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Decline in Interest in Biology among Elementary School Pupils During a Generation

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A decline in biology interest has often been claimed but seldom with an empirically substantiation. This study was based on a sample of 3rd and 4th grade pupils within the same geographical area as Löwe's (1987, 1992) previous results from southwest Germany from the year 1983. We used a four-point Likert-type questionnaire to assess interest with 30 items (zoology, botany, human biology). Here we show for the first time, that elementary school pupils have lower interest in biology than one generation before. This decline between 1983 and 2011 was about 10%, with only 3% in zoology and 12% in botany. As interest is an important variable, programs should be developed to foster pupils' interest already on the primary school level.

Keywords: decline in interest, botany, zoology, human biology, generational trend

INTRODUCTION

Interest is among the most powerful variables explaining achievement and motivation in educational research in general (Alexander *et al.* 1995; Hidi, 2006), and in science or, specifically, biological education (e.g., Randler and Bogner, 2007). Further, interest is amongst others one facet of intrinsic motivation, and motivation, in turn, is needed to foster learning (Deci and Ryan, 1985). There are some survey studies about interest in biological education, addressing various aspects spreading from gender differences (Elster, 2006, Uitto *et al.*, 2003) to international comparisons (Schreiner and Sjøberg, 2004) or focusing on developmental aspects by cross-sectional studies (Löwe, 1992).

Gender differences have been reported in some studies. For example, Jones *et al.* (2000) found gender differences in 6th grade students. Girls were more interested in AIDS or in eating to stay healthy than boys, who reported more interest in technical aspects. In young elementary school pupils, when given a choice,

boys tended to choose to work in the physical sciences, and girls in the biological and social sciences (Adamson *et al.*, 1999). In most studies, girls had a higher interest in biology and in particular in botany or human biology (Elster, 2006, Uitto *et al.*, 2006, Dawson, 2000). However, some studies found no gender differences in interest and attitude towards biology. In particular, girls and boys from 3rd and 4th grade did not differ in their interest concerning amphibians (Randler *et al.*, 2005). Also, Baram-Tsabari and Yarden (2005) reported no gender differences in self-generated questions relating to 'Human biology', 'Zoology', and 'Botany' in a large sample from Israel.

Developmental or ontogenetic aspects based on age and/or grade levels have been conducted in some cross-sectional studies, and most of them found a decrease in interest (or attitude towards biology) with increasing age or grade level (Löwe, 1992, Prokop *et al.*, 2007). These changes were sometimes subject-specific and interest in human biology increased while interest in zoology decreased (Baram-Tsabari and Yarden 2005).

There were some differences within general biology when looking at different subjects and topics. For example, Korean pupils rated genetics, reproduction of animals, evolution, morphology of animals, and human biology as most interesting (Hong *et al.*, 1998).

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State of the literature

- Interest is a powerful variable in Science and biological education.
- Previous studies showed that there is a difference between boys and girls.
- Also there are developmental aspects with a decline in interest right from the primary school level.
- Only one intergenerational study by Dawson (2000) found a decline in interest over two decades.
- Many studies postulate a decline in interest without any empirical backup with data.

Contribution of this paper to the literature

- We here show for the first time that there is a decline in interest in biology in elementary school pupils over a time span of about thirty years, which is approximately one generation.
- This decline is the size of about 10%, but is lowest in zoology.
- Further, we found lower interest scores in 4th graders compared to 3rd graders, and we report gender differences.

Human biology and environmental topics were reported as most interesting in older pupils (e.g., Finke, 1998) while Vogt *et al.* (1998) mentioned zoological aspects (whales, bats, and birds) as topics of highest interest in sixth graders. Hemmer and Werner (1976) found zoology, human biology, and botany the most interesting topics. Tamir and Gardner (1989), Löwe (1992), and Finke (1998) noted high interest in human biology and environmental aspects. Most of these studies were based on questionnaires with closed questions. However, in open question, children and adolescents asked many questions related to zoology (72%), emphasizing its importance in contradiction to human biology (Baram-Tsabari and Yarden, 2005). Therefore, it seems to have an influence whether Likert-scale type questions were used or open-ended questions.

However, one aspect which is often claimed, but seldom backed up with empirical data, is a general decline in interest in science (Dawson, 2000; Osborne *et al.*, 2003). Dawson (2000) showed that interest in science between 1980 and 1997 decreased in grade 7 in South Australia. Specifically, the interest scores in biology (20 items) decreased from 3.09 to 2.91 in boys and from 3.35 to 3.14 in girls based on a five-point Likert scale. In Osborne *et al.*'s overview (2003), a decline was found in numbers of students choosing to study science but there was no immediate comparison as in Dawson's (2000) study. Thus, there is only one source with quantitative empirical data that analyses

differences in interest in biology between two decades (Dawson, 2000) using a similar questionnaire.

In this present study, we investigated the decline in interest in biology within one generation. For the first time, this was made for elementary school pupils, and for the second time, we compare differences over a long time span (more than one generation).

METHODS

Löwe (1983 and 1987 cited in 1992) made surveys about interest in elementary school pupils the year 1980 in the "Metropolregion Rhein-Neckar" centering around the cities of Heidelberg and Mannheim, Germany from March to April. We have repeated this survey from March to July 2011 (by Janina Osti) using basically an identical questionnaire. In 2011 127 boys and 132 girls from 5 different schools and from 18 different classes participated in this study. There were 137, 3rd and 122 4th graders. In the original study of Löwe (1983) there were 495 pupils (222 girls, 273 boys) from 6 different schools and from 24 classes. The pupils were tested in their normal classroom setting and informed consent was obtained from the pupils, and written consent from the parents. Teachers and principals agreed to carry out the study. Interest in zoology (10 items), botany (14 items) and human biology (5 items) were calculated according to Löwe (1987). The addition of all questions and one question about the likeness of "MeNuK", which is the subject that covers biology and other scientific disciplines in grammar school, lead to a total score of interest in biology (30 items). The questionnaire was based on a Likert-scale rating from 1 to 4 and higher values correspond to higher interest. No item was inversely coded. The Cronbach's alphas were 0.89 for the total scales, 0.88 for botany, 0.68 for zoology, and 0.64 for human biology. For comparison with Löwe's data, we used a one-sample T-Test, for comparisons between gender and grade in our present sample, we used a Student's T-test, and for comparison within subjects (e.g. when comparing interest in zoology with botany), we used a matched-pair t-test. In the following results, we depict mean \pm SD. Significance levels were set at 5% (two-tailed).

RESULTS

In 2011, general interest in biology, as well as in the specific subjects zoology, botany and human biology were significantly lower than in 1983 (Table 1).

Further, we found differences in gender and grade. Boys in 3rd and 4th grade elementary school reported a lower interest in in botany than girls. No differences existed in zoology; and in human biology, there was trend for higher interest in boys (Table 2).

Table 1. Comparison of interest in biology and in the subspecific domains botany, zoology and human biology

	2011 (Mean \pm SD)	1980 (Mean \pm SD)	Decline to %	<i>T</i>	<i>df</i>	<i>p</i>
General biology	2.98 \pm .45	3.23 \pm .35	92%	-8.64	258	<.001
Botany	2.95 \pm .59	3.32 \pm .46	88%	-9.77	258	<.001
Zoology	3.07 \pm .45	3.16 \pm .38	97%	-3.00	258	=.003
Human biology	2.82 \pm .65	3.13 \pm .73	90%	-7.62	258	<.001

Table 2. Comparison between boys (N=127) and girls (N=132) and between 3rd (N=137) and 4th (N=122) graders in biology interest and in the subspecific domains botany, zoology and human biology

		Mean	<i>SD</i>	<i>T</i>	<i>df</i>	<i>p</i>
General biology	boys	2.93	0.49	-1.91	257	0.056
	girls	3.04	0.42			
Botany	boys	2.83	0.65	-3.58	257	0.000
	girls	3.09	0.52			
Zoology	boys	3.06	0.49	-0.70	257	0.480
	girls	3.10	0.41			
Human biology	boys	2.90	0.63	1.94	257	0.053
	girls	2.74	0.67			
General biology	grade 3	3.05	0.48	2.48	257	0.014
	grade 4	2.91	0.42			
botany	grade 3	2.99	0.63	0.97	257	0.330
	grade 4	2.92	0.55			
zoology	grade 3	3.15	0.46	2.64	257	0.009
	grade 4	3.00	0.43			
Human biology	grade 3	2.98	0.62	4.32	257	0.000
	grade 4	2.64	0.64			

3rd graders showed a higher interest in general and in zoology and human biology, but no differences existed in botany (Table 2). Within subject comparisons showed higher interest in zoology compared to botany ($t=-4.081$, $p<0.001$, $df=258$) and higher interest in zoology than in human biology ($t=6.702$, $p<0.001$, $df=258$), while there was no difference between human biology and botany ($t=3.189$, $p=0.002$, $df=258$).

DISCUSSION

A decline in interest of about 10% has been found in our study. This is of great concern because interest is seen as an influential predictor of learning. Elster (2006) noted that “those results from the IPN Interest Study (Hoffmann et al., 1998), which was carried out 10 years ago, it is noticeable that adolescent interest in human biology and medical topics remains high”. However, the specific items used in both studies are not identical, and hence, not easily comparable. Our results – based on the similar questionnaire – showed a decline comparable to the values of Dawson (2000) of about 10% between the years 1980 and 1997 in Australian 7th graders. Although there are only two studies now comparing a longer time

span, both are important because they show a decline in interest between decades similar in strength. Also, these two studies cover different parts of the world (Australia and Germany) and different grades (3rd and 4th versus 7th). Both studies have been carried out in developed countries and it seems that in such countries interest in biology and science decreases while it is high in some of the less developed countries, e.g. from Africa (Schreiner and Sjøberg, 2004). It is also interesting, that interest in zoology showed the weakest decline (3%), while interest in botany decreased by about 12%. This might be related to leisure activities, e.g., working in the garden seems to be less important for nutrition than 30 years ago, while keeping pets may still be an important leisure activity.

We could confirm the patterns of gender differences, with girls scoring higher in interest in botany. This is in contrast to e.g., Elster (2006) where girls showed a higher interest in zoology and boys in botany; in human biology, girls again were scoring higher (Elster, 2006). In Finland, more boys than girls were interested in basic processes in biology, whilst more girls than boys found human biology and health education interesting (Uitto, 2006). Dawson (2000) reported that girls rated aspects

of botany, growth of a baby and similarity between parents and children higher than boys, and in dissection and dinosaurs it was vice versa. Using all items ($N=20$) of the total scale, there were no significant differences between boys and girls (Dawson, 2000). This is similar to our results where there were no gender differences in general. Löwe (1987) and Prokop et al. (2007) also reported higher interest in girls. The different studies are partially in accordance, with girls often showing higher interest in biology, and almost always higher interest in botany, and most often in human biology.

We found a decline in interest on a developmental perspective already between 3rd and 4th graders, suggesting that biology becomes uninteresting right from the primary school level. This has also been found previously by Löwe (1987). Prokop et al. (2007) reported a decreasing interest with increasing age or grade. This is similar to nearly all studies, but some showed an increase again after grade 10 (Dietze, 2007).

In detail, zoology was rated as the most important subject in comparison to botany and human biology. This might be a result of the low age of the pupils (elementary school) and was also reported in previous studies (Löwe, 1992, Vogt et al., 1999), while human biology becomes more important and interesting during adolescence (Dietze, 2007, Löwe, 1992).

Implications

First, we need further studies about the decline in interest backed up with empirical data from different countries to support the recent findings. Second, we propose to repeat our study and that of Dawson (2000) in the future to follow the decline over the next decades. Third, there is a need to develop educational programs to increase interest, especially in botany. Further, the differing results of the interest studies with respect to gender difference request a rigorous meta-analysis on this topic.

Limitations

One limitation is the basic questionnaire developed by Löwe (1992), e.g. ecology has become very important but is not covered by this survey. Further, modern biology teaching should rather head for competences than for the traditional disciplines. Science-related activities such as "experiments" or "stories about scientists" may not be affected by the decline of interest in the same way as botany, and they are also a part of "biology".

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