the differences between British and Czech textbooks.

Methods of research

Content analysis became the principal point of the qualitative research. Selected Czech and British biological textbooks were analysed. This content analysis focused on the used charts, tables and statistics. The work analysed the following biological textbooks for secondary schools (see Tab. 1 and Tab. 2).

Table 1 Selected British textbooks

Name of text book	Reference
A2-Level Biology	Burrows (2012)
GCSE science: higher	Brodie (2006)

Table 2 Selected Czech textbooks

Name of text book	Reference
Human and nature – Air	Dietrich (2005)
Human and nature – Health	Klepel (2005)

Commonly used Czech biological textbooks do not contain any charts and tables with data. But there is an edition of integrated science textbooks published by Fraus which found its influence in pedagogical constructivism. Therefore, those textbooks were selected for the comparison and content analysis. The fact that these textbooks contain similar topics as the selected British textbooks written by Burrows (2012) and Brodie (2006) comprises another reason to include them in the comparison.

Statistics in British biological textbooks

The textbook by Burrows (2012) contains many pieces of information regarding data processing. The first chapter focuses on the process of science – how to develop theories, testing the theories, communicating the results, validating the theory by means of more testing and how to reject or accept a theory. The chapter also concentrates on reliability, drawing conclusions from data and also decision making. This chapter provides a very useful material for students because the following chapters work with charts, tables and statistics. It introduces students to working with data and thinking about data. There is an appendix in Burrows (2012) which explains how to deal with answering data questions. This part aims at describing data with charts and tables, drawing and checking conclusions, explaining the evidence, commenting on their reliability and analysing data. It explains to students how to deal with exam test focused on answering data questions. The Brodie textbook (2006) does not contain a similar introduction or appendix but it also works with charts, tables and statistics.

In general both British biological textbooks contain charts, tables and also statistical terminology:

Charts

Both analysed textbooks contain many charts for the representation of various situations. Specifically, time series are very often described by charts (e.g. Fig. 1 and Fig. 2). Another type of chart is a chart describing the dependence of two variables. This chart usually contains a line of best fit.
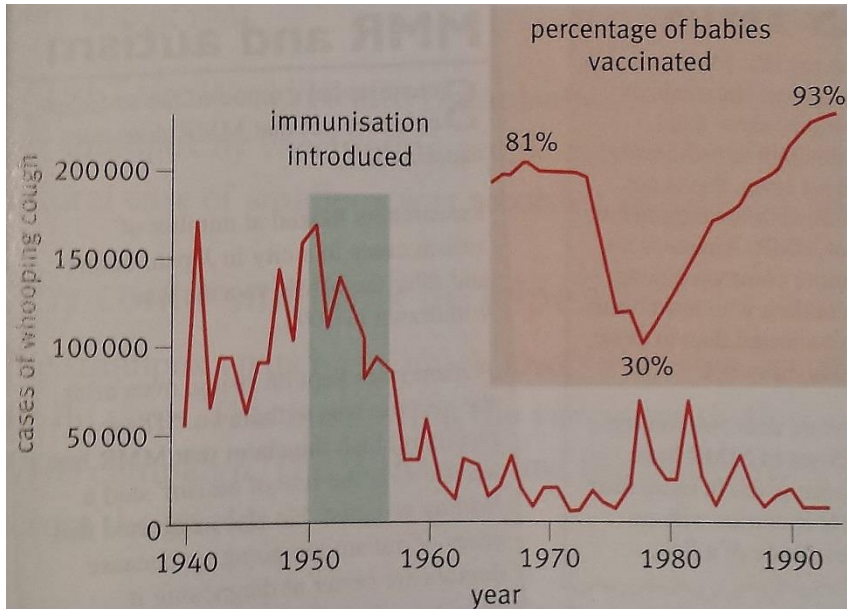

Figure 1 Time series – Chart showing the number of whooping cough cases in the UK each year between 1940 and 1922   Source: Brodie, 2006
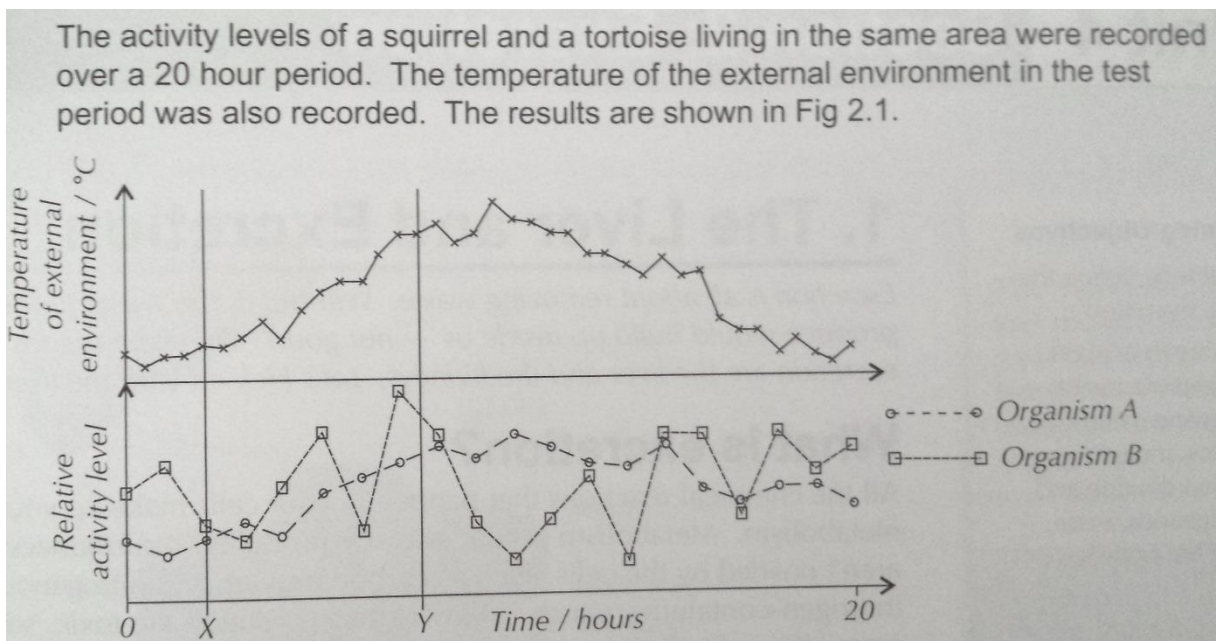

Figure 2   Time series – Chart describing the activity levels of a squirrel
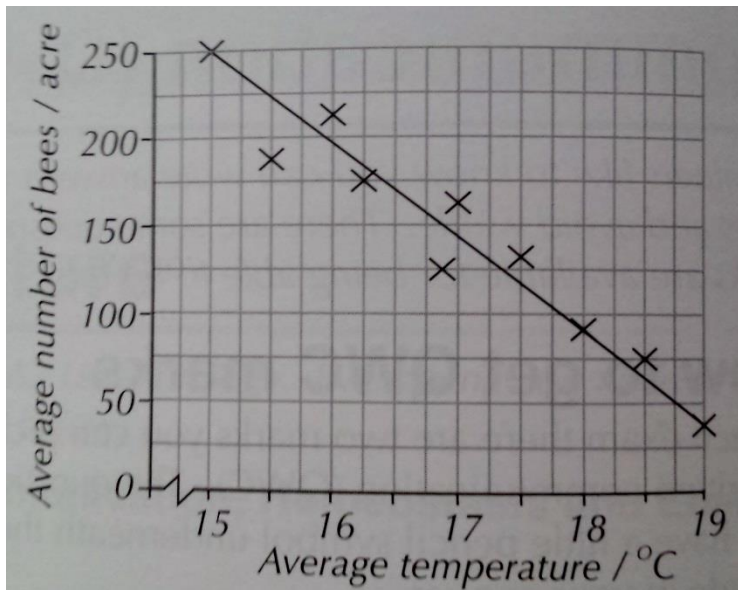*   Source: Burrows (2012)*

Figure 3 Chart used for explaining correlation   *Source: Burrows (2012)*

Tables

British textbooks also use tables to show data or data summary. They use one-dimensional or two-dimensional tables. An example of using tables in practical questions arises in Fig. 4. Both British textbooks contain a lot of tables to show students data.

Haemophilia B is caused by a mutation in the gene for the blood clotting factor IX (FIX). Sufferers usually have FIX levels less than 1% of normal values, causing frequent bleeding and often early death. Increasing levels to greater than 1% can greatly improve patient health. Treatment usually involves FIX injections multiple times a week, which is expensive and inconvenient. A trial has investigated the use of somatic gene therapy to treat haemophilia B. Six patients were injected with a virus carrying the normal FIX gene. Some results are shown on the right.

Q1 Explain the role of the virus.
Q2 Calculate the average maximum FIX level after gene therapy.
Q3 Was the trial a success? Give evidence to support your answer.
Q4 Describe the possible advantages and disadvantages of this treatment.

Patient	Maximum FIX level (% of normal) after therapy
1	2
2	2
3	3
4	4
5	8
6	12

Figure 4 Practical questions using tables   *Source: Burrows (2012)*

Statistical terminology

British textbooks use statistical terminology. These include terms from descriptive statistics as mean, mode, median, standard deviation, variation and error bar. But they introduce more difficult concepts as well, such as χ^2 test, reliability, sampling, methods for investigating populations.

Statistics in Czech biological textbooks

No charts and tables made it into standard Czech biological textbooks. Textbooks are conceived transmissive. The influence of constructivism is obvious in the edition of the Fraus publisher, which presents the curriculum of natural sciences in an integrated way.

Czech textbooks do not contain any introduction to data analysis. And they do not focus on chart and table skills either. Both the analysed Czech textbooks contain only few charts and tables. Tables are mainly one-dimensional. The books provide no deeper view into understanding data.

Despite the facts mentioned above, the textbooks contain a number of tasks and experiments that require the ability to create a table or chart and also working with data. Following is an example of such a task: "*Measure pressure, humidity and air temperature three times a day, always at the same time. Perform the measurement for a whole month. Create a table and graphically show the results of their measurements. Discuss with classmates.*" (Dietrich, 2005).

The statistical terminology used proves narrower than in the British textbooks. No more terms than mean and variation appear in the Czech textbooks.

Conclusion

Finally, we will present the most important findings and recommendations for Czech authors of biological textbooks. Czech biological textbooks are predominantly transmissively conceived. The influence of constructivism clearly shows in the integrated textbooks of the Fraus publisher.

Chapters focused on chart and table skills and also on data processing prove very useful because students have to pass exams containing questions on understanding and drawing charts as well (Burrows, 2012; Brodie, 2006). Besides, PISA testing contains this kind of questions. That constitutes another reason for a change in attitude among authors of Czech biological textbooks. Czech students have no good results in PISA in the questions regarding the methodology of science.

To improve these skills, inquiry based learning is implemented into Czech primary and secondary schools. However, it is also important to include this change into the curriculum. Clearly, this task proves long-term in its character.

Acknowledgement

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