

HEALTH EDUCATION AND TEACHING GENETICS AT ELEMENTARY SCHOOLS

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Abstract: *This paper shows the results of an anonymous survey carried out amongst 73 elementary teachers in the South Moravian region. The subjects in question taught genetics as part of the natural history curriculum. Our research attempted to find out to what extent the lack of teacher training in the subjects of biology and genetics in the 1960s is apparent today. As well as that, the survey assayed the teachers' approach to teaching genetics nowadays and the use of genetics in health education.*

It was found out that a majority of teachers are motivated and enthusiastic to teach genetics; many of them make their own didactic tools for lessons. However, the handicap in teachers' specialized knowledge still remains and professional teaching of genetics is guaranteed only in 40 per cent of the schools monitored.

Keywords: *genetics, pedagogue, undergraduate education, health education, elementary school, pupil*

Introduction

Although the study of genetics originated in our country, both scientific research and teacher training (for future elementary school teachers) in this area started as late as the 1960s (cf. Havelková et al., 2007; Havelková et al., 2008). This led to a severe lack of well-trained teachers willing and motivated to teach genetics at all types of schools. Consequently, whole generations of pupils and students were brought up with little or no understanding of genetics; it is also a well-known fact that elementary school teachers of natural history complain nowadays that the knowledge and skills they acquired at universities were minimal. This state of affairs inspired us to carry out a survey of the contemporary state of elementary education, as far as genetics was concerned.

Materials and methods

The questionnaire research focused on teachers of genetics at elementary schools in the Zlín and Brno districts. A total of 236 schools were contacted and presented with

anonymous questionnaires, with the return rate of 36.5 %. The sample of respondents submitted for analysis amounted to 73 teachers (14 male, 59 female).

The non-standardized questionnaire consisted of personal information items (age, gender, length of teaching experience) and 13 question items (5 limited choice items, 5 half-open questions and 3 open questions). The questions focused on the following: textbooks used in natural history lessons, their evaluation and teachers' preferences, the position of genetics within the curriculum, the number of teaching hours devoted to teaching genetics, availability and accessibility of teaching aids, the importance of the study of genetics, its popularity amongst teachers and pupils, the topics studied and, finally, opinions relating to the transition to RVP ZV (The Educational Framework Programme for Elementary Education).

At the beginning of the questionnaire, the teachers were briefly informed about the aims of the study and were given the names of the researchers, together with their contact details. The data were recorded electronically and then processed using the following software: EpiInfo 6 En (Dean et al., 1994) and Statistica for Windows 7 Cz (StatSoft Inc., 2004). Using statistical tests (χ^2 , Fisher exact), we determined the level of statistical significance when dividing the research sample along the lines of age, gender and the subjects studied at university.

Results

The following tables and graphs present the proportional distribution of the respondents' answers. Group 1 represents the subset of respondents from the Zlín district ($n=36$), Group 2 contains respondents from the South Moravian district ($n=37$).

Table 1: Gender distribution

Group	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
1	9	64.3	27	45.8	36	49.3
2	5	35.7	32	54.2	37	50.7
Total	14	100	59	100	73	100

In both subsets of the research sample, female teachers dominated in number over male teachers.

Table 2: Length of relevant teaching experience with regard to gender

Experience	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
0–5 years	3	21.4	20	34.5	23	31.9
5–10 years	5	35.7	4	6.9	9	12.5
10–15 years	2	14.3	8	13.8	10	13.9
15–20 years	0	0	11	18.9	11	15.3
over 20 years	4	28.6	15	25.9	19	26.4
Total	14	100	58	100	72	100

Most female teachers' teaching experience ranged from 0 to 5 years, followed by the '15–20' and 'over 20' ranges. Male teachers covered all the ranges with the exception of '15–20 years'. Therefore, differences in the length of teaching experience are statistically significant ($p < 0,05$, χ^2) only in the '15–20 years' category, which contains about one fifth of all the female teachers and no male teachers.

Table 3: The popularity of genetics as a teaching subject with respect to gender

Popularity of genetics	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
Likes it	13	92.9	38	64.4	51	69.9
Dislikes it	1	7.1	21	35.6	22	30.1
Total	14	100	59	100	73	100

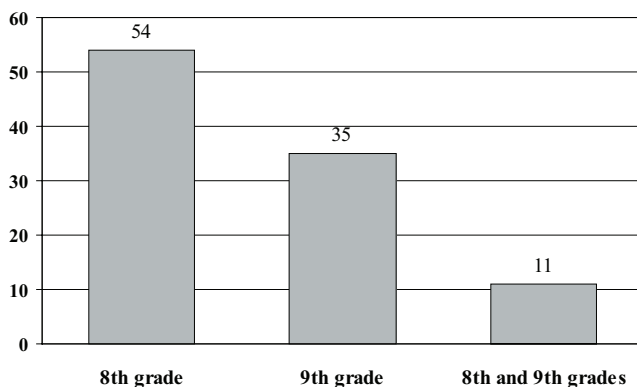
Table 3 shows the popularity of genetics as a teaching subject amongst male and female teachers. A single male teacher dislikes teaching genetics, while in the case of female teachers, the figure amounts to a little over a third of the subset ($p < 0,05$, Fisher exact).

Table 4: The importance of genetics within the curriculum

The importance of genetics	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
Less important	0	0	17	29.3	17	23.6
Equally important	12	85.7	40	69.0	52	72.2
More important	2	14.3	1	1.7	3	4.2
Total	14	100	58	100	72	100

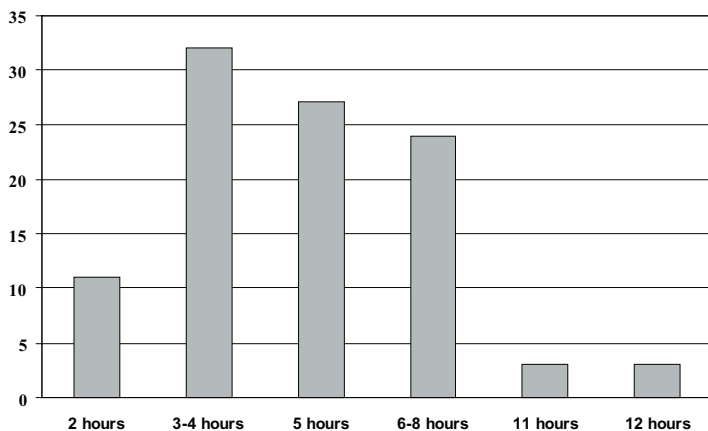
Most male teachers find genetics as important as other subject matter. However, almost a third of the female teachers regard genetics as less significant than other topics in the curriculum ($p < 0,05$, χ^2). The number of these female respondents more or less corresponds to the number of female teachers who dislike teaching genetics (cf. Table 3).

Graph 1: The position of genetics within the curriculum (%)



The position of genetics within the curriculum (that is, in which grade it is taught) is mostly determined by the textbooks used, or by the curriculums adopted by the respective schools. Over a half of the respondents teach genetics in the 8th grade; only 11 % of the teachers deal with it in the 8th and 9th grades.

Graph 2: Number of teaching hours devoted to genetics (%)



On average, around 5 teaching hours are devoted to genetics at the schools we have studied. Two teaching hours are reported as a minimum; two respondents even mention a figure higher than 10 hours.

Elementary schools currently have six modern natural history textbooks to choose from. The following titles of textbooks were offered to the respondents, including a slot for an open answer.

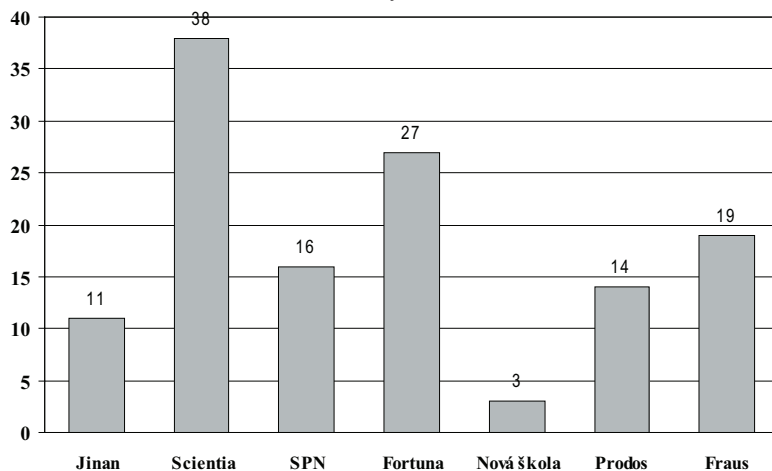
- KOČÁREK, E. *Přírodopis pro 9. ročník základní školy*. Praha: Jinan, 2001. 96 p. ISBN 80-86491-00-5.
- DOBRORUKA, L. *Přírodopis III*. 2. vydání. Praha: Scientia, 2001. 159 p. ISBN 80-7183-246-4.
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- HAVLÍK, I. *Přírodopis pro 7. ročník*. Brno: Nová škola. 1999. 87 p. ISBN 80-8560-798-0

As we can see in Graph 3, the most popular textbook was *Přírodopis III*. (Natural History III.) published by Scientia, followed by *Ekologický přírodopis* (Ecological

Natural History) published by Fortuna, while the Fraus publishing house ranked third. The Nová škola publishing company turned out to be the least favorite.

Some teachers said they were using a number of different textbooks, while their students had only one; this appears to be a particularly good and flexible solution if the school does not have the financial means to buy new textbooks at hand.

Graph 3: Textbooks used in natural history classes



According to graph 4, genetics is popular with roughly 70 % of the respondents; the remaining thirty-two per cent dislike teaching it. When asked why genetics was popular with them, the teachers usually mentioned its practical applicability, usefulness for life and an overall fondness of natural history. We are quoting an interesting reason given by one of the teachers: *‘It’s a challenge to motivate a weak class and make them cooperate when working on such a difficult topic.’*

Graph 4: Popularity of genetics as a teaching subject amongst teachers

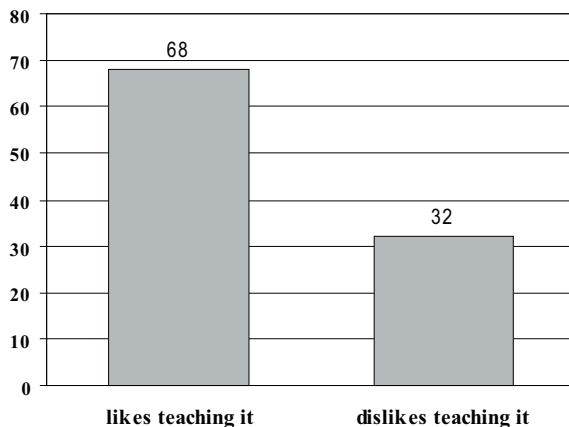


Table 5: Reasons why genetics is popular / unpopular with teachers

Reasons why they dislike teaching it	Number	%	Reasons why they like teaching it	Number	%
Complicated for pupils	8	42.1	Important for life	7	29.2
Difficult to explain	3	15.8	Practical application	5	20.8
Too abstract	3	15.8	General fondness of natural history	5	20.8
Too many concepts	2	10.5	Interesting for pupils	4	16.7
Complicated for teachers	2	10.5	Long-term interest in the subject	2	8.3
Boring	1	5.3	A challenge	1	4.2
Total	19	100	Total	24	100

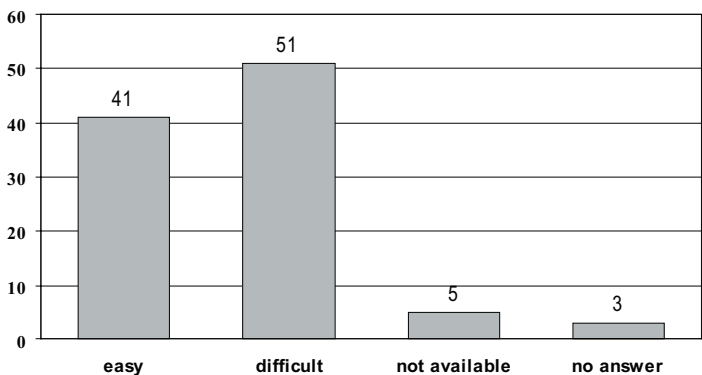
Table 5 shows a number of reasons why genetics is or is not popular with the respondents. Those who dislike teaching it claim, for the most part, that the subject matter is too complex for the pupils. Others mentioned the complexity of explanations, the abstract nature of the subject and the great number of concepts used. One teacher found the subject matter boring and two others found it too complex even for themselves.

Table 6: Using supplementary materials in teaching genetics

Using supplementary materials	Number of answers	%
Yes	32	86.5
No	5	13.5
Total	37	100

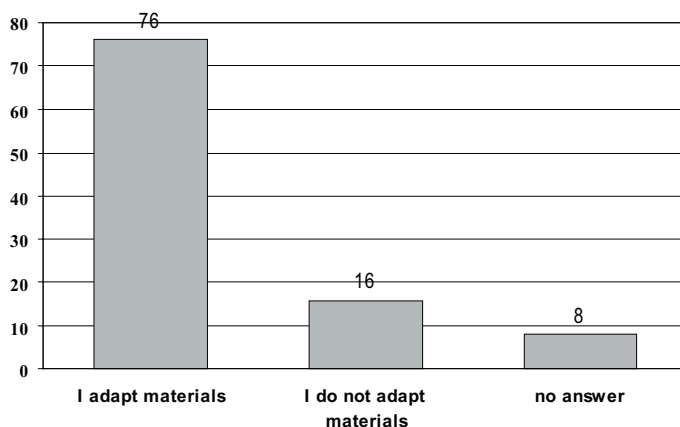
Using supplementary materials and other teaching aids (see Table 6) forms a necessary prerequisite of good, well-balanced teaching, while making the lessons more interesting and motivating pupils. Also, these materials and didactic tools work towards a better understanding of the subject matter. The most commonly used materials are magazine articles and posters; the internet and various encyclopaedias also serve as good sources of information.

Graph 5: Availability of supplementary materials (%)



As we can see in Graph 5, 92 % of the respondents are able to find supplementary materials (41 % find acquiring them easy, 51 % find it difficult). Only 5 % of the respondents are not able to find supplementary materials, or do not use them. The remaining three per cent are difficult to determine, as no answer was given.

Graph 6: Work with supplementary materials (%)



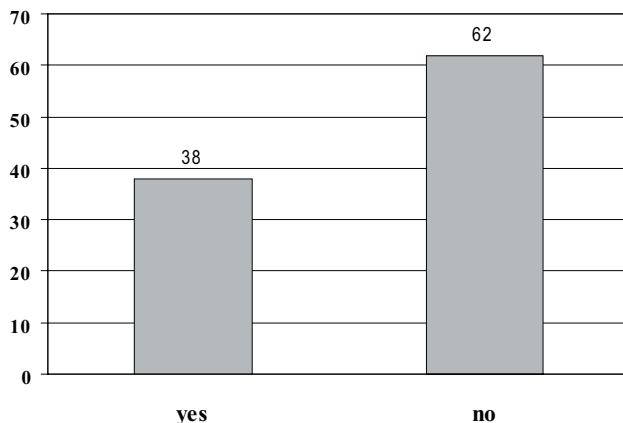
Graph 6 shows us that over three quarters of the supplementary materials found by teachers need to be adapted for lessons; only a fifth of the materials need no changes before they are presented to students.

Table 7: Types of supplementary materials and teaching aids used

Types of materials	Number of answers	%
Magazines	10	18.9
Posters	8	15.1
Internet resources	7	13.2
Encyclopaedias	6	11,3
Videos	6	11.3
Books	6	11.3
Own presentations	3	5.7
Visits to J. G. Mendel Museum	3	5.7
Charts and drawings	2	3.7
Didactic games	1	1.9
An interview with a paediatrician	1	1.9
Total	53	100

Magazine articles and posters are the most common supplementary materials used; teachers also benefit from the use of encyclopaedias and the internet. Only three teachers mentioned visiting the J. G. Mendel Museum.

Graph 7: Using practical exercises in teaching genetics (%)



Teaching genetics does not comprise only concepts and theories. Doing practical exercises in genetics shows its immediate practical application. A majority of the respondents (62 %) do not address practical problems with pupils; 38% include problem-solving activities in their lessons (see Graph 7).

Table 8: Topics in the genetics curriculum

Topics	Number of answers (n=37)	%
Basic concepts	22	59.5
J. G. Mendel	17	45.9
Heredity of blood groups	10	27.0
Genetic engineering	9	24.3
Crossbreeding	9	24.3
Hereditary diseases	8	21.6
Cloning	7	18.9
Genetically modified organisms	6	16.2
Mutation	6	16.2
Cell division	5	13.5
Problem-solving activities	3	8.1
Labs	1	2.7

Teaching basic concepts appears to be the most common topic in teaching genetics. Over half the respondents mentioned teaching about J. G. Mendel. Heredity of blood groups, genetic engineering, crossbreeding and hereditary diseases are also common topics in lessons of genetics. Relatively less attention is paid to cloning, genetically modified organisms, mutation and cell division. Only three of the teachers mentioned doing practical exercises, though in Graph 7, we have seen that almost 40 % of the teachers claim to be doing problem-solving activities. Only one teacher mentions working in the laboratory.

The questionnaire was concluded with an open question: *'Does teaching genetics somehow relate to health education?'*

All the respondents gave a positive answer. The most common reasons mentioned were as follows:

- assaying the genetic load in the family
- a healthy baby = a relative certainty
- preventing the development of a hereditary disease or defect
- assessing the risk of developing a tumor; preventive measures
- assessing the risk of developing a pathological addiction; opportunity for specific preventive measures to be implemented
- treatment on the gene level – correcting or replacing the faulty gene
- organ transplants

Research outcome

- In the South Moravian region, an average of five teaching hours is devoted to teaching genetics in a single school year (most often in 8th grade).
- In teaching genetics, Natural History III. (*Přirodopis III*. Prague: Scientia, 2001) is most widely used, though a textbook published by Fraus is the most widely acclaimed.
- In order to supplement the textbook and motivate the pupils, magazines, posters and internet resources are most widely used. Supplementary materials are, however, rather difficult to find and must be, in most cases, adapted for teaching.
- The genetics curriculum is chiefly composed of basic concepts, the life and work of J. G. Mendel and current topics such as genetic engineering, cloning, genetically modified organisms and mutation.
- An important note – the teacher's attitude towards the subject matter is reflected in the pupils' attitude and motivation.
- A majority of the respondents finds genetics equally as important as other subject matter within the curriculum.
- In comparing the current school curriculum and the RVP ZV (The Educational Framework Programme for Elementary Education), the teachers see the transition from the former to the latter as marked by a greater deal of effort, which is in contrast to the few benefits it brings.

Discussion

As was stated earlier, only about 40% of the teachers contacted (36.5 %, to be precise) filled in and sent back the questionnaires. The low return rate was surprising – in most cases, elementary school teachers are said to be very cooperative and attentive in research of this kind.

After our survey had been concluded, we thanked all the schools for their cooperation. A few days later, a number of teachers sent us a total of 58 messages, apologizing for not having cooperated with us.

Most of the reasons mentioned were as follows:

- I am sorry for not answering, but I do not understand genetics very much (39x)
- I love genetics, but I find it impossible to explain to elementary school pupils (I graduated in molecular biology and genetics) (1x)
- I do not teach genetics; there is not enough time for that – I assume that secondary schools will do the job (18x)

These explanations shed some light on the issue of the low return rate of our questionnaires. In general, those who answered were the only ones who could answer. The teachers who did not send back their questionnaires do not – in most cases – understand genetics enough to answer the questions in our survey.

To support our argument, we should note that genetics was not taught at the Faculty of Education MU in Brno before 1990; therefore, university students have had a chance to study it for a mere 17 years. It is clear that those teachers who did not have the opportunity to study genetics at university could neither teach it nor fill in our questionnaire.

In the light of our findings, we are forced to conclude that in the Zlín and South Moravian regions, genetics is taught at roughly 40 % of the schools studied. The remaining 60 % of the schools offer no lessons of genetics or teach it insufficiently.

This conclusion presents our faculty with a great challenge. We will need to make immense effort to teach future natural history teachers genetics, so that the current handicap that exists at elementary schools is eradicated.

Conclusion

Our research analysis may inspire mild optimism – wherever teaching genetics does take place, it is relatively well-managed. Most teachers are motivated to teach the subject and are active in finding supplementary materials and implementing them into their lesson plans.

However, genetics is taught at roughly 40 % of the schools in the Zlín and South Moravian regions; 60 % of the schools offer no lessons of genetics or teach it insufficiently.

Therefore, there is still a notable gap in elementary school teachers' knowledge as far as genetics is concerned. This situation disfavors pupils in their future jobs and lives, since genetics is an important and rapidly developing science, closely linked with the whole ecosystem, people's lives and their health.

Getting rid of this gap should become a chief concern for all institutions of higher education that train students to become teachers of natural history.

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VÝCHOVA KE ZDRAVÍ A VÝUKA GENETIKY NA ZÁKLADNÍCH ŠKOLÁCH

Souhrn: Práce přináší výsledky anonymního dotazování, které bylo realizováno na vzorku 73 pedagogů vyučujících genetice v rámci přírodopisu na základních školách Jihomoravského regionu. Snaží se ověřit, zda se deficit odborné přípravy učitelů v biologii a genetice ze 60. let 20. století projevuje i v současnosti. Příspěvek též prezentuje přístup dnešních učitelů k výuce genetiky, sleduje, zda učitelé této vědecké disciplíny využívají i v otázkách výchovy ke zdraví.

Bylo zjištěno, že většina pedagogů učí genetice ráda, se zaujetím, řada z nich si připravuje vlastní pomůcky. Handicap v odborných znalostech pedagogů z minulosti však stále přetrvává a výuka genetiky je erudovaně zajištěna pouze na 40 % sledovaných škol.

Klíčová slova: genetika, pedagog, pregraduální výuka, výchova ke zdraví, základní škola, žák