AIR TRAFFIC CONTROLLERS and SIMULATORS – the implementation of a participant-oriented learning practice at Naviair – the air navigation service in Danmark

With the airstrips of Copenhagen Airport as a backdrop, a massive competence development is underway among air traffic controllers at Naviair, the Danish centre for air traffic control. This article is about the training of air traffic controllers, but especially about the introduction of a special concept for the education of air traffic controllers, including the special form of educational thinking and practice connected with this, known as PEC – Participant-Oriented Educational Concept.

This article was written on the basis of one year of work during the period of 2009-2010, implementing the PEC concept at Naviair in connection with the training of aspiring air traffic controllers.

”Please, fasten your seatbelts”…

When you go away on holiday, as a passenger in an airplane, probably only very few people consider the fact that there are others, beside the pilot, monitoring the aircraft's safe passage from A to B. On the ground, in the control tower or control centre, air traffic controllers control all commercial flights with the purpose of ensuring safety and efficiency. This is done with the help of radar, which enables the air traffic controllers to see where and at which altitude the various planes are. When navigating through airspace, the pilot knows where he is in terms of geographic location and altitude, but not where he is in relation to other aircraft. Only air traffic controllers have this kind of overview, and as such they are therefore responsible for making sure - through the use of course, altitude and speed control - that aircraft do not get too close to each other.

Air navigation service provider Naviair trains its own air traffic controllers. It is situated in Kastrup with, among other things, the control centre from where all air traffic in Danish airspace is monitored.

The training to become an air traffic controller involves alternation between theory and simulator training, with the emphasis on simulator training. Here, students practise using airspace which is hardly distinguishable from reality, with radar blips, pilots, wind and weather, and aircraft manoeuvring according to guidelines defined by air traffic controllers.
Training air traffic controllers with the help of simulators has been the practice for many years.

Training an air traffic controller is very costly**.** The cost is about 400,000 Euros. Throughout the course, trainees are followed by a trained air traffic controller, and as the course lasts 2½ years it is therefore a costly affair if a student does not meet the set targets, and the training has to be terminated. Needless to say, there is obviously a strong motivation factor for making the training of air traffic controllers as optimal as possible. In this process, having well-qualified instructors is a deciding factor.

Optimisation of teaching – and learning!

The training of instructors is therefore important. Every air traffic controller or air traffic controller assistant completes a basic teaching course following two years of work, after which every instructor has to take a brush-up course every third year. Completing the basic course as well as the brush-up courses is a prerequisite for working as an instructor.

In order to optimise the training of air traffic controllers, simulators are frequently used during the course – adjusted to the various stages of development through which the trainees progress.

Training is seen as an important factor within Naviair's most important priority, which is safety in air traffic movement. Great demands are placed during the screening of future air traffic controllers, and the competence development system described above is part of maintaining a high quality of air safety.

Participant-Oriented Educational Concept (PEC)

For 14 years, SIMU-learning.com has worked with Force Technology on a special concept concerning the educational use of simulators. Through this partnership, SIMU-learning.com has worked for - amongst others - Venice Pilots, SAMTRA, South Africa (South Africa Maritime Training Academy), Caribbean Maritime Institute, Jamaica and Vikingline. On the basis of this proven concept, SIMU-learning.com started working with Naviair in 2008.

The goals for the partnership with Naviair were to optimise teaching – and learning – and through this, the wish for securing a higher completion rate in connection with the training of new air traffic controllers. In the following, we will explain the thinking behind the concept – *the Participant-Oriented Educational Concept*.

The development of competencies – requires practice!

There are many theories about how we learn. Research from recent decades, however, along with the experience gained in the field of adult education, is pointing to some increasingly well-founded assumptions: **Developing competencies must involve practice, and learning is a relational, social activity**. For example, one rarely learns new social skills in a closed cubicle, or how to use agricultural machinery in a classroom. Learning is something the learner does, but this often happens through exchange and interaction with the surroundings (people, situations and contexts). Learning is therefore a much more complex activity than the earlier "learning by rote" way of thinking had assumed. A complex activity which has three fundamental central aspects, however:

The **importance** of

> 1) focusing on a desired **goal** (the participant's goal),

> 2) basic **confidence** (the participant's belief in his or her own abilities and faith in the positive intentions of any assistants), and

3) having focused a**tten**tion on **t**he present and what is happening (and not what should have happened / should be happening).

The PEC concept builds on this understanding when learning is placed in an educational context. In this way, the work of the instructor – the teaching – must follow the participant's learning processes – and continuously bear these in mind. The participant rationale lies exactly in this point, i.e. that the teaching must be structured so that it follows the participant's way of thinking, as opposed to the instructor's way of thinking or the logic of the subject matter. When the teaching consistently meets the participant where he or she is, stimulating and closely following their learning processes, the possibility that the learning will be integrated into the participant's understanding will be greater - as opposed to just providing a meaningless implant.

The right challenge, adequate disturbance, the help which is helpful ...

This thinking is not new. Danish philosopher Søren Kierkegaard wrote about it over 150 years ago, and several theorists on learning have followed in his footsteps: If you truly wish to help, you have to first of all meet the other person where he or she is – and first of all understand what the learner understands – before you can make your extra understanding count (loosely quoted)[1] .

Part of the learning process entails the participant's understanding being challenged and "disturbed", so that he or she is actively involved in creating a new and greater understanding/mastery. This active collaboration is yet another aspect in the view of learning underlying the PEC concept.

The learner as an active participant...

The person who works is the one who learns. Learning *can* be fun, but is often laborious work, *sometimes* associated with frustration, *at times* with delayed fulfilment of the expectations of progress. At the same time, the learning process is connected with a certain courage, as aforementioned Søren Kierkegaard said. Daring to lose your footing for a moment. Venturing into unknown territory. Therefore, the psychological framework of the learning process is incredibly important to its outcome.

"You can lead a horse to water, but you can't make it drink" is an old saying which expresses very well something which also applies to learning. In order to create meaningful learning, the learner has to *want* to learn and be able to see the benefit from it. This is one of the insights pointed out by modern research on learning[2]. Therefore, the importance of motivation and insisting on an active contribution to the learning process cannot be emphasised enough. This must be incorporated into the distribution of roles, the methodology and the overall learning environment.

[1] Søren Kierkegaard: "On helping…" (The Point of View of My Work as an Author, Paragraph 2, 1843).
[2] See the leaflet on transfer from The National Centre of Competence Development, 2009.

Experiences and lessons learned

Yet another cornerstone in the view of learning underlying the concept is to do with reflection. The importance of this has been in focus in educational trends for a couple of decades. A lot has been said and written about this, both in Danish and international literature. Nevertheless, it is our impression that there is still "room for improvement" in the educational practice within this field in many teaching environments. There is a lot of "gold" waiting to be collected from many teaching activities, where the work on reflection is too often neglected or turned into something of a ritual character.

However, experiences do not become lessons until they are processed. It is therefore obvious to make the many and realistic experiences of the simulators the subject of thorough reflection. This is often where an important part of learning occurs.

This view of learning has been the basis for the development of the concept which we will describe further in the following.

The view of learning and the practice connected with it was also specifically thought out and developed according to SIMU-Learning.com's many years of working with organisational learning, and especially the question of how to ensure the maximum effect of the concepts of education and training which are used. That is, the question of *transfer*.

High transfer from training to application – the design of the PEC concept

A number of education and development projects are affected by the fact that there is poor organisational effect from the education and training programmes that are carried out. This shows as low or no transfer. The participants may express a high degree of satisfaction when evaluating individual education programmes, but satisfaction is not a good yardstick for the effect of learning.

When Naviair and SIMU-learning.com planned and developed the PEC concept, it was therefore important to us that the concept as a rule should increase transfer. That is, processing and applying the information learned in the work context.

The latest research on transfer between education and work points out a number of factors which help increase transfer. These include:

- that the learner can see the point in what has to be learned, in relation to the work situation
- that there is a realistic objective in terms of applying the material learned
- that elements from the workplace are part of the education and are applied with a view to using the material learned in concrete contexts
- that focus is on the social relationships at the workplace – support from colleagues, management and so on.[3]

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3 Wahlgren 2009

Transfer is very much connected with the creation of value for the organisation. It is therefore vital to incorporate this issue into the design of the project. In short: High transfer is a prerequisite in order for the organisation's investment in the project to yield a return.

To ensure this creation of value for the organisation, we designed the concept as shown in the following steps.

Designing the PEC project

Selection of instructors

- Interviews with potential instructors

Analysis and research

- Observation of the present debriefing practice. What works well already? Identification of development needs and organisational, structural and cultural barriers.
- Workshop (final definition of development plan, including criteria for success, milestones and timeline)

Education and training

- Education and training of relevant group of instructors (chief instructors, course leaders, senior instructors) with subsequent supervision of the transfer into practice
- Planning which makes sense to the participant
- Debriefing methodology

Planning and organisation of teaching

- Adjusting course descriptions, statements of aims, material, and exercises according to the concept
- Support for the establishment of a self-sustaining appreciation and team culture among the instructors

The model shows the critical phases of the project design. A special mention must be made for the importance of research, selection of instructors and the training of internal super instructors as well as continuous supervision.

During the research phase, the focus was: Where does the organisation succeed already, where is there room for improvement, and what should be the concrete focus areas? The result of this research was presented to the most important partners in the project and was the subject of dialogue, exploration and further clarification. The aim was also to turn the interested parties into active players.

Selection and training of internal PEC instructors

The selection and training of 18 internal PEC instructors was intended to ensure that Naviair had its own expertise in the form of instructors. These should be able to train, retrain and supervise about 300 local instructors (known as OJTI's) responsible for the practical training in air traffic. An internal job advert for instructor trainees was put up, with subsequent interviews and selection. The process took place as a collaboration between internal chief instructors with daily knowledge of possible candidates, project management and external consultants. In addition to relevant experience and competences, great emphasis was put on the attitude towards the role of "norm setter" in relation to the colleagues with whom instructors worked on a daily basis.

In this way, PEC principles were applied in all corners, and in principle the project became self-supporting and less dependent on external consultants.

Supervision as a fundamental principle within PEC

Right from the start, supervision was incorporated into several levels of the project, precisely in order to ensure a high degree of transfer. The first level of supervision was in the role of instructor in relation to own trainees. On the second level, it was supervision in relation to the role of instructor of other instructors, as well as supervision in the role of facilitator and coach in terms of completing the training and education course for other instructors (OJTI's). Supervision is crucial if the individual instructor is to have the possibility, together with the external consultant, of reflecting on their own practice and formulating their own goals for their development as instructors. Furthermore, supervision made the consultants much more aware of the possibilities and limitations of using PEC in a work context, both in terms of more general issues (such as values in the company culture), but also in terms of entirely practical aspects, such as the possibility of carrying out debriefing between instructor and trainee in favourable physical surroundings.

"The customer as co-builder"

In this way, it could be said that the PEC concept was designed so that the customer is a "co-builder" in the continuous development and design of the project. The fundamental idea is that the concept will not be finished and functional, until Naviair builds on what

will one day become a finished house, to use a metaphor. External consultants deliver the foundation – the view of learning, theoretical basis and methodology. Together with Naviair, we build walls, lay down floors, put in windows and construct the roof, and at the end, we come to a joint decision on possible extensions. The role of the external consultants could very well be termed "learning architects".

The importance of an appreciative and approving approach

The PEC concept is based on an appreciative and approving approach towards learning and development. This implies being respectful and approving towards the competences, culture and values found in the organisation. So, instead of being "troubleshooter-expert-consultants", we start by observing the existing practice for debriefing from an appreciative angle, as mentioned above. What is already working well, and where is there room for improvement?

In the Naviair project, we presented our observations at a workshop where a number of the most important players were present. The purpose of this workshop was to turn the participants into active players in the process and get feedback on the observations carried out.

Appreciative and approving education is the foundation of the whole PEC approach to learning, and is a cornerstone in all the interventions found in PEC: training and supervision and also in the actual debriefing between instructor and trainee.

The fundamental premises of this approach can be briefly formulated like this:

- What we focus on becomes a larger part of our reality

- Appreciative education is about asking questions based on the belief that others – both trainees and colleagues – have good reasons to do what they are doing, and that they have important and valuable contributions to make

- Appreciative education focuses on concrete actions which can help improve the learning and performance of trainees, instructors and colleagues

- Appreciative education focuses on the agency of trainees and instructors. That is, the "intelligent" actions and reflections which each of us make in order to improve, while showing respect for the work with professional or educational problems and challenges. Some versions of appreciative and approving education have unfortunately ended up in a dogmatic worship of "positivity" and a denial of any problems. We do not wish to fall into that trap.

In PEC, the basis is to work on problems in relations and in the concrete context and externalise them, rather than making them internalised problems, either with the individual trainee or instructor. It is not about what the trainee is, but about what she does. In practice, this meant a move away from "pocket-psychological gut feelings" of the individual instructor, towards a professional approach to practice, based more on observations than on evaluation.

All things being equal, a trainee will be more willing and open to learn – even faced with great professional challenges – if he or she can look at their professional practice as a performance, where focus is on the concrete actions instead of the person. In this context, we formulated the motto: "Be tough on the problem and soft on the person."

The role of instructor from "expert" to "facilitator"

In the participant-logical approach, which PEC is based on, it is crucial that the individual instructor should leave their role as experts, instructing, giving out advice and correcting the individual trainee or co-worker. Instead, the objective for her is to take on the role of a facilitator. That is, an instructor who supports and controls learning processes together with the trainee, and helps the trainee reflect on the simulator training or on an air traffic situation.

In collaboration with the trainee, the instructor should therefore:

- establish a safe and supportive learning environment with suitable challenges
- organise and adjust simulator training and traffic situations in relation to the learning processes of the individual trainee or co-worker
- incorporate the context in which the learning will later be used
- make the trainee an active player in the learning process with focus on participation and processing of experiences and lessons learned
- structure pre-briefing and debriefing in terms of objectives and focus areas, in relation to the nearest development zone of the trainee and the decisive dimensions for professional performance
- use a reflective questioning methodology which makes it possible for the trainee to gain insight and develop his or her competences

For the instructors, some simple rules were listed for the role as facilitator:

- Practise listening – it is more important to hear the trainee's version of the exercise than your own
- Distribution of speaking time – 80% for the trainee and 20% for you as instructor
- Take pre- and debriefing seriously – this meant allocating more time and physically separating the debriefing from the place where the work function was carried out.

Pre-briefing and debriefing

In order to support the instructors in their role as facilitators, we used the following concept for pre-briefing and debriefing.

0) Pre-briefing – target and focus for the subsequent exercise/traffic situation.
The purpose of pre-briefing is also to enter into a psychological contract, thereby balancing the mutual expectations so that both parties are aware of their context and role.

1) Simulator training – adjustment of appropriate challenges.

2) Debriefing – furthering the awareness and reflection of the participants and their incentives for actions and for qualifying their actions. Here, our starting point was a reflective questioning model[4], where the instructor moves through four steps.

   Step 1 is a defining and delimiting step where – via open information questions – the instructor helps the trainee reflect on what happened during training/in the situation.

   Step 2 focuses on exploring relations and contexts. Here, the instructor poses questions that invite participants to understand and reflect on the effects of actions, as well as other people's ways of seeing and perceiving the situation.

   Step 3 is about challenging perceptions and views and welcoming new and different ways of looking at things. Here, the instructor will typically ask hypothetical questions.

   Step 4 is the final part of the debriefing, where the instructor invites the trainee to reflect on the insight he or she has gained and the situations in which this insight can be used, thereby formulating a synthesis of the whole learning process.

The questioning methodology used by the instructors in connection with pre- and debriefing can be divided into the following categories:

Information questions – Defining and delimiting

Relational questions – Exploring relations and contexts

Hypothetical questions – Encouraging new perceptions and views

Behaviour-affecting questions – Influencing a change in thinking and behaviour
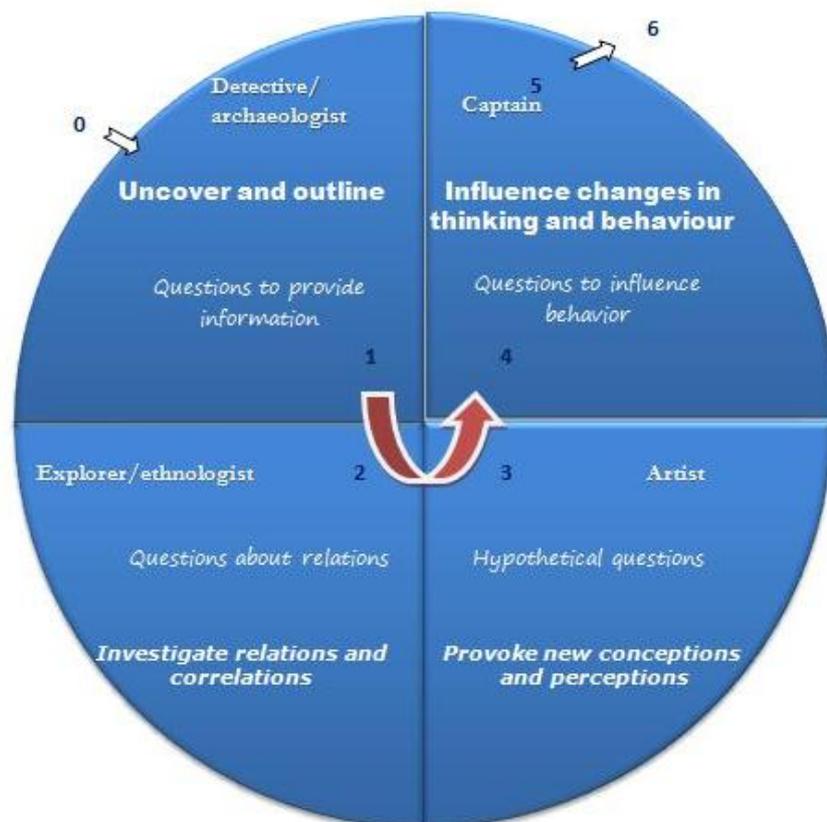
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4 Tomm, K. (1988): "Interventive interviewing: Part III. Intending to ask, lineal, circular, strategic, or reflective questions?" Family Process, 27, 1-15.

The relationship between instructor and trainee before and now

Previously, it was widespread practice that the instructor alone was in charge of formulating objectives for exercises, carrying out pre-briefing and, after the exercise, carrying out a relatively short debriefing, which was mostly in the nature of an assessment of the trainee. The distribution of speaking time was roughly 80 percent for the instructor and 20 for the trainee. This was done with the best intentions, and it was generally accepted practice.

In contrast to this, the basic idea in PEC is that when the instructor and the trainee have to find joint objectives and extract learning from an exercise together, the effect is that the trainee is put in a position of competence. In this position, she will feel that she can directly influence what is to be learned, and where she is in the process. This entails a large degree of involvement and responsibility for her own learning. The whole PEC concept is built on the joint creation of a relationship between trainee and instructor, at eye level. Hereby, the foundation is laid for a learning environment where mistakes and alternative solutions are not used as tools to "hit" the trainee over the head, but rather as situations from which valuable learning can be extracted.

The time used for a simulator exercise was also previously an hour, but the disposition of the time has now been changed. Before, the trainees themselves would start the exercise, and the instructor would then appear at the simulator after about 10 minutes. The idea was that the trainee could study air traffic without having to think about an instructor sitting behind him or her, probably evaluating the dispositions made. After an hour's simulator exercise, the instructor would debrief the trainee. This would typically entail the instructor asking critical questions about the trainee's way of handling traffic. After this, the instructor would give out the answers to the questions asked, followed by suggested solutions and good advice. It was a widespread troubleshooting culture where the instructor considered it his or her most important job to correct the trainee, whenever he or she had performed an undesirable action.

The instructor-trainee relationship was an expert-beginner relationship where the instructor would decide at all times which learning could be extracted from a given situation. This meant that the trainee was not always aware of where he or she was in relation to the targets set for the individual phases of the education, and would therefore constantly need evaluation from the instructor. The trainee also did not have any influence on which areas of focus were relevant for training.

The results so far...

The training of air traffic controllers has traditionally been subject to a very high failure rate in the simulator module. Earlier, this has fluctuated between 40-100% of a class. After the first two courses using the new approach, the failure rate in the simulator module has fallen to 0-17%.

There are obviously many factors that can influence these numbers, but on top of the decreasing failure rates, the experiences and lessons found in the instructor work is promising. A seed has been sown in terms of making learning a collaborative effort between instructor and student.

Future perspectives

There are plenty of different aspects within a change in the educational thinking and learning environment such as the one launched by Naviair. And very significant results have already been achieved. The continued consolidation of the project depends on a coordination of many initiatives on several levels. The organisational culture and involvement of management are two essential aspects of this realisation.

While the PEC project challenges traditional theories of learning, it is in harmony with a series of other current changes within management thinking and organisational development.

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