INQUIBIDT – Inquiry-based Biodiversity Teaching in Teacher Education

Summary:

Within the INQUIBIDT-approach (Inquiry-based Biodiversity Teaching) learners use modern technologies to support self-directed, location-based learning and knowledge construction outdoors in the field. They explore the flora and fauna just at their doorstep, they gather data about it and they communicate their results as open source material. ICT and mobile devices are used as information resources, as inquiry aid, as communication and dissemination tools to spread the idea of learning about biodiversity by inquiry. The target groups are pre-service and in –service teachers as well as secondary school students.

Aims:

The central idea of the best practice project is to create a modern approach to explore a traditional field of biology, the biodiversity of plants and animals, using the IBSE approach.
Learners use digital media to investigate the kingdoms of plants and animals as well as their taxonomic relationship within location-based activities in the nature. Mobile learning devices allow to explore different ecosystems outdoors and to do serious inquiry about a specific habitat and its biozenosis. Mobile devices support the learners to interact and to create information directly in the habitat to facilitate the inquiry process. Mobile learning activities allow to individualize the requirements of the inquiry process and thus, to differentiate between learners' capabilities.
Pre-service teachers are confronted with inquiry-based science education approaches (IBSE) within guided, self-directed and cooperative field work to explore biodiversity, in-service teachers get within a workshop an experience of the INQUIBIDT-approach for the implementation in their classes.
At all levels, pre- and in-service-techers as well as school students explore biodiversity and they create a comprehensive scope of information for interested public, which could profit of the worked examples directly in the nature.

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PATHWAY

Main activities:

- inquiry of biodiversity at a landscape/ habitat: description of abiotic factors (light, humidity, mineralisation of soil, temperature, ...), identification of specific organisms (plants, arthropods, destruents, ...)
- construction of a systematic overview of the kingdom of plants and animals within CSCL activities (eg. jigsaw-method, collaborative knowledge mapping using mind/ concept maps, collaborative work on a wiki)
- data collection, data processing, data presentation, supported by the use of mobile devices (cell phones, smartphones, GPS)
- communication using open source tools for the creation of information scopes, applicable on mobile devices in the landscapes as well as on regular ICT

Narrative:

The course starts with an introduction to the system of plants and the biodiversity of local flora and fauna. Then the students work in small groups (expert groups) in different habitats in the surrounding of the university within a radius of 15 km, each group a specific site. Learners use GOOGLE maps and GPS to find the habitats. The task of each group is to record the plants, to describe and to document them in a hidden Wiki online.

Thus, the data is developed as an information resource on the internet for different specific habitat in which the results of all groups are summarized. Furthermore, the expert groups leave a geocache, in which a so-called QRcode (barcode readable by cell phones and smartphones) is located.

This QRcode refers to the information on the project Wiki which can be viewed only on-site with mobile devices.

In the next step, each group visits all habitats, which are chosen to be very different and have different living conditions (arid, humid, wetland, riverside, ...). The groups again explore the habitats and they verify their results using the mobile devices via the QR codes. In the final step, the geocache coordinates are published on the Wiki to allow teachers with their students or even the interested public to explore the landscapes.

End user:
Pre-service teacher students (age 18 to at least 23 years), in-service teachers, secondary school students grade 5-9 (11-15 years)

Involved actors:
Researchers, teacher educators, in-service teachers

Location:
school, schoolyard, field and outdoor, internet

Connection with the curriculum:
Biodiversity as part of the environmental education and the education for sustainable development can be found in secondary school curricula as well as in the curriculum for pre-service teacher education and in-service teacher training.

Languages available:
German

Where to find the application or case:
web-based information, location-based learning using geocaches and mobile devices

Evaluation parameters:
INQUIBIDT evolved since 2004 and different aspects have been highlighted. Compared to traditional biodiversity teaching, the INQUIBIDT approach showed higher achievement and emotional involvement compared to traditional teaching concepts (Schaal&Randler, 2004, Schaal, 2009, Schaal& Matt, 2011).

Duration:
A pre-service teacher INQUIBIDT course is designed for 3 ECTS which means for about 90 hours in total (attendance and self-directed learning).
An in-service teacher workshop is conceptualized for about 8 hours.

Additional information or resources:
http://wikis.zum.de/inquibidt

Teachers' Competencies

1	subject matter/content knowledge	x
2	nature of science	x
3	Multidisciplinary	x
4	knowledge of contemporary science	
5	variety of (especially student-centred) instructional strategies	x
6	lifelong learning	
7	self-reflection	
8	teaching/ learning processes within the domain	x
9	using laboratories, experiments, projects	x
10	common sense knowledge and learning difficulties	
11	use of ICTs	x
12	knowledge, planning and use of curricular materials	
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	x

Mapping best practices with main principles

PATHWAY

1. Building interest in natural science phenomena and explanations:

The students study a question independently and are given the opportunity of elaborating their own approach. In detail, learners are introduced to the biodiversity just in front of their doorstep.

2. Building up informed citizens: Students understanding the nature of Science & Science in society:

INQUIBIDT...

- provides a survey of the regional biodiversity
- conveys theoretical knowledge supported by practical exercises
- enables students on excursions to:
  1. closely familiarize themselves with plants,
  2. classify animals with the help of the classification keys
  3. better understand the biodiversity and look at it with deeper respect - motivates students for action (protection of the environment, protection of species, rural conservation)

3. Develop multiple goals:

- **understanding big ideas in science including ideas of science, and ideas about science**
- **scientific capabilities concerned with gathering and using evidence**
- **scientific attitudes**

The learners present a hypothesis. It is confirmed or rejected by an activity, by data collection and its analysis. The learners classify plants on the spot and try to find out which abiotic factors favour the spread of the species. Using appropriate tools and techniques for data collection is an essential aspect of the BP. Establishing connections between concrete results and explaining such connections by scientific arguments is one of the most important aspects of the BP.

4. Understanding students' concepts and learning style about of science phenomena:

The teacher, distributing tasks, is no longer the centre of attention, but the individual learner directs his/her own studies. The teacher helps the learners to process information, he motivates them and supports their thought processes.

5. Relevance of the content to daily life of students:

The relevance of learning contents for the learners' everyday lives is of enormous importance. What is the use, for instance, of knowing and recognizing plants in a meadow for the learners? This is a concrete question which seems even more important when a lot of littlequestions are asked: Which plants produce our daily food? Which plants are used as remedies? Which plants are poisonous?

6. Understanding science as a process not as stable facts. Using up to date information of science and education:

The key of this BP is to regard the different parts of an ecosystem not as separate parts but as components of this system, as little 'cogwheels in a clock'. Thesecomponents form a 'whole' in which each 'cogwheel' plays a distinctpart. Sustainable knowledge is based on an understanding of phenomena and relations between biocenosis and abiotic factors. Knowledge of species is only valuable if it forms a coherent 'whole'.

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

Learners are able to critically and logically think about relations between concrete results and explanations, find and analyze alternative explanations and transmit scientific arguments. For instance, the relationship of water and temperature to hygrophytes in a specific habitat could be a result of a location-based inquiry process.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

In order to achieve results it is the students' task to carry out serious inquiry in the field. The latter comprehends:
1. collecting data. 2. listing all the plant species found in a given area. 3. classifying the plant species, their frequency and appearance. 4. analyzing the plants' abiotic needs. 5. comparing different areas to find out differences and similarities. 6. explaining fauna differences caused by different abiotic factors. 7. embedding all data in an overall concept.

9. Assessment: formative ~ of students' learning and the summative ~ of their progress:

Cognitive achievement is measured with concept maps, the IMI scale is used for motivational variables. Teaching attitudes are assessed using a questionnaire, computer self-efficacy (CUSE) and experience (CE) are controlled. Finally, the learners' opinion about the INQUIBIDT approach is assessed by structured interviews.

10. Cooperation among teachers and with experts:

In-service teachers are supported directly by the researchers when they carry out the INQUIBIDT approach in their classromm teaching. They receive the hardware for the outdoor inquiry (tablet/ smartphone, GPS) and furthermore, the project wiki can be used for further support.