Teleteaching: From unidirectionalism to multidirectionalism

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Teleteaching is currently in most cases a simple port of common structures like lectures or practices to an equivalent distance version like books, CD-ROM's or send-in reports. These methods are good for teaching knowledge, but are unsuited for learning transferable skills like communication-skills, self-organization or teamwork, which are of increasing importance for the work-life. Courses like seminars, who address these issues in conventional teaching, are held either with physical presence or not at all. In contrast to this, networks and groupware allow new types of courses, where students need not gather to work in groups but share a common context providing virtual proximity. This allows practicing these skills in a completely virtual university. In this paper, some ideas for improving teleteaching by including group work over a distance are presented and both advantages and potential problems are identified and discussed, according to the experiences with a number of virtual seminars in the past.

1. Introduction and Motivation

In the field of distance teaching, a lot of emphasis is put on holding lectures (e. g. by use of video-conferencing systems) or producing materials for telelearning in a conventional way (like multimedia CD's or books) [8], but they are only a part of the teaching at universities and only teach contents. This is just a transfer of current structures with as little changes as possible to new and widely different technologies.

It is important to recognize the necessity for a transition from teaching specific content (knowledge) to teaching ways of learning and methods of work (skills). With the acceleration of half-life of knowledge (especially in computer science), the duration in which a fact is of importance continually grew shorter. Therefore the students must no longer be prepared with pre-found knowledge, but with the abilities of acquiring the newest findings when the need arises. As the transfer of knowledge is the focal point of lectures, they slowly grow less important while practices and seminars

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with their emphasis on interaction receive more and more attention. They should therefore also be available in the way of teleteaching instead of being mostly limited to on-site education.

It is my opinion that a complete rethinking and a fundamental change to teleteaching are needed to really exploit the benefits new technologies can offer. Examples for these are the new possibilities to teach transferable skills like self-organization or communication skills, which are important in work-life and cannot be included in the usual ways of teleteaching. Furthermore networks and groupware allow to focus on the task of working together (coordination, cooperation, co-decision, discussion of intermediate results, etc.) without the restrictions as having to be at the same place or to work at the same time which are common in conventional teaching [5].

Some ideas for teleteaching to move on to a flexible and virtual university and the experiences gained from organizing a number of "Virtual Seminars" will be presented in this paper.

2. Unidirectionalism vs. Multidirectionalism

To clarify the meaning of and the difference between unidirectionalism and multidirectionalism a definition is needed. In this paper the following are used:

- ⇨ *Unidirectionalism*: Teaching occurs only between the teacher and the student in the form of transfer of knowledge or skills from the teacher to the student and includes feedback to the teacher. This way of working and studying alone is based on several centuries of experience at schools, universities and other learning institutions and can be applied to Teleteaching. Summary: One piece of knowledge is distributed identically to an arbitrary number of participants. The focus is on the knowledge itself.
- ⇨ *Multidirectionalism*: Teaching occurs between the teacher and the students but also amongst them. Every student works on a different aspect of a common problem and learns about his own topic and from the results of the other ones by communicating with them. The role of the teacher changes from a provider of knowledge to a provider of information, methods and skills. He offers guidance, feedback, initial starting points and help when someone gets stuck or is heading a wrong way. Summary: A number of persons learn in moderate detail about more or less different but interrelated pieces of knowledge and acquire an overview on the whole by intensive communication. The focus is how to acquire, interrelate, use and present the knowledge.

The difference between those two ideas is displayed in the following picture:

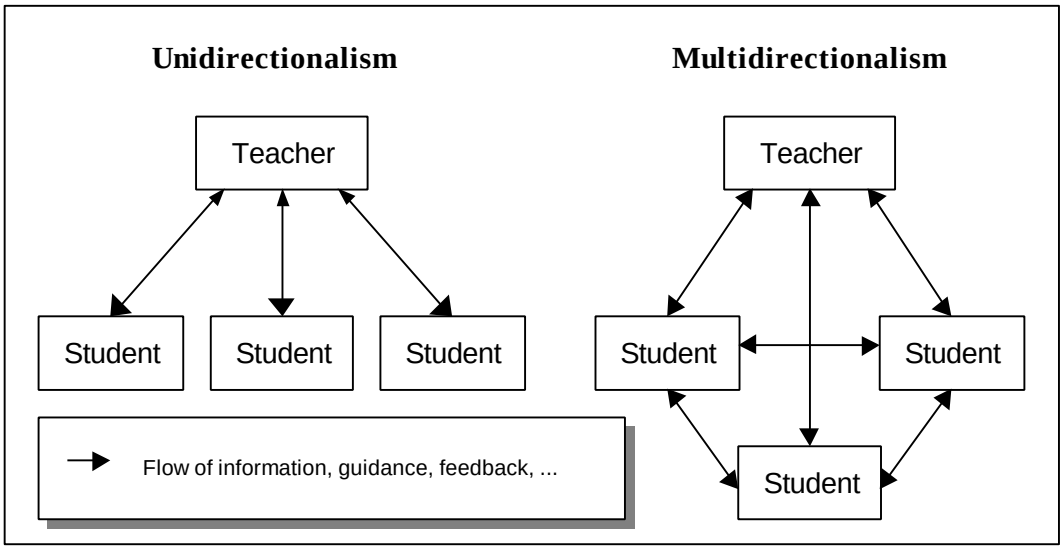

Figure 1: Unidirectionalism vs. Multidirectionalism

While "Teleteaching" and "Group work" might seem to be mutually exclusive as the former implies *distance* while the latter one includes the meaning of *close cooperation*, computers and networks can bridge this gap by providing a virtual proximity, allowing to combine both.

3. Elements for moving onwards

Teleteaching introduces many new possibilities and chances to the learning and teaching process. At several of them we will take a closer look and explain their connection with multidirectionalism:

3.1. "Net-"working

As many people do not think in linear structures but rather in associations connecting similar but also seemingly different things, an inherently multidirectional structure, "omni-directional-thinking" (knowledge consists of interrelated relativistic terms rather than isolated bits of information, [3]) increases in importance. Although it is not the best solution for every situation (teaching basic knowledge is more successful if done in a rather conventional way), it is important to recognize its usefulness for acquiring a broad overview with particular areas of expertise.

Because of this, it is necessary to adapt the way work is usually done in seminars or projects. Currently a task is assigned and then the student works for himself (or with a bit of communication with the teacher) and finally presents his results. This should be changed to a pattern where the stu-

dent not only exchanges his ideas and insights with the teacher, but also interacts with other students, e. g. asking them if they know a pointer to further literature or telling them what he thinks is unclear in their intermediate or final results. In a more technical sense, networking is very important too: The Internet gains importance and every student should be able to use it active and passive.

A typical example for multidirectionalism would be a course, where students at home create webpages on different aspects of a general topic, which are then combined to a single website. Every participant reads the results of the other ones and incorporates their parts into his by inserting appropriate links, producing a network of information. Another possibility is developing a common set of criteria or other results where individuals and groups must present initial ideas and all participants discuss them and have to agree on a final set at the end.

3.2. Integration of external experts

Teleteaching allows involving far away experts on special topics into courses. They can provide detailed advice and be either appointed by the organizers of the course or contacted by the students during their work, extending the interaction beyond the (although virtual) classroom. This improves not only the content of the work but also the abilities of the students to find and get in touch with other people, which is important for the future. The expert can profit by this too: He may get new ideas and can keep up to date on new developments with little work. Concerning this several by-products can be identified: Working with people from different countries serves to build an international community and outgrow nationalistic tendencies. It also sharpens the view on problems of large-distance-communication like differences in local time, the way of teaching, curricula's, etc.

3.3. Time independence

New technologies like e-mail and newsgroups allow asynchronous communication in a very fast and efficient way. As nowadays most students possess their own computer and ubiquitous access to them at the university becomes more and more common, checking for new messages and answering them can be done very conveniently at any time. This approach allows to bridge the gap between synchronous (avoiding the need to meet at exactly the same time) and asynchronous communication (no discussions stretched over a long time with sparse contributions and problems to remember the last messages and the own replies) [11]. In this way it is possible to participate in multiple interlocking conversations. It also allows to do work more efficiently: Communication can be grouped

to a specific time and distractions from other work by being interrupted with synchronous communication can be minimized.

Independence of time enhances multidirectionalism, as it is e. g. impossible to participate in more than one conversation at the same time. This is because changing the context (i. e. the previous sentences in a conversation) cannot be done very fast and in addition it may not be complete (some sentences might go unnoticed). In an asynchronous electronic discussion the context is stored for easy access and without omissions and there is enough time for changing between and remembering them, allowing an easy switch of context.

3.4. Learning transferable skills by doing

Transferable skills like self-organization, time-management, cooperation in teams or communication skills can only be learned by practicing them. Receiving theoretical information is necessary, but every person has to internalize them for himself and find his own particular way. These skills are inherently multidirectional, as communication, coordination and/or cooperation with a larger number of persons is required.

Although multimedia-CDs are a large step forward from books, e-mail allows faster discussions between the teacher and the student compared to letters and lectures by videoconferencing can reach many more students than an ordinary lecture, they do not add to the education in transferable skills. These common ways of teleteaching focus instead on uni- or only bi-directional ones: Reproducing knowledge, understanding basic concepts, discussions between two persons, etc. In contrast to this transferable skills are often only taught and practiced in condensed and short periods of time, where the students physically gather and the virtual university steps back to a conventional one. If teleteaching successfully wants to claim that everything can be taught from afar, it must also be prepared to instruct students in these skills over any distance, no matter how large.

A way to do this can be virtual seminars, where students collaborate over the Internet to work on a common topic (see case study).

3.5. Easy archivation and access to previous materials/results

Introducing electronic discussions and presentation of results into teleteaching automatically opens new ways of access, which can be reached in conventional teaching only through a lot of additional work. Everybody can present his conclusions to the public when using e. g. the WWW, in this way

extending the audience and enabling comments on it from many different sources: the teacher, external experts, other students, interested persons. In contrast to this, conventional teleteaching (working individually) yields feedback only from the teacher or, in the case of the mostly rare meetings, from other students participating in this particular course. Moreover, electronically available results can be easily duplicated and therefore integrated in later courses, while results of conventional teaching are only available on paper or not at all in the case of discussions. These former results also do not disappear in some archive, where they can be found only with a lot of work and dedication. They can be presented for example on webpages, keeping them ready for access by the public for a long time without any significant difficulties or costs. Additionally, these work is available even if only very recently produced and can be used everywhere simultaneously. Storing results in an electronic form is a prerequisite for multidirectionalism, as it allows easy duplication and distribution where conventional products and responses could only be distributed with higher costs and longer delays.

Integrating a search-engine into the electronic storage enables to retrieve information easily that otherwise would probably remain hidden. In this way, students can be introduced more easily to the idea of building up on previous work rather than re-inventing it. The barrier to do an electronic search is much lower and yields faster and more up-to-date results than to go to a library and try to find something there, which might take a long time if the book is not available locally. This is also a practice for finding information in the Internet, a hard but necessary task because of the mass of rather unimportant data.

Even more dramatic are the advantages of electronic discussions or shared workspaces: What formerly could not be kept is now automatically saved, maybe even with version control, so any intermediate status can be reconstructed for later use. These results will likely be not made available to the public but they are an important mnemonic aid for the participants, enabling asynchronous multidirectional discussions by providing a context for the individual contributions: An exchange of e-mails between two persons can be stored easily in any e-mail-program, but the structure in a discussion between three or more participants dissolves without dedicated support.

3.6. Cooperative environments

A major part in the shift from uni- to multidirectionalism is groupware. Although video-conferencing systems get cheaper every month and the bandwidth available for transmission increases steadily, it will be a long time till conventional teamwork will be able to rely completely on

this. Even then, only a small number of participants can work together simultaneously because of the available screen size and the lack of overview on large numbers (e. g. 10 videoconferencing windows on one screen cannot be watched at the same time). Moreover, this provides only a shared audio-visual environment where every participant has to take his own (not electronically available) notes, in this way increasing the odds on producing inconsistencies. An important issue for furthering the usefulness and acceptance of distributed teamwork is therefore to widen the shared environment (i. e. context), a task that is supported by groupware.

3.6.1. Distributed interaction and the shift to multidirectionalism

Synchronous distributed interaction (same time, different place) can be used unidirectional between the teacher and the student for discussing webpages or between students for co-authoring a document. Moving on to multidirectionalism means in this context to extend teleteaching to online group-discussions (chat) or division of themes between the participants using a co-decision system. An advantage of this is, that more areas of holding a course can be held distributed at all or more easily or faster.

Examples for asynchronous distributed interaction (different time and different place) are announcements to the students via e-mail and starting points for information on a topic. Examples for multilateral time-independent co-operation are the coordination of the time-plan between group members via e-mail or threaded discussions using newsgroups or the WWW. Advantages are for example that less synchronous meetings are required (e. g. telephone calls for scheduling appointments or gathering for a discussion) and that multiple interlocked conversations are possible.

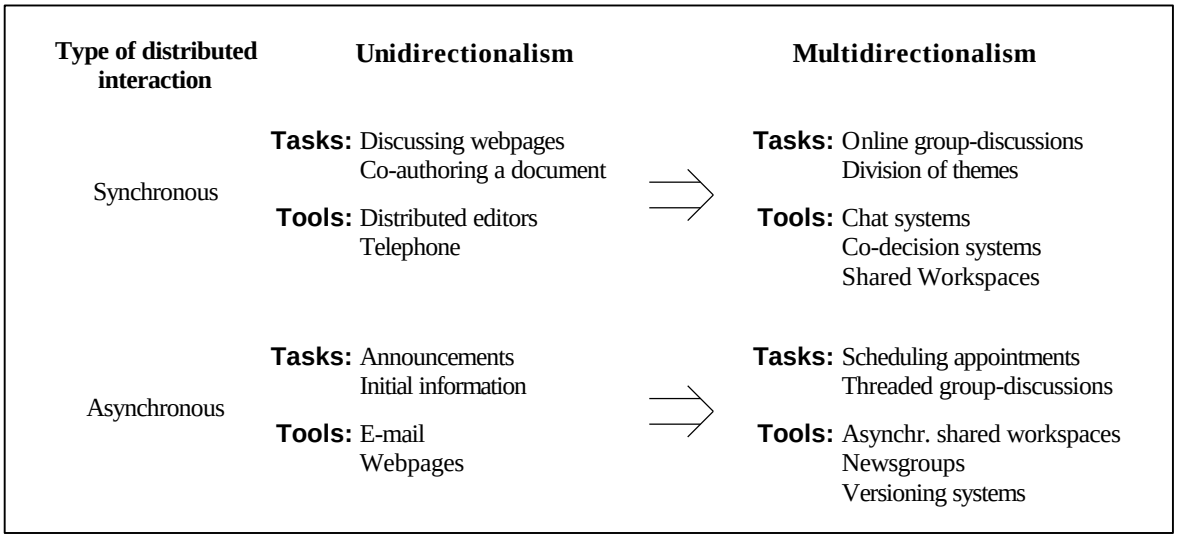

Figure 2: Extension of asynchronous and synchronous distributed interaction to multidirectionalism

3.6.2. Practical requirements for groupware used in Teleteaching

There are a number of requirements groupware should fulfill to be suited for multidirectional teleteaching:

- It is important that it can be used at approximately the same speed and without any additional complexity, regardless if it is used by one person or many at the same time. This is especially important in multidirectional communication as participants might join or leave a session at any time; synchronization should be done automatically to spare the users these complicated tasks.
- Although the primary focus in teleteaching is on asynchronous communication, the tool should also support synchronous usage so "virtual meetings" are possible when needed. Concerning this, support for asynchronously arranging these meetings is needed. This is important for the extension of teleteaching, so it must be easy to use, even if the student has no in-depth experience with computers.
- Groupware for teleteaching need not only support communication but must additionally offer links to external information (e. g. to deliver learning material). It must allow to present results and integrate them, providing a shared environment both for subgroups, a course and the whole curricula, where access is limited according to the identity of the user. In addition, both private and public comments are necessary to ease the task of discussing for example a large number of reports interlocked.
- In a more technical perspective, it should be useable with a low-bandwidth connection as still many students have only a rather slow modem connection. The software should be easily available and should not require special hardware (or only optionally). This guideline will change with the passing of time and is therefore to be considered only as a secondary requirement.

3.6.3. Examples for groupware in Teleteaching

A few years ago no special tools were available, only the basic Internet-tools, which had to be converted manually from 1:1 (e-mail) or 1:N relation (webpages) to N:N relations (shared environment). Now multidirectional Teleteaching is possible without having to create a custom shared environment. There are a lot of systems available, so only two (and the Internet for comparison) will be mentioned here as examples:

- *ProTo* (Project Tools for Learning, [7]): A dedicated tool for teaching, providing both synchronous (videoconferencing, chat,…) and asynchronous (video on demand, message boards, document repository,…) tools. The main focus is on providing information and to enable communication. The presentation of results has to be done with separate tools. Higher bandwidth is needed for video-applications. It is based on the WWW.

- *BSCW* (Basic Support for Cooperative Work, [4], [10]): A collaboration tool, extending the WWW with shared workspaces and tools for co-ordination (e. g. scheduling meetings). There are no synchronous elements included. The images used can be downloaded in advance so the bandwidth needed is rather low. It can be used to manage a shared website where different persons have rights to change certain parts of the site. BSCW is not primarily intended for Teleteaching but for group-work.

- *Internet*: E-mail, webpages, newsgroups, mailing lists, chats etc. can be used together as a basic environment for Teleteaching ("The poor man's groupware"), but providing mostly asynchronous services. Little dedicated software (cheap and stable) is needed and most students can use those tools. The problem is, that all aspects use special programs and there is no integration or even common user interface. Usually a very low bandwidth is needed.

4. Case study: Distributed seminars with international groups

In the context of the international EU-supported project on Telelearning APPLAUD (A Programme for People to Learn At University-level at a Distance, [2]), the institute organized and carried through two distributed seminars, based on past experiences ([1], [6]) with similar courses. These were held entirely over the internet and the students had to work in groups, which were scattered over different locations: In the first course each group consisted of a student from Switzerland, from the university Linz and the PADB Linz (Federal pedagogic academy). In the second one a student from the university Linz, a student from the pedagogic academy and a pupil from an AHS (Academic secondary school/upper level) worked together. The aims of the courses were twofold: First, we tried to find out how to hold courses with distributed and international groups. Second, the participants had interesting topics to work on: Comparative review of homepages and finding assessment criteria for CBT (Computer Based Training) courses. The focus during the seminars was on stimulating multidirectional interaction between members of a group and between groups: All participants had for example to agree on a final set of criteria after creating initial catalogs in small

groups. Based on the experiences in these courses, advantages and potential problems of combining group work and teleteaching will be explained.

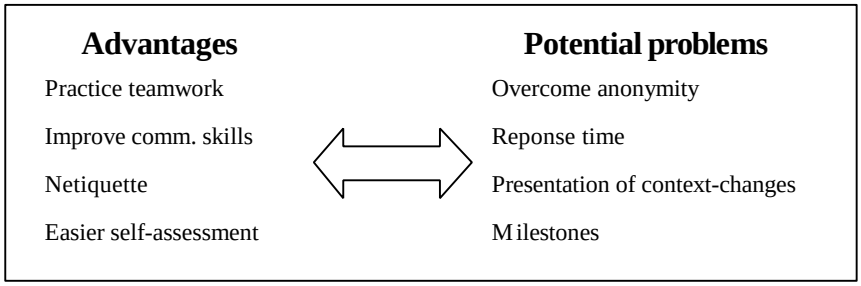

Figure 3: Advantages and problems when introducing group work to teleteaching

4.1. Advantages of group work in Teleteaching

Introducing multidirectionalism to teleteaching means incorporating group work. What are now the important advantages of combining these two:

Practice teamwork: Working together in groups allows to overcome the usual result of teleteaching that everybody works on his own by including feedback, comments and hints from other members of the group. This improves the results produced in courses and increases both the knowledge (knowing also about the themes the others work on) and the skills (co-operation in teams, giving and receiving support, offering constructive critique, …) of the participants.

Improve communication skills: As it clearly showed in our courses, mixed groups both internationally and between schools are a valuable addition (both in the view of the participants and the teachers), as new and different ideas and points of view are introduced. Only being separated from the other group-members by a larger geographic distance (minimum: not at the same educational institution) leads to using electronic communication skills, otherwise first-person-meetings are almost inevitable. Those skills then move to the main mean of collaboration instead of being just one to use when there is no other possibility, largely increasing the practice of the students.

Netiquette: Another important issue is to learn discipline in electronic communication and to adhere to special rules. In our first seminars, there were some problems in connection with this as e. g. a mailinglist dedicated for the course was misused for propaganda. On a less intentional scale students have for example to realize what happens if all members of a group post every message to one member instead of only to this one to the whole group: everybody gets swamped with (for them) irrelevant e-mails. Another example is the use of appropriate subject-lines, which can tremendously ease handling messages. However, the most important problem is, that e-mails are sent much easier than a letter: They are posted without thinking if the content should really be sent and if these par-

ticular phrases should be used. All those rules and many more are rather easy to learn and most participants know them already, but adhering to them can be reached only through training (and sometimes experiencing the lack of them!). Virtual courses where group work over distance is used serves as a chance for practical training of this so-called "Netiquette" [9].

Easier self-assessment: Comparing the own progress in learning is much more difficult in teleteaching than in conventional teaching as everybody works on his own and receives feedback only from the teacher and not from listening to examinations or statements from other students. In contrast to this multidirectionalism allows assessing the results of other participants and provides an environment where the students can compare the progress of their work, their quality and their achievements.

4.2. Potential problems of Tele-Group work

Everything has some drawbacks and Tele-group work is no exception. The main problems (and possible solutions for them) added by introducing group work to teleteaching are the following:

Overcome anonymity: Self-organization alone is not sufficient. Waiting for the students to begin the work or form groups can take a very long time or might not happen at all, because in Teleteaching the participants will usually not know each other and therefore be reluctant to share the same "fate" when building a team. To ameliorate this there should be some information on the participants online (ideally a personal homepage, but a standardized form with some personal information can suffice also). This is necessary as joint working in a group successfully does not spring from a combination of the right knowledge, but rather from matching individuals by methods of work, temperament, interests, etc.

Response time: Another critical factor for the success of multidirectional co-operation is the time between contributions to a discussion. Providing a shared context allows multiple interlocking conversations, but even then there should not be too long a delay between individual contributions or reactions else the strain on the memory gets to large and the time it takes to reach results grows. For example one round in a conversation where everybody makes a statement and the others all reply might easily take a week. To avoid this a combination of several measures should be used: An extensive and flexible context allows to follow messages easier; ubiquitous, easy and fast access to the environment removes inhibitions for using it and rules for response times can add to timely responses.

Presentation of context-changes: An important point to enable multiple conversations is, that changes, updates and additions are marked in the presentation of the context. Nobody wants to hunt through a large space of information to find the new additions (and if there are such at all). Most newsreaders do this automatically, so newsgroups are a good choice for this, but in an (anonymous) webboard or on a website this is not possible without extra effort. As an example a webpage in our courses can serve, where the students added their own pages using FTP below predefined links. So everybody had to try all links just to find out if pages had already been submitted till a CGI-program was introduced, presenting an icon according to the state (existence and time last changed) of the file behind the link. A good support system for multidirectional teleteaching should support *personal* marking changes for *all* items, as the amount of states to remember is much larger as in bi-directional communication.

Milestones: They are indispensable in virtual seminars. If there are no intermediate results or first contributions, there is nothing to comment on and no discussion or interaction will happen. This is no problem in unidirectional teaching as the teacher can wait until results are presented, but in multidirectional teaching, which is all about interaction, they are a necessity. This has to be planned from the beginning when choosing the topic(s) of the course: There should be either several distinct phases or mandatory intermediate reports (for example a short introduction or completed sub-parts). In a more general setting, co-operation and communication needs to be planned; it usually will not just happen if the participants do not already know each other. The tasks and the content that is taught must therefore be selected to be suitable for multidirectionalism (i.e. encourage or require co-operation).

5. Lessons learnt

This paper has presented some ideas about introducing multidirectionalism to Teleteaching by including group work over distance and explained advantages and potential problems. Below are the essential findings, based on our past experiences, which should be heeded when holding a course:

- Regulation needs motivation: If the students shall use special modes of working (e. g. from home, in groups, use special software/hardware), there needs to be a motivation behind this. Prescribing this usually won't work at a university or only poorly, so a motivation to do the work in this special way is needed, which must not be hindered by problems like technical breakdowns, costs or simply a lack of knowledge about how to use the tools. This motivation

could be either free time-management, less or new ways of work or simply that it cannot be done otherwise, like using electronic communication in international courses (the best variant). Only if the participants see the advantages and experience them by themselves they will learn through participating.

- Effectivity in contrast to efficiency: Effectivity (doing something perfect) alone doesn't lead to success in multidirectional teleteaching (e. g. using the newest technology, producing educational perfect CD-ROMs, …), efficiency (doing the *right* thing) is also important. It is better for the students to participate in a virtual seminar and learn a broad overview on new developments than to learn something in depth from a CD-ROM which might be two years old.

- Focus on skills instead of specialist knowledge: The main focus when introducing group work to teleteaching should be on teaching transferable skills like cooperation in teams and communication skills. Those are skills which are especially difficult to teach over distance, but a truly virtual university must include them. One way to achieve this goal is to include virtual courses in the curriculum, where these skills are needed and can be practiced. As content for these courses, topics should be selected where interaction is required to fulfill both the common goal and the individual tasks of the participants.

- Multidirectionalism is only an extension: With all the advantages of tele-group work it is important to recognize that it is not suitable for teaching everything. Transfer of knowledge and basic information is better done in more conventional ways like lectures (or teleteaching equivalents like CD-ROM's). Multidirectionalism provides additional value but there are areas it is definitely not good to use for: in-depth studies of small topics, teaching basic concepts or practicing skills like programming.

- Changing role of the organizer: According to the new focus of tele-group work the organizer of a course has new and other tasks. Instead of having to prepare a presentation his work is mostly shifted to support during the course: Providing encouragement, feedback and constructive critique on the results, steer discussions back to the topic, keep the students working and help them overcome difficulties. The organizer changes from an expert who transfers his own knowledge to a coach, providing information, methods and skills and generally helping them when acquiring knowledge by themselves. This does not mean that the teacher need not know anything about the topic of the course, but rather that he must not know everything in advance. He must be proficient in the skills to teach and needs an overview and an average knowledge on the sub-

themes (and may learn from holding this course too). In a virtual course it is necessary to plan the desired interaction in advance and serve as a good example: The fastest responses, the most detailed critique and the best advice should be from the teacher.

- Do not focus on technology: When organizing a virtual course, new technology should not be an important issue. Using widespread software and readily available hardware should be preferred as a multidirectional course is about learning skills and topics, and not how to use certain soft- or hardware. It is more important to learn how to use e-mail or newsgroups well and in real applications, than to do an occasional multipoint-videoconference just for experiencing them and learning a few very basic rules. An exception to this guideline are Web-based learning environments: They are not standardized and the usage needs to be learned but they are especially tailored to teaching needs and are, through using the WWW as a platform, available without problems and can be used in a well-known and consistent manner.

In my opinion, multidirectionalism is an important additional idea to consider when thinking of Teleteaching. It allows extending the area of teleteaching from transferring knowledge to teaching communication- and cooperation skills while preparing the students for professional life where teamwork is an important issue.

6. Literature

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