A short history of web based learning including GIS

Gilbert Ahamer

Austrian Academy of Science, Institute for GIScience,
gilbert.ahamer@oeaw.ac.at

***Abstract*:**
This paper suggests a short history of web based learning in three generations according to the usage of web based functionalities while presenting practical cases. The idea is to show how (1) content, (2) communication and (3) assessment have evolved in steps which are referred to as "generations of web learning". A fourth and a fifth step is proposed, making use of multi-perspectivism and geographic Information Systems (GIS).

The reader is offered a stepwise description of both didactic foundations of university lectures and a practical implementation of a widely available web platform. The relative weight of directive elements has gradually decreased through the "three generations", whereas characteristics of self-responsibility and self-guided learning have gained in importance.

1. Content was in early stages presented and expected to be learned but later on it was expected to be constructed for examples using case studies.
2. Communication meant in early stages delivering assignments to the lecturer but later on forming teams, exchanging standpoints and reviewing mutually.
3. Assessment initially consisted in marks invented and added up by the lecturer but was later enriched by peer review, mutual grading and voting procedures.

How much "added value" can the web provide for teaching, training and learning? Twelve years of experience suggest: mainly insofar as new (collaborative and self-directed) didactic scenarios are implemented.

Keywords: e-learning history, .web-based learning, communication, content, assessment.

1. History of the "three initial generations of web based learning"

The target of this paper is to compare several strategies of assessing students' academic performance in cases where there is "more than one truth".

This text discerns three phases of web based teaching / training / learning (WBT) according to how didactic objectives and concepts are transposed (Bork, 2001, Prensky, 2001). Over the last years e-learning activities have increasingly made use of technological possibilities offered by current web platforms. In a number of cases, this enabled strife for student-centered and problem-based learning. Earlier work of the author is taken as an example for defining the three "generations" of web based learning (see Fig. 1).

2. Three initial generations of web support in practical examples

2.1. First generation: content and quiz

Very often, "putting one's lecture onto the web" means in practice to provide students with written online documents which replace many printed pages. Such content-centered understanding of "web based teaching" intrigues lecturers due to the decrease of administrative work that is expected as a result of pasting a link to a PDF file into an existing university web page. Such an approach might recall former times.

As a case for the 1st generation, since 1999 three *interdisciplinary* courses are held at an Austrian University of Applied Science (FH Joanneum FHJ), namely "Technology Assessment", "Systems Theory and Biology", and "Environmental Technology" (see cover pages in Fig. 2).

With the kind and helpful initial support of FHJ's Centre for Multimedia and Learning (CML) and its founder, several *functionalities* of the then newly acquired web platform Web Course Tools (WebCT, 2004) were employed in order to

1. present content to students and to allow students to study independently of time and place (Lo et al., 1999)
2. assess students' specific interests and preferences at the outset of the lecture in an "initial survey"
3. provide several case studies as topics for students' written assignments, allowing for differentiated anonymous personal choice
4. provide a discussion forum, where individual students could submit their resulting essays and where they would receive the lecturer's evaluation
5. require traditional results of cognitive learning (quiz equaling the written exam) and inform about exam results
6. ask students for their overall feedback after the end of the courses in a "final survey",

which is graphically represented in the left part of Fig. **5**.

Content provided on the web platform was hierarchically structured into

1. one list of links representing the table of contents of the course
2. a set of 50 transparencies (in doc file format) used for face-to-face teaching
3. a multitude of 100's of text files and links covering details of all subject matters

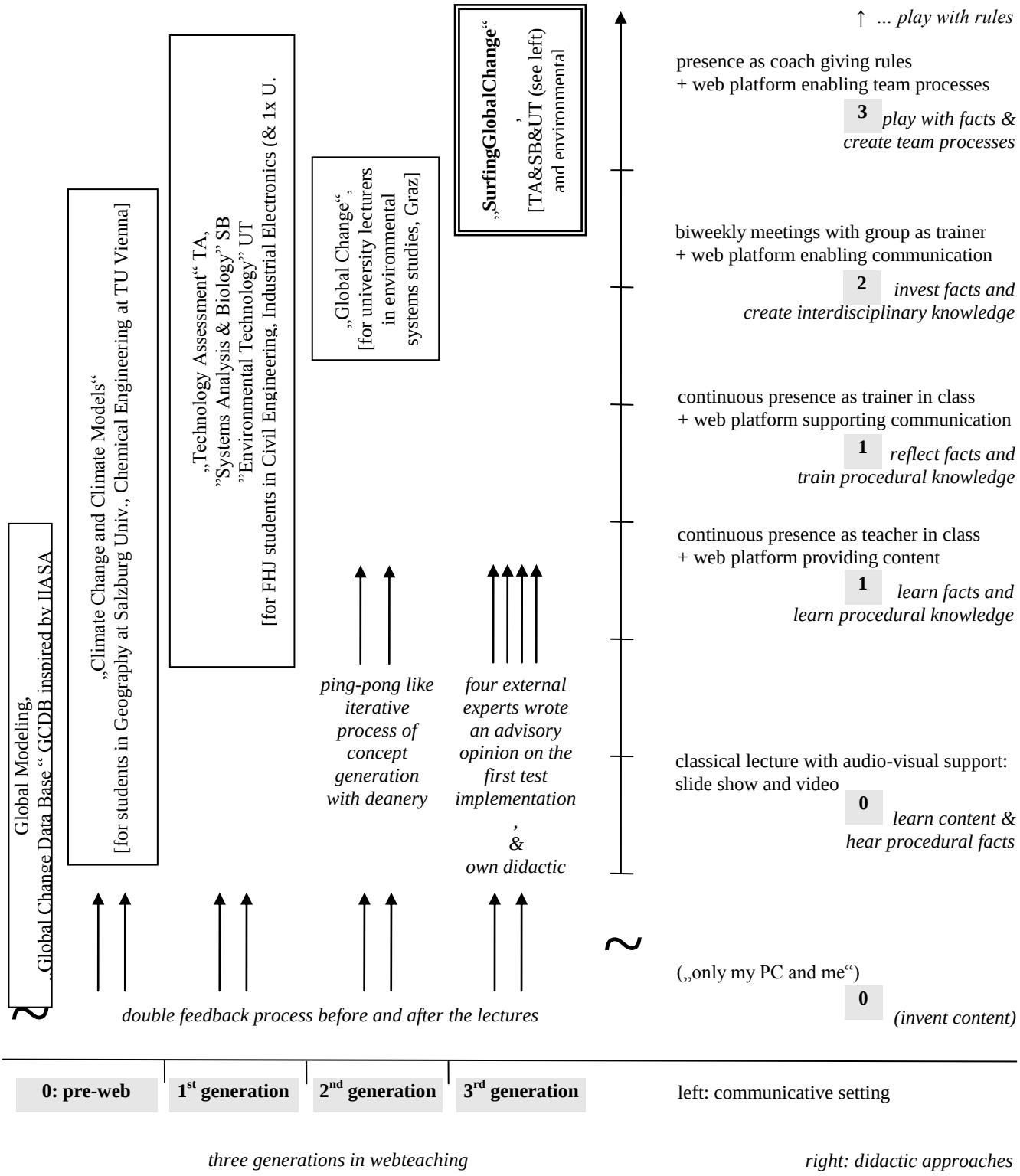

Fig. 1: History of three generations of web based learning as based on the author's earlier scientific work starting from the "Global Change Data Base" GCDB. Years indicate summer semesters; generations indicate steps in implementing communicative structures; arrows denote inputs; the right hand side shows the conceptual basis (communication and didactics).

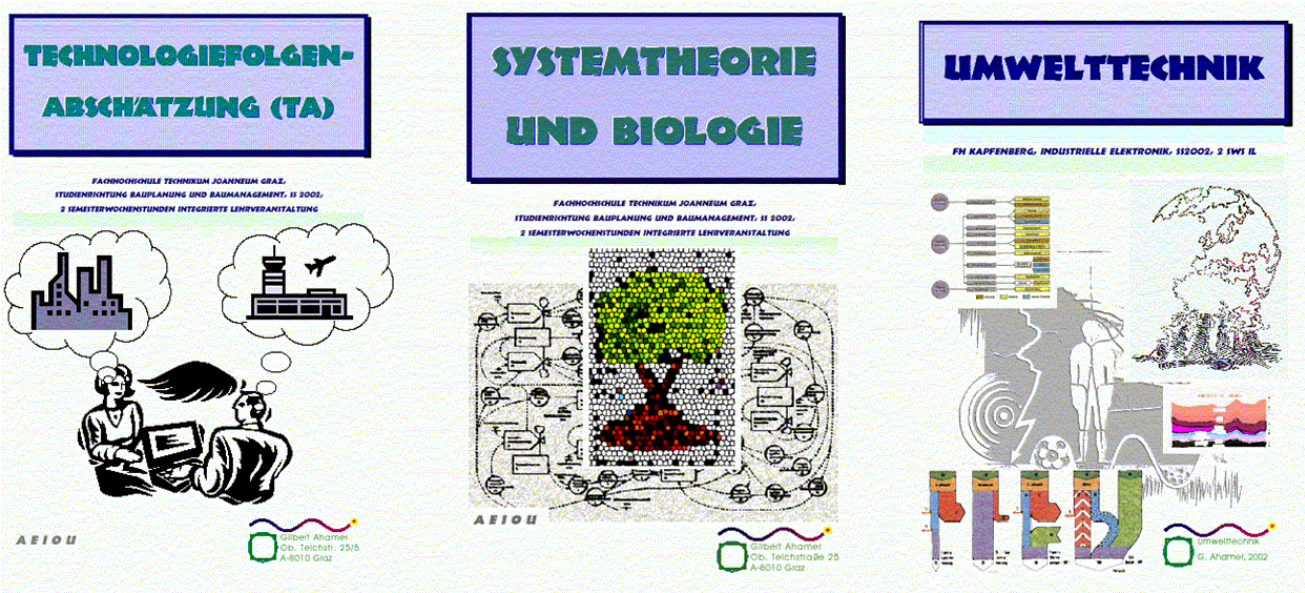

Fig. 2: First generation 1999: Three cover pages representing content delivered to students via both a web platform and a paper manuscript: "Technology Assessment" (TA), "Systems Analysis and Biology" (SB) and "Environmental Technology" (UT) at FH Joanneum over a period of six years. Source: Ahamer (1999).

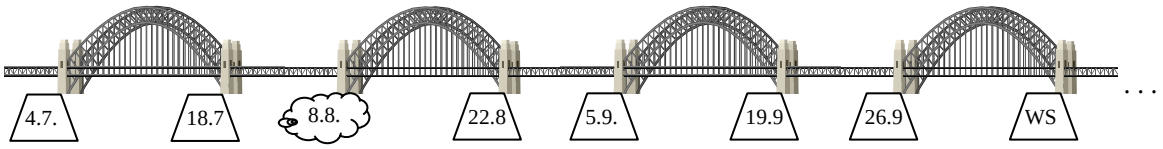

Fig. 3: Second generation 2002: time structure of 8 face-to-face meetings with online phases in between. Only one real meeting was replaced by a virtual one (cloud).

The *final grade* for these three courses (TA, SB, UT) consists of several components (
Fig. **5** left) that reflect both cognitive and creative abilities of the students, namely the

1. individual written online exam administered during lecture time in class while being supervised by the lecturer (max. 30 or 50 points for compulsory share plus max. 20 points for optional share)
2. "short" case study (1 page/person) on a general topic like ethics (written and oral performance); in earlier years with an oral presentation in class and in later years with directed mutual peer reviews among students via a platform
3. "long" case study (5 pages/team) as preparation for role-play in class representing a negotiation of a construction project as used in the Environmental Impact Assessment (EIA, 1997 and EIA, 2000).

Teaching occurred face-to-face because at that early stage no administrative high-level support for tele-teaching seemed realistic. Also, all three lectures had a strong component of individuals' aims and of the ethical orientation that seemed to necessitate personal contact. In line with the experience of the author, here web tools played at best a supportive role. Later on the term "*blended learning*" was coined for such a combined teaching style.

2.2. Second generation: communication and construction

After four years of such a relatively simple architecture in web teaching, any interested actor would have felt a notable increase in

1. general awareness of didactic implications, e.g. by activities in the Austrian "Forum Neue Medien" (BMBWK, 2000) or in individual universities (NML, 2002)
2. community-building among web-trainers, e.g. three informal Austrian meetings on web didactics and seminars (Gierlinger, 2002) organized by the author
3. structures for professional formation (e.g. the multiple course schedules "Train-the-Trainer") organized by FH Joanneum and others (CML, 2002).

In order to push ahead the target percentage of realistically implemented "web based training", the vice-deanery at Graz University tasked the author with holding a summer course from July to October 2002 with *three distinct objectives:*

1. to train university teachers to utilize the WebCT platform
2. to create samples of online course material for later usage

3. to train lecturers in interdisciplinary collaboration.

The course *schedule* envisioned one face-to-face meeting every second week and online work in between (Ahamer, 2002; Ahamer and Carstensen, 2002), akin to a bridge with pillars (Fig. 3).

The architecture (Ahamer, 2002) comprised *6 phases* of ca. two weeks each:

1. concept and media (kick-off meeting, team building and planning)
2. collection of materials (creation of content pool and mutual commenting)
3. didactic processing of materials and condensing into web media (90min/team)
4. trial and evaluation (mutual teaching as test, subsequent documentation)
5. analysis and revision (reworking of web media, mutual commenting)
6. an entire interdisciplinary course is implemented in team teaching.

How well were initial objectives attained? *Evaluation* is of essential value (Barz et al., 1997; Carstensen & Reissert, 1997). A critical reflection and monitoring (Carstensen, 2002) states that 12 weeks time is too short for three ambitious goals. Encountered difficulties (like different activity level, high time consumption, decrease in motivation) are believed to be typical for future web teaching implementations by course members. In the view of the author, targets were reached according to Tab. 1.

Tab. 1: Monitoring of the degree to which the targets of the summer course have been reached according to the personal view of the author.

target according to initial concept of summer course	**attainment of target after course**
usage of web platform for communication	85%
authoring of concept and scenario for lecture	80%
generation of module of web content	80%
collaboration (independent of time and space)	80%
technically mastering WebCT	75%
didactic sense for implementation of web based training	75%
team generation and group formation	70%
interdisciplinary dialogue inside the teams	60%
usage & interpretation of the Global Change Data Base	30%
interdisciplinary dialogue between the teams	30%

Fig. 4: Third generation 2003-2005: Welcome screen of SurfingGlobalChange SGC.

The *iterative character* of the course and its successors comprises the years 2002-05:

1. the trainees of the first step (= summer course 2002) build up the structure of a web based "interdisciplinary course for Environmental Systems Sciences" (IPK-USW) in 2002/03
2. this course comprising 6 weekly hours is implemented via WebCT (Ahamer et al., 2002); students are required to merge technological, ecological and economic views and produces a number of written and reflected standpoints by using the game "SurfingGlobalChange"
3. innovative students from this first course propose a second implementation of SGC with different case studies focusing on the EU enlargement process (Florian, 2004). Thus the web based material will be annually expanded.

2.3. Third generation: collaboration and mutual assessment

Based on experiences described earlier, an original web based negotiation game "SurfingGlobalChange" (
Fig. **4**) was invented and implemented (Ahamer, 2004a).

This role-play is inspired by the conviction that equilibrium between two major complementary groups of skills has to be reached for successful professional life, namely *competition and consensus*.

Until 2010, SGC was implemented 25 times for Graz University (USW, 2010) and FH Joanneum in interdisciplinary courses for advanced semesters: Resulting social dynamics was monitored by a number of independent experts invited and financed by the author (e.g. Rauch, 2003). Moreover, a subset of the game idea of level3 was delivered as input to an EU project "UniGame"; additionally, a didactically founded game concept for the Graz contribution to this project was provided (Ahamer, 2003). Furthermore, a game scenario was developed in collaboration with FHJ members (Ahamer et al., 2003), which serves as a basis for a game that has been renamed in the meantime "UniGame: Social skills and knowledge training".

Detailed statistical evaluation of students' results has shown that cognitive performance (e.g. measured by quiz grades), skills of authoring academic articles, skills of reviewing them, and skills of discussion are to a large extent uncorrelated with each other and could be seen as independently varying. For the time being the conclusion is made that such skills have to be measured and assessed separately from each other in order to draw a complete picture of a personality.

3. Comparison of characteristics in three generations

3.1. Is there a trend in web platforms' functionalities used?

The *three main functionalities* of the web platforms, namely content, quizzes and communication are employed across the three generations, while the clear main trend is a *shift* away from the usage of content-oriented towards the usage of communication-oriented functionalities in the web platforms. The sharply increasing hit frequency underlines such a view and suggests that for students a discussion forum is a tool to create public space for members.

Digital media may serve as a *vehicle* for self-guided learning in thematically and communicatively open structures. Didactic deliberations and fundaments are largely available in Gierlinger et al.(2004) and Ahamer (2004). Web platforms are able to create *public space* as an easily accessible "home" for newly forming groups and as mentally comfortable living room for learners.

The overall trend regarding assessments consists in a *shift of roles*: initially only the lecturer has the power to grade, later on well-defined sub-portions of grading tasks are performed by peer students. Such development is well in line with a finding for another professional field, namely that for the assessment of university studies both internal and external evaluation is necessary (Reissert & Carstensen 1998).

3.2. How did assessment and grading develop?

Fig. **5** comprises the development of course units from the first to the third generation taking the described lectures as an example. It is visible that the invention of the web based negotiation game "SurfingGlobalChange" by the author equals further development of two earlier interdisciplinary web based lectures.

3.3. Which didactic method is chosen?

Based on the result of three generations of web based learning, SurfingGlobalChange is grounded in didactic deliberations made earlier (Ahamer, 2004) and

- builds on a tradition of simulation and gaming (Klabbers, 2001)
- relies on ethics of negotiation (e.g. Fischer-Kowalski et al., 1995)
- is inspired by constructing realities (Foerster, 2003; Kerres, 2001a)
- does not attempt to mathematically simulate complex realities (Meadows, 2001; Burns, 2002)
- but is simulative for real-life processes (Myers, 1999)
- is founded on systems thinking (Richmond, 1993; Ossimitz, 2000)
- allows for pragmatic strategies (Reilly, 2003)
- and uses environmental topics as trigger for the emerging global responsibility of humanity (Rauch, 2000, 2002, 2002a).

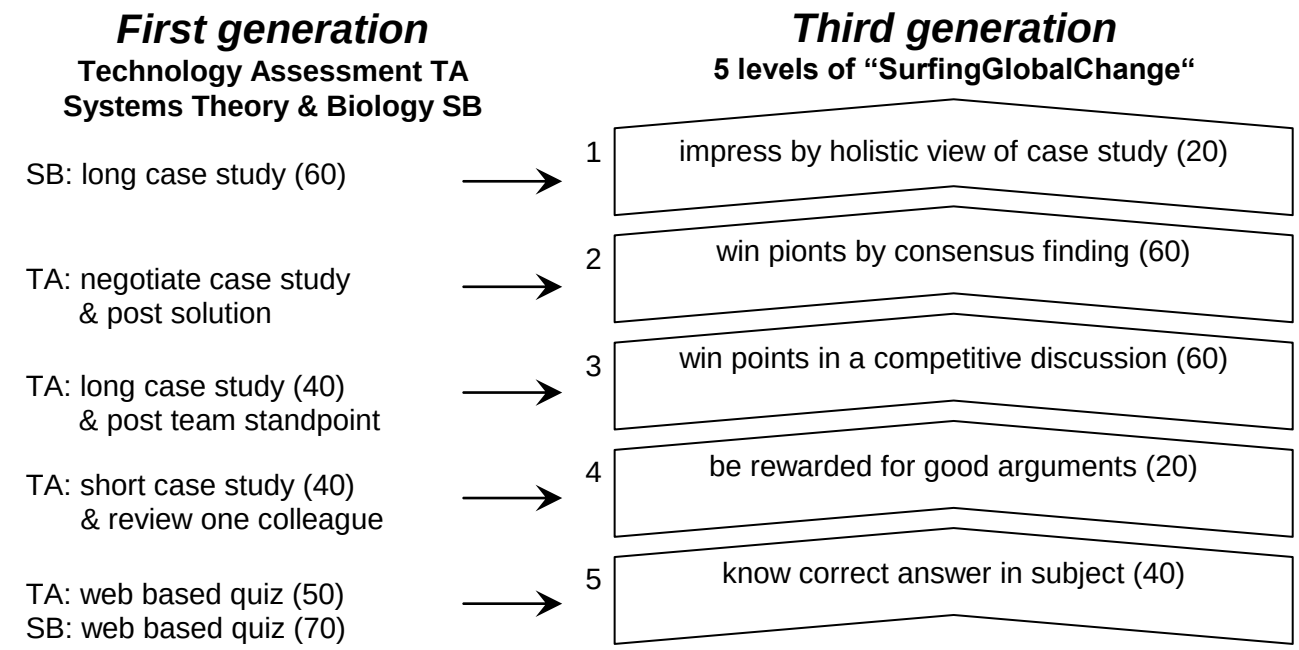

Fig. 5: Development of course components comprising 4 weekly hours from classical web teaching in the first generation (left) to SGC as the third generation (right). Maximum rewards in the single levels are added in parentheses.

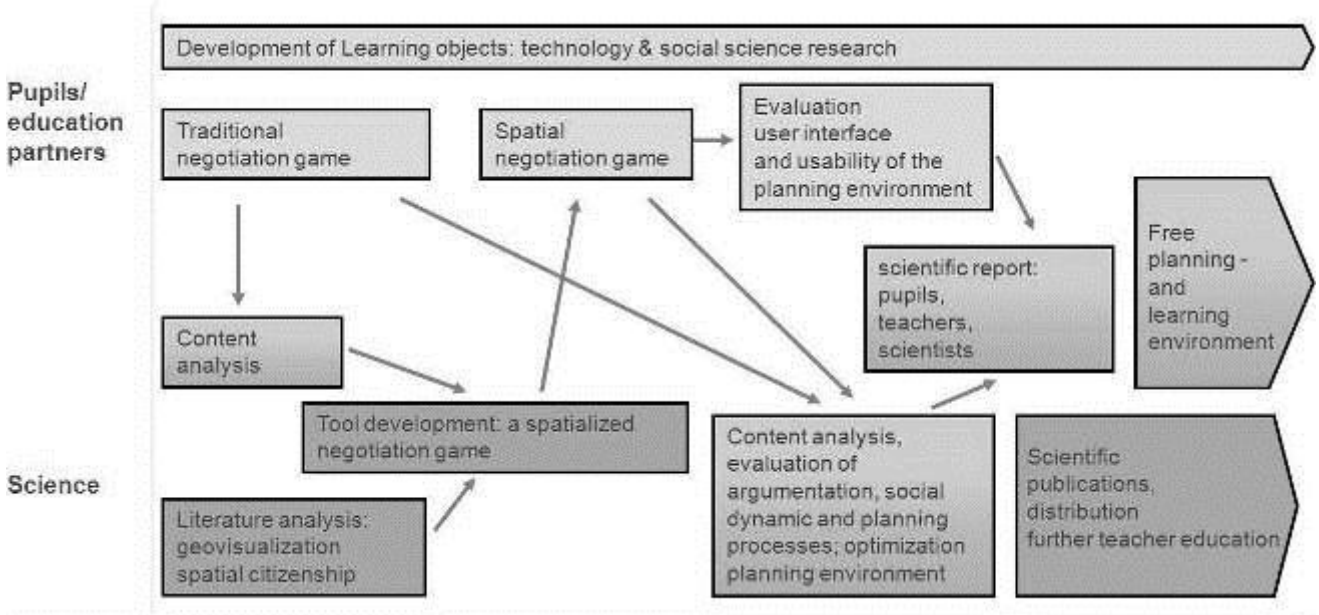

Fig. 6: The project structure of GEOKOM-PEP (Jekel et al., 2009, Vogler et al., 2010) supports decision making through visualization and mapping.

4. Game based learning as the fourth generation

4.1. Gaming – through a theoretical lens

The 3rd generation approach of collaboration and mutual assessment opens into focusing on "perspectives" as the main constituents of reality. Multiperspectivism (GS, 2010; IE, 2010) is an approach that specially suits international projects, intercultural approximation and peace efforts.

On the didactic level, this paper suggests to depart from "fact" to "view". Students are invited to take roles and implement them along a series debates backed by previously written and academically supported standpoint papers (levels 3 onwards in SGC). Perry and Sanderson (1998) inspires to such a "theatre of arguments" where bundles of arguments can be handed over from player to player. On the stage of the social spaces defined by the rules of SGC, students can tentatively take roles, adopt, share, transmit and perceive views and fight for them or mould them into a greater consensus. The substrate of action is "views", not "facts".

Views can be handed over to colleagues and slipped into, similar to clothes on a stage. Students explore the argumentative potential of diverse conglomerates of ethic convictions mixed into scientifically backed argumentative approaches.

Such a panel for gaming permits border conditions that are loose enough to allow for readaptation of own convictions along the learning process and tight enough to structurize an ordered debate. Human explanatory constructs are traded among participants and their explanatory value is counterchecked. Each participant feels stimulated to adapt previously adopted aggregates of world views in order to optimize their potential in finding allies.

Coming from the science of "design", Bucciarelli (1998) deals with such "designing of social processes"; Heaton (2002) introduces the notion of „cultural frame", expanding on the idea of "technological frame" and "frame of meaning". MacGregor's (2002) core method to increase appropriate levels of "awareness" throughout the design process is to encourage for "switching" of roles (as does SGC). SGC's rhythms of social interaction implement permanent refaming in the "space of meaning.

Restrepo and Christiaans (2004) in a very good article stress the importance of Underdeterminism and a sufficient amount of degrees of freedom for learning (= adopting new world views) – which is in fact "gaming".

4.2. Gaming – the practice

According to the rules of the web-based five-level negotiation game "Surfing Global Change" four to five tables in the lecture room symbolize the views which interact vividly during hour-long structured discussions (Fig. 7). Literally, the lecture room becomes a material manifestation of world views.

Students outside the ring of tables have the task to monitor the performance of their colleagues during discussion and to provide written feedback, thus introducing an element of "reflection in action" and "peer review" into the social process. This allows actors to deepen their understanding by adding an outside view to their actions.

5. Geographic Information Systems enable the fifth generation

5.1. Public Participation Geographic Information Systems (PPGIS)

Collaborative learning as developed until the 4th generation calls for suitable technological tools to manage the underlying complex fact-based and opinion-driven procedures of communication. During the last years, interactive tools for geo-information (GI) based learning environments has created vast new possibilities.

Both planning and learning processes can be seen as compatible – see Jekel (all years), Mayer et al. (2004, 2004a) – because they are socially embedded in a constructivist model (Foerster 2003, Vygotsky 1978, 1986) and open to Vygotsky's "psychology of play".

First evaluations of GI-based globes yield very positive results regarding the inclusion of learners and the quality of results (Strobl, 2007). Hereby they fulfil the requirements that are requested from constructivist-oriented multimedia learning environments (cf. e.g. Baumgartner 1995).

What do Geographic Information Systems (GIS) provide? Essentially a "viewing tool", a "macroscope": Geographic Information Systems (GIS) under the form of Google Earth or Bing Maps have entered virtually every living room when it comes to finding hotels in an unknown city or discussing about the optimal route to the next holiday site. After holiday, GIS may provide another (idealized) view of lived reality as in the four examples of

Fig. **8**: a bird's view during summer containing the route undertaken by car, a collection of downhill ski routes undertaken during on the first day together with a panorama photo, a documentation of the first beginners' attempts to learn snowboarding on a baby lift and then outreaching to more difficult slopes (together with another author's photo of these slopes), and finally a summer view of the entire ski resort "Marilleva 2000" through the lens of a satellite and of a fotographer posted near a church from opposite.

In this understanding, "geography" is understood as the science providing views. Geographic Information Systems (GIS) does the same, only quicker.

Fig. 7: Setting while gaming during discussions of "Surfing Global Change" 2007.

Fig. 8: Views on the same "real facts" strongly depend on the viewers, even in such simple cases as an Italian winter holiday site in the western dolomites in 2010.

5.2. PPGIS – towards a new participatory practice

Since 2009, a new project (building among others on SGC) explores the enhanced effect of GIS tools on the quality and speed of consensus building (GEOKOM-PEP, 2009, Jekel et al., 2009, Vogler et al., 2010), see Fig. 6.

It is expected that earlier research work will be corroborated indicating that interindividual negotiation processes and consensus finding is significantly enhance when stakeholders use (virtual) maps to visualize their proposals, views and recommendations for solutions.

6. Conclusions

This article told the story of the steady development of university courses while gradually increasing the complexity of communication and assessment structures. The guiding philosophy is web based collaborative learning in cases and constructionism.

Seen from the perspective of trainers and learners, the bundle of formerly cognition-oriented targets is enriched: (i) find learning targets yourself, (ii) form teams, (iii) give and get feedback, (iv) reflect and stepwise improve own and others' work.

Concluding from the courses described in this paper, participating students can be observed to pass through consecutive steps as a function of novelty and appeal:

1. learn facts
2. play with facts according to game rules
3. play with rules in an autopoietic way.

Geographic information systems such as virtual globes promise to provides prime options and facilities to ease sustainable decision making.

May the interesting experiences made by game based learning enhanced by virtual globes contribute to developing a sustainable humane future!

7. Acknowledgements

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Author Biography

Gilbert Ahamer: Born and working in the historic city of Salzburg, he has always been interested in the history of technology and science, despite being trained as a physicist, environmentalist and economist. At the Austrian Academy of Sciences he tries to link the concept of "spaces" with options provided by Information and Communication Technologies ICT.
Participation and GIS as a case study promise to facilitate procedures of human understanding.