Bilingual Teaching in Biology: Impressions from the Viewpoint of Biology Didactics

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Michael Ewig
Overview

- Look back at the „History“ of Bilingual Teaching
- Bilingual Teaching at school - an example
- Some research questions - and first findings
- Looking ahead...
Implementation of bilingual teaching at German schools (Thürmann, 1997)

Motivation: „Culture“ … „Economy“ … … and today: „Science“ - with English as *lingua franca*
Structure of bilingual branch at a secondary school in NRW

Model of *Sekundarstufe I* at a school in research project

<table>
<thead>
<tr>
<th>Grade</th>
<th>lessons / week</th>
<th>lessons / week</th>
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<tbody>
<tr>
<td></td>
<td>English</td>
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<tr>
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Some research questions - and first findings
(from the viewpoint of Biology Didactics …)

- A) Who „needs“ students being taught bilingually in Biology?
- B) How about teaching material for bilingual education in Biology?
- C) Naming, knowing and protecting species - open questions for learning on „biodiversity“…
A - Who „needs“...?

Question:
Is there some interest in students being taught bilingually in Biology?

Research approach:
Questionnaire on languages used at a faculty of Biology at a German university
1.) Hauptsprache: **Deutsch**  - Signatur in der Tabelle: „1“
2.) zweithäufigste Sprache: **Englisch**  - Signatur in der Tabelle: „2“
3.) evtl. weitere Sprache: ****  - Signatur in der Tabelle: „3“

Tragen Sie nun bitte unter Verwendung der Signaturen in die Tabelle ein, welche Sprachen von welchen Personengruppen in welchen Zusammenhängen tatsächlich genutzt werden.

<table>
<thead>
<tr>
<th>Zusammenhang</th>
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<td>2/1</td>
<td>1</td>
<td>2/1</td>
<td>2/1</td>
<td>2/1</td>
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</table>

| Publikationen                |        |       | 2   | 2      |
| national                     | 1      | 1     |     |        |
| international                | 2      | 2     |     |        |

| (Tele-) Kommunikation i.w.S. |        | 2     | 2   | 2      |
| national                     | 1      | 1     | 1   | 1      |
| mündlich                     | 1      | 1     | 1   | 1      |
| international                | 2      | 2     | 2   | 2      |
| schriftl.                    |        | 2     | 2   | 2      |

| Tagungen                     |        | 2     | 2   |
| national                     | 2/1    | 2    |
| Vortrag                      |        | 2    |
| Poster                       | 2      | 2    |

| Software                     |        | 2/1  | 2/1 | 2/1    | 2/1 | 2/1 | 2/1 |
| Seminare, Besprechungen mit ausländischen Gästen | 2      | 2    | 2    | 2     |
A - „Who needs...“ - Results

Scientific language at a German faculty of Biology is English

Non-scientific staff should be able to communicate in English or „bilingually“ up to 40% - depending on context

Students should be able to communicate in English or „bilingually“ up to 40% - depending on context

Lecturers are willing to communicate up to 50% in English or „bilingually“ in their lectures and seminars

Results are supposed to be similar at other faculties of Biology in Germany/Europe

50% of lecturers at a faculty of Biology are supposed to be interested in students that have been taught bilingually (De/En) in Biology - in all grades („Sek I & II“)
Bilingual Biology classes are taught only at about 100 schools throughout the country.

This market is too small for publishing companies as to provide suitable textbooks - so textbooks are imported from abroad.

Questions:
- Which materials are being used in bilingual Biology classes, which are required?
- Do foreign textbooks match the German curriculum to be applied? Do they lead to the same academic objectives as in German Biology classes?
1st strand of investigation (Sabine Kozianka, 2005): Materials used and needed

- **Question:**
  Which materials are being used in bilingual Biology classes, which are required?

- **Hypothesis:**
  Most materials being used in bilingual Biology classes are imported or created by teachers themselves – relief of teachers is desirable.
Sources for ready-for-use materials (n=60)

- science textbooks: 70%
- school science textbooks: 90%
- internet: 70%
- others: 50%

Reference: PH Weingarten, 14.10.2009, Referent: Dr. Ewig
Translation of materials

Bar chart showing the sources from which teachers translate materials for bilingual education in Biology (n=29):

- Science textbook: 60%
- School science textbook: 10%
- Internet: 70%
- Others: 10%

Translation of materials from sources which teachers translate materials for bilingual education in Biology (n=29)
Use of school science textbooks

Countries of origin of textbooks that teachers use in bilingual Biology classes (n=60)

Teachers use one specific textbook from country of target language

- Yes: 81.36%
- No: 18.64%
Examples of adopted textbooks
Problems when adopting materials (n=41)

- Vocabulary problems
- Missing accordance with curriculum
- Level does not fit
- Different emphasis
- Others

%
Desired materials

- Modules
- Exam questions
- Diagrams, etc.
- Films
- Vocabulary lists
- Computer programmes
- Others

%100
Pool of materials

- Interested in a pool of materials (n=59)
- Willingness to contribute to a pool of materials (=60)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Interested</td>
<td>80</td>
<td>20</td>
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<td>Willingness to</td>
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<tr>
<td>contribute</td>
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</table>
Conclusion (1st strand)

(Kozianka & Ewig, in press)

- Caveamus:
  There are no reference data of Biology teachers teaching in German for all data mentioned.

- Nevertheless:
  - Teachers of bilingual Biology classes use science textbooks and the internet as a source for creating their own teaching materials.
  - Teachers import textbooks from target language countries.
  - Teachers exchange materials and are interested in accessing a pool of materials and contributing to such a pool.
  - Most of all, teachers would like to have stand-alone materials for single topics, films and vocabulary lists for bilingual Biology classes.

This points at areas of interest for both foreign language didactics and didactics in the subject matter (here: Biology didactics).
2nd strand of investigation (Sarah Uckelmann, 2006): comparison of school science textbooks (Biology / Ecology)

Hypotheses:

- English textbooks are not suitable for the use in bilingual Biology classes in Germany as they do not cover all contents required by the curriculum
- Linguistic demands in English textbooks are too high for German students
## Textbooks compared

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Publisher</th>
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<tbody>
<tr>
<td>Jones, M. &amp; G. Jones</td>
<td>Biology</td>
<td>CUP</td>
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<tr>
<td>Pickering, W.R.</td>
<td>Complete Biology</td>
<td>OUP</td>
</tr>
<tr>
<td>Martin, J.</td>
<td>Core Biology</td>
<td>CUP</td>
</tr>
<tr>
<td>Beckett, B.S. &amp; R. Gallagher</td>
<td>All about Biology</td>
<td>OUP</td>
</tr>
<tr>
<td>Bethell, G. &amp; D. Coppock</td>
<td>Biology first</td>
<td>OUP</td>
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<td>Haala, G. et al.</td>
<td>Natura</td>
<td>Klett</td>
</tr>
<tr>
<td>Jütte, M.</td>
<td>Biologie heute entdecken</td>
<td>Schroedel</td>
</tr>
</tbody>
</table>

[Titles underlined were taken into account for closer comparison]
Hypotheses (2nd strand)

I. English textbooks are not suitable for the use in bilingual Biology classes in Germany as they do not cover all contents required by the curriculum.

II. Linguistic demands in English textbooks are too high for German students
Hypothesis I - content comparison - methods

- Curriculum of the federal state North Rhine-Westphalia (NRW) as framework of reference
- Biological topic ‘ecology‘ as field of investigation
- Content comparison of six English & two German textbooks by means of synoptical table
Topics demanded by the curriculum but (totally or almost: 4-5) missing in the English school science textbooks compared:

- **Description of a chosen habitat**
  taking into account aspects of structure and abiotic factors

- **Plants** as part of the biocoenosis:
  - Special requirements of *seed plants* with local importance
  - Ecological importance of *mosses*
  - Reproduction, alternation of generations in *ferns*

- **Animals** as part of the biocoenosis:
  - *Insects*: Eyes, reproduction and development,
    Eusociality, Ecological aspects of chosen insect orders
  - *Annelids*: body function, locomotion, reproduction, habitat and ecological
    relations of the earthworm, importance for the improvement of soil quality
  - *Snails*: anatomy, locomotion, nutrition, reproduction
  - *Protozoa*: nutrition, habitat and ecological relations

- **Fungi** as part of the biocoenosis: Symbiosis between fungi and cormophytae or algae;
  edible mushrooms (classification of local mushrooms)

- Protection of the **environment** in the own town or region
Hypothesis I - content comparison - discussion

- None of the English textbooks compared covers the topics prescribed by the curriculum completely.

- For different topics, English textbooks differ in their degree of deviation from the German curriculum.

- Thus, none of the English textbooks can be used solely and continuously in German bilingual Biology courses.

- The need to compile and compare different English textbooks results in some extra work for teachers.
Hypotheses (2nd strand)

I. English textbooks are not suitable for the use in bilingual Biology classes in Germany as they do not cover all contents required by the curriculum.

II. Linguistic demands in English textbooks are too high for German students
Hypothesis II - linguistic demands - methods

- Comparison of ‘readability’ of sample texts on the ecological topic of the carbon cycle


- Text length about 220 words, 43 gaps each; 3 bilingual classes (grade 8), 81 students in total; 45 min. working time; classes split half according to Biology marks => homogeneous subgroups for E+G & G+E sequences of test reading
Hypothesis II - linguistic demands - categories

[according to VAUGHAM, 1989]

- Gaps filled in correctly < 40%: text hardly understood at all
- Gaps filled in correctly 40-60%: students need instruction to understand text
- Gaps filled in correctly > 60%: text well understood
Results of the readability test. Average number of gaps filled in correctly.

<table>
<thead>
<tr>
<th>Textbook</th>
<th>Average number of gaps filled in correctly (M)</th>
<th>Standard deviation (STD)</th>
<th>Gaps filled in correctly in relation to the total number of gaps (43) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biologie heute entdecken</td>
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<td>All about Biology</td>
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<tr>
<td>Biology</td>
<td></td>
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</tbody>
</table>
Students in this study - participants (grade 8) of the bilingual branch at their school - had less problems to understand the English text passages than the German ones (sic!)

Thus, under the aspect of ‘readability’, English textbooks may be used exclusively in bilingual Biology classes.

It has to be asked whether students from bilingual Biology classes should really back up their teaching results with German textbooks at home - without any instruction.
Conclusion (2nd strand)

(Uckelmann & Ewig, 2008, in: Scheersoi & Klein (Hrsg.), 49-67)

Hypothesis I can be accepted - with reservations: English textbooks are not suitable for the [exclusive] use in bilingual Biology classes in Germany as they do not cover all contents required by the curriculum.

Hypothesis II must be rejected - for the texts and students chosen: Linguistic demands in English textbooks are not too high for German students - participating in a bilingual branch at their school.
C) Naming, knowing and protecting species - open questions for learning about „biodiversity“...

- From 2005 to 2014 we are living in the **UN Decade of Education for Sustainable Development**
- One aspect of ESD refers to knowledge and protection of biodiversity, i.e. variety of plant and animal species
- From research in Biology Didactics we know: knowing species is a prerequisite for protection of species (cf. Berck 2005)
- Therefor Biology education - among other objectives and not only in the Decade of ESD - aims at knowledge about the variety of plant and animal species, thus supporting the protection of biodiversity
Names can foster - or hinder - knowledge of species…

Spießente
[lit.: „Spear Duck“]
- Northern Pintail
- Anas acuta

Schellente
[lit.: „Sond / Sund Duck“]
- Common Goldeneye
- Bucephala clangula

Trauerente
[lit.: „Mourning Duck“]
- Black Scoter
- Melanitta nigra

[Pictures from Wikipedia]
Names can foster - or hinder - knowledge of species


Q.: Randler & Metz (2005), PdN-BioS 6/54, 41-42
Education for Sustainable Development also aims at protection of biodiversity - i.e. the variety of plant and animal species…

… protection of species depends on knowing the species…

… knowing of species depends on naming the species…

… naming of species depends on „easy“ associations…

But: How about „easy“ associations when learning species names in a foreign language?
References

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… to the faculty of Biology, students and teachers, who worked with our research group

… to those who inspired, conducted and evaluated the studies:
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  Karen Drews & Birgit Kondring,
  Sabine Kozianka & Julia Galinowski
  Sarah Uckelmann

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Disclaimer: This product reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.
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www.ph-weingarten.de