

Evolution, Teaching and Assessment of Students in Pre-Service Primary School Teacher Education.

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Abstract

This project aims at assessment of learning outcome of teaching evolutionary theory to pre-service primary school teacher students. The quality of the students understanding and use of evolutionary theory after their participation in seminars and lectures was made by analysing written reflections of the students. The texts were primarily written by students to show that the knowledge requirements of the course were accomplished but they were here used to analyse their ability to communicate the content but also to evaluate the depth of their understanding of evolutionary theory. For this assessment two different methods were used aiming at the two different targets. One was focused on the students' use of evolutionary terminology and to what extent they used the language of an evolutionist. Here, we also analysed whether the students gave accurate explanations or descriptions without using the traditional evolutionary terminology. Thus, mainly the students' ability in their own writing to present evolutionary reflections in an everyday language was here investigated. This ability may be useful when teaching young students without using a theoretical framework. For the assessment of quality of the students' own understanding of the theory Doll's criteria, the four R's, richness, recursion, relations, and rigor, were used. Richness refers to the depth, the layers of meaning in their texts. Recursion is here referring to the students' use of making thoughts loop back on themselves and earlier experiences. The use of relations are important when developing thinking in different areas. Here, both the students' references to relations to other persons as well as to objects, theories, places etc. were recorded. Rigor means in this context to purposely look for different alternatives, relations, connections, new combinations, interpretations and patterns.

The results may briefly be summarized as follows: 1) most of the students use evolutionary terminology and 2) are fairly good at presenting their thoughts within the theoretical framework in everyday language, although 3) they often show problems in distinguishing processes on molecular, individual, and population levels.

1. Introduction

The difficulties in understanding theories of evolution has previously been described [1, 2]. These difficulties include misconceptions of the terminology used in explaining evolutionary theories and the common mix of individual and population concepts in describing evolutionary processes. Since Swedish teachers in primary school have to teach evolutionary theory in school a larger emphasize should be put on teaching of evolution during teacher training. One of the aim of biology education in the Swedish compulsory school is that the student should get an "insight into the world view of science with the theory of evolution as a foundation". In the curriculum for the compulsory school [3] year 6, one of the core contents is: "Development of life and adaptation of organisms to different habitats" and the knowledge requirement is: "pupils can talk about the development of life and give examples of the adaptation of organisms to different living environments". This represents high requirements on a teacher in primary school and demonstrate that biology education of teacher students should emphasize knowledge of evolutionary theory. In order to measure the students' capability to write reflections concerning evolution we analysed written report and investigated the use of evolutionary concepts. We also evaluated the proper use of the concepts.

2. Methods

Students in primary school teacher education taking a course in natural science for eight weeks were asked to write a short meaningful and thoughtful reflection about evolution. The reflection should contain argumentation of why or why not accepts the theory. The 39 written reports were analysed by scoring 20 different biological and evolutionary concepts used by the students. The written reports were analysed by scoring the number of concepts used in the explanation of evolutionary theories. The chosen concepts included both strict evolutionary terms and more general biological terms. We wanted to see if a student using the typical evolutionary concepts also used other biological concepts

more often compared to other students. The student reflections were studied in order to analyse the use of adaptation, random, natural selection, variation and selection as typical evolutionary concepts. We also used Doll's criteria, the four R's [4], to evaluate the evolutionary knowledge of the student.

3. Results

Twenty two different concepts were scored in the 39 students written reflections about evolution. Twelve of the students used the concepts ten or fewer times in their reports, whereas eleven students used the concepts more than twenty times. The others used the concepts between ten and nineteen times. The most common concepts were "species", "development", "family", and "generation" used 121, 52, 42, and 39 times respectively. The least used concepts were "inherited", "pool" and "population", used 1, 2, and 2 times respectively (Table 1).

Biological concepts						Evolutionary concepts	
Genes	14	Family	4	Hereditary	1	Adaptation	32
Development	50	Genera	42	Trait	22	Natural Selection	14
Generation	39	Species	121	Origin	15	Random	14
Inheritance	10	Mutation	10	Population	2	Variation	19
Environment	32	Heredity	5	Pool	2	Selection	6

Table 1. *The number of concepts found in the students reflections*

As expected, the students using the highest number of concepts, also used the highest number of evolutionary concepts in their reports. The students were arranged in four groups depending on the number of evolutionary concepts, with 0, 1, 2–3, and 4 or more used. These groups were analysed by usage of 15 general biological concepts such as development, species, environment etc. Fig. 1 shows the average usage of the different kind of concepts in each group.

The result shows that there is a correlation between use of evolutionary concepts and the use of biological concepts up to a certain level. Students using a large number of evolutionary concepts seem to diminish the use of biological ones although their total number of used concepts are larger.

When analysing the quality of the texts by using Rigor, Richness, Recursion and Relation we found that the text using many concepts had most of the 4 R's indicating a broader knowledge of evolution. However, some students lacking concepts still had good understanding of the theory of evolution.

Some of the students were mixing Darwinist and teleological theories describing natural selection and adaptation as a voluntary action rather than a random event. One example is: "The stronger, alternative most inventive individual wins." Another example is "since monkeys should not eat fruits before they are ripe, the fruit developed and became colourful before it was good to eat." A large number of students were referring to the difficulty of understanding the long period of evolution and mentioned their thoughts of how to visualize the time scale to school children. Several of them described an exercise where they used a scale of 15 meters measuring the time of evolution from the big bang to modern time and how recent humans evolved.

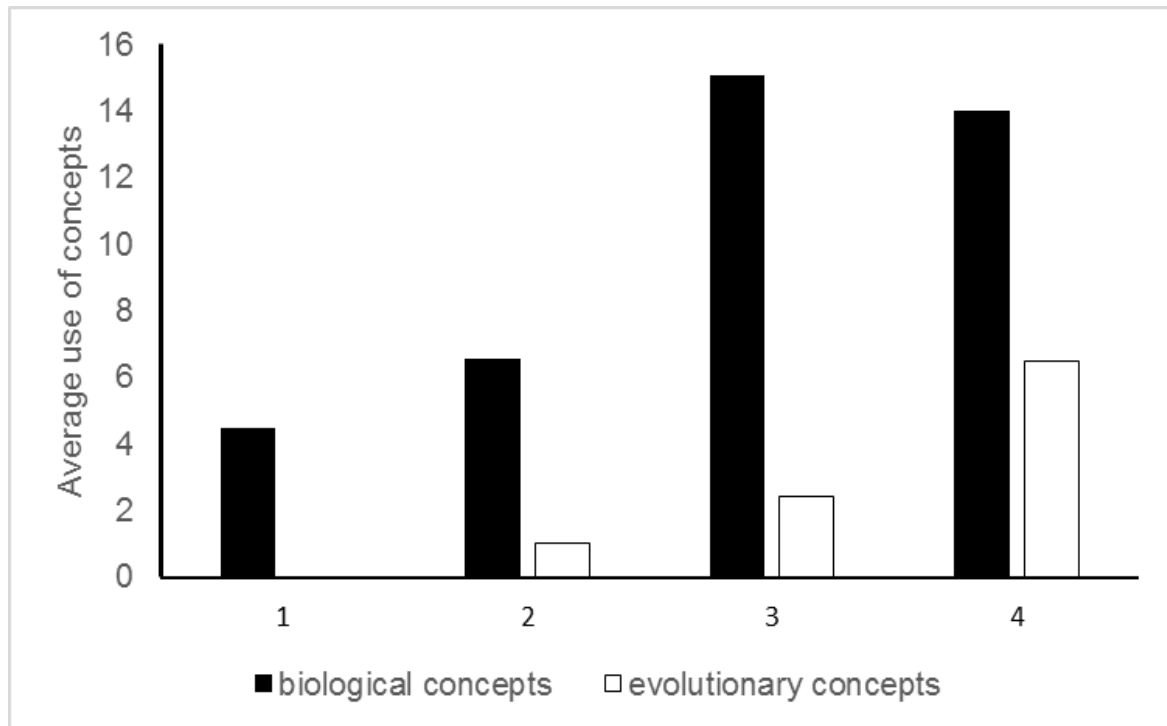


Fig.1. Number refers to students arranged in four groups depending on the number of evolutionary concepts, with 0, 1, 2–3, and 4 or more used.

4. Discussion

Knowledge of evolution as basic knowledge requirement for education in biology in school, is expressed in the Swedish curriculum for compulsory school [3]. Thus, teacher have to have a good knowledge of the theory and be well prepared to critical analyse different evolutionary presentations. One important skill is the use of a varied vocabulary adapted to the evolutionary context. As this study shows, there seem to be a lesser need to use general biological concepts if the writer/speaker is comfortable in using the evolutionary ones. On the other hand, the number of students using the evolutionary vocabulary is limited. This may be a challenge for future education. It is probably necessary to make all biology evolutionary [5] or, which is worse, try to clearly discriminate between evolution and other biology.

References

- [1] Alters, B. J. & Nelson C. E. (2002). Teaching evolution in higher education. *Evolution*, 56, 1891-1901
- [2] Smith, M.U. (2010) Current status of research in teaching and learning Evolution: II. Pedagogical issues. *Science & Education* 19:539–571
- [3] Skolverket (Swedish National Agency for Education). (2010). *Curriculum for the compulsory school, preschool class and the recreation centre 2011*. Stockholm: Skolverket
- [4] Doll, W. E., Jr. (1993). *A post-modern perspective on curriculum*. New York: Teacher College Press.
- [5] Mutvei, A. & Mattsson J.-E. (2014) Big ideas in science education in teacher training program, *Procedia - Social and Behavioral Sciences* 167 190–197. The XVI International Organisation for Science and Technology Education Symposium (IOSTE Borneo 2014)