PROFILES

Inquiry-Based Science Education in Science and Technology Education as a Connectivist Method

5 July,16:45 -17:45

Josef Trna, Eva Trnova

Masaryk University,Brno

Czech Republic, EU

SEVENTH FRAMEWORK PROGRAMME

5.2.2.1 – SiS-2010-2.2.1 Grant agreement no.: 266589

Table of Contents

Introduction

Contrary to the fact that scientific knowledge, new scientific tools and technologies increasingly affects people‘s daily lives, science educators struggle with low students’ interest in science and technology.

So, why students are not interested in science?

- outdated teaching methods
- different learning style of today’s students, members of the Net Generation (D. Oblinger & J. Oblinger, 2005)

Changes in teaching caused by the fast development of ICT are dealt with by connectivism as the “learning theory for the digital age” (Siemens, 2005).

Introduction

Outcomes of our research:

- students consider science content as unnecessary for their everyday life
- students perceive gap between science at school and how science is presented by society (media)

Innovations of teaching/learning methods should contribute to bridging the science and society gap.

IBSE is an approach to teaching/learning science that comes from an understanding of how students learn the nature of science inquiry, and a focus on basic content to be learned (Narode, 1987).

IBSE respects different learning style of today's students, involves connectivist aspects. Specific examples of connectivist application in IBSE are presented in our study.

Rationale

2.1 Characteristics of the new students' generation

- *Net generation takes the use of ICT for granted component of everyday life.*
- *Net generation uses ICT as well as other devices intuitively, without instructions manual.*
- *Net generation is visually more literate, its reading literacy is less developed.*
- *Net generation performs more activities at the same time and they prefer speed to precision.*
- *Net generation prefers practical activities to theoretical studies.*
- *Net generation prefers learning and working in teams.*

Rationale

2.2 Innovation of educational methods (connectivism and IBSE)

Connectivism reflects the influence of ICT to education.

One of the thoughts of connectivism to which teachers should react in teaching is that the ability to learn what we need for tomorrow is more important than what we know today.

The thesis of „know-where" substitutes the present theses "know-what" and "know-how".

We should be teaching our students not only finished knowledge but also the path to it and skills to assess its relevance.

Rationale

2.2 Innovation of educational methods (connectivism and IBSE)

- *IBSE creates the activities of students in which they realize inquiry and they themselves discover the natural relations.*
- *IBSE is based on constructivism.*
- *IBSE engages students in the investigative nature of science and helps them put materials into a meaningful context, supports critical thinking (Narode et al., 1987).*
- *IBSE develops positive attitudes toward science (Kyle et al., 1985; Rakow, 1986).*
- *In the contrary to traditional teaching/learning, students apply their skills and knowledge to solving of real-world problems.*

Students we apply IBSE on are already the NET generation.

It is therefore necessary to connect IBSE and connectivism.

Research questions and methodology

If we are able organically to connect IBSE and connectivist approach, we have a big chance to obtain efficient teaching/learning methods.

The objective of this study is searching for answer to a general research question:

- *Which IBSE components may be modified into the form of connectivist methods?*

Research questions and methodology

Design-based research is the basic research method - connects research, and development, theory and practise.

- The research was carried out by the applying the action research in school education of science.
- The research team consisting of a researcher and teacher applied a certain element of IBSE, and he implemented in it connectivist approach.
- Efficiency of these methods was verified within this action research by empiric methods of questionnaire, test, analysis of students´ products, observation, etc.

Research results

The first research result is a list of common features of IBSE and connectivism:

Research results

Connectivism	*IBSE*
Based on the theory of constructivism	Based on the theory of constructivism
Suitable contents are themes from everyday life	Suitable contents are themes from everyday life
Fundamental role of ICT	Often uses ICT
Students do not like working according to precise instructions.	The objective for the students is to pursue ways and think, not to follow instructions blindly.
Students prefer peer-to-peer approach.	Students work in groups, cooperate, and communicate.
Students should not memorize facts but they should be able to search for them, and know where to find them.	Students learn to think logically, interconnect facts and draw conclusions from them – not to memorize them.
In searching for information, students meet information from many fields they have to be able to interconnect.	Students´ activities are of interdisciplinary nature.

Research results

Connectivism	*IBSE*
The objective is learning of many skills.	The objective is the development of skills and competences .
To be able to find facts is more important than the facts themselves.	The skills of "how to learn" is more important than any particular information being presented.
Students learn to distinguish which information is important and where to find it (Internet).	They check or find the importance of information with the help of inquiry.
Students connected in the network pass information, discuss, etc. In the avalanche communication, students seemingly “get lost” but this field might bring many new findings and it develops skills.	Students recommend their solutions, discuss, new solutions emerge, it is not given which results are to be achieved. Students learn how to research which is more important than the result of this research.
In network connecting, students are not of the same age, they are connected by interest.	Students do not have to be of the same age but they should have the same interest.
In connection with the network, the role of the leading authority disappears. Teacher has to gain authority through his or her professional abilities.	Teacher fulfils the role of adviser and guide.

Research results

Complex design-based research has brought results which is a set of the IBSE connectivist methods.

We give examples of educational methods where IBSE components are modified by the connectivist approach.

For the individual methods, we give a brief characteristic and a concrete example:

Research results

4.1 International student collaborative teamwork

We implemented this cooperation so that students were solving cooperatively online issues in teaching, which was under way in a Czech and Portuguese school at the same time (age 16; study year 2008/2009). The teaching theme was photosynthesis.

- students did online experiments (according to the instruction of the students from the partner country)
- students were preparing common videoconferences where they presented the results of their experiments

Students answers indicate high levels of both motivation and engagement:

Research results

4.1 International student collaborative teamwork

Questions and responses by Portuguese/Czech students (from the student questionnaire): N = 27/21	*Disagree*	*Partially Agree*	*Agree*	*Strongly Agree*	*No opinion*
Online experiments realized in collaboration Czech/ Portuguese students well supported my understanding.	**5/5 %**	**26/33 %**	**46/38 %**	**18/19 %**	**5/5 %**
Collaboration in online environment with Czech/ Portuguese students helps me to understand and learn better.	**0/0 %**	**17/19 %**	**54/48 %**	**24/28 %**	**5/5 %**

Research results

4.2 Educational games

- Connecting of several features of the Net generation (common use of ICT, advanced visual literacy, multitasking) is reflected in the popularity of educational games.
- Students adopt knowledge and train skills.
- Many web sites with educational games from different themes for different age categories.
- In the Czech Republic, there is, for example, a game named EKOPOLIS (http://www.ekopolis.cz/hmenu/english.aspx), in which students solve environmental problems.

Research results

4.3 Comics creation

Students of the Net generation have strongly developed visual literacy and they easily express themselves with the help of images but have difficulties reading long texts with comprehension.

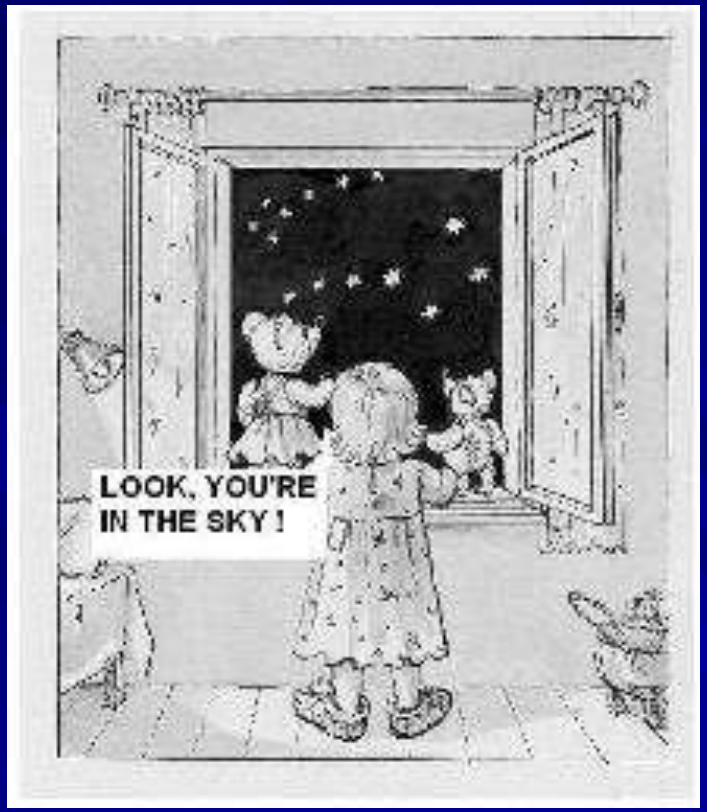
If a theme is not interesting for them, they skip passages and try to get to the end fast (Grunwald, 2003).

Comics:

- Comics combine text with images.
- IBSE point of view - necessary students actively participate - do not perceive comics just passively.
- To include students in the creation of comics.
- There are certain web sites that allow creating of comics.

Research results

4.3 Comics creation



Comic: Little Bear and Big Bear

Research results

4.4 Creation of multimedia presentations

Net generation students:

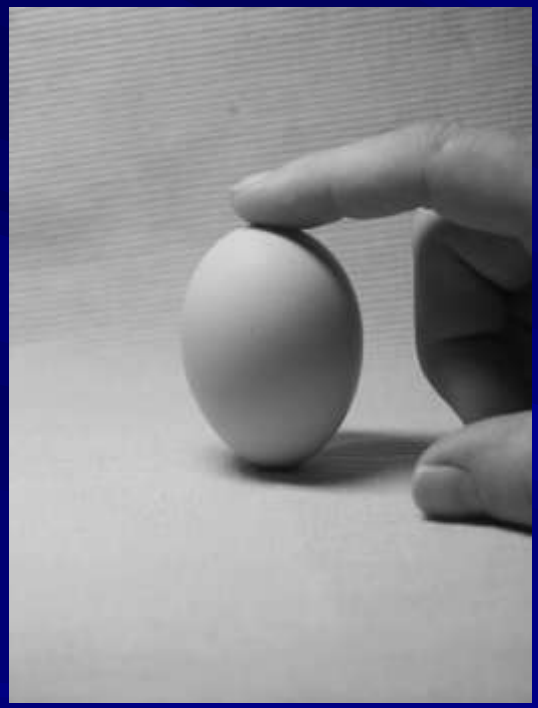
- are able to integrate images, audio, and text quite naturally
- are able to move very fast between the reality and virtual environment
- have knowledge of a wide assortment of ICT applications, which allow them to create their own multimedia presentations
- are joined in online communities where they present the results of their work to others
- express their opinions and advise each other on problems etc.

We assigned a task to the students to record an experiment containing experiments with egg of Columbus.

Students in the groups recorded a video, presented it to the others in their class, and discussed the presented variants of the experiment. Subsequently, they presented their experiments on the Internet (photo examples):

Research results

4.4 Creation of multimedia presentations



Egg of Columbus

Conclusions and discussion

- By comparative analysis, we have created a summary of common features of IBSE and connectivism.
- On the basis of these common characteristics of IBSE and connectivism we have developed several IBSE connectivist methods by the design-based research.
- These issues have to be included in the pre-service and in-service science teacher training.
- The issue of continuous professional development science teachers in IBSE covers PROFILES, a European project in the scope of which many of the above-mentioned ideas originated (http://www.profiles-project.eu/).

Thank you for your attention

Josef Trna, Eva Trnova

Masaryk University
Brno, Czech Republic
trnova@ped.muni.cz