Pasi Mattila and Pasi Silander (eds.)

HOW TO CREATE THE SCHOOL OF THE FUTURE

– Revolutionary thinking and design from Finland

"The School of

the Future

is Created by Visions"

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– Revolutionary thinking and design from Finland

University of Oulu
Center for Internet Excellence

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Foreword:

Finnish education system – steps to the future

The Finnish education system has garnered much interest internationally, and with good reason. In Finnish schools, students are prepared well for their further studies, future work and life in general. Education is socially valued in society, and it has traditionally been the key to a better future.

The Finnish education system has been born as a result of long-term work. The comprehensive school has been developed to meet the needs of education, and it has produced excellent results during the last few decades, when the benefits have been measured by various international studies. Technology and internationalisation have changed the nature of the work, however. Education and the school must be continuously developed so that they can keep up with the times. In this way, they will continue to offer a basis for future work, in which thinking skills, social interaction, information processing skills and the skills in producing information are emphasised.

Change in the education system and curriculum reform are topical issues everywhere. This book provides a vision and the basis for development as well as ways of leading a change in the working culture, drawing up the curriculum and developing learning environments when moving from a traditional school towards the school of the future.

The book helps with making the decision to develop schools and learning environments. It is even more important to know how to take the first steps in development, how to start the development and what to invest in – so that the change process can begin. The change is a shared journey with the goal of improving the existing and prevailing practices. The change always starts with leadership and developing new competences.

Introduction

1

PASI MATTILA AND PASI SILANDER

The key factor in developing the education system is to influence and change the operational and pedagogical culture at school. Change in the operational culture does not happen automatically or by developing a single aspect alone. Instead, all important aspects that affect change must be developed and advanced equally towards the school and students of the future. The learner is in the centre of change, and the focus of learning moves away from the teacher, textbooks and teaching, and towards a learner-centred, learning process-based and personalised learning.

Aspects of operational culture change:
1. Leadership
2. Pedagogy
3. Capacity building
4. Technology
5. Architecture

It takes time to change the operational culture. If you start now, your development will likely bear fruit after three to five years, when the organisational thinking is ripe for new development ideas. The work needs patience and time to change your own thinking as well as that of the work community and the surrounding society. Changing the operational culture requires changing the conceptions of learning and knowledge. The change must occur both in the staff and the learners as well as the learners' parents, the spaces and the use of technology. The change culminates in leading pedagogy, architecture and technological development.

The fastest and most concrete effects can be achieved in the spaces and the technology. For this reason, it is easy to start with changing the physical environment, and a change in the physical environment is also reflected in pedagogical change – or at least the need for it. Rearranging the classroom furniture, introducing new kinds of furnishings in the learning environment, or a pilot project in a few classrooms are good ways to start – and they may not even require large financial resources. The change starts from a pedagogical vision and its implementation. Changing the physical working environment causes pressure to change the other aspects, too, acting as a facilitator of comprehensive systemic change.

Another rapid development path involves the development of technology. Including virtual 3D learning and educational environments as a part of teaching or utilising gamification or technology-assisted spaces enable ubiquitous learning and distance education, and they also enrich projects that cross the boundaries between subjects. The strength of technology is in supporting social interaction and making it possible to see, experience and learn things that would not be otherwise possible in education. Changing the operational culture is a longer process that includes planning and implementing leadership, teaching. learning and capacity building.

2 Cycle of change

PASI MATTILA & PASI SILANDER

Changing the operational culture is, at its best, a well-led process that is set as a common goal at the strategic level.

The development cycle can be described using the washing machine model. You put the dirty laundry (traditional education) into the washing machine and select a suitable washing programme. The hotter the wash, the cleaner and more in-depth the result, but the washing time is correspondingly longer. Rinsing and spin cycles follow the actual washing. Sometimes, pre-washing the laundry is needed as a basis for the change process – a critical review of and reflection on traditional teaching and the changed world.

The change may begin with an introductory session, supported by the development of leadership and development measures concerning teaching and the operational culture. To get a good start, the need for change, the most central aspects and the objects of development should be processed collaboratively and common goals should be created.

In the first phase, it is important to reach a mutual understanding and idea of the desired state between the staff and the actors and create a positive, permissive atmosphere for change. Common issues are considered and developed for the good of everyone, building a better future for the students. In fact, it is extremely important to bring in basic information and practical examples to start the change process.

In the next phase, common methods are constructed (such as team teaching, co-teaching), pedagogical solutions are developed (e.g. inquiry learning and phenomenon-based learning, projects that cross the boundaries between subjects) and a new curriculum is created, along with utilising information and communication technology in the learning process (technology-assisted learning environments, media spaces, virtual worlds and gamification, among other things).

After the change process has started, it moves deeper into developing leadership, continuing education for teachers, adapting spaces and developing technology. This development can be supported by innovative procurement. The change process often requires continuing education and change leadership. The goal is that when the clean laundry is hung out to dry, it has not been dyed pink, but is all clean, clear and shining bright.

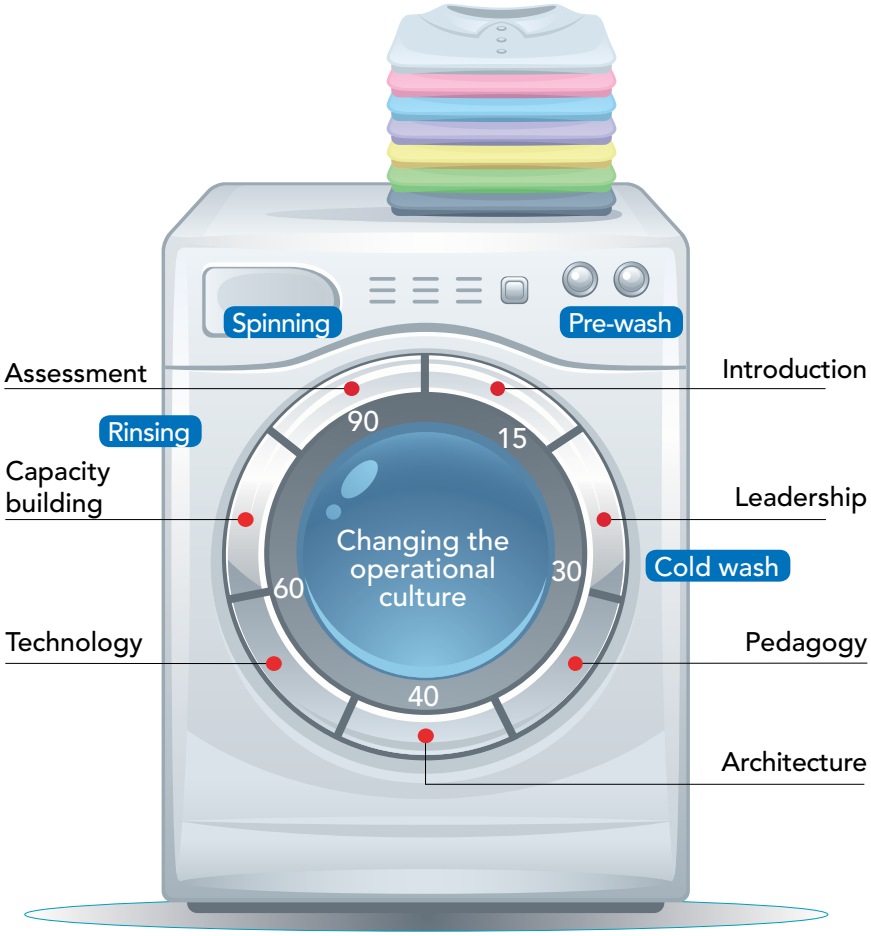

Figure 1. Cycle of change

Elements

Introduction

To start the development of schools and learning environments, it is important to hold an introductory event, in which development ideas, experiences from previous development measures and examples of various objects of development are discussed. Change is a shared journey. In the first stages of the journey, its goals and clear objectives must be set. The introductory session acts as a tool for common goal-setting.

Leadership

The key to changing the operational culture is leadership. Leadership is committed to the organisational values, the vision, the strategy and the discussion culture, among other things. Together, these factors determine the organisation's ability to respond to challenges in society and renew itself. Without the right kind of leadership, changing and developing the operational culture is not possible. In that case, instilling the new methods and the results of development as a part of the everyday life at the school or organisation becomes difficult. Leadership must be future-oriented and systemic.

Pedagogy

Pedagogical change is needed, because the skills the learners will need in the society and working life of the future have changed. Our knowledge of how human beings learn has also greatly increased in the last few decades – but pedagogy, teaching practices and school structures have not developed accordingly. Teaching and teachers easily become an objective and a value in themselves, when learning and learners should be the ultimate goal at centre stage. The change in pedagogy is linked to the concept of learning of the organisation and the teachers – in fact, the greatest change in thinking is required of the teachers. The best way of developing pedagogy is to develop the teachers' thinking through a new form of consultative in-service training or coaching.

Architecture

Arranging the furniture in the teaching space, opening the doors and utilising all spaces in the building as a learning environment is the first step to changing the spaces and their functions. Building a pilot environment requires breaking down the partition walls, installing new doors and windows and developing the functions of the spaces. The pilot project can be implemented through interior and furnishing design, supported by architectural, electric and audiovisual design. However, developing the learning environment must always be based on pedagogical modelling, where the pedagogical activities of the learner, the teacher and the learning community are described.

A large-scale renovation or construction project provides an opportunity to think about the architecture and school design in more depth. The openability, adaptability and pedagogical versatility of the spaces have become an increasingly central requirement for architecture. The era of the traditional school with corridors and classrooms is over, and new space arrangements are taking over and revolutionising school construction. At the same time, they challenge and enable the development of pedagogy and technology and the design and construction of technology-assisted media spaces.

Technology

Our society and business life are highly digital, but the educational institutions are only just taking the first steps in becoming digital. The digitalisation of teaching and education cannot be achieved by purchasing computers, tablets or interactive whiteboards – as counterintuitive as it may seem, thoughtlessly acquired technological equipment often proves to be an obstacle slowing down digitalisation. Digitalisation of the school should always involve enabling new, more efficient learning and teaching processes in information technology – making new processes possible – not simply replacing the pen or the blackboard with an electronic version. Technology must always bring added value to pedagogy. Schools must solve several problems related to mobile technology, virtual and 3D environments as well as wirelessness and create a strategy for using, developing and assessing information technology.

Capacity building

The most important production factor in an educational organisation is the methodical competence of the teachers. The way the teachers have mastered the pedagogical methods, instruction methods and assessment methods greatly affects how well the learners learn and how the school fulfils its social mission. The teachers' methodical competence is immediately evident in their ability to utilise information technology and support the development of the learners' thinking skills, as well as in the teachers' well-being at work and job satisfaction. Investing in the teachers' capacity building, in-service training, is the best way to create the preconditions in which the educational institution can carry out its primary task, as well as its capacity to develop and respond to future challenges. In fact, every educational institution should have a capacity building plan for developing common capacity. The best way to build capacity is through consultative in-service training, coaching, and mentored learning on the job for the teachers.

Evaluation and organisational self-reflection

In changing and developing the operational culture, it is always essential to get up-to-date information on which measures have been effective and what the effects of development have been. The ability to evaluate and reflect on its own activities is a part of an educational organisation's ability to change and develop. Evaluating the activities is not an end in itself; the activities must be led and changed as necessary based on the evaluation. The evaluation can come in many forms, focusing on, for example, the development of the teachers' competence, the curriculum, the pedagogical settings, the instruction, the learning environment, etc. The goal of the evaluation is also to find objects of future development.



3 Digital pedagogy

PASI SILANDER

Information technology can be used to enrich teaching and increase its methodical diversity, thereby providing students with better prerequisites for learning new things. However, using information technology in teaching and learning must be carried out systematically, based on the strategic goals of the curriculum and the educational institution. The main focus in using technology in teaching is not on learning the technical skills, but on utilising information and communication technology pedagogically in different subjects and themes. In fact, the greatest benefits of using technology are gained from systematic use, closely linked to the learner's learning process.

The role of information and communication technology in learning and teaching

Media

Information technology acts as a medium in teaching situations when it is used to distribute learning material, for example. The learning material may either be created by the teacher or it may be available on the Internet. Nowadays, there is a large amount of ready-made material available online, such as learning objects, video clips and online journals.

Information source

Searching for information is a key application of the Internet and information technology. Web and social media are vast sources of information, and in fact, the Inter-

net been described as a 'worldwide library'. There are plenty of sources online that can be searched via search services as well as article databases. Usable information for teaching and learning is also available on Wikipedia (www.wikipedia.org), a collaboratively created online encyclopaedia.

Communication

One of the most important applications of technology is communication. Computers and the Internet allow us to send e-mails and make voice calls from one device to another, as well as hold video conferences. Learners can use IT to communicate with each other, for example, or they can be in contact with experts in different fields. The dialogue between learners and tutors online is another form of communication. A computer is no longer just a computer, it is also a central communication medium.

Content creation tool

Information and communication technology is at its best when learners use it to create their own content. Learners can create their own texts, images, sound, music, etc. naturally on computers or mobile devices. A more advanced form of utilising information technology involves learners creating interactive content and using programs and algorithms in their output.

Publication channel

The web and social media in particular can be used to publish the learner's or the whole group's joint output. For example, the learners can create an online magazine or publish their own pieces of music or video clips. Publishing the learners' output often has a very motivating effect – "the output is not just made for the teacher to read".

A tool for the learners to develop their own conceptual artifacts

With IT, learners can develop their own conceptual artifacts, such as concept maps, diagrams or graphs, in which case IT acts as an important thinking tool. The most important thing is not the output itself, but the process through which the learners develop their own information structures and modes of thinking.

A platform for collaborative knowledge building

Online learning environments offer tools, such as discussion forums, for collaborative knowledge building by learners. The principle of collaborative knowledge building is that constructing information together – building knowledge – makes for better learning and a better end result than working alone. Collaborative knowledge building online is important for learning, because there the knowledge building process with its different stages is documented and remains visible. This process can be reviewed after the fact, and it is possible to return to the thoughts presented and continue them later.

Thinking partner

In the modern information society, the role of a computer or information and communication technology approaches that of a thinking partner. Even though computers do not yet think for themselves, they can offer important support for the learners' thinking processes by posing analytic questions and reflection (or mirroring thoughts), for example.

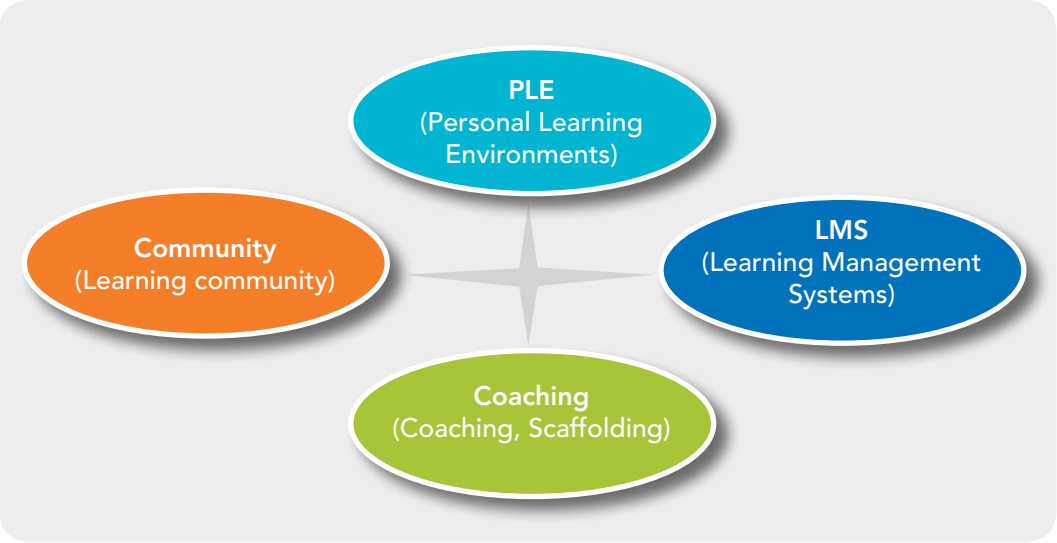

Figure 1. Pedagogical solutions in eLearning

eLearning refers to learning and teaching that utilise information technology at least partially. eLearning can have very diverse forms and be closely linked to contact teaching and other learning situations.

eLearning has traditionally utilised online learning environments (Learning Management Systems, LMS), which are open learning environments. The openness refers to the learning environment being open with regard to pedagogy and content. Teachers can use the learning environment in various pedagogical settings and in accordance with different pedagogical models. The content is created in a learning process together with the learners and the teacher. The content includes, among other things, knowledge building on discussion forums, output by the learners, and learning tasks. Therefore, online learning environments can be used in different kinds of subjects and themes, such as languages, mathematics, history, biology, physics, media education, etc.

Modern eLearning environments are personal learning environments, PLEs. The PLEs are learning environments for the students, meaning environments for the students to build knowledge, communicate, and share and publish things, such as ePortfolio or the various social media applications. In contrast, Learning Management Systems (LMS) are primarily intended as teachers' aids in managing courses and study modules. Both of them have their own tasks. The following table contains a comparison of the differences between PLEs and LMSs:

Personal Learning Environment (PLE) (e.g. ePortfolio)	**Learning Management System (LMS) (e.g. Moodle, Fronter)**
Students' tool for managing learning processes and creating their own content	Tool for teacher-led management of online courses
Student-centred	Teacher-centred
Tools for creating and publishing students' own content and documenting the learning process	No particular tool for publishing students' own content or documenting the learning process
Based on the students' own content and output	Based on the materials and assignments distributed by the teacher
Continuum, lifelong learning	No continuum as such
Opens online and towards social media	A closed environment

(Silander 2014)

eLearning

The main purpose of eLearning is not the technology; it is what information technology as a method makes possible in learning and teaching. Information and communication technology allows the use of methods promoting learning that could not be implemented in practice otherwise. Therefore, eLearning introduces several pedagogically meaningful working methods to both contact and distance teaching. Currently, the focus of eLearning is on collaborative forms of work in particular, both in contact and distance situations.

Some of the benefits of eLearning most commonly highlighted by teachers and learners are listed below:

- The learners are active in the learning environment; they are actively engaged in studying.
- Information technology enables pedagogically meaningful methods for both teachers and learners, leading to a deeper learning.
- Collaborative knowledge building is easy to implement with online tools.
- In online learning environments, the learners' thinking and problem-solving processes become visible and are documented. The learners can learn things from this externalised thinking process that could not be studied otherwise.
- The web transforms learning from simply repeating information to constructing and using information.
- If necessary, learning can be arranged regardless of time and place.
- Learners can progress individually and at their own pace; they can be differentiated easily.
- All learners receive the same space online, including the ones that might be quiet in the classroom.
- Online learning environments and social media applications are tools for collaborative knowledge building.
- eLearning skills are needed in further study and working life.

eLearning can consist of, for example, online study and work guided systematically with learning tasks. Learning tasks methodically guide how learners observe and process information – how they learn. Therefore, the goal of learning tasks is always to learn something new, not to test what has already been learned.

Another key element of eLearning is knowledge building. The learners combine and construct new knowledge for themselves using different sources. Possible sources include webpages, books, magazines or personal experiences and observations, for example. Learning is seen as an activity in which learners construct new information for themselves.

Knowledge building can also be collaborative. eLearning easily enables discussion and developing ideas together with the teacher and the other learners. In that case, it is important to publish ideas and output still in progress online, gain feedback on them during the process and develop them further together. If learners only receive feedback at the end of the learning process, they will not be able to use the feedback in learning.

How to design an effective eLearning process?

Teachers influence learning online or when using technology by means that differ from those used in contact teaching – therefore, eLearning must be studied and designed more from the point of view of the learners' learning process. Designing traditional contact teaching has mostly been based on designing the teacher's activities and teaching process, while in designing eLearning, the starting point must genuinely be designing the learner's learning process. Designing the teacher's actions, guidance, task assignments etc. that promote the learner's learning process can only occur after the learner's learning process (or what kind of cognitive activity the learner needs to learn the issue) has been designed. This can be considered a paradigm shift in instructional design.

The starting point for designing the eLearning process includes the learning goals and the learners' prior knowledge and competence. Reflecting the competence, knowledge and skills gained as a result of the learning process on the learners' prior competence results in a clear framework for constructing the learning process. A key issue in designing is to consider how different learners learn and achieve competence in accordance with the goals. How does a learner learn?

In learning process-based teaching, the different elements – learning situation, learning tasks, teaching, and guidance and feedback – are closely linked together and form a complete continuum of time. In learning process-based eTeaching, the teaching situations, both contact and distance teaching, have therefore been bound into a uniform whole. eLearning based on the learning process is centrally

described by guidance and feedback during the whole learning process, based on which the learners develop their own competence.

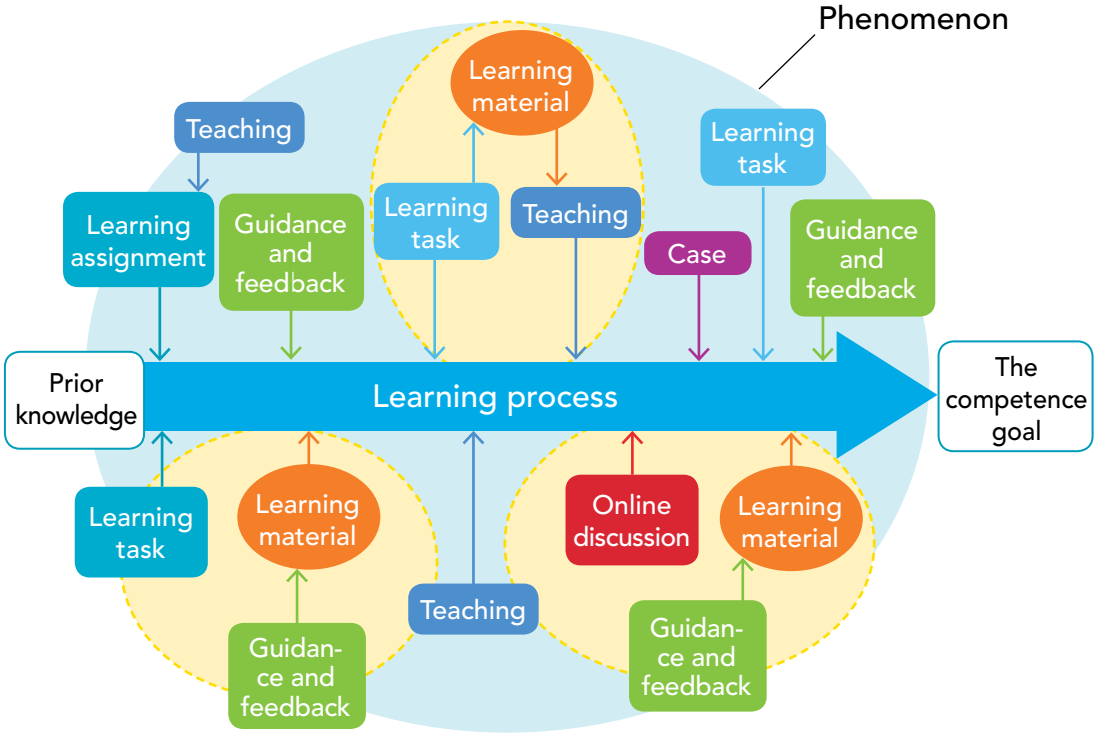

Figure 2. Learning process-based design of teaching and learning

The learning process can be structured in the manner presented above into units formed by teaching and learning material, learning task and its guidance – learning situations. This makes guidance a clear, meaningful whole, both with regard to content and the progress of the process. The teaching situation and the related learning tasks create a clear basis for guidance and assessment during the process. The guidance is designed to promote learning and, in particular, problem-solving related to the learning task. The objective of the teaching situation, learning task, guidance and assessment is to further the learning process – to promote learning.

Competence gained in the learning process is a sum of the learning events during the learning process. As the different learning situations, learning tasks and guidance are made visible during the teaching design phase, it is possible to design in advance the things for which things feedback will be given and which things will require guidance. As a result of the learning process, learners create new knowledge, i.e., information and skills. Knowledge is a more extensive concept than information, and it includes information usage skills, problem-solving skills, inference rules etc. in addition to the information itself. The learning in the learning process refers to learners generating knowledge by themselves.

Designing learning processes and making them visible is an important tool in developing the pedagogical community and culture of the educational institution. When the teachers make learning and the design of teaching visible in learning process diagrams, they can be discussed with colleagues and developed together. There are several different kinds of techniques and applications available for designing and describing learning processes.

Phenomenon-Based Learning as the pedagogical approach for eLearning

In Phenomenon-Based Learning (PhenoBL) and teaching, holistic real-world phenomena provide the starting point for learning. The phenomena are studied as complete entities, in their real context, and the information and skills related to them are studied by crossing the boundaries between subjects. The starting point differs from the traditional school culture divided into subjects, where the things studied are often split into relatively small, separate parts (decontextualisation).

Phenomenon-based structure in a curriculum also actively creates better opportunities for integrating different subjects and themes as well as the systematic use of

pedagogically meaningful methods, such as inquiry learning, problem-based learning, project learning and portfolios. The phenomenon-based approach is also key in the versatile utilisation of different learning environments (e.g. in diversifying and enriching learning while using eLearning environments).

Deep learning and understanding are the goals of phenomenon-based learning

Phenomenon-based learning starts from the shared observation of holistic, genuine real-world phenomena in the learning community. The observation is not limited to one single point of view; the phenomena are instead studied holistically from different points of view, crossing the boundaries between subjects naturally and integrating different subjects and themes.

In phenomenon-based teaching, understanding and studying the phenomenon together starts from asking questions or posing problems (e.g. Why does an aeroplane fly and stay up in the air?). At its best, phenomenon-based learning is problem-based learning, where the learners build answers together to questions or problems posed concerning a phenomenon that interests them. The problems and questions have been posed by the learners together – they are things the learners are genuinely interested in.

The phenomenon-based approach is anchored learning, where the questions asked and issues to be learned are naturally anchored in real-world phenomena, and the information and skills to be learned can be directly applied across borders between subjects and outside the classroom in situations where the information and skills are used (natural transfer).

In the learning process, new information is always applied to the phenomenon or solving a problem, which means that the theories and information have immediate utility value that is already evident in the learning situation. For absorbing new information and deep learning, it is very important that the learners apply and use the information during the learning situation. Information learned only at the level of reading or theory (such as memorised physics formulas and calculation rules without real context or related problems) often remain superficial and separate details for the learners, without their gaining a comprehensive understanding of the information (and the real-world phenomenon behind it) or internalising its meaning.

Phenomenon-based approach generates rich learning experiences. Personal perceptions, interpretation, creating meaning, and activity support the understanding of the things to be taught, and learning becomes a meaningful, significant activity for the learner.

A phenomenon can be…

- An authentic object of observation
- A systemic framework for the things to be learned (systemic model)
- A metaphorical framework for the things to be learned (analogous model)
- However, sometimes also a motivating "base" for attaching the things to be learned

The phenomenon-based approach can significantly increase the authenticity of learning. In this context, the authenticity culminates in the learner's cognitive processes (thinking processes) being authentic – in a learning situation, the learner's cognitive processes therefore correspond to the cognitive processes required in the actual situation where the information/skills are used. Authenticity is a key requirement for the transfer and practical application of information. Often, it has been said that "you cannot learn to drive a car just by using pen and paper" or that "cloze tests only teach answering cloze tests – there are no cloze tests in real life or working life, there are only real communication situations where information must be applied and messages must be transmitted comprehensively and understandably to another person". In authentic learning, the aim is to bring genuine working life practices and processes into learning situations in a pedagogically structured way, when applicable, which allows the learner to participate in the real expert culture in the field and its practices (c.f. community of practice).

Motivational factors in phenomenon-based teaching and learning

Phenomenon-based teaching motivates learners and creates internal motivation, because:

- learning is needs-oriented
- learners see utility value in the theories and information in the learning situation
- the learners themselves can set interests and pose problems as starting points for the learning process
- learning starts with the goal of understanding real-world phenomena
- phenomenon-based teaching is learner-centred; the learners are active creators and actors
- the theoretical things to be learned are anchored in practical situations and phenomena
- real methods, sources and tools are used in the learning situation
- learning is a conscious, goal-oriented activity; the learners know the learning goals (intentionality)
- learning occurs in a real, holistic context (contextuality, c.f. individual, decontextualised and disconnected small tasks as its opposite)
- the learning process is a complete goal-oriented continuum

The learning theories and pedagogical models behind phenomenon-based teaching

The starting point of phenomenon-based teaching is constructivism, in which learners are seen as active knowledge builders and information is seen as being constructed as a result of problem-solving, constructed out of 'little pieces' into a whole that suits the situation in which it is used at the time. When phenomenon-based learning occurs in a collaborative setting (the learners work in teams, for example), it supports the socio-constructivist and sociocultural learning theories, in which information is not seen only as an internal element of an individual; instead, information is seen as being formed in a social context. Central issues in the sociocultural learning theories include cultural artifacts (e.g. systems of symbols such as language, mathematical calculation rules and different kinds of thinking tools) – not every learner needs to reinvent the wheel, they can use the information and tools transmitted by cultures.

In curricula, the phenomenon-based approach supports, in particular, learning in accordance with inquiry learning, problem-based learning and project and portfolio learning in educational institutions as well as their the practical implementation.

Digital learning material – learning objects

Digital learning material plays a multifaceted role in teaching. The learning material is seen as raw material for the learner's information processing or a way to create context; a foundation for the knowledge building process and an element to guide it. The digital learning material used must be integrated in the overall learning process – learning material rarely acts in a pedagogically meaningful way alone without a designed learning process, such as learning tasks guiding the learner's information processing or guidance and activation by the teacher.

Learning objects (LO) are individual, compact multimedia-based 'pieces of learning material' or tutorials that can be used in different kinds of learning processes and at different stages of the learning process. They are relatively atomic, independent entities, which makes them versatile. The learning objects can be used in online learning processes in accordance with a variety of pedagogical models – they are pedagogically open in that respect. However, the learning object typically guides the learners' perception and information processing in the sub-process of learning or an individual learning situation. Compared to the traditional online material, learning objects offer more open possibilities for use with regard to the content, too. The same learning object can usually be used in different subjects or fields of education. By combining learning objects in different ways in the learning process, it is also possible to take different kinds of learners into account better and create individual learning paths in online learning – learning processes.

Learning objects come in a variety of shapes and purposes. They can guide the learners' information processing or act as raw material for learning, such as creating context and serving as a starting point for collaborative discussion. Learning objects bring added value particularly to the stages of the learning process (issues and phenomena) that are otherwise difficult to teach or demonstrate. Learning objects may be visualisations or interactive simulations that concretise abstract issues through analogies, for example. The learning object can also be a framework or a foundation, a 'blank' processed further by the learner.

The concept of a learning object is primarily used to describe learning materials that guide the learner's learning sub-processes, are pedagogically structured, and initiate learning processes in the learner. If the learning object is seen as the object of learning or as information content (such as a word list), it will not bring any especially pedagogically significant added value to online teaching and learning. Learning objects can also take the form of a content-independent learning and thinking tool that guides the learners' information processing. On the other hand, tools that are too generic (such as spread-

sheet applications) cannot be considered learning objects, because such a tool does not actually guide the learning (sub)processes.

Learning object types

1. Learning seeds
Learning seeds are learning objects that do their part to intentionally initiate learning processes in the learners and often guide their information processing – learning. In these learning objects, the learners' perception and information processing can be guided by activating questions, functional support, interaction and feedback, for example. Learning seeds can also act as raw material in online discussion and collaborative knowledge building, and they can act as frameworks or foundations for learners in processing the issue.
2. Object of learning
This class includes content-oriented learning objects as presentations, in which the content to be learned has been described. Illustrative learning objects with the purpose of illustrating the issue/phenomenon to be learned (such as animations or passive simulations) are also included in this class. The learning objects in question are suitable for purposes such as information searches. In that case, the learner may play a very passive role. Compared to traditional media, such as books, the added value of these learning objects may be somewhat questionable.
3. Learning tools (cf. mind tools)
These learning objects can be (a.) context-specific learning objects (bound to a certain content) that guide the learners' information processing (learning sub-process); often they also provide feedback to the learner. This class includes, for example, interactive simulation tools that act as tools and ways of illustrating the issue, partially guiding the learners' perception and information processing. These learning objects can bring significant added value to learning compared to traditional media. On the other hand, learning tools can be (b.) context-free learning objects that can be used in learning different things. They primarily promote learning at the level of the learners' cognitive processes (perception, thinking) and knowledge building. Context-free learning objects can be used to form concepts or guide the learners' process in accordance with the pedagogical model used, for example.
4. Tools/utilities
Utility-type learning objects include software intended for drawing or calculations, for example, that cannot be included in the class of learning tools because they do not guide the learning sub-processes, the learners' thinking or the problem-solving process. The tools are usually not too context-specific, either; they do not provide material to be learned as such, and therefore the learners must construct the content themselves.

Using learning objects as a part of the learning process

The pedagogical functions of learning objects create an interface for the way the learning object and its related learning sub-process are linked to the overall learning process. The same learning object, such as a simulation, can be used at different points of the learning process, in which case it can have several pedagogical functions. For example, a simulation can be used as a basis for setting up problems at the beginning of the learning process, and the same simulation can be used for reflection at the final stages of the learning process.

The learning object itself may include several access points that orient the learner (pedagogical functions and possibilities for use); otherwise the teacher/tutor must create them in the learning situation. The teacher (or tutor) can create an access point to the learning object by assigning learning tasks or activating the student cognitively, for example. The access point is like a pair of glasses (context and focus) the learner uses to study the learning object and process the issue to be learned. It should be noted that the access point is often the thing the teacher uses to create a pedagogical function for the learning object.

The interfaces of the learning object – how the learning object is pedagogically and meaningfully linked to the overall learning process or how it is a part of the overall learning process – must be created actively. Otherwise, there is a high risk of learning objects remaining separate and splintered pieces of information without an overarching meaning.

For example, when using simulations as a basis for setting up problems, a learning object can be accessed through a question posed by the teacher: "Why does the simulation progress occur as it does?" or "Why was the end result of the simulation like this, and what questions do the learners want to ask based on the simulation?" Next, the learners can be instructed to go to the online discussion forum and write the questions that come to mind and pose their own problems. In the reflection phase, the learners can mirror their own competence and knowledge based on the simulation – are the explanations and conclusions they constructed during the learning process sufficient to explain the events of the simulation, do they have in-depth understanding of the phenomenon/issue presented by the simulation and how did the simulation illustrate it, and what have they learned? Therefore, learning objects often require pedagogical structure and modelling the issue/phenomenon, as well as guiding the learner's cognitive processes such as perception.

Pedagogical function of learning objects – application in the learning process

Special attention must be paid to designing the learning process and integrating the learning objects into the learning process in the design of online teaching. Because learning objects are small, compact pieces of learning material, there is a risk of the learning process and the information becoming splintered. Careful consideration must be given to the application of learning objects in the learning process and how they are linked to the other elements of the learning process. In learning process-based online teaching, it is important to consider the pedagogical function of the learning object, the objective of its use. How is the learning object intended to advance learning? The first application of the learning object that comes to mind may not be the pedagogically most effective.

The pedagogical function of a learning object that defines the learning object's application and context in the learning process can be used to help with designing the learning process and using learning objects. It should be noted that one single learning object, such as a simulation, may have several pedagogical functions and applications. In addition to the learning object, the pedagogical function may be determined by assigning a learning task or by the teacher's instructions on the point of view from which the learning object should be studied and how it should be processed.

Pedagogical functions of a learning object – applications in the learning process:

1. Activation (cognitive)
A learning object used to activate the learner's previous information structures and cognitive processes that promote learning something new.
2. Creating the context, setting up a problem
The learning object used to create context can be, for example, a video-based case description that can be used to create an authentic starting point for setting up authentic problems to the learners. The learning object used in posing problems can be pedagogically structured so that it guides learners to the content area in setting up central problems.
3. Testing the hypothesis/working theory
A learning object that the learners can use to test their own explanations (working theory and hypothesis) and draw their own conclusions based on it. An interactive simulation, for example, can be such a learning object.
4. Information source
Most learning objects can be used as information sources in searching for information in collaborative problem-solving processes and knowledge building. (The learning objects used as a kind of information source in this context are primarily learning objects used as raw material for knowledge building, not for purposes such as creating context or testing a hypothesis.) Learning objects can typically be used to illustrate the issue or phenomenon to be taught – particularly in describing procedural information.
5. Knowledge building
The knowledge building process is guided by learning objects, which typically are learning tools. They may include, for example, tools for presenting the learner's conceptual artifacts, tools for distributed cognition including functional support, or problem-solving tools.
6. Reflection
Mirroring the learning process, the learner's thinking, operating models, competence etc. with the help of a learning object. The learning object can guide the learner's reflection process.
7. Testing/Assessment
A learning object used to test the learners' skills and knowledge and assess their learning and competence. At their best, such learning objects are created so that they allow the use of more authentic tools to test learning and assess the learner's competence in online learning compared to the traditional methods of measuring learning (such as tests and examinations).

eLearning as collaborative learning

The best way of learning takes place in a social context, based on collaborative knowledge building and shared expertise. Externalising one's own thoughts and presenting them to other learners, as well as peer feedback, have a central significance here. In collaborative knowledge building, thoughts are developed and knowledge is built together; people receive comments and new ideas from other learners and they are faced with reflecting on their own thinking. Collaborative learning can be implemented e.g. in contact teaching in a classroom, in various projects, and in online learning with the help of online learning environments.

The best setting for online learning is not the old-fashioned computer lab model, where each learner sits alone behind a computer and dabbles around on it alone. As a rule, collaborative learning occurs either in pairs or small groups.

In a collaborative situation, all learners can bring their own small bit of expertise and experience to the shared process. Learners should be encouraged to present their incomplete thoughts and output as well as things still being developed, even if the final output is an assignment to be returned to the teacher separately.



4

Leadership connects development projects to the primary task of the organisation

ESSI RYYMIN AND PASI SILANDER

Development projects are an excellent tool for changing and developing the operational culture of an organisation. Their central role is often to create new activity that gradually becomes established as a part of the organisation's operational culture. Projects are a way to implement development needs systematically. Development projects cannot be separated from the organisation's action plan, goals or activities. If the development projects or their results are not established in the operational culture, they are not useful for the organisation's operation in the long term.

Typically, development projects have been used to gain various short-term advantages for organisations. These include networking, developing individual practices or new methods, allocating additional resources, or concrete output such as publications and learning materials. Often, the abovementioned benefits exist only during the project and fade into the background when the project ends. The new competence generated by the project is typically focused only on the active participants of the project, and it does not spread throughout the organisation as common competence. Nonetheless, the projects have been a good way for the participants themselves to develop professionally.

If no attention is paid to changing the operational culture of the organisation outside the development project, the new activities developed have no opportunity to become established in the organisation. This often creates frustration in development projects in the organisation and easily tires out the project participants. Development projects cannot be simply piled on top of existing activities as extra work.

Teacher-oriented development projects

Traditionally, developing schools and educational institutions has involved the belief that active teachers develop the whole school or educational institution as a part of developing their own work, thus acting as the backbone of development projects. It has been believed that the results and output of development projects spread from an active group of teachers to the whole community, spontaneously creating new kinds of methods in the organisation.

In fact, development project do often have many positive effects. They create ownership and work motivation in the teachers who are active in the project and develop their professional competence. Projects often influence the learning of individual students, too, through experiments with using new teaching methods for studying or implementing learning projects, for example.

However, a teacher-oriented approach in development projects does not promote a change in the operational culture at the organisational level. The methods, good practices and new professional competence developed in the projects do not spread throughout the organisation. The results and output of the project as well as the competence remain the ownership of individual teachers, not the property of the whole organisation. This means that in practice, the school or educational institution development project focuses only on the development of a few active teachers.

Development requires leadership

An individual teacher or a group of teachers cannot change the structures of a school or an educational institution, which is what development work and a new operational culture requires. Changing the operational culture of an organisation always involves a demanding leadership process, and it cannot be left as the responsibility of individual actors or groups of actors in the organisation. Only strategic leadership can change and develop organisational structures.

Often, in development projects the leaders have enabled the development by allocating time and resources to the project participants during the project and arranging opportunities to present the results and output of the project. However, these actions will not lead to changes in the organisational structures and operational culture. A project led on the level of the project participants does not have the opportunity to become established in an organisation.

Therefore, each development project should include a plan on the leadership process during the development and change of the organisational structures and operational culture. In the planning stage, the systematic leadership actions and decisions used to permanently include the project activities and output in the organisation's operational culture must be drawn up in addition to the actions already included in the leadership process during the project.

Project goals – organisational goals

It is regrettably common for the development of an organisation to splinter into extra tasks or support functions that do not match the organisation's core functions or its development. For this reason, development is one of the first things people start saving on in economically difficult times. It is a sign that development has been misfocused in the organisation in the first place. When saving on development, you can also ask whether the organisation has ever had any true development activities, and has the organisation actually been developed at all?

The goals of the development projects must derive from the goals of the organisation and their implementation. Development projects are a part of the continuing development that forms a part of the organisation's primary task and supports the realisation of the organisational goals. Successful development requires that the goals of organisational activity have been collaboratively acknowledged and explicitly stated. Only then can development be led. Explicitly and clearly stated organisational goals also act as outlining tools and structures in evaluating the kind of development or projects in which the organisation should become involved.

In Finland, education is steered nationally, which determines the primary task of schools and educational institutions and the goals of their activity: the task of the schools and educational institutions is to implement the national core curriculum. Therefore, development must primarily be linked to implementing the curriculum goals or it must support the organisation's ability to implement the curriculum.

In many schools and educational institutions, other reasons also determine the operational goals. Sometimes, organisations define the activity itself, the 'logistics', as the goal of organisational activities. If the everyday activities have been highlighted as the organisational goal, the organisation may seem from the outside to operate quite efficiently, but it nevertheless has no chance to develop or remain functional in the long term. In fact, leading development in schools and educational



Figure 1. The operating environment of a development project in the organisation.

institutions can be crystallised as leading through the organisation's strategic and functional goals.

Strategic planning of development projects

Figure 1 illustrates the context of a development project in an organisation, i.e., the key factors of an organisational operating environment that define the development projects carried out in an organisation. It is important to take these factors into account in the strategic planning of a development project. The factors of the organisational operating environment affect the development project, but for its part, the project's task is also to influence and develop the organisational operating environment's factors. The factors presented in the figure are a prerequisite for the project's success and for establishing the activity in the organisation.

Curriculum goals

Schools and educational institutions have the task of implementing the curriculum. Projects and development must also be primarily linked to implementing the curriculum and must support the organisation's ability to implement the curriculum. In Finland, education is steered nationally, which means that the primary task of the school or educational institution and the objectives of its activities derive from the national reference framework.

The organisational development objectives must derive from the primary task of the organisation and its operational goals; these are then operationalised into a development project. Often the connection between the development project and the curriculum in projects is considered obvious, or the definition is left loose and open to interpretation. However, defining the link between the project and the organisation's primary task imprecisely leads to the effects of the development project fading out in the long term. Therefore, it is important to express how the development project is based on the curriculum objectives in a structured way during the project planning stage.

Organisational strategy and action plan

The planning and implementation of a project often highlight the fact that the school or educational institution does not necessarily have an explicitly stated and commonly shared strategy, or any idea on how to implement one. At times, even strategy itself is a foreign and unclear concept for the organisation. Sometimes the organisation has not been able to define a comprehensive plan for reaching the operational goals. If the organisation has no strategy, steering the organisational activities is difficult or even impossible.

In that case, you can reasonably ask what the development project in the organisation is based on. It is surprisingly common to find that in an organisation without a strategy, the development projects are based on the personal interests of individual actors and groups of actors. If the organisational strategy is unclear for some reason, a development project is not the right way to organise the activities. Collaborative strategy work is the only meaningful option in such cases.

Based on its goals, the organisation defines its strategic action plan, meaning the actions taken by the organisation to reach its goal. In many schools and educational institutions, the operations are routinely planned every year. The action planning must include the development objects and projects for the organisation's next operating period; that is to say, the projects must be in accordance with the organisational action plan and approved in it.

Expertise

The expertise and competence required in development projects are focused on development and process competence instead of traditional content-related competence. Development and process competence have not traditionally been a part of the profession of a teacher. Therefore, particular attention should be paid to developing the development competence of teachers. Development competence includes, for example, tolerating uncertainty and understanding that it is not necessarily possible to predict the output of development accurately in advance; instead, it arises during the process.

The organisation's own expertise is not always a sufficient catalyst for changing the existing operational culture. In that case, the organisation can acquire development competence and consultancy from other expert communities and actors. However, it is important that the organisation does not outsource its development

competence, because it erodes the organisation's primary task and ability to function in the long term. Development is not excluded from the organisation's primary task; on the contrary, it is an essential part of it. In fact, development competence should be a part of the organisational capital.

Changing and developing the operational culture

Development projects are often understood as creating and developing a new product. However, designing and implementing the process that results in the output is more important than the output itself. Crystallised for the world of educational institutions, this means that the object of development projects should always be the pedagogical operational culture.

Change in the pedagogical operational culture is not possible without reviewing and changing the existing structures of the organisation. Naturally, change in the whole operational culture of the organisation is not only carried out by the people active in the project; it requires a collaborative process in the organisation and the leader actively making decisions and taking action.

Developing and changing the structures

If the goal is to develop the organisational activities, it can only be reached by developing the structures. Structures and their change and development must in turn be studied through the organisational strategy and goals. The structures must serve the operational goals, and they must also change flexibly and dynamically according to the goals. The structures are not a value in the organisation in themselves.

Often, it is more productive for the pedagogical community to create a shared goal state for new structures than to criticise the existing model. Changing structures is challenging, because they are linked to many emotional factors such as the feeling of safety or images of capability and permanence. In an organisation that does not link development to its primary task, the rules and structures of the organisation have become a value in themselves.

However, changing the structures is an absolute requirement to establish the activities of development projects. Many development projects break down because of the unchanging and inflexible, and often also hidden, structures maintained by the organisation. Only the leader of the organisation can change the structures.

Leadership

Development and development projects must be led. In the context of a development project, leadership means leading strategic thinking and making decisions and taking actions regarding activities in the whole organisation, not just within the development project. In other words, the leader's decisions do not apply only to the development project, they apply to the whole organisation. Leading the development project as a separate project without leadership actions in the whole organisation easily results in two leadership processes: the development project process and the process of the whole organisation.

The leader is responsible for all factors in the context of the development project in the organisation (see Figure 1). The leader cannot give the leadership of the organisation to anyone else, but it is nevertheless possible to share leadership naturally with the teachers active in the development project.

Assessing effectiveness

The effectiveness of development projects must be evaluated over a long period of time from the point of view of the goals and operational culture of the organisation. Assessing effectiveness covers all factors in the operating environment. It is important that the actors in the organisation are aware of and describe how the project affects the operating environment. Assessing effectiveness directs and guides further organisational development and helps the organisation to identify its future development needs. In a development project, it is good to consider the desired effects and define the ways of assessing the project's effectiveness as early as during the planning phase.

Leading development projects

Leading development projects can be described by using elements of leadership, which form the leadership landscape of the development project. As it is not possible to study development project leadership separately from leadership of whole organisation, the leadership landscape of the organisation is the same as that of the development project. Figure 2 illustrates the leadership landscape of the develop-

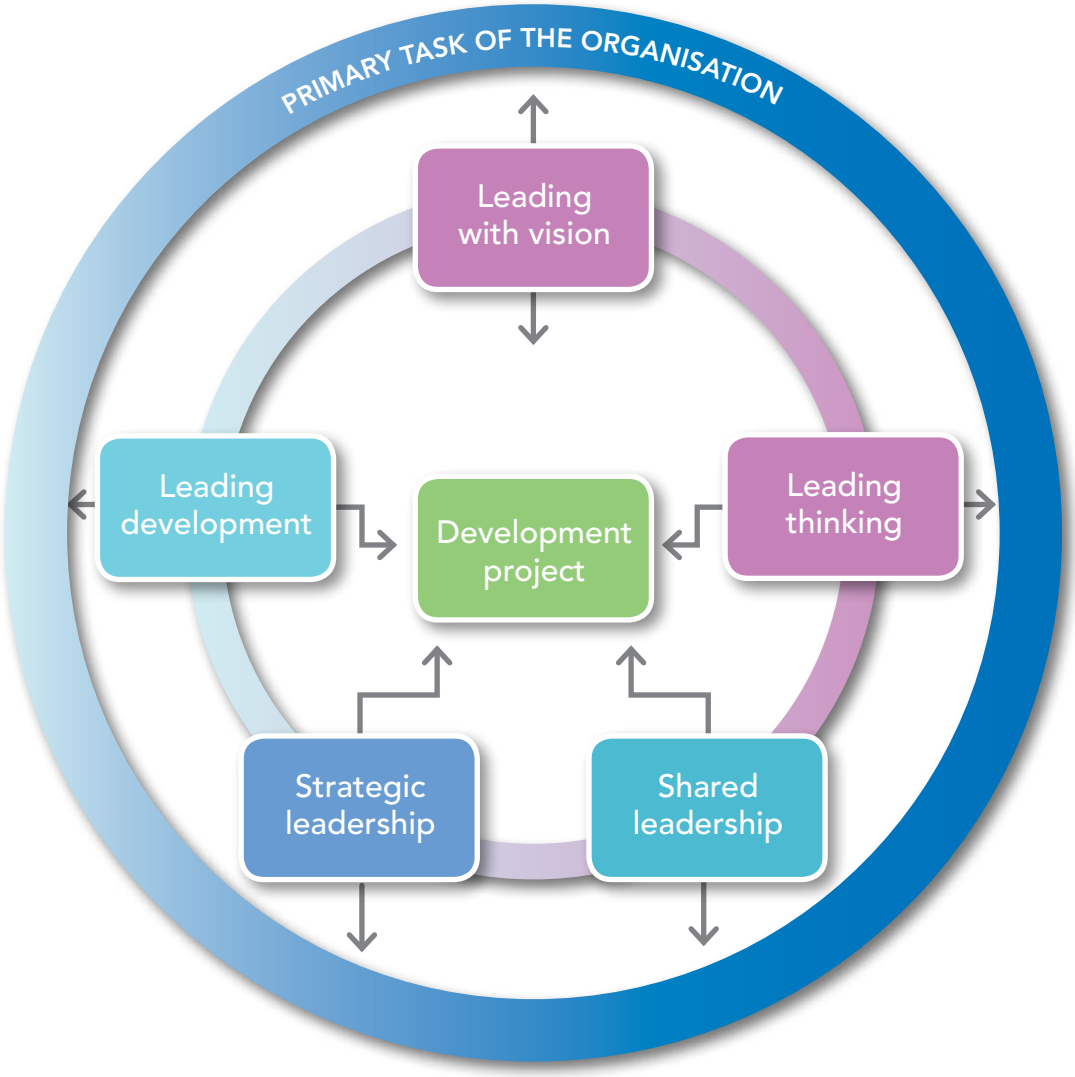

Figure 2. The leadership landscape of a development project.

ment project, meaning the elements of leading the whole organisation that create the prerequisites of success for the development project.

Figure 2 also illustrates how the leadership elements link the development project to the organisation's primary task. Through the leadership elements, the development project is disseminated through and established in the organisation. Primarily, leadership creates the prerequisites for utilising the results and output of development throughout the organisation.

Leading with vision

The landscape of leading a development project is built on the level of true leadership (see: Chapter 5, Figure 2).

True leadership is founded on the vision or goal state of the organisation as well as a shared strategy. The goal state is used to create an image of the future for every employee of the organisation. Without a shared vision, the development lacks direction and guidance for prioritising the operational goals and development.

The goal state of the development project must be in accordance with the goal state of the organisation; a development project cannot be led based on a vision that differs from the organisational activities. The development project can also clarify and enrich the vision and inspire commitment to common goals in the organisation.

Leading thinking

Leadership primarily involves leading the collaborative thinking of the organisation as well as the thinking of individuals; Its object is to lead thinking. The goal is to steer the collaborative thinking of the organisation's members so that it matches the goal state and creates ways to reach it. Leading thinking is based on the idea that only a change in thinking leads to a change in activity.

According to this idea, the activity in a development project cannot be led without leading thinking either. It is important to consider what kind of new thinking and competence the organisation can gain with a development project. A development project can promote and speed up a conceptual change in the thinking of organisational actors.

Shared leadership

Shared leadership creates shared structures in the organisation, such as teams and working groups with defined roles, goals and tasks. However, the teams do not simply function on the operative level to complete a single task; instead, they plan and steer their activities in accordance with collaboratively set strategy and goals. The shared structures of organisational leadership must support development projects.

If development projects are not implemented with the support of the shared structures of the organisation, the projects are not established as a part of the organisational activities and they do not become the organisation's common property. For their part, development projects can also promote the renewal of the organisational structures into something better suited for the purpose.

Strategic leadership

A strategy is a comprehensive action plan used to reach the goals of an organisation. Development projects are a part of organisational strategy and activities in accordance with the strategy. If development projects are not in accordance with the organisational strategy, they are constructed outside the organisation's activities or exist as extraneous functions on top of another activity.

Strategic leadership defines policies for the different aspects of organisational activity, including leadership itself. For development projects, strategic leadership primarily means all decisions and leadership actions in accordance with the organisational strategy. The results of development projects become established as a part of organisational activities through leadership actions.

Leading development

Development projects are a way to organise and lead development in an organisation. Projects begin and end, but development as a process is a continuous part of the operational culture. Projects can promote and speed up the achievement of goals; they can be used to respond to development needs for topical goals or ones prioritised by the community. Development always requires leadership (see Chapter 5, Figure 2) – including in projects.



5 Leadership as a tool for transforming the operational culture

PASI SILANDER JA ESSI RYYMIN

The changing and developing information society requires developing the operational culture of schools and educational institutions. Different kinds of development projects have been used centrally with the aim to change and develop the pedagogical operational culture. For example, several development projects concerning the use of information and communication technology in teaching or learning environments have been implemented without them actually resulting in any permanent change in the pedagogical operational culture.

When the goal is, for example, to create a common vision for the educational institution, develop common competence or organise new structures, changing the pedagogical operational culture requires leadership. Only through leadership can the common goals and team structures as well as team authorities, tasks and roles be built.

Development in the educational sector has largely been carried out through externally funded projects, in which enthusiastic teachers develop teaching practices and the use of information and communication technology as a part of the learning environment. These development projects have relied heavily on the competence and resources of individual teachers.

It is clear that such grassroots level projects cannot achieve a permanent change in the operational culture of a pedagogical organisation. Therefore, the foundation of every new development project should be transforming the whole operational culture of the organisation, because only then can the project become established as an organisational activity. If the project does not change the operational culture and structures of the organisation, it will naturally not have the space or opportunities to survive in the organisation and its old structures.

The process of change has rested on the shoulders of individual teachers

Previously, it was assumed that bottom up-projects commit and empower teachers to change and develop their own work. However, in reality it seems that instead of being empowered, the teachers encounter the organisational structures and the limits and constraints of the old operational culture. This does not lead to pedagogical renewal; it leads to the actors becoming exhausted. Leadership is the only way the organisation can become empowered and commit to change. The only way to empower teachers is through leadership. There is no other way.

On the other hand, financing in the development project programmes of schools and educational institutions has not been allocated to developing leadership until now. Change has not really been studied at the level of leadership. The criteria of development projects have not been the leadership practices or structures of the education organiser; instead, development has been seen as the result of the personal effort of teachers. While projects have resulted in significant benefit for developing the teachers' professional competence, they have not reached the desired effectiveness and neither have they effected permanent changes in the organisation.

There have been attempts to approach the problems involved in establishing development project activities and putting them into practice from the starting points of project presentations, dissemination and common sharing, but the results have been discouraging. Even though in many projects an establishment plan has already been drawn up in the planning phase, the project has not been functionally established. The forgotten aspect of establishing projects is leadership as a tool for transforming the pedagogical operational culture.

A model of strategic leadership in information society development

The model of strategic leadership in the development of an information society illustrates the leadership required in all development of the pedagogical operational culture. The model has been developed based on the assessment and conclusions of the OSUKE project (2009–2012) as well as reflection on findings related to the project.

In the model of strategic leadership of information society development, experiences from the OSUKE project are crystallised into a working model on develop-

ing pedagogical leadership. This model is a heuristically created thinking tool, and its aim has been to state explicitly the meta-level tacit knowledge generated in the OSUKE project.

The goal of the leadership model is to help review leadership in changing the pedagogical operational culture of an educational institution and to act as a frame of reference for research, development and further actions. The model offers developers and leaders a point of view and a tool for comprehensive, systematic development of leadership.

Development is a part of the primary task of schools and educational institutions

According to the observations and conclusions based on the OSUKE project, development should be an intrinsic part of the continuous primary task of schools and educational institutions. Development should be derived from the organisation's primary task, not produced by externally funded projects.
If the aim is to develop the organisation, leadership must support the development methodically and systematically. In that case, the organisational leadership is something quite different – it is development leadership. In addition to development leadership, the organisation naturally needs operation and process leadership, too.

Strategic leadership of information society development in schools and educational institutions can be studied via five dimensions: object, structure, method, style and output (Figure 1).

Dimensions of the strategic leadership of information society development

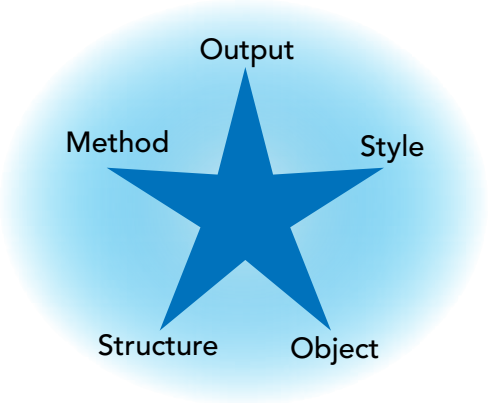

Figure 1. Strategic leadership of the information society – leadership dimensions.

1. Object of leadership
The object refers to the primary object of leadership, seen as a tool for effective leadership. The object describes what is being led.

2. Leadership structure
The structure of leadership describes how the organisation's leadership system is constructed.

3. Leadership method
The method describes how leadership manifests through the whole of the tools and methods of leadership.

4. Leadership style
The style of leadership expresses the foundations of leadership. For example, leadership can be based on rules or the goal and vision of organisational activities.

5. Leadership output
The output describes the focus of leadership in the organisational activities, and what can be achieved by leadership.

Analysing leadership on three levels: true leadership, management and lack of leadership

Through the dimensions, leadership can be studied on three levels as described by the model: true leadership, management and lack of leadership. The levels are situated hierarchically so that the level of leadership reflects leadership of information society development – the leadership required in all development. True leadership means strategic leadership based on a vision and a goal, and it enables change and development of the operational culture. True leadership is the only level at which the operational culture of the organisation can be changed and steered.

The management level is based on managing activities and production, thereby maintaining existing functions. At the management level, it is impossible to move on from managing predefined operations to developing the operations.

The organisation's understanding and ability to function are limited to repeating and maintaining operations.

At the level of a lack of leadership, it is impossible to consciously analyse and use leadership as a tool in implementing the organisation's basic activities. In that case, leadership is often focused on secondary issues and operates at a superficial level.

Leadership is derived from the operational goals of the organisation. If the operational goals have not been explicitly stated and defined in the organisation, there can naturally be no real leadership. Leadership is not a position that has been granted; it means leading the organisational activities based on goals.

The true leadership level means leading thinking

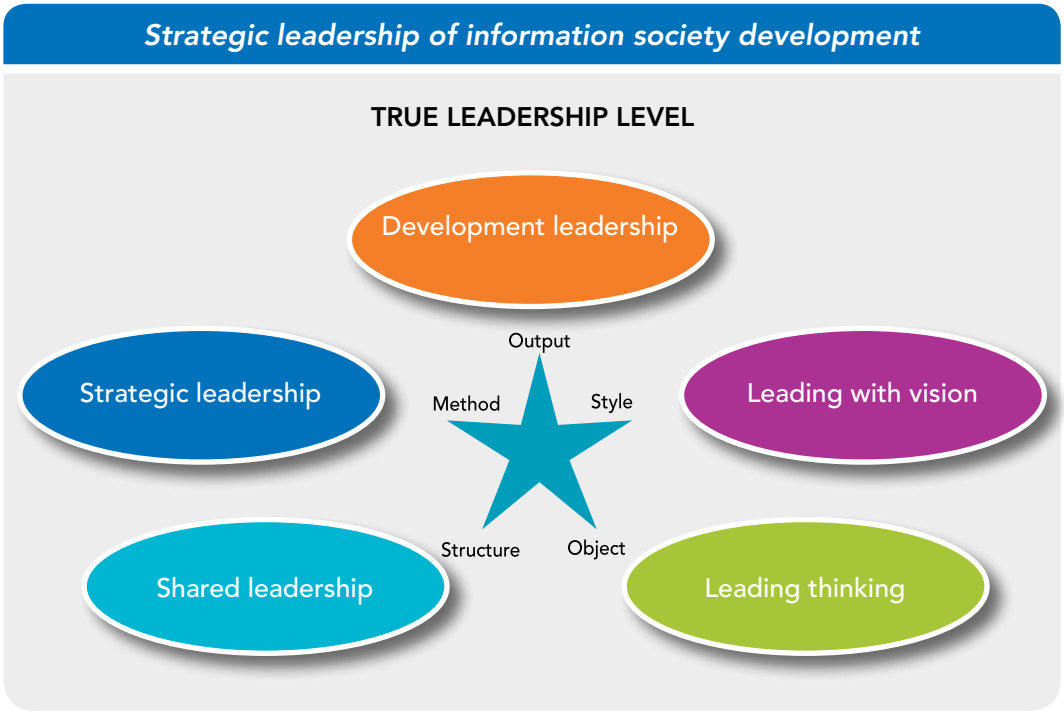

Figure 2. Strategic leadership of information society development – leadership level.

Leadership is not only linked to leaders and their decisions, it is also present in the policy documents of the organisation, its common strategy, the everyday operational culture and the speech and language of the community, among other things.

The level of true leadership (Figure 2) starts from the vision or goal state of the organisation and its common strategy. In leadership, achieving the goal state is seen as the basis and strategy is seen as the action plan to reach the goal state.

Leadership primarily focuses on the common organisational and individual thinking; its object is leading thinking. The goal is to guide thinking so that it meets the goal state and the ways to achieve it. Leadership is based on the idea that only a change in think-

ing leads to a change in action. Actions cannot be changed without a change in thinking. Leading thinking requires cognitive capacity, cognitive motivation and competence from the leader. This sparks the question of how much field-specific expertise leaders need, and to what extent is generic leadership competence sufficient?

A pedagogical leader is a pedagogical expert

Leading pedagogical operational culture involves working with intangible issues. This means that leading people's thinking is the only leadership method. Changes in the pedagogical operational culture highlight the leaders' abilities to act based on pedagogical expertise. In order for pedagogical leadership to be truly realised in an educational institution, the principal must possess particularly deep pedagogical expertise. As a pedagogical leader, it is important that the principal implement shared and engaging leadership together with the other pedagogical actors in the organisation.

Strategic leadership defines the policies for the different aspects of organisational activity, including leadership itself. Strategic leadership means strategic decisions made guided by the future goal state. The decisions need support from organisational processes. Implementing them in practice often requires a change in the organisational processes.

Shared leadership

True leadership means shared leadership. This means that collaborative structures have been created in the organisation, such as teams and working groups with defined roles, goals and tasks.

However, the teams are not active only at the operative level to complete an individual task; instead, they plan and guide their own activities steered by the collaboratively set strategy and goals. These structures of leadership enable development and create a context for pedagogical innovations to arise.

If development is not actively led in the organisation, leadership only maintains the existing practices and activities. In that case, the leadership style can be characterised as rule-based, meaning that instead of a shared vision, the activity is based on rules and their enforcement. Rule-based leadership is focused on leading activities, not assessing and redeveloping methods.

The management level maintains existing practices

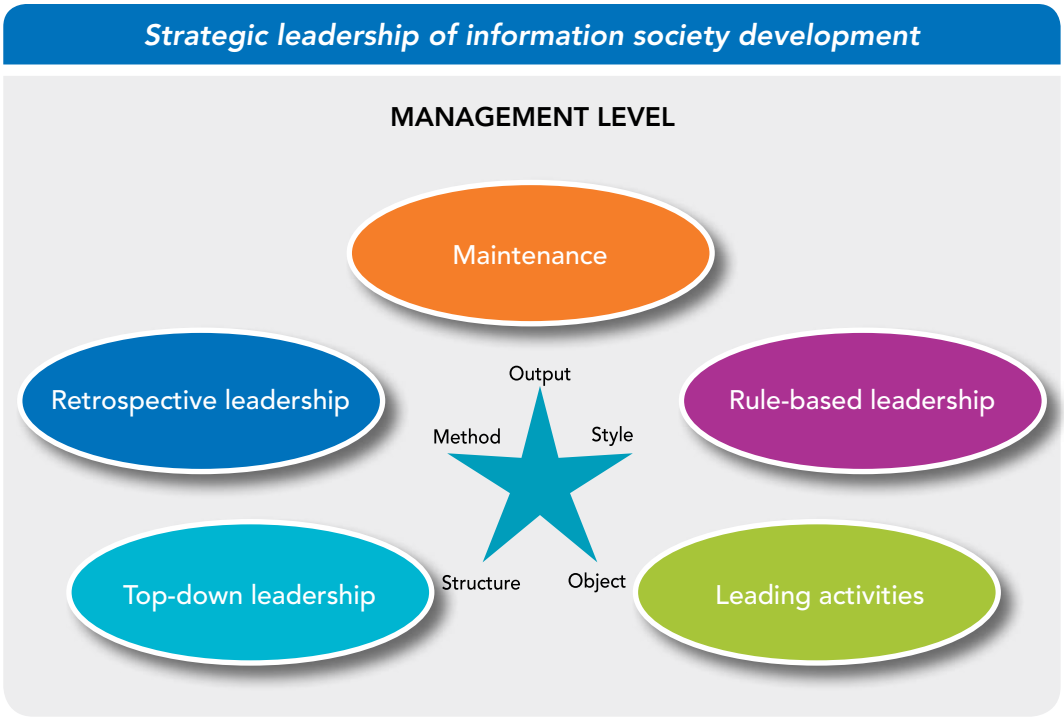

Figure 3. Strategic leadership of information society development – management level.

At the management level, reactions to changes happen after the fact

The management structure consists of assignments issued from above and reacting to situations after the fact. There is a delay before taking the changing operating environment into account. In such cases, the organisational activities are retroactive reactions to events that have already happened. The organisation is not capable of responding to internal or external development needs dynamically or flexibly.

At the management level, it is not possible to create structures or an operational culture that would, for example, promote the establishment of development project

activities as a part of the organisational activities. At the management level development projects may instead seem to be superfluous actions outside the primary task that threaten and disturb the existing operational culture. The connection of the development projects to the organisational vision and strategy is unclear.

Management seems effective in a short-term cross-section, but in reality it paralyses development in the long term.

Lack of leadership provides a fertile ground for rumours and beliefs

Lack of leadership describes a state where leadership only has external structures, and is mainly focused on issues secondary to the organisation's primary task and operational goals. At this level, leadership does not create any actual added value for the core functions of the organisation, and it remains mainly token leadership.

If leadership has no structure or a clear object, it inevitably leads to disorganisation. In that case, beliefs and rumours steer the organisational activities and operational culture instead of strategy and the goal state. At worst, leadership itself is based on personal beliefs and rumours.

Lack of leadership has lost sight of goals

In educational institutions, the level of lack of leadership may be evidenced, for example, by the construction of the weekly timetables being the most important and the only tool of leadership. In such an operational culture, the organisational activities are only seen as logistics; they define the organisational goals in a backwards manner. This means that action becomes the goal, instead of the goal becoming action. People who have worked in such an operational culture for a long time may even find it difficult to question the role of activity as the goal. In the context of lack of leadership, it is impossible to achieve a change in the pedagogical operational culture.

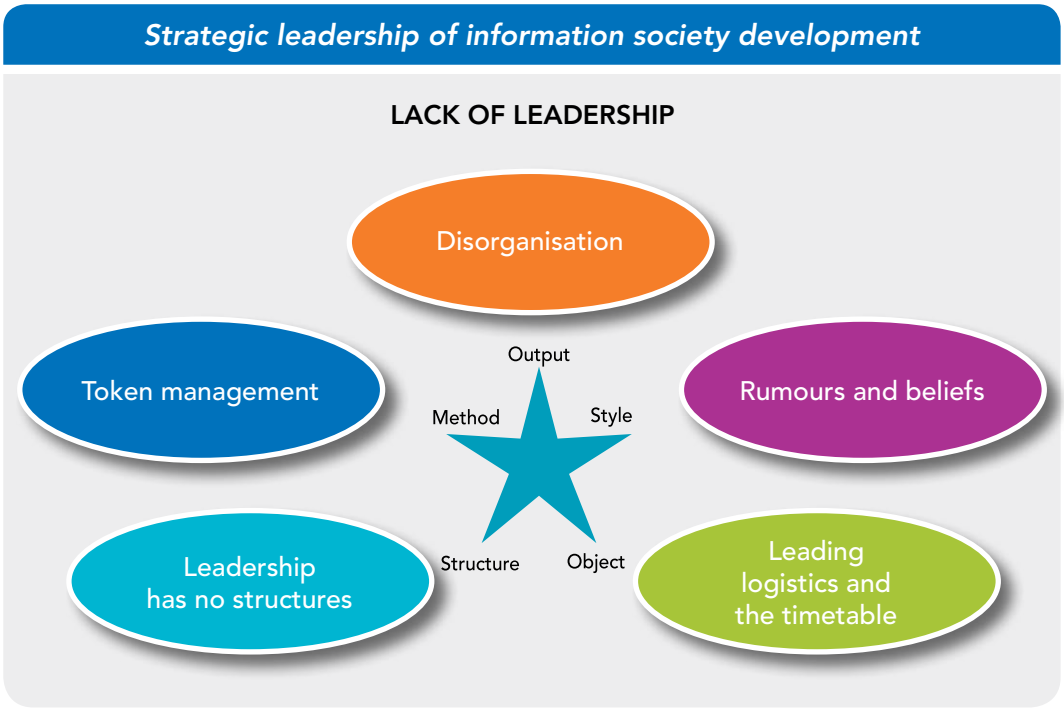

Figure 4. Strategic leadership of information society development – lack of leadership

Leadership competence must be developed in the pedagogical operating context

Special pedagogical expertise and leadership are required from a pedagogical leader. General and business leadership theory does not recognise the pedagogical expertise that the leader of an educational organisation needs. Other special characteristics include the pedagogical organisation's operational goals and their guidance and organising teaching as a form of organisational activity. In the pedagogical operating context, a completely new kind of leadership competence development is needed.

Key parts of the development of pedagogical leadership competence include reflection and making the pedagogical leadership concept visible. Pedagogical leaders must be able to model and reflectively study their own thinking and activities in relation to the organisational strategy and goals.

The pedagogical operational culture is influenced, among other things, by the principals' and teachers' conceptions of learning and human, the conception of one's own work, the structures of the school or educational institution as well as the teaching organiser, and the national history and tradition of school and teaching. A pedagogical (change) leader should be able to analyse all this critically.

Strategic leadership is the key to establishing the use of information and communication technology in teaching and learning

Ignoring the review of leadership in development projects and educational institutions and by the organiser of education is a key reason for the failure to establish information and communication technology in pedagogical use. We need new, correctly allocated development of the leadership culture – tools, models and a selection of methods – as well as a strong social moral purpose for developing the strategic leadership of information society development.

To summarise the strategic leadership of information society development, leadership is always a part of the operational culture, and a transformation in the operational culture can only be achieved through leadership. Therefore, project funding for schools and education should be centrally allocated for developing leadership and its structures.

The point of view and actions of operational culture change leadership should be strongly linked to all funded development projects. The new activities generated by the projects do not become established in the organisation without leadership measures and structural changes applying to the whole community.



6 Expertise and leadership in the information society – tinkering or thinking?

ESSI RYYMIN JA PASI SILANDER

What is expertise in the information society? Is it found within organisations, in individual actors, experts, leaders or external networks?

Is organisational strategy a sign of expertise in the organisation? What if experts openly state that they find strategy as a concept foreign and difficult; what has happened to expertise in that case? How has leadership supported the realisation of the organisation's strategic and operational goals? In organisations it is often necessary to ask these questions.

In a traditional organisation implementing a static task, expertise and expert tasks can be described in a very detailed manner. However, the continuing development of the information society and maintaining the ability to function require expertise that is dynamic, proactive and able to transform, meaning an ability to function actively in, create and control change. Where in the organisation should expertise be located so that it could also act as an agent of change?

The aim of this chapter is to analyse expertise in the information society and the dependence between leadership and expertise, and to propose new approaches and tools for developing expertise, leadership and the operational culture in a knowledge-intensive organisation.

The operational culture of a knowledge-intensive organisation is an expert culture

Leadership defines expertise in an organisation and its development even when the expert task is very autonomous and self-directed. Leaders always lead expertise with organisational visions, policies, goals and strategy. The information society's organisations are multifaceted and networked, and knowledge-intensive activity has spread out among different interest groups and actors. In modern, dynamic expert organisations, expertise and expert work can no longer be led by tasks and individual decisions.

In a knowledge-intensive organisation, expert culture consists of an operational culture in which expertise is bound to the organisation's strategic core activity, for which the experts are responsible. More is expected of leadership than simply allocating resources, scheduling or repeatedly defining the primary task. Leadership ensures that the organisational goals are reached by supporting and maintaining the culture of expertise. In practice, this means that experts are empowered to define their tasks and job descriptions dynamically in constantly changing situations.

Therefore, leadership focuses broadly on the strategic activity of the organisation, not on individual tasks or work content. It is no longer possible to lead experts like a production plant or by administrative or operative methods. Expertise is not a performance based on top-down assignments, always repeated in the same way, or recurring routine processes. If expertise is conceptually or functionally lost, the organisation's functional ability is naturally weak and it is incapable of reacting to change in society.

Currently weak signals of returning to authoritarian traditions can be seen in society. Power is centralised, information is restricted instead of being freely shared, expert working groups are not empowered, and the information they produce does not receive sufficient weight in decision-making. Does this signal difficulties in accepting the new nature of expert work? Or is it a sign that no one knows how to lead the new expertise and work required by the information society? An authoritarian leadership model that emphasises doing may often seem like a safe, stable alternative in the information society's chaos of events and information. However, there is reason to ask whether the traditional leadership model still works in a changed context and a new situation.

A traditional, often mechanistic leadership orientation easily paralyses the operational culture of a knowledge-intensive organisation. The requirement of maintain-

ing old routines and structures as well as a static primary task is absurd in the modern, constantly changing information society, where success requires solving open problems, self-direction and creating new information and methods.

A typical mistake in building a new operational culture is to adapt the new models as a part of the old structures and methods. The same phenomenon is found in applying information technology as a tool of expertise and leadership; new equipment and media are adapted to existing activities instead of creating new methods of higher quality. Sometimes, even the coaches and consultants asked to support the organisational development find it easier to seek the organisation's static primary task or handle the emotions evoked by the pressure for change than help the organisation develop towards a new operational culture. The organisational culture cannot be changed without developing leadership. For this reason, the in-service training and coaching that aim at changing the operational culture without also developing leadership often fail to produce results.

The organisation may need the same kind of conceptual change and a review of the paradigm as what has recently occurred regarding the conceptions of teaching and learning. In the same way as a change in the teaching culture has required a conceptual change in thinking, a change in expert culture also requires new systemic thinking and breaking into a new operational culture.

What kind of expertise does leadership generate?

The development of expertise in an organisation is dependent on leadership. On the other hand, expertise is always a manifestation of leadership (see Figure 2). In the information society, there is a new kind of dependence, mutuality and reciprocity between leadership and expertise. The quality of the relationship between leadership and expertise shapes both leadership and expert culture. At best, leadership is shared and penetrates the experts' shared cognition and collective intellect.

Leadership of the modern age enables expert culture. Expert culture is a manifestation of an operational culture in which expertise primarily involves thinking competence, cognitive expertise (see Figure 1). At its best, this systemic expertise is used to continuously recreate the organisational strategy, which allows the organisation to achieve more than just its latest goals.

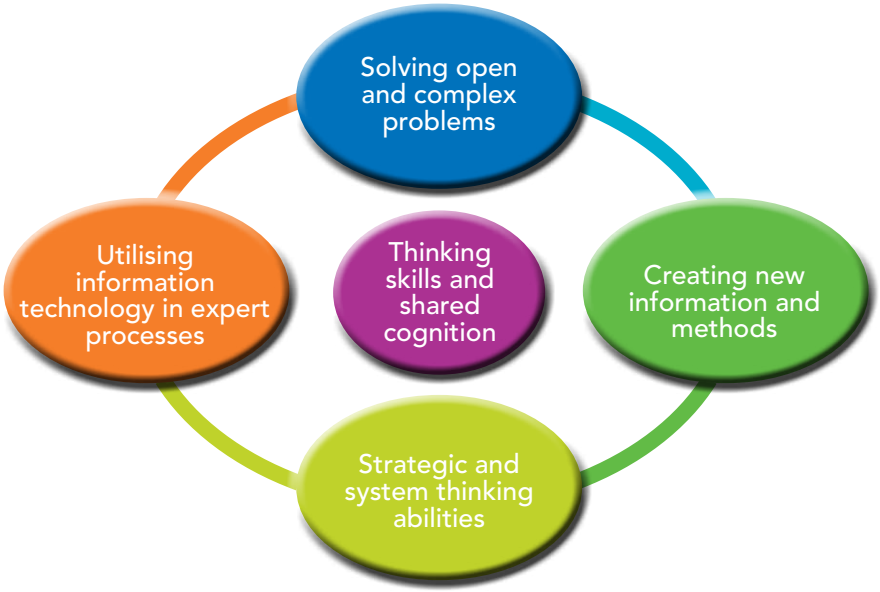

Figure 1. Cognitive expertise required by expert culture in an organisation.

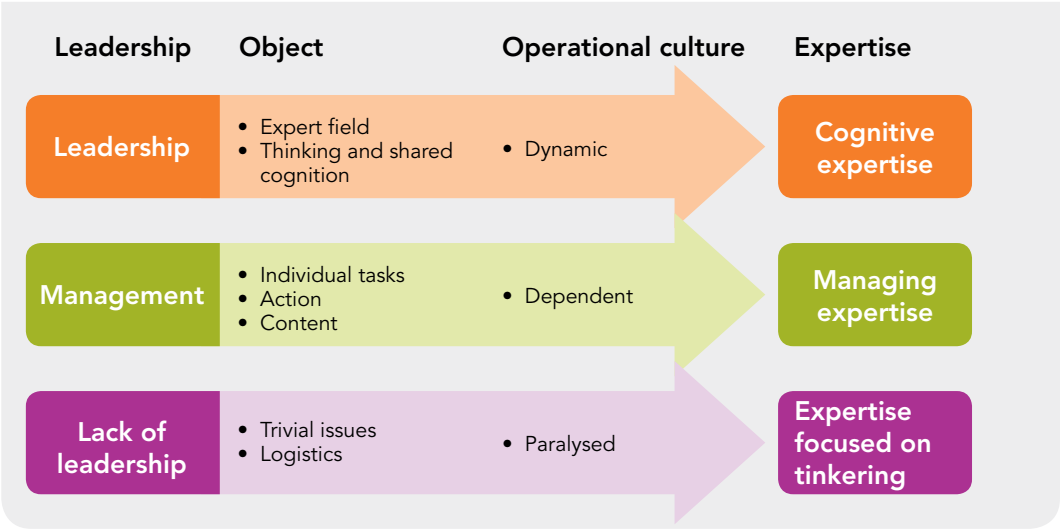

Figure 2. Effect of leadership on expert culture.

Leadership – thought leadership

Thought leadership means leading thinking in an expert field; not leading the thinking of individual experts, but more broadly the knowledge, understanding and competence that the field produces collectively in a distributed way. In thought leadership, the goal is not standardising and centralising thinking – quite the opposite. The aim of leadership is to enrich and diversify thinking, activate interaction and problem-solving, and create space and tools for collaborative thinking. In the end, thought leadership means leading collective intelligence and intelligent networks. However, collective intelligence and intelligent networks require that the expertise of each of the actors is at a cognitively sufficient level.

Thought leadership relies on the competence of experts. This trust manifests in the leader empowering the experts themselves to create the practices of working, the tools and the methods for reaching the goals. The leader actively communicates with the experts on the organisational strategy and goals.

Management – leadership with competence in the field

If leadership focuses on the content and practical arrangements of expert work, the first impression of the situation may be highly positive: leaders are interested in the work of experts and want to make their own contribution to it. However, on closer inspection this proves not to be a sustainable method. Expertise is built on the wrong kind of interdependence. In addition to leadership, a leader easily turns into a kind of a poorly resourced expert in the field, unable to contribute time and cognitive effort in the same way as a real expert.

In the long term, if experts cannot advance the content of their work independently but need to gain the leader's confirmation or approval at every turn, it creates an expert culture in the organisation that lacks independence. The relationship between leadership and expertise becomes skewed. In a dependent expert culture, people are not able to solve problems independently and creatively, and the expert community can no longer implement the organisation's primary task or strategy. In such an operational culture, expertise is mere management focusing on practical arrangements and routines.

The challenge of developing management is that focusing on practical actions easily gives a busy, socially acceptable impression, and it is not always easy to notice that the

industrious activity is not producing any results. Management as an operational culture easily prevails in organisations without a strategy or in which the strategy is not understood, or in which goals have not been defined or the activity itself is seen as the goal.

The lack of renewal in expert culture due to activity only becomes evident over time, and often only at a stage where it is almost impossible for the organisation to handle the development requirements by itself.

Lack of leadership

If the leadership focuses primarily on the logistics of activity that are completely trivial with regard to expertise and the development of the expert field, it erodes the whole expert culture in the long term by directing attention and energy into inconsequentialities instead of goals and content. Such an expert culture is paralysed.

Experts wanting to develop continuously in their field often face the challenge of finding leadership for their work. In order to develop, it is essential that experts work in intelligent networks, where field-specific thinking is visible as well as continuously challenged and enriched. This is particularly important when experts are exposed to a paralysing operational culture in their daily work.

Leadership and expertise are closely interwoven cognitive systems

Do leaders need to be content experts in the field they lead in order to produce a dynamic, creative expert culture with their leadership? Because a leader's most important task is to lead the organisational strategy, goals and activities, the leader cannot focus on individual contents and tasks. Expert tasks and their management may bring the leader the desired feeling of competence and control, but this often occurs at the cost of leadership and expert culture.

Constructing the concept of leadership and defining the methods and objects of leadership requires a demanding cognitive effort – a radical conceptual change and development in thinking. In order to lead expert culture at the thought level, leaders must nevertheless be top experts in their field. This expertise does not manifest as detailed content expertise; it is expertise in field-specific cognitive processes. The

leader's expertise involves constructing and controlling shared cognition in accordance with the organisational strategy and goals.

In the organisation, leadership and expertise are not administrative structures, task descriptions or positions; they involve operational cultures of expertise and leadership. From this point of view, leadership and expertise are cultural and cognitive systems that are interwoven with each other (see Figure 3).

The operational culture of an expert organisation is developed by developing leadership

When the aim is to develop the expert culture and the operational preconditions of an organisation and make them more efficient, everything starts from the development of leadership. Without developing leadership, the expert and operational cultures of the organisation cannot be made dynamic. This is why the in-service training of the personnel, for example, is not a very effective instrument in developing operational culture or expertise in the organisation. Expertise in a knowledge-intensive organisation is largely bound to the organisational leadership, its methods and its object.

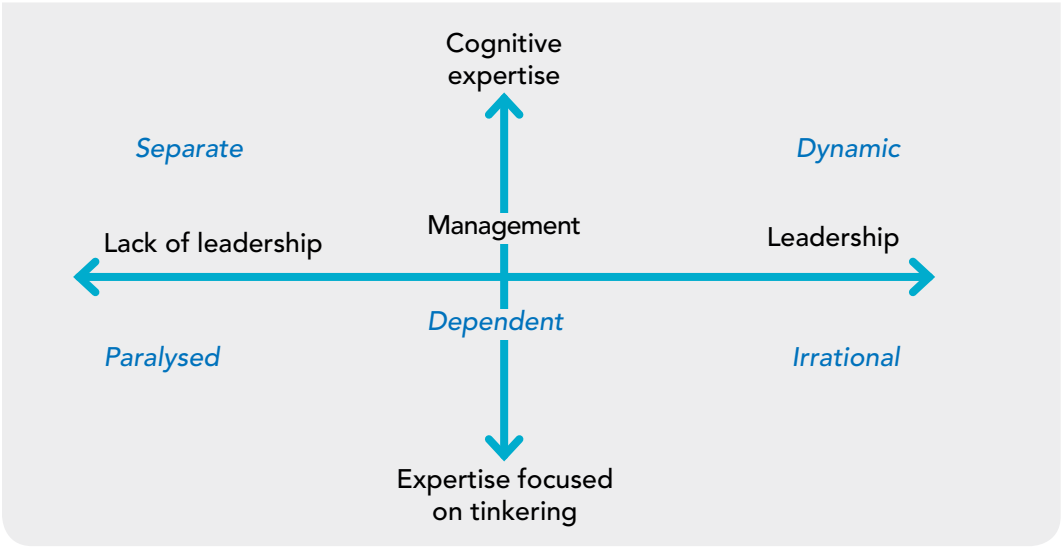

Figure 3. The relationship of leadership and expertise with operational and expert cultures.

Using the graph (Figure 3), it is possible to study the goals, operational preconditions and expert culture of a knowledge-intensive organisation in relation to leadership (horizontal axis) and expertise (vertical axis). When the dynamics and possible conflicts between them are made apparent, changing and developing the operational culture of the organisation can begin. The graph acts as a cognitive, collaborative tool for changing the operational culture. It can be used to identify the development path into new expert and operational cultures.

Instructions for identifying the development path:

- The placement of organisational goals (G) and vision (V) in the fields of the grid is identified. The best way to achieve this is through collaborative discussion.
- The placement of prevalent operational and expert cultures (OC, EC) in the fields of the grid is identified collaboratively, together with experts.
- The placement of leadership (L) in the organisation on the horizontal axis is estimated and marked on the graph.
- The placements of the current expert functions (E) in the organisation on the vertical axis are estimated and marked.

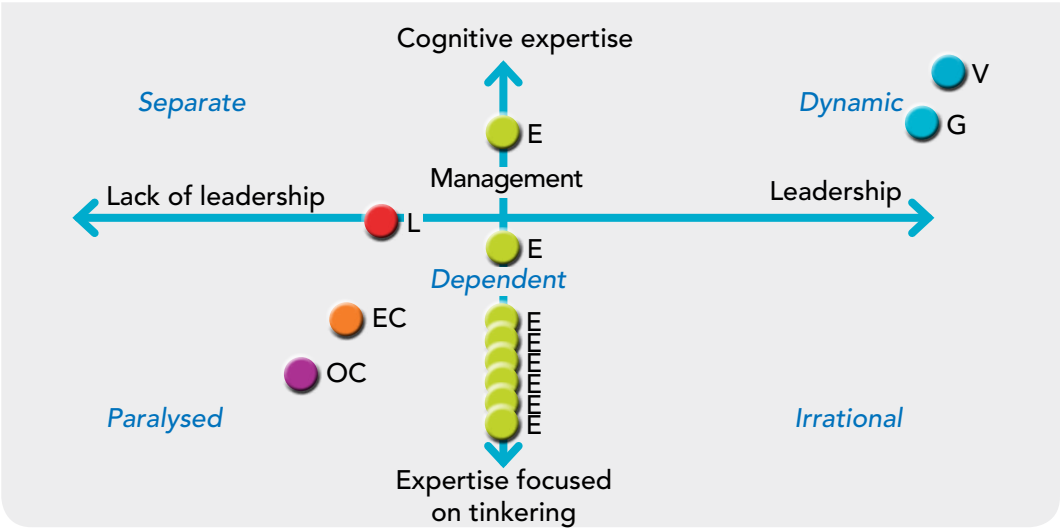

Figure 4. An example illustrating the disparity between organisational visions (V) and goals (G) and the existing operational and expert cultures (OC, EC) and leadership (L).

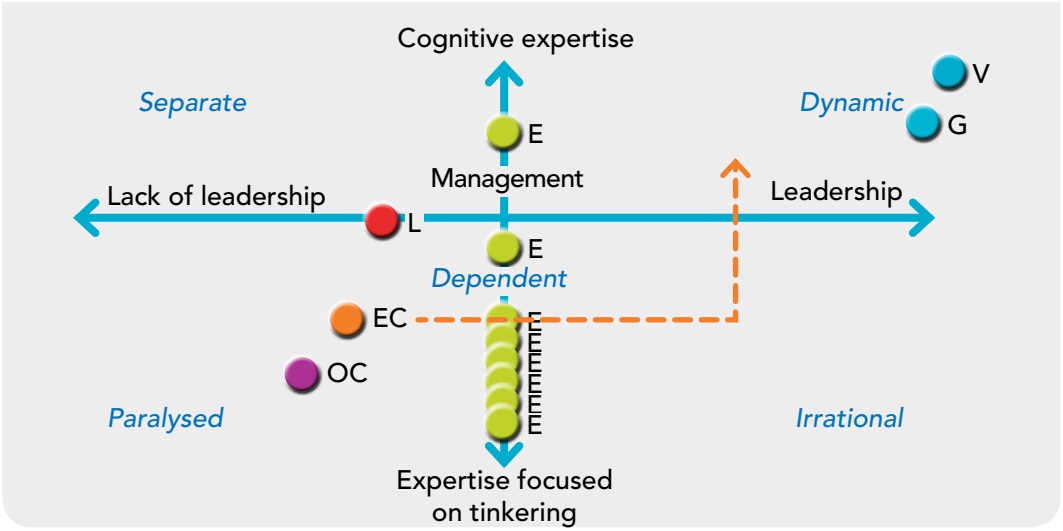

Figure 5. An example with the necessary development path to a new operational and expert culture marked (with a dotted line).

The graph (Figure 5) illustrates a development path to new operational and expert cultures, which requires first developing leadership (horizontal axis) from management towards real leadership, followed by developing cognitive expertise as a part of the expert culture. This requires the experts to evaluate their own expertise consciously and critically (vertical axis). Issues to be considered in particular include whether the focus of developing one's own expert activity is on individual tasks ('tinkering'), practical arrangements ('management') or the characteristics of creative, dynamic expertise (see Figure 1), i.e. cognitive expertise?



7

Competence leadership in schools and educational institutions

ESSI RYYMIN JA PASI SILANDER

Developing competence increases the ability of the educational institution to function in accordance with the goal. Competence leadership involves maintaining and increasing the organisational ability to function. The goal of competence development is to support and ensure the common competence of the community. In schools and educational institutions, competences are developed to make the organisation better able to reach the goals of its primary task, implementing the curriculum. The continuous development of competences is a prerequisite for schools and educational institutions to be active in the information society.

An educational organisation has no production equipment or machinery; competence is the only tool available for implementing the primary task of the organisation. An educational organisation primarily develops competence, which sets particular requirements for it in competence leadership. Competence leadership ensures that the organisation has sufficient competence, capacity and resources to provide new competence for the learners.

In addition to recruitment, in-service training is one of the instruments used to acquire competence for the organisation. It is typically used by teachers or groups of teachers for gaining additional professional expertise. On the other hand, if in-service training only serves the individual and it is not realised as organisational competence, it often involves only individual coaching or maintaining an individual's ability to work. For the organisation, developing the competences of an individual teacher or a group is not enough; the competence should be transformed into capacity for the whole organisation. The transformation process can be promoted through leadership and by developing structures for organisational knowledge management.

Leading competence development is a continuous process

Competence leadership at schools and educational institutions is a process that supports the organisation's primary task, in which a strategy is defined based on goals and implemented in order to develop the shared competence capital. It can be implemented as a collaborative process for the whole organisation, in which all of the teaching personnel participate in defining the necessary competence and its development. Particular attention must be paid to ensuring that the competence development measures aim at supporting the realisation of the organisational vision or goal state.

In a collaborative process of defining competence, competence surveys and competence matrices act as a support. In competence matrices, the competences required in the organisation is defined by work roles – not individuals. Competence can be studied as generic competence and as profession-specific competences. A competence development plan is drawn up as a result of the collaborative process.



Figure 1. Competence leadership process in an educational institution.

Objectives

The task of competence leadership in schools and educational institutions is to define, based on the organisational goals, what kind of competences are needed for the organisation to operate and carry out its task. In defining competence, the organisation's core competence is a good starting point, after which the generic and occupation-specific competence can be defined. In this process, the existing competence in the organisation is also identified.

Strategy

A strategy must be drawn up for developing and acquiring competence. The strategy includes systematic practices for acquiring, developing and sharing competences in the organisation. The strategy defines a dynamic response to new challenges in developing competence.

In the information society, competence development is a continuous process, which must be taken into account particularly in the strategic planning and leadership of the operation of schools and educational institutions. The strategy also takes a stand regarding the methods and instruments used to develop competence. The collaborative process of developing competences makes the teaching personnel ponder the question of each teacher's responsibility for keeping their own competences up to date in the information society.

Implementation

Instruments of developing competence include, among other things, development projects, peer support and mentoring, sharing good practices, pedagogical dialogue (such as pedagogical cafés) and co-teaching. These instruments often achieve an immediate effect in the teacher's own work, but effectiveness at the organisational level requires strategic leadership.

New competence acquired through different instruments is only significant for the organisation when it becomes evident as a change in the operation. New competences must become implemented in the existing operational culture of the organisation and do their part to change the culture. The organisational structures

and practices must support the common sharing and establishment of new competence. Competence leadership requires continuous monitoring and forethought.

In-service training has been the most often used instrument of competence development. The lesson learned from in-service training on information and communication technology targeted at teaching staff is that in-service training does not always have the desired effect on pedagogical practices and the pedagogical operational culture. For example, the in-service training may have focused on issues irrelevant to developing the teacher's expertise.

Often in training sessions the skills of using information and communication technology have been considered mechanical and they have been studied through model learning, which has not allowed development or conceptual change in the teachers' own thinking. If no opportunities have been created for conceptual change and the development of thinking in teachers during the in-service training, it is difficult for the teachers to change their own teaching practices or teaching culture.

Teachers' information society competences

The current and future competences of teachers have been described from different points of view (see for example Jarva 2011, Luukkainen 2003, Niemi & Jakku-Sihvonen 2011). In this context, however, competences are discussed in the context of information society development. Competence refers to skills and knowledge, not professional or formal qualifications as such. Competence is discussed from the point of view of developing and planning teaching practice.

The starting point is the view that there are generalisable skills independent of the teacher's field or mastery of the subject behind even very specific competence. Developing the teachers' competence and competence leadership should focus on these shared, generalisable skills. Developing the teachers' mechanical skills (such as the use of specific software) does not achieve sustainable competence in an educational institution.

In this context, the competences of developer teachers that have been described in Tables 1 and 2 refer to competence that is significant for the future operation of the educational institution. The analysis of the survey of teacher competence in using information and communication technology in teaching as well as the competence development plans of schools (the OSUKE project) has influenced the definition of competences. In addition to this, observations and conclusions on the development plans concerning school learning environments have also affected the definition.

Table 1. Teachers' information society competences.

Competence	Description
Goal orientation	• intentional approach to work (goal-oriented, conscious activity) • ability to plan and guide the learning process according to the goal
Development and process competence	• ability to picture the development need and set the development goals based on it • ability to develop new and previously undetermined things in the process and tolerate the fact that the end result is not yet known or has not been specified in detail • ability to picture the steps of development/process phases for developing an issue • process management
Self-leadership	• ability to guide one's own activity in accordance with the strategy • ability to set goals for one's own activity • ability to participate in shared and collaborative leadership
Collaboration and communication skills	• collaboration skills • communication skills • dialogue
Metacognition	• ability to monitor, reflect on and assess one's own as well as the organisation's activities • cognitive skills and strategies • professional self-knowledge
Future and anticipation skills	• ability to create alternative points of view for the future • picturing plausible future scenarios • ability to picture the causalities of activity
Expert culture	• expert procedures and methods • modelling professional practices and stating them explicitly • problem solving and analysis

Teacher competences and developing the use of information and communication technology in teaching

In Table 2, the generic competences of a developer teacher are studied in the context of using communication technology in teaching. The table offers the organisation leader a tool for planning competence development at both the individual and the organisational level. The table can also be utilised in recruitment planning and recruitment situations to ensure that the educational organisation receives relevant information society competence. The table also functions as a tool in development discussions. It offers a frame of reference for developing and assessing the information society competence of the individual and the organisation.

Table 2. Teacher competences and developing the use of information and communication technology (ICT) in teaching.

Competence	Use of ICT in teaching
Goal orientation	• teaching is based on curriculum goals • ability to plan and guide the learning process in accordance with the goal • making the learning objectives visible for the learners, too
Development and process competence	• picturing the goals of using ICT in teaching • ability to apply and develop new teaching practices in one's own teaching • planning competence in the learning processes using ICT
Self-leadership	• ability to guide one's own teaching in accordance with the goals and strategy of the school or educational institution • ability to set explicitly stated shared goals for one's own teaching and the learning of learners • ability to participate in shared and collaborative pedagogical leadership

Competence	Use of ICT in teaching
Collaboration and communication skills	• ability to use ICT in collaborative work and learning • ability to use ICT in communication • technology-mediated guidance dialogue competence • ability to plan teaching together (co-teaching)
Metacognition	• ability to monitor, reflect on and assess one's own ICT use process and use in teaching • cognitive skills and strategies on which the use of ICT is based • professional self-knowledge
Future and anticipation skills	• picturing the skills needed in the future information society • ability to predict the effectiveness of different teaching methods • selecting optimal teaching methods • picturing the effects of teaching
Expert culture	• expert procedures and methods in planning, implementing and assessing teaching • modelling pedagogical practices and stating them explicitly • problem solving and analysis in the context of information technology

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8 Developing the learning environment is a change process of the pedagogical operational culture

PASI MATTILA

Change in learning environments occurs at different levels: teaching, leadership, learning, technologies and spaces. The highest effectiveness is achieved by developing each aspect in the same direction. A change in a single aspect is often not enough to achieve permanent effectiveness and operational culture; the change occurs through comprehensive development. However, the situation in a development project may be different. In a single project, it is possible to take risks and develop a particular solution, such as technology, further than the other aspects with external funding and without risk.

Changes in the learning environment should start from leadership. Strategic leadership is the key to change, and it often makes work towards change possible. It also brings in the necessary resources through decision-making. The most concrete decisions in developing learning environments are made concerning the spaces and furnishings as well as technology. The change is made visible by developing these aspects, which makes it possible to justify it to the whole community. By developing spaces or technologies, the pedagogical change is taken to the next level, ena-

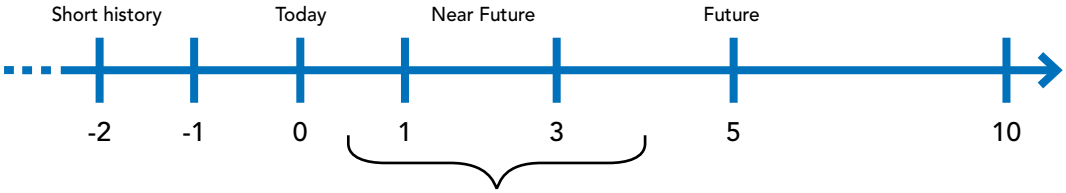

Figure 1. The direction of development measures is from the present towards the future.

bling new kinds of activities by the users. However, the final, permanent change can only be achieved by changing the operational culture. This includes a change in teaching from the culture of working alone to collaborative, shared expertise and teamwork as well as the pedagogical models and methods used in them.

Change requires courage and the ability to look forward to the future in development. Changes in operational culture are not directed towards the past or the present, they are directed towards the near future a few years ahead. The period of three to five years is a time we can easily comprehend and use to concretise solutions. The goal of the changes may be further in the future.

School change process

An individual school or educational institution needs information to support the change process. It is not worth it for every work community to try to find all information by themselves; often it is easier to introduce the knowledge into the school change process and to those responsible for development in suitable packages and education units.

A change process starts from the same basic elements everywhere. It is based on the need to change and develop the operations. Vision, goals and an implementation

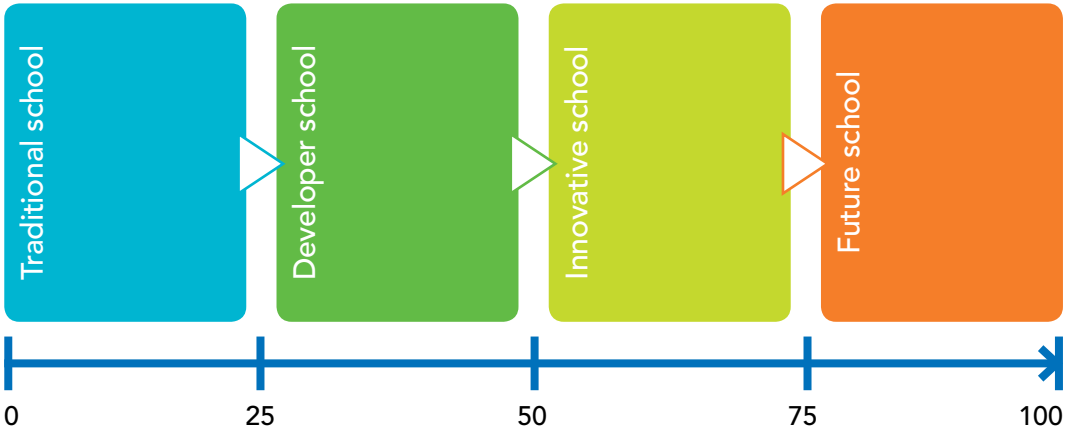

Figure 2. School development process

plan are created to implement the process. The plan is a document in which the central development measures and their stages, schedule and budget are described.

Before making an implementation plan, it is worth drawing up a school development plan to support the change in the learning environment.

The task of the school development plan is to describe the present and the goal state. The development plan goes through the essential factors affecting the school's activities, such as learning solutions, leadership, technologies, spaces and furnishings, and the influence of the surrounding environment as well as the cooperation networks. The school development plan creates a framework that supports the school development and defines the vision and goals as well as the level of implementation set for them.

The school development plan also describes the current level of the educational institution on the following scale: traditional school, developer school, innovative school or future school. In addition to this, it defines the schedule and the goal level at which the development measures aim. When the current and desired levels have been defined, the measures required by change can be described.

Knowledge at schools and educational institutions on developing learning environments

Experience has proved that change should start with certain basic stages. The process starts with acquiring basic information on the issue and defining the development needs of the surrounding environment and their extent. At this stage, the whole community is given an introductory talk on the subject. The purpose of the address is to open people's eyes so that they see the situation in their own work and study community as well as the opportunities for change, thereby inspiring the users to observe their own situation with different kinds of fresh thoughts.

"You do not know how to ask the right questions – if you do not know they exist in the first place." Outside experience is often needed to achieve the right kind of frame of reference and to specify the operational goals. External experts guide the process in the right direction. Developing schools and learning environments resembles a journey. At the start, there are many challenges and resistance to change ahead, but there are also even greater opportunities. Soon, it becomes evident that there is no end of work in sight.

It makes sense to scale the changes in learning environment at one school to other schools, too. In fact, scalability is one of the greatest challenges in developing learning environments. There are no ready-made mechanisms for transferring solutions. In using a development plan, the objective is to create an open process where knowledge increases along the way. The process can start from finding additional information on and an understanding of the issue under the guidance of an expert and studying the best examples and models used elsewhere. Based on these, the change in learning environments is described and drawn up.

Additional information from experts on innovative pedagogy, architecture and technology is collected around the change. Based on this information, the change in the learning environment or the school's operational culture is constructed and projectised according to its own needs and objective. At this stage, it is also worth considering how to spread the change from one school to another and from one learning environment to another, thereby enabling equal learning for the learners.

Pedagogy, architecture and technology as driving forces of change

Making things visible is key in developing learning environments. The central ideas of development can be summed up as developing pedagogy, architecture and technology. The most important element of change is the pedagogical point of view: what kind of activity is planned for the learning environment?

The change should start from learning and teaching, or putting learning solutions into practice. These actions have an immediate effect on the actions of the learners, the work of the teachers and thereby also leadership, in addition to arranging the activities of the whole school and the daily rhythm of life.

The task of the physical environment is to enable the implementation of the desired functions.

This requires the ability to transform from the planning and implementation of spaces, which in turn allows pedagogical solutions to be implemented. The spaces must adapt to many different kinds of activities and students of various ages, including lifelong learning.

Technology offers an opportunity to organise and disseminate teaching effectively, but it supports individual learning paths and learning processes equally well.

Mobile devices, tablets and electronic learning environments change ways of working, freeing students from the traditional methods.

Education is the key to change. Teacher education and in-service training must be arranged so that in addition to the latest pedagogical and technological innovations, the participants receive training in practical, everyday situations and have the opportunity to influence and adapt their own operating environment themselves. Modelling the operating environment and going through the processes in advance offer opportunities to develop the operational culture before practical teaching, working with learners or moving to new spaces.

The users have the last word. The users define the implementation of solutions and the products chosen based on it for implementing their own functions in their best understanding.

In fact, changing the learning environment should start from the users and their training, so that the right starting points can be found from the start for the change in the operational culture or the planning process of the new learning environment. The starting points and basic principles of developing the learning environment have been described in the chapter ***Points of view to learning spaces*** in the book ***Strategic leadership of information society development in schools and the field of education***. The chapter moves to a deeper, more concrete level of implementing the changes by discussing the implementation itself and its different levels.

The book ***Strategic leadership of information society development in schools and the field of education*** can be found as an electronic version online at the following address: http://tinyurl.com/tomut-julkaisu-2012 (in Finnish).

Spaces as enablers of change in the operational culture

Through a participatory planning process, the learning environments and the spaces of an educational institution can be designed to be genuinely collaborative and supportive of social interaction. Instead of a school, the learning environment is a community centre, or a centre of learning for the community. The building must support the needs of the different user groups, and for this reason, the evening and weekend users' needs must also be taken into account in its planning. Social interaction occurs in groups of different sizes and in varying active situations. The spaces and the technology must support learning environments that in turn support interactive and collaborative activity.

When users themselves have the opportunity to influence the design and implementation of a space, they feel a sense of ownership for the space, consider it meaningful and use it effectively. At the same time, the users and different user groups design the functionality and technology of the space by thinking about the final solutions in advance.

Different levels can be observed in designing the spaces of a learning environment and defining their needs. Learning spaces can be roughly divided into four different groups. In these groups, spaces are separated by the degree of publicity – are the spaces public, semi-public or private? Different spaces are used in different ways, include different kinds of technologies and support different kinds of functions. The users of the space want versatile, soft, colourful and functional solutions that adapt and support activity as well as feeding creativity and innovations in learning.

Learning spaces can be divided into four categories:
1. Outdoor areas and the surrounding environment
2. Lobbies and corridors
3. Thematic classrooms
4. Personal spaces

Surrounding environment

The surrounding environment and nature are an integral part of the learning environment. The four walls of the traditional classroom fell down when technology bulldozed its way in. Studying has moved out of the classroom and into the authentic phenomena and problem-solving situations in the surrounding environment on which the learners work with their team. Mobile devices and personal technology support activity in the environment outside. In the surrounding environment and at home, the students can log on the same servers and cloud services as in the learning environment at the community centre, only through more informal learning. The surrounding nature as well as the companies close by are involved in supporting the learning process. The outdoor learning environment formed by the yard plays an important role in supporting the emergence of collaboration and growing into society – in addition to the significant effect the outdoor learning environment has on local exercise and the well-being of the pupils.

Characteristics:

- public space, all actors have free access
- no limits on the opportunities for action
- examples: homes, stores, companies in the area, surrounding nature
- originality of the community and the construction of identity
- informal and non-formal learning
- authentic everyday learning situations

Lobbies

The public spaces of a learning environment act as meeting places of the community. These spaces include lobbies or corridors as well as libraries and cafés. The spaces and their services are open to all age groups and user groups. The lobby must be a clear space that guides people deeper into other learning areas. The entrance and the lobby communicate the originality of the learning environment (brand). Through mobile devices and the learning environments used, lobbies act as a part of the electronic learning environment and provide information to the outside world about the learning solutions used at school.

Characteristics:

- public space, user groups have free access
- opportunities for action can be restricted based on the use
- examples: lobbies, corridors, libraries, cafés
- brand of the community and a business card to the outside world
- lifelong learning, meeting people of different ages
- technology supports communication with the outside and image creation as well as collaborative activity

Thematic classroom

Thematic classrooms are intended for supporting collaborative and interactive learning situations. The space is used efficiently for learning, and it serves research projects crossing borders between subjects. Thematic classrooms are an extension of personal learning spaces, supporting schoolwork with the modifiability of tech-

nology and the spaces themselves. A traditional classroom can become a thematic classroom when its openness is increased and the connections to other learning environments are emphasised. A thematic classroom does not operate only in one direction of teaching, it adapts flexibly based on the needs of learning and the users for study groups of different sizes. The students can adapt the space in thematic classrooms, and they have the necessary teaching materials, source materials and presentation technologies available. Smaller learning lounges or larger auditoriums of different kinds complement the activity in thematic classrooms. A team of several education professionals works in thematic classrooms; there always is a safe adult and a personal space for all kinds of learning available.

Characteristics:

- semi-public space used for teaching and learning
- not every space is the same; spaces are designed in accordance with the activities
- examples: science cells, language teaching, humanities as well as arts and crafts
- supporting learning projects
- investigative, phenomenon-based learning, project learning
- main learning environment, from which divergence into functional spaces occurs as necessary
- technology is present and easily available

Personal space

Personal learning areas and learning bases are spaces that are private in nature, with limited access for outsiders. The spaces are most effective in individual, pair or group work. There are many kinds of private learning spaces, which can be delimited by furniture, curtains, glass walls, partitions or closed structures. Simply using technology such as headphones in an area can form a private, personal learning environment, a space for learning. Personalised technology and learning environments as well as learning assessment environments support personal space. At their best, the technologies and spaces blend in together in connection with personal spaces, forming a functional whole for both contact teaching as well as activity in global networks.



Figure 3. Active classroom

Characteristics:

- private space, with individual, pair and group work at centre stage
- learning bases or private spaces
- examples: individual furniture solutions, demonstration spaces, bases delimited by curtains or glass cubicles
- teamwork, individual or pair work
- interaction and working together
- technology supports working in a group and sharing information

When building new or renovating old learning environments, different kinds of learning spaces can be built in accordance with the needs of the users. When activity in the learning environment or the operational culture of an educational institution is changed, spaces can only be adapted to work better in a limited way, because large spatial or technological improvements are not possible without resources.

The classroom solution that works best is an 'active classroom'. In an active classroom, the students cooperate. Active learning environments are connected to the school's other spaces and personal learning stations naturally. In active classrooms, learning does not happen in only one direction; instead of a board in the front, the activity is directed towards at least two other walls, integrated into group work. The learners are not bound into place to listen, they can act as a part of the learning process. In an active classroom, the learners are not just objects; they are actors affecting their own learning and defining the objectives and benefits, involved in choosing the learning solutions.

Technology as an enabler of change in pedagogical operational culture

Modern collaboration is found in social networks. Online communities, virtual life and the new tools for influencing issues and networking created by social media change the ways we communicate. Technological innovations and pedagogical

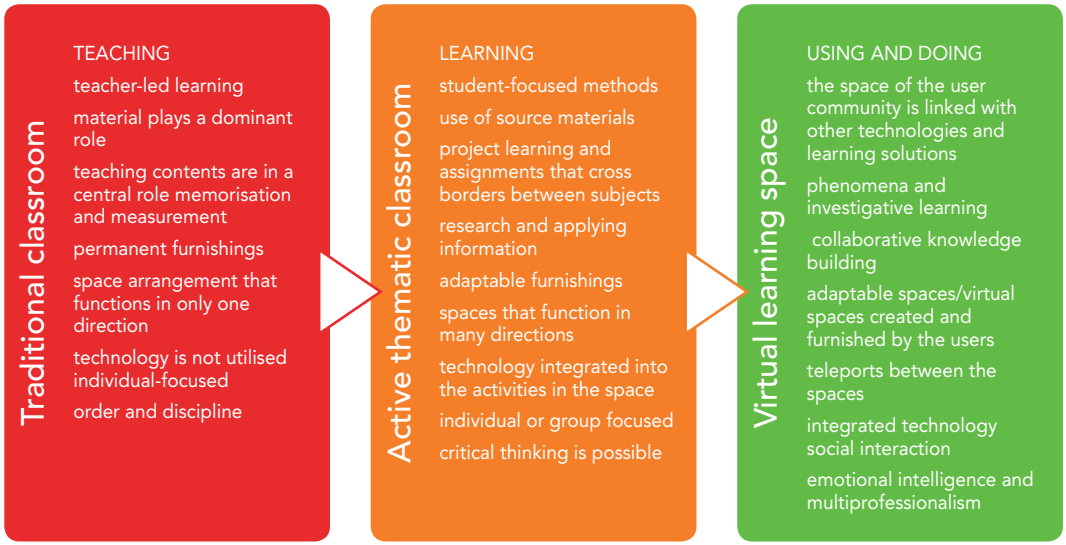

Figure 4. Development of the learning environment and characteristics of different learning spaces.

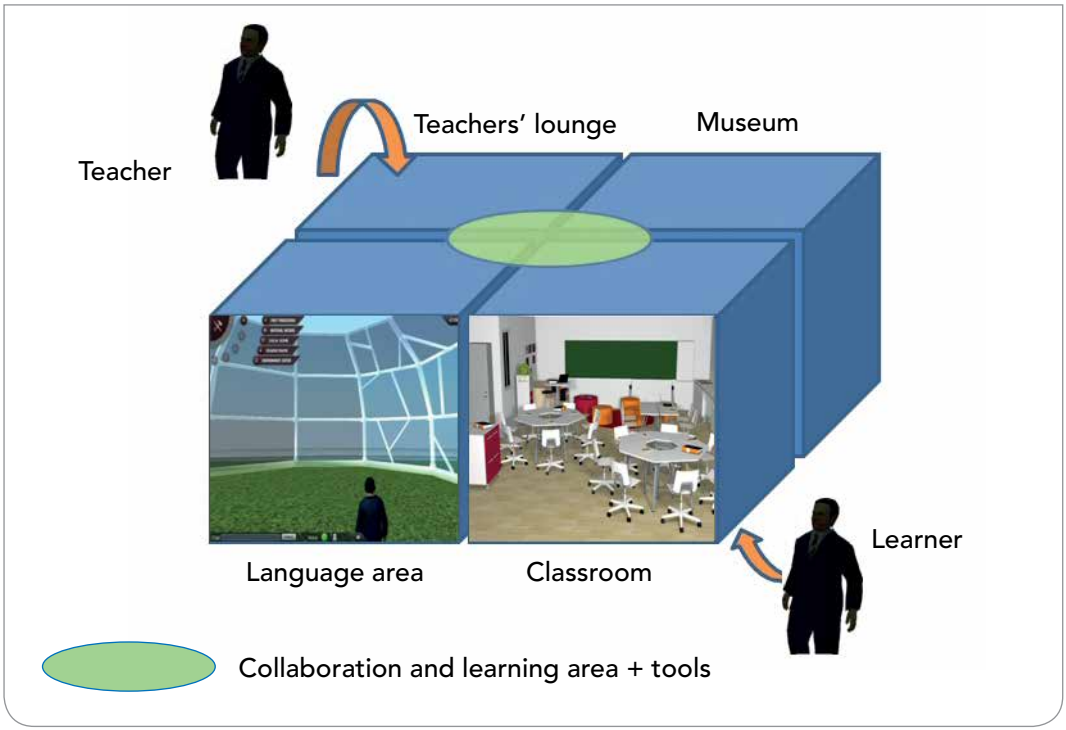

Figure 5. Virtual learning space.

solutions are connected to each other. Developing technology inevitably affects spaces and furnishings, which are concrete and visible factors affecting the ways of learning, teaching and acting in a learning environment. Leadership and in-service training in tandem also need to support a change in the operational culture.

It must be possible to put technological change into practice in the classroom. Traditional teacher-led, textbook-oriented and individual-focused teaching changes into an interactive network of social activity, with the goal of improved learning.

Learning material is transformed into source material, used together with other sources in different environments in order to solve the task to be learned. Internet, e-mail, e-learning solutions, mobile devices, social media, cooperative solutions for school and home, electronic learning material and different kinds of learning envi-

ronments have improved the traditional classroom environment, but they have not offered tools for renewing the activities and the culture of working together.

The future virtual learning environments and playful learning material make change in the technological operational culture possible. The fundamental difference is in the interaction. In a virtual environment, we act through technology in a social interaction situation, which facilitates collaborative methods and real learning situations. In a virtual world, we are represented by an avatar, a personalised image of ourselves. It is important to have opportunities to build, adapt the environment and make learning visible in the virtual world. In practice, we live in a 3D world, which means that the methods used in a virtual learning and education environment are familiar to us from the real world. We can combine the currently used learning solutions and services with them as interfaces.

The future virtual learning environment

The interactive virtual space of the future consists of different kinds of learning areas the users can link together. The virtual spaces support social activity, as do physical spaces. For example, a virtual lobby can be a focal point of the community's activities, like a virtual homepage. Instead of the users setting up a website for the school, they enter the educational institution's space, in which its activities are presented and issues of interest to the users are demonstrated. The lobby has teleports or transitions to more individual thematic classrooms and personal learning spaces, where the learning services and tools that are available take centre stage.

The virtual thematic classrooms support the study of phenomena, such as physical phenomena or models of atoms in teaching science. Learning spaces are also effective spaces for interaction in e.g. language teaching, which emphasises the use of language, sharing and social activity. Thematic classrooms are supported by the personal spaces of the learner or teacher; they can be furnished and equipped to match your personality according to your own needs and preferences. The personal learning portfolio, key content, source material and projects are stored in the personal space. A working group can be invited into the space to work together, or the spaces can be used as environments for assessing learning or giving feedback.

What makes virtual spaces particularly interesting is the opportunity to store personal history by developing the avatar's characteristics, such as sociability, interaction, cooperation or emotional skills.

In the future, when the aim is to develop the operational culture of an educational institution, the use of the spaces and activity can also be modelled by using a virtual environment. In that case, the operational culture of a new school or educational institution, for example, can be developed by means of participatory planning before the actual physical environment is finished. In the best case scenario, the construction of the physical environment can be influenced and some solutions changed by studying them in advance in the virtual environment. Through developing the virtual environment, the user can participate in the learning environment development or construction project. Personal participation in an issue increases commitment to it.

In addition to virtual environments, augmented and mixed realities, AR/MR, offer a solution for developing teaching technology. Augmented reality refers to objects modelled with computer graphics, which can be viewed on different kinds of displays, such as mobile devices. These solutions allow the virtual and real worlds to be combined so that the combination serves teaching and education needs.

One way to make the virtual world visible in the real world is to use a CAVE space. These virtual laboratories are spaces in which the virtual world is included as a part of a physical space and an immersive user experience through various projection solutions. The use of virtual and augmented reality solutions in learning and educational environments increases as people begin to understand their development opportunities and potential.

Change in the operational culture – change in the learning environment

Concrete change in learning environments opens the doors for a change in pedagogy and the collaborative operational culture. Development does not involve only a small group of developer teachers; developing learning environments and learning concerns all teachers. The solutions are created in the learners' best interests. The development must be carried out collaboratively, with an open, transparent discussion culture. A leader cannot change a community alone – everyone's contribution is needed to make a change. On the other hand, employees cannot change the operational culture unless they have the support and guidance of their leaders. In addition to this, all users and user groups must commit to the change, which can only be accomplished through participation. Teachers, students, the leadership, oth-

er staff, parents and other interest groups develop the operational culture of schools and educational institutions together.

Therefore, the keys to changing a school's operational culture are collaboration and social interaction. Everyone must have an opportunity to participate in developing operational culture. Vision, strategy, values, goals and objectives must be commonly acknowledged and shared; people strive towards them together. However, change processes have their challenges: when schools and learning remain unchanged for a long time, educational institutions become calcified into certain safe, inflexible structures. Even if change is considered necessary, it cannot be implemented unless people let go of the old way of working. If they try to maintain both the old and the new method, change becomes difficult or even impossible.

Building a good operational culture requires time, resources and control. Knowledge is needed to support the change process while constructing change. The change starts from defining the current situation and the goal state. In addition to this, information about the future pedagogy, architecture, technology, etc. is needed. All interest groups must be persuaded to participate in making the change and the users must be included in the specification process. Changing the operational culture requires time, letting go of familiar patterns and adopting new thinking. It is good to build a transparent coaching programme as support, in which leadership and teaching at the school are developed. These actions make an impact on learning and at the level of learners.

Change always requires resources, but most of them surely exist already. Often a lot can be done by utilising the annual budget available to schools.

The attention must be on the change, and time and resources need to be liberated from the traditional solutions. The school leadership is tasked with thinking up the right operating models and the opportunities for action in practice.

The school must challenge the learners to learn, but it also needs to raise learners for the work and society of the future. In order to succeed in this mission, the school must live with the times, where homes, the business sector and the rest of the society are, not in the operational culture of the past. Learning arises from real learning situations and the ways of acting the children and young people value and to which they are ready to commit.

10 basic principles of school development

1. *When developing solutions, look 3–5 years to the future*
   Do not focus on the past or the present situation, create your own vision and requirements for teaching in the future and direct the development measures towards this goal.
2. *Learning is an important part of the innovation ecosystem of the whole society*
   Develop a seamless learning path from day care to vocational and higher education. Pilot the solutions to be developed in practical test environments. Network at the local, regional, national and global levels in development.
3. *The school is a community centre, a centre of learning for the community*
   Learning solutions and learning spaces are designed to meet the needs of lifelong learning. When designing schools, attention is also paid to their use in evenings, weekends and the summer, taking the different user groups and their special needs into account.
4. *All spaces are and should be seen first and foremost as learning spaces*
   The future learning does not take place behind closed doors during 45-minute lessons, it expands into the corridors, l obbies and the environment outside. The learning environments must be designed so that the spaces, furnishings and the technology enable multiform learning and adapt to learning needs.
5. *From frontal teaching to collaborative learning and teamwork*
   At its best, the learning environment works in all directions, offering stimuli and working methods on every surface. A change in the spaces and the technology also changes the operational culture, the teachers' and pupils' methods, as well as the use of technology as a part of the learning process.
6. *Technology is at its most efficient when it is a natural part of the space and does not visibly control the activities*
   Technology should be seen as an enabler of and a tool for learning, not as a value in itself. User-friendly user interfaces and ease of use as well as functional solutions and applications produce the best end result.
7. *Developing technology, games and playful applications are a part of future schools and the world of the pupils*
   Homes and the technologies used by students in their free time have developed radically during the last few years, while schools and learning environments have remained unchanged for a very long time.
8. *The architecture of learning environments is developing, and a community centre without corridors is the learning centre of the future*
   School spaces are no longer designed based on traditional classrooms; instead, the future learning spaces must offer opportunities for changeable groups and versatile use of the spaces. Not all classrooms need to be identical; learning environments are designed in accordance with learning needs and user preferences.
9. *Self-development and strategic leadership competence are the keys to changing the operational culture*
   Learning occurs in real, personal learning situations. Learning is growth that occurs in an interaction between the teacher, the pupil and the peer pupils. Development is not only the privilege of a certain group to which it can be isolated, it applies to everyone and works in the best interest of the pupils. Leadership methods must be created for this purpose and resources must be found to change the operational culture.
10. *Learning has a social role*
    Learning occurs between and among people. Spaces and interactive learning environments support interaction and cooperation. Technology-assisted learning and learning environments support learning.



9

Learning environment assessment framework for educational leaders

PASI SILANDER JA ESSI RYYMIN

Developing the learning environment is a part of the operational culture

Learning environment refers to the learning-related whole that consists of the physical environment, psychological factors and social relationships, in which studying and learning occur (Finnish National Board of Education 2004). A pedagogical learning environment consists of the pedagogical methods and practices used in learning and teaching. The task of the learning environment and its different operating environments and equipment is to allow the use of versatile learning and working methods. Learners have many different learning environments in which they act in different ways during the school day and along their learning path. It is important to identify these learning environments and continuously assess them in the pedagogical discussion at school.

The operational culture at schools and educational institutions affects the structures of the learning environment, particularly the pedagogical practices. The operational culture is built on the commonly shared values as well as collaborative activity and practices. The goal is that all practices at school are consistently built to support the achievement of goals set for education and teaching. The operational culture includes all official and unofficial rules and operating and behavioural models at schools or educational institutions, as well as the values, principles and criteria on which the quality of schoolwork is based.

Learners must have the opportunity to participate in creating and developing the operational culture of the school or educational institution. The goal is an open, interactive operational culture that supports cooperation both within the school and together with homes and the rest of the society.

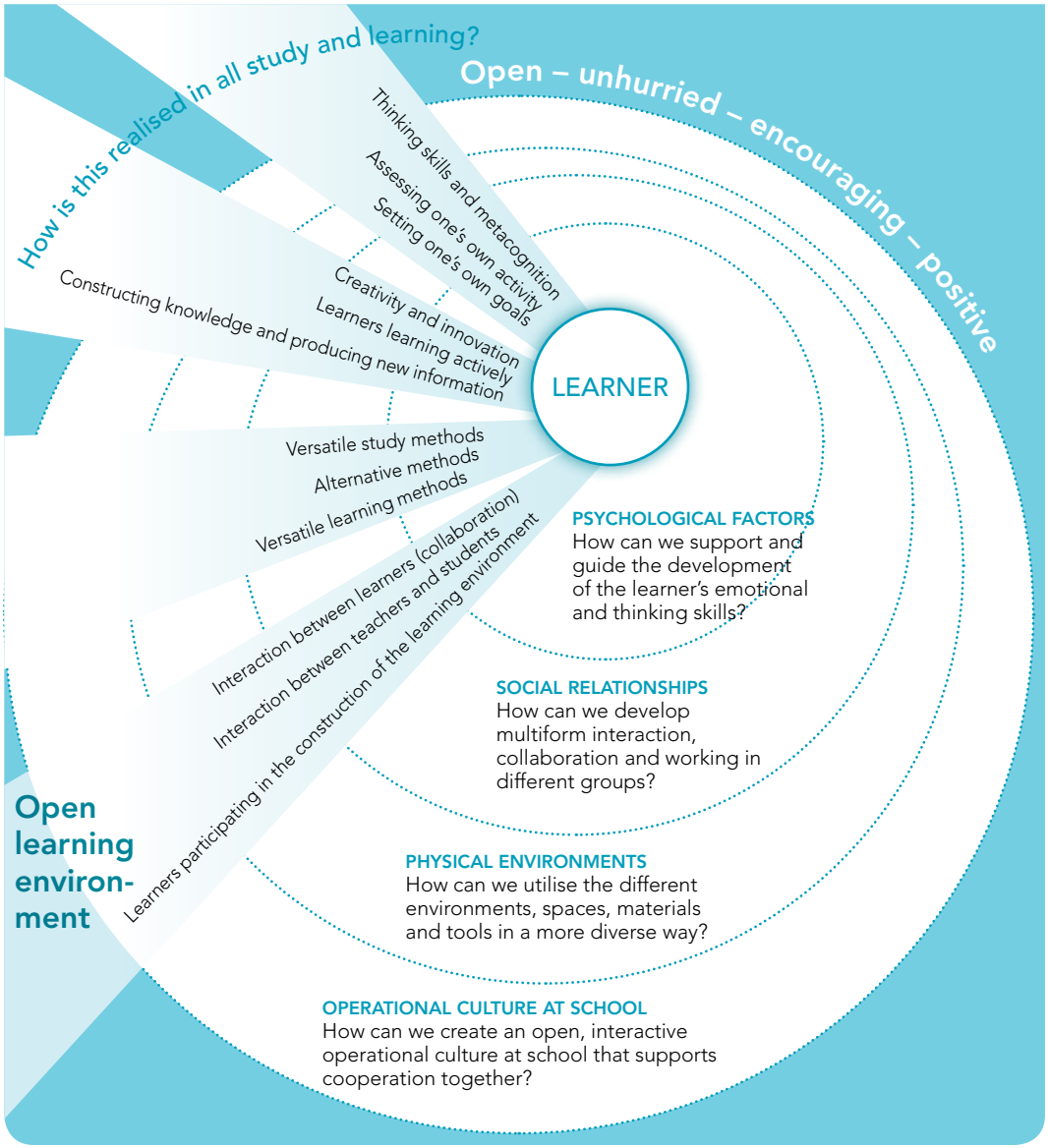

Figure 1. Learning environment and its different elements based on the national core curricula (Orava & Silander 2010).

What is a learning environment?

A learning environment can be defined as a place or a community, in which the learners have different resources available for understanding different things and developing meaningful solutions to various problems (Wilson 1996). A learning environment can be described as a place, space or working practice with the purpose of promoting learning (Manninen & Pesonen 1997). The different elements of a learning environment include, for example, the physical or virtual environment, the learners, teachers, tools and equipment as well as operating models.

A learning environment can be studied from different points of view (Manninen et al. 2007). The physical point of view refers to the spaces and buildings in which learning takes place. The social point of view studies interaction, and the technical one is focused on educational technology. The local point of view emphasises the place and space of learning and its immediate surroundings. The pedagogical-didactic point of view examines how the environment supports learning.

A learning environment can also be described as open or closed. In a closed learning environment, the goals and information are issued from above, the learners respond to predefined questions, and the learning process is predetermined and bound to the context. The activities are based on a collective learning process led from above.

In an open learning environment, on the other hand, the learners can set their own goals, build knowledge collaboratively and create their own content and questions. Open learning environments make different kinds of learning processes possible.

A good learning environment supports the learners' growth, learning and self-direction and gives them an opportunity to set their own goals and assess activities. The equipment in the learning environment supports the pupils' development as members of the modern information society, and it enables the use of computers, other media technology and information networks, promoting the learners' activity, self-direction and creativity.

How does a learning environment facilitate collaborative inquiry learning?

A learning environment that promotes progressive inquiry learning (Hakkarainen et al. 1999), enables physically and socially distributed cognition and offers cognitive tools – thinking aids – to learners. Thinking aids can include, for example, different kinds of concepts, theories, diagrams and drawings, machines, computer software, or forms of activity.

The learning environment supports socially shared cognition by enabling interaction among the learners and peer learning in a learning community, among other things, as well as by supporting different kinds of interaction models and the sharing of expertise.

An environment that supports collaborative and inquiry learning also supports commonly shared representations and their construction, production of conceptual artifacts and reflectivity. A functional learning environment enables phenomenon-based learning and holistic review of the phenomena to be studied, and it supports authenticity of learning.

A learning environment supporting collaborative and inquiry learning is not only restricted to the classroom or the school building, it opens up a whole world both physically and via the Internet.

Learning environment development and assessment tool

The goal of the learning environment development and assessment tool (Table 1) is to support the developer teachers and the leadership of schools and educational institutions in the assessment of learning environments based on pedagogical factors.

The tool can be used to identify pedagogical development needs in the learning environment and to direct development measures to targets important to learning instead of interior decoration elements. The goal of the tool is to make the pedagogical development of the learning environment a goal-oriented, conscious and controlled process.

The collaborative learning environment development process of the educational institution is an excellent learning path for both teachers and the leadership of the educational institution. If the pedagogical concepts related to developing the learning environment are not already familiar, this is also a good opportunity

to update one's own pedagogical competence during the learning environment development process.

The pedagogical assessment and development criteria of the tool are based on constructive and sociocultural learning theories (see for example Vygotsky 1978) as well as conceptually progressive inquiry learning (Hakkarainen et al. 1999) and the theories behind it. The learners are seen as collaborative knowledge builders, operating actively in their learning environment.

The background of the assessment criteria can also be found in the definition of the Finnish national core curricula, in which the learning environment is seen as an environment consisting of physical, psychological and social factors, in which studying and learning occurs (Finnish National Board of Education 2004).

Even though the learning environment assessment and development tool is based on the view of learning presented in the pedagogical model of conceptually collaborative inquiry learning, it is not limited to describing the learning environment of inquiry learning; it mainly describes an open learning environment in accordance with the sociocultural concepts of learning. The characteristics of the learning environment are studied through the following pedagogical criteria:
1) pedagogical usability of the learning environment, 2) interaction models, 3) producing conceptual artifacts and 4) shared representations and their presentation.

What is the pedagogical usability of the learning environment like?

In a high quality learning environment, different kinds of learning process-based pedagogical models can be used. These models include, for example, collaborative and inquiry learning, problem-based learning, dialogical learning, case-based learning, project learning and phenomenon-based learning. The learning environment supports learning as a process and enables the learners to ask their own open questions and study them. The learning environment has elements that guide the learner's motivation, the stages of the learning process and directing the learner's attention. In addition to this, the learning environment provides different kinds of pedagogical tools and methods for the learners. In a highly pedagogically usable learning environment, the learners' own activity and self-direction and the development of the learners' learning skills are highlighted. In fact, the environment emphasises carrying out the learners' higher level cognitive functions, such as goal-setting and versatile learning methods, and their pedagogical support and guidance.

What kind of interaction patterns does the learning environment support?

A high quality learning environment promotes interaction between learners in different configurations, such as small groups and teams, and it creates many different kinds of opportunities for peer interaction between the learners, such as peer feedback and support. The guidance dialogue in the learners' learning process is an essential part of interaction in the learning environment; learning environments should promote and enable the interaction between the teacher and the learner in many different ways.

In a learning environment, interaction can be organised through tools and media, and different kinds of flexible and creative structural solutions for interaction can be created. Such solutions include, for example, debates, meetings, panels, amphitheatres and votes. When developing the learning environment, it is good to think about what kind of different interaction tools and methods it offers for learners and teachers.

How does the learning environment support the learners in creating their own conceptual artifacts?

A good learning environment supports the learners in creating their own conceptual artifacts and offers them different kinds of tools, methods and media to develop conceptual creations. A conceptual artifact (see for example Bereiter 2002) refers to a cognitive creation instead of a concrete material product, such as an object. Conceptual artifacts include, for example, thoughts, ideas, problems, hypotheses, theories, explanations, interpretations or plans. Conceptual artifacts can be criticised, expanded, developed and adapted. Processing conceptual artifacts is the basis for high quality learning and developing the understanding of groups and individuals. Conceptual artifacts act as thinking tools.

A learning environment that promotes learning effectively makes the learner's development of conceptual artifacts intentional (goal-oriented, conscious) and offers tools and support for it. It is good for the developers of learning environments to consider what and what kind of conceptual artifacts are intended to be processed and developed in the learning environment, and what kind of requirements does the development set for the learning environment?

How does the learning environment support shared representations and their presentation?

A representation refers to a mental presentation or description of a thing. Mental representations include, for example, the learners' own understanding of real world phenomena or events. Representations can be verbal or visual.

A verbal representation can be a story about a previous event, for example. A presentation of the schoolyard is one example of a visual representation.

A shared representation refers to representations that are collaboratively produced and created by learners together with other learners. Shared representations and their collaborative reflection and assessment are important for learning and the learning process of individuals and groups.

When planning and developing a learning environment, it is important to consider the ways in which learning environments support the learners' shared representations, their creation and presentation. A learning environment should offer learners and teachers a diverse selection of different kinds of planning and development tools, methods and media for the development, presentation and assessment of shared representations.

Learning environment development and assessment tool for educational leaders

1. What is the pedagogical usability of the learning environment like?

a) How does the learning environment enable learners in terms of asking open questions and studying them?	
b) How does the learning environment support the implementation of different kinds of pedagogical settings?	
c) How/with what elements does the learning environment support the learning process?	
d) How/with what elements does the learning environment guide the learners' motivation, stages of the learning process and the focus of the learner's attention?	
e) How/with what elements does the learning environment make the learners' motivation, stages of the learning process and the focus of attention visible?	
f) Which pedagogical tools and methods does the learning environment provide for the learners?	

2. What kind of interaction patterns does the learning environment support?

a) How does the learning environment support interaction between learners in small groups (teams)?	
b) How does the learning environment support the guidance dialogue in the learning process (interaction between the teacher and the learner)?	
c) How does the learning environment support peer interaction between the learners, such as peer feedback and support?	
d) How does the learning environment support interaction through tools and media?	
e) Does the learning environment enable structural solutions for different kinds of interaction models, such as debates, meetings, panels, amphitheatres, voting? (Which interaction models does the learning environment support, and how?)	
f) Which interaction tools and methods does the learning environment make available to the learners?	

3. How does the learning environment support the learners in creating their own conceptual artifacts?

a) In which ways does the learning environment support learners in creating their own conceptual artifacts?	
b) What kind of tools, methods and media does the learning environment offer for developing conceptual artifacts?	
c) How does the learning environment enable the learners in developing conceptual artifacts intentionally (in a goal-oriented, conscious way)?	
d) What/What kind of conceptual artifacts are processed and developed in the learning environment?	

4. How does the learning environment support shared representations and their presentation?

a) In which ways does the learning environment support the learners' shared representations, their creation and presentation?	
b) What kind of tools, methods and media does the learning environment offer for developing and presenting shared representations and assessing them together?	
c) How does the environment make developing and presenting shared representations intentional (goal-oriented and conscious)?	

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10 Points of view on learning spaces

PASI MATTILA

Spaces characteristic of knowledge work

Doing knowledge work is characteristic of the information society. Instead of hard physical labour, an increasing number of people work with information. Utilising communication technology and working together with a useful network is characteristic of knowledge work. This kind of work requires changes in the working environment and the spaces used. Learning is also typical of the work.

There are no ready-made answers available; information is produced at the same time as it is being researched. When we come across a problem at work, we do not go looking for answers in books, we search for information related to the subject online and ask our colleagues or discuss the problem with them. In the future, more and more problems will be solved directly online in virtual environments and social networks.

The same regularities that prevailed in the classrooms of the industrial society will no longer apply in the future learning and working environments. The furnishings for learning environments are no longer found only in the school catalogues of service providers. Increasingly often, the solutions are found in home-like learning spaces, meeting areas or office furniture.

We are moving from solution-oriented technology, furniture or interior design towards service-oriented design of spaces and furnishings, which is even more focused on the needs of users and activities than before. This makes it very important for the users to have clear needs and plans for directing space planning. The planning is based on the desired activity and a description of the activities desired in the spaces at a given moment – not only the purpose of use they were originally designed for.

Learning spaces become more flexible

Time, place and spaces must be reserved for learning in everyone's immediate surroundings in the future, too. Nothing erases the importance of goal-oriented education, learning and teaching in the growth of individuals and society. The spaces and furnishings become more flexible than before and transform according to the needs and the activities.

Traditionally, decision-makers make the decisions on new learning environments while tying up the resources concerning the new space. After this, the space is constructed through very clear-cut, straightforward architectural and engineering work. Except for at the start of the contract, the voice of the users is not heard. After this, people usually no longer have an opportunity to influence issues. The space is delivered on a turnkey basis, and school starts in the fine, new learning environments in the same way as usual. Can the users ask the right questions at the right time, if they do not even know they exist?

Learning spaces and learning environments are an investment far into the future of the learners. It is worth designing and constructing them carefully whenever possible. Is it worth it to carry out the construction traditionally, as it has always been done before? We know that learning needs, teaching methods and the requirements of learning environments are changing as the information society develops.

The present school building will turn into an adaptable, multi-purpose competence centre that serves the whole community around it better. An attractive solution creates satisfied users and improves well-being, thereby influencing learning results positively. Future schools should be designed as learning environments that cannot be distinguished from the rest of the society either externally or based on their purpose of use.

What kind of a school would you build, if you had the latest research data, pedagogical competence and a developing work community that encourages itself as well as modern teaching technology available? Would your school encourage creative teaching situations, support personal learning, raise future workers for the area and bring students and teachers to work together, and would its spaces be sufficiently adaptable to respond flexibly to different kinds of learning needs? Or would it still be the same school that you went to in your youth, with the same equipment and methods?

Are you ready to question the current school construction, and are you prepared to think about all of the school spaces as learning spaces and design a com-

munity centre that responds to the challenges of the surrounding world and society and future education even better? A learning environment that has been designed and completed together provides the best possible prerequisites for building future skills and knowledge.

Starting points for developing the learning environment

The world has changed, learning has changed, pupils have changed. The school no longer has exclusive rights to learning. In addition to formal learning at school, learning occurs in informal and non-formal situations. Pupils use technology and the tools provided by media to network and find out about things. Homes have been modernised, and domestic interior design has focused on comfort and relaxation together. Workplaces have invested in comfortable and inspiring environments. In contrast, schools have clung to the same basic format for a long time.

Children starting school this year will graduate and begin working life within the next two decades. The technologies or job titles they use may not have been invented yet, but the school should nevertheless be able to rise to the challenge. Space planning, the implementation of learning environments and their furnishing and equipment are important in designing future schools. They are ways of meeting the challenges of future education and competence.

Expanding the concept of a learning environment is a starting point for a new way of thinking. As long as work is teacher-led, textbook-bound, subject-bound and classroom-bound, a traditional classroom is enough. Phenomenon-based learning, inquiry learning, creative problem-solving, collaborative learning or project work crossing boundaries between subjects all require a new kind of approach to spaces and furnishings. When individual learning styles and pupils with special needs are taken into account, factors related to the spaces include, among others, open learning environments, furniture that adapts to the activities, utilisation of ubiquitous computing, mobile technology and adaptable lighting and interior design.

The learning environments in the future school will be more open than before, and they will include a fresh range of different kinds of pedagogical opportunities for action, while also including the traditional ways of teaching and learning. They will offer flexibly adaptable learning environments that are available for the whole surrounding community from morning to night.

The teachers need to be closely listened to, but all users of the space have equal say: pupils, parents, companies in the area and the whole surrounding community. The space must serve all users and offer facilities for both everyday life and special occasions.

In the future, central spaces valuable to the surrounding community will be used more efficiently in diverse ways in the evenings, weekends and during school holidays. Making operations more efficient creates savings, but first and foremost, it produces new kinds of services for the information society.

Personalising learning is particularly important for gifted children and pupils with special needs. The need for special needs education is increasing constantly, setting its own requirements for the spaces. Inclusion and integration pose their own challenges for space planning and demand flexibility from the spaces in order to accommodate different kinds of learners and learning groups. Designing multipurpose spaces makes flexible use of the building possible based on different situations and the needs and requirements of groups of different sizes (such as camp schools and people on holiday).

The world's best school

Finnish school construction has long traditions. Finnish architecture has sparked interest and roused passions around the world and throughout history. Architecture, furnishings and interior design as well as lighting, electrical and audiovisual design are Finnish strengths that guarantee high quality learning and functional, practical learning environments.

We should think about school buildings and the design of learning environments as a part of modern times and future needs, and we should, in particular, consider how to develop them further based first and foremost on learning and the needs of the pupils. What is the best school in the world formed of, and how can we develop its strengths together both now and in the near future?

School of the past and teacher-led classrooms

The school building and learning spaces have long been designed based on the same principles and current regulations. It is nevertheless possible to order, design

and implement a school based on points of view other than instructions and official regulations issued in the 1980s. Yet this is still our prevailing custom. If the school building and learning spaces are designed and implemented based on 1980s principles, will the space meet the learning needs of the 2000s? Is it possible to implement the idea of the school of the future in this space?

Pedagogy, technology and school spaces must support each other. In that case, the operational culture at school can be built into a functional whole with regard to learning, pedagogical teaching methods and the use of time. A properly designed and built learning space supports the learning event, and the requirements of the learning event must correspondingly guide the space planning.

School of the present and space planning

By taking the views of the users into account in the design process, the school building is designed to support collaboration in accordance with the local school principle. The learning environment, teaching and the spaces are constructed so that the teaching occurs in a learning community. This means teaching in age groups or in tutor group cells.

The teachers work in pairs or collaborative teams. A single age group consists of approximately 80–120 pupils. The average school size is approximately 450–600 pupils, but well-designed school centres may be larger.

The learning community and the age groups are located in the same area or close to each other. The autonomous classroom is abandoned, and teaching is carried out as pair or team teaching, where a group of education professionals takes care of the pupils and utilises the spaces maximally based on the needs of learning.

In using the spaces, the age group is divided into two or three smaller groups. The necessary number of teachers and assistants are assigned to the groups. The pupils have traditional tutor group rooms and multi-purpose spaces available; they can be large or small, and they can be easily adapted based on the activity. The spaces are centrally connected to each other. Moving between them is flexible, natural and easy. Moving and adapting the spaces and furniture to suit different purposes needs to be easy.

In addition to the learning environments of the tutor group, the pupils have separate spaces available for subject studies. The teaching of arts and sciences requires its own separate spaces designed for the purpose. The age groups visit these spac-

es as necessary. A functional school library or media centre is at the heart of the school building.

The same spaces are utilised by different administrative branches, which means that day care services, the school, youth and sports services, the library and the folk high school operate in shared spaces. The starting point of designing a current school building is a community centre that serves all inhabitants, a competence centre for the community.

A scenario of school architecture and the school of the future

Learning spaces in the 2000s, community competence centres

A traditional type of school is no longer suitable for the new third generation school system, and therefore old schools are renovated one space at a time. Day care centres, game spaces for young people, media libraries with information search points and sports facilities are constructed in the new community centres in addition to spaces for the surrounding community, in which the inhabitants can meet for lifelong learning together.

The key idea in the design is that all spaces are learning spaces. The more efficient utilisation of spaces and technology and implementation of services are considered in the light of new learning. As a result, the role of the school building changes. It blends in and is designed as a more and more fixed part of the residential area to be constructed, its surrounding community.

Increasing amounts of adaptability are expected of learning. The wishes of the users put pressure on the changing space and technology needs: furnishings, interior design, colour and lighting design and defining technology; in fact, an increasing amount of attention is paid to these issues. The pupils live in a global world, where the need for space reserved for learning, as well as its size, change accordingly.

The learning spaces are virtually linked to each other in a 3D world, which is already utilised in designing the spaces and the game-like learning materials produced. The educational institutions are developing into innovation environments, which form a source of creativity and innovation generation as a part of the construction of the welfare state. In the new learning environments, people learn in meaningful situations without being forced to study.

The starting points of space planning

Space planning is always based on a functional starting point. The teachers and the rest of the staff will not commit to working in an environment, if they do not understand its significance and have not been able to influence its design. The thinking on the future of education must already be included in the learning environment design process by inspiring the staff both before design and during the design process. If the object of design has a particular strategic goal, this is taken into account in designing the learning environments. A new school building is always an opportunity. Investments bring resources, which must be utilised sensibly. The future challenges must be turned into opportunities, and change needs to be found in structural solutions that improve productivity and the quality of operations.

Taking the life cycle approach into account during the design and construction phase is important. When we consider the whole life cycle of the building and its service life with regard to the costs incurred over a period of forty years, construction costs account for one per cent of the costs, maintenance costs account for ten per cent and the rest consists of other costs, most of which involve personnel costs. Participatory design during the construction phase and satisfied users are the key to developing learning environments successfully.

Compromising on the solutions at the construction stage may affect well-being at work, study comfort and learning results negatively. Can we afford this, or should we try to find solutions during the construction design phase for well-being at school, collaboration and a change in the operational culture?

Future school construction will not necessarily increase costs; instead, the thinking is directed to the functional and pedagogical development of learning environments – something unfamiliar in traditional school construction. Development enables the creation of new kinds of collaborative services regardless of the borders between administrative branches, according to the life situation of the child and families with children.

In constructing future schools, attention is paid to the functioning of learning environments, the formation of a learning community, the study of the functioning of spaces and their shared use, furnishings, interior design and audiovisual design as well as utilising teaching and educational technology. These issues affect the construction of teamwork and the operational culture at school. Creating a relaxed, comfortable learning environment influences comfort at school, well-being at work and learning motivation positively.

Investing in the design of learning environments is a long-term investment in the future of children. For this reason, design must not be carried out in a certain way simply because it has always been done that way. Often, it is also appropriate to ask the users and study how the children function.

Joint design by pedagogues, architects and other participants in the design is important for the success of the whole. This is an essential change compared to the traditional model, in which the spaces are finalised based on ready-made patterns and released ready for school use. A prerequisite for success is that the creators have a common vision and goal, based on which creative solutions are designed and spaces are drawn up for the individual needs of the area and the users.

Furnishing schools

Proper design of individual spaces is crucial in changing the learning environment. The change from a traditional classroom into a future learning environment happens through defining the furnishings, interior design, lighting and technology. Furnishings and technology play a particularly important role, because new ways of working and acting require different kinds of learning and working environments to function.

Learning environments should be designed based on different starting points from the ones that have been used until now, which means redefining the furnishings, interior design and technology of each learning space based on the users' needs. In that case, the spaces of an educational institution form a functioning whole – with the particular idea that all spaces are learning spaces, and not all spaces need to come from the same mould.

Learning is fundamentally social in nature, based on the meeting of the teacher and the pupil or meeting other learners. Schoolwork and learning occur increasingly often in situations involving group or team interaction or as individual or pair work, not only in fixed class groups. The spaces needed for future learning differ from the standard classrooms.

The renovated spaces are soft, colourful and pleasant meeting spaces. They form learning areas, in which learning new things is pleasant and motivating. Not all spaces need, or even should, be the same; instead, different kinds of spaces should exist for a larger group of students to support changing learning situations. In addition to the furnishings in the classrooms, the spaces outside classrooms, cor-

ridors and lobbies also create important learning areas, as do various thematic classrooms. Furnishing them often provides an opportunity to think up more innovative solutions.

The furnishings in future learning environments will support interaction. Rote memorisation and completing exams alone have been replaced by the skill of finding out things, discussing issues and creating useful learning networks. Individuality is also experienced in a different way compared to before. Courage, personality and creative curiosity are important characteristics that everyone develops in themselves.

How do interaction and individuality show through in the current learning environment? How is well-being or collaboration supported in the schools of today? The learning environment and the furnishings must support the construction of the skills sought by future learning. Experiences from developed learning environments show that the physical learning environment greatly influences the pupils' motivation and well-being and with it, their learning results and ways of learning. The same influences are also reflected in the teachers' opinions and feedback.

Modern learning environments are not necessarily any more expensive than the old ones, but their importance in the development of pedagogy and technology is great. A single educational institution may not be able to afford to renovate the whole school all at once, but it is often possible to separate resources from the annual budget for the long-term development of learning environments in one or two spaces, or even just one space at a time. Nonetheless, with this method the school will have been renovated surprisingly quickly over the years.

What changes in the learning environment?

We are used to school buildings that consist of classrooms, to which we are led by teachers to study for 45-minute lessons. The same pattern is repeated over and over again, every weekday. Learning means attending lessons for nine to twelve years. However, the model does not serve future learning in the best way possible; instead, people are moving away from the autonomous classroom and towards a learning community. In that case, a class of pupils consists of several groups of pupils led by the same number of adults as before. They design the learning practices and the spaces used together. All pupils have their own safe places and a skilled professional adult present in the learning environment, just like always.

Instead of one single space, however, the larger groups can utilise several learning environments designed for them, which can be easily adapted according to the current activity. In addition to this, the community centre and the building itself or the schools nearby include special spaces utilised in project studies or subject units.

The learning environments are designed in variable shapes. Instead of four walls, a learning space may have five walls or adaptable opening wall elements. Openness and transparency create a sense of solidarity. In addition to traditional lecture halls, spaces are needed for project work, team learning or individual work. The learning spaces are naturally linked as a part of corridors and lobbies, which also changes the role of these spaces.

The best designed learning environment is a space without corridors or wasted areas; instead, all spaces are learning spaces, designed and constructed on the terms of learning. This means that most of the daily activities take place in a larger project work area, where professional tutors are always available. Naturally, learning spaces designed in different ways also serve pupils with special needs better, because differentiating between more challenged or gifted children can be accomplished there more flexibly than now.

The future learning spaces are not only in use during school hours, they can be used for lifelong learning regardless of the hour. In addition to the schooling of children and young people, they also serve afternoon clubs and hobby groups, for example. Adults can utilise the spaces for activities such as studying, clubs and collaborative activities, and as cultural or sports spaces. The spaces are developed into 'houses of experiences' for the whole community, which support marvelling at things and learning about new phenomena.

The starting point in designing the space does not only involve the activities of a class or one half of a class. The group size has been 25 pupils on average, with 12 pupils in one half of a group. The future spaces will function well with groups of this size, too. In addition to such thematic classrooms, spaces of different sizes are needed for different learning situations. Above all, the importance of spaces for the needs of groups of different sizes is increasing.

The most important learning situations occur in team and group situations, where the group size is 3–5 or 5–8 pupils. They carry out a shared task, which means that the spaces and the technology must serve the goals of learning and problem solving. Learning also happens in smaller units, meaning individual, pair and group discussions.

Individual and pair work supported by technology becomes more widespread when moving to personalised teaching. The space must offer opportunities for

working and exchanging ideas in peace. Spaces of different shapes and sizes are suitable for different kinds of learning needs. The number of adults increases based on the nature of the activity.

The activity taking place in the space should guide the space planning. The spaces are concrete, and it is easy to control one's own activities based on them. As the traditional spaces limit learning methods, the future space arrangements and technology will allow even more flexible ways of acting than before. Softness is taken into account in interior design and colours are used boldly, which inspires people to learn new things.

Interior design can also be designed to change according to the theme and the subject. Soft, comfortable furniture and lighting suitable for the mood tune all senses to learning and influence the learning experience positively. When working in groups of varying sizes and spaces of different shapes and by utilising technology, the traditional lighting arranged in three rows is not necessary; in addition to general lighting, the lighting should be adaptable, adjustable as needed and it should include spotlights. The technology brings its own sources of light, which reduces the amount of light needed, but emphasises its adjustability. Natural light outside has been found to influence the state of awareness positively, making learning more effective. The amount of light can also be adjusted automatically, which allows it to follow the circadian rhythm of natural light and the learners. In this way, the lighting can be maintained at a level suitable for the learning situation.

Future learning spaces

Future learning spaces will be designed to support creativity and innovation. The activity defines the terms and the spaces provide the opportunity. It does not erase the desire to create spaces that are as comfortable, relaxed and impressive as possible, with technology playing a large role, in addition to furnishings. User-oriented design also plays an important role in designing the spaces.

In addition to architecture, the specification and placement of the technology must be taken into account in design. Above all, the focal points and originality of the educational institution influence learning environment design and bring their own contribution to it. The spaces and furniture can be purchased ready for use based on existing examples or catalogues, or they can be designed and tailored according to the users' needs on site.

No matter what their final form is, they have a concrete, visible role in shaping the operational culture and an impact on well-being and collaboration. Examples of future space solutions include constructing spaces functioning as bases, floors with integrated technology, meeting furniture, furniture solutions designed for users, media walls or other media elements, as well as game-like learning environments. They enable teaching that crosses subject boundaries, inquiry or phenomenon-based learning, project work, or collaborative work, which all change and challenge the traditional pedagogical working models.

Recommended future space arrangements

The following presents some examples of learning solutions that will be used in the learning environments of the future information society (Table 1). In what kind of spaces and learning environments will the future learning take place? How should learning environments be designed, and which aspects will the spatial arrangements affect?

Table 1. Learning spaces and solutions in the information society.

	
1. Culture of learning and teaching • Learning plays a social role; learning means encountering other people and thoughts. • Learning spaces need to support collaboration and working together. • Teacher-focused, 'front-led' classrooms are abandoned for student-focused methods and learning areas, in which the basic activities take place.	





2. Strategic leadership

- The leader of the building is the managing director of the community centre, guiding the cooperation and the budget as well as the teaching and the operational culture.
- The leader is responsible for competence management, in-service training, the course offerings and leadership training.
- Leadership increasingly involves a global exchange of thoughts and information.





3. Thematic classrooms

- Thematic classrooms change the role of a traditional classroom into a place for studying that is more open than before.
- They enable flexible pedagogical models and integrating technology as a part of the activities.
- Thematic classrooms supported by other spaces are a practical place for implementing projects that cross borders between subjects.
- The furnishing of a thematic classroom changes so that the desks are not arranged in lines and rows, and the activities take place in groups of variable sizes while the teacher acts as the tutor for the groups.





4. Corridors and learning bases

- All spaces should be seen as learning spaces.
- Pedagogy is developed in such a way that the different spaces can be put to maximal use.
- Learning bases are intended for teamwork or individual and pair work in contact or distance teaching groups.





5. Lobbies as a competence space for the community

- The entrance lobby should be seen as a learning space.
- The lobby acts as a meeting place for the community.
- Technology, the focus areas of the building and the works of students are presented in the lobby.
- The lobby needs to offer learning environments for all of the community's inhabitants of different ages.





6. Outside learning environment

- The space outside supports well-being and promotes a healthy lifestyle.
- Lifelong learning and use by the community are the strengths of a local exercise environment.
- They increase the attractiveness of the residential area, and technology can be integrated into them.





7. Media space, school library in the information society

- Media literacy and the ability to evaluate media critically will be the keys to literacy in the future.
- The spaces need to support investigative methods, observation of phenomena and doing project work.
- Electronic learning material, simulations and 3D game-like learning environments are an integral part of the media world of educational institutions.

Images: Pasi Mattila
Images 1b, 3b, 4b: Archeus Oy. Timo Korhonen

Results of developing the physical learning environment and a summary

Making the school building important to the whole surrounding community ensures that people will invest in its condition, functioning and development. Designing and building learning environments, specifying the furnishing and interior design solutions and developing the operational culture at school towards collaboration and community centre thinking are centrally linked to the development of future learning solutions.

Learning environments refer to both the traditional physical as well as the virtual electronic learning spaces. The evolution of traditional school and classroom environments into future learning environments occurs via proven operating models and by outlining new examples that the users and actors can influence significantly. Concrete examples of the solutions can be found at pilot sites as well as both old and new schools.

When moving from one system or method to another, it is important to get research results on their effectiveness. When we talk about learning, it does not only concern a group of developer teachers or experts in a certain field, such as technology; it concerns all teachers. It is important to anticipate changes through future working situations and competence needs.

More research results from cooperation between the public, research and private sectors are continuously needed so that the decisions that have been made work as desired and produce the desired results. The results are both qualitative and quantitative. When more effective operation in the space results in savings or the operating environment can be utilised in more versatile ways than before, we are making strides. The most important result is nevertheless the increase of well-being and collaboration in the renewed learning environments.

11 New educational technology

PASI MATTILA

Social change

In the information society, the culture of working has changed completely in a very short period of time. People have moved away from paper-pushing to paperless offices and using information technology. Today, a large number of adults use information technology in their daily work. Without technology, completing many work tasks would not be possible. Almost every one of us carries a laptop or a phone all the time when working, studying or during our leisure time.

Adaptation of the operational culture has not been instantaneous. It has taken time and met resistance to change. Nevertheless, it has inevitably progressed and taken place (see Figure 1). Society and its members have a tendency to develop themselves and the operational culture around them. However, a new way of working usually takes more resources in the beginning, because people try to do things both the old and the new way. The benefits only appear after they can let go of the old way of operating and accept the new way, a new operational culture.

Change in the electronic operational culture and equipment

The use of e-learning environments in teaching has become more common, but until now they have mainly consisted of storage places for information, applications for completing textbook assignments or simple exercises, or chat environments. Interaction has been one-sided, considering learning specifically involves interaction supported by the learning material or the environment used.

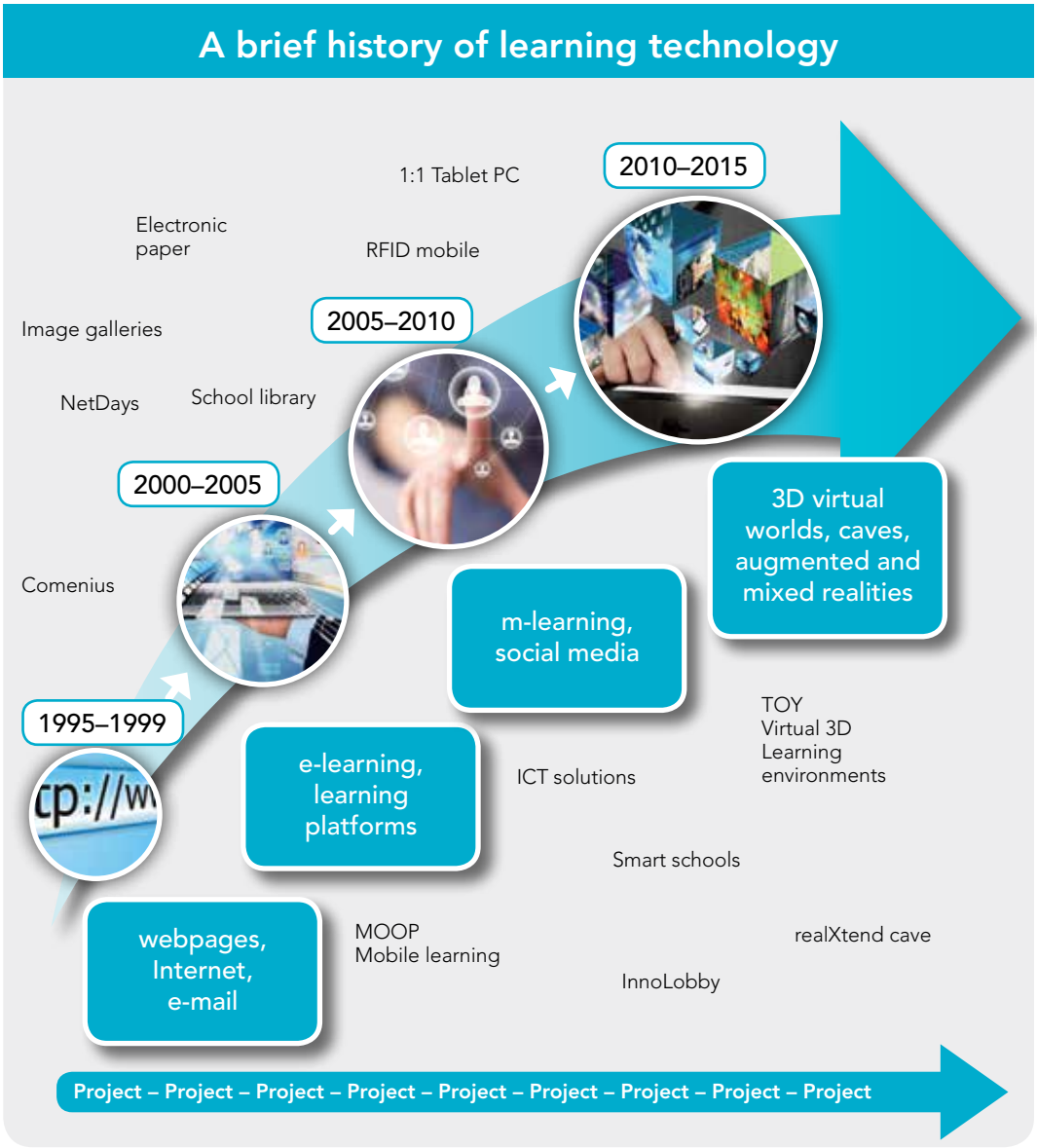


Figure 1. A brief history of learning technology.

Each commercial or open source e-learning environment has been developed with its own technology, and users have not been able to move between the services they offer. People are moving from closed e-learning environments towards open learning platform solutions, where the users can link to materials they have produced themselves. In the best case scenario, they enable the use of social media applications as a part of the learning project.

Electronic learning content has been created for different subjects. Mathematics, languages and music are examples of subjects in which ready-made software can be utilised. There are learning materials and learning environments available, but they have not yet become a practical part of everyday schoolwork everywhere. Electronic learning material is ready for extensive production and circulation, but its progress is hindered by many factors, such as copyright issues, revenue generation models, media criticism and learning material production as well as the traditional methods used at schools.

Playfulness and gamification play an increasingly important role in learning. Through games and play, children start learning at a younger and younger age. Studies have shown that gamification and learning have positive connections with language learning, for example, which definitely increases the popularity of learning games among the users. The external learning environment plays an important role in both learning and the use of technology in schoolwork and as a part of the surrounding community.

New initiatives in technology

Technology makes it possible to move forward on the arc of development. Virtual 3D operating environments can be combined with the best features of e-learning environments, web conferencing systems and electronic learning material. Open source realXtend technology is the next generation of virtual environments. The future learning environment TOY (Tulevaisuuden OppimisYmpäristö) has been constructed on top of it as a service and content visible to the user.

The environment is a unique service built based on learning needs, and it is one of the technologically leading open source 3D worlds (see Figures 2 and 3). In creating a virtual learning environment, current pedagogical competence and key experiences gained during the change in the traditional environments have been combined into a virtual world that is not limited to the traditional operating models. The learning space that has been created makes it possible to develop national

teaching and education to a new level. In this case, teaching and education are no longer discussed as extremes; they are seen instead as ways of highlighting learning opportunities in cooperation better than at the moment.

While in a traditional school, most of the time involves teaching with very little left for other activities, in the school of the future working is learning, and it can be accomplished by diverse methods. This refers to simulations, game-like learning situations, exercises and project work, for example. The virtual environment that has been created is designed to support phenomenon-based investigative learning and cooperation crossing the borders between subjects – simultaneously enabling personal learning and interaction, in which the pupil is an active worker and the teacher is a learning resource.

Characteristics of a learning environment and developing them

Currently virtual worlds are under heavy development, and only the tip of the iceberg of their potential is visible. The future learning environments are designed for investigative study of phenomena and game-like processing of information. Imagine yourself as a teacher in the middle of a classroom, wishing that you could change the learning environment simply by clicking your fingers in order to better demonstrate the issue to be learned.

In a virtual environment, this is already possible. Thanks to saving and loading, the learning situation can be changed very quickly from a rainforest into a desert and further into the pyramids of Egypt or space, for example. A virtual learning environment supports formal teaching, but it also enables informal and non-formal ways of learning. The friends you meet in a traditional learning environment live a bicycle ride away from school. In a virtual environment, you can meet these same friends during or after school hours, but if you want, you can also learn with peer learners from anywhere in the world. Local learning is still at the centre even with virtual environments, but if we want, they can easily become global like the world of children and young people today.

At the moment, the most widely known virtual world is Second Life. Until now, it has only been open to legal adults, but in the future, suitable parts of it will be opened to younger people, too. What kind of features do people then want in a virtual world? Such a virtual learning environment should have equipment for drawing

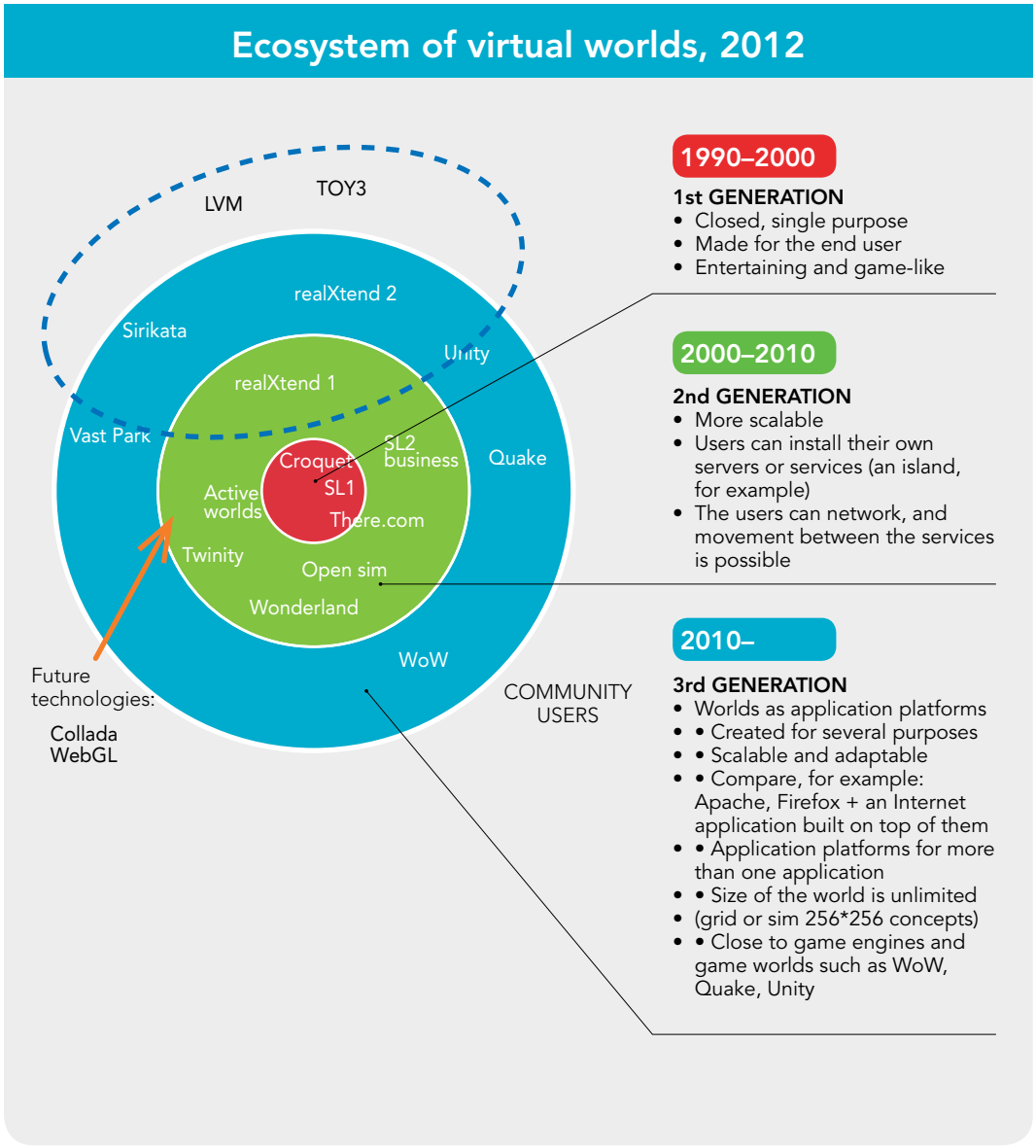


Figure 2. Leading virtual worlds and their development.

or writing things together, another level or space for learning, a natural voice connection, and the option of operating under one's own identity as well as a possibility to save and load the information being processed.

The TOY environment includes these operating environment features desired by the users. In the next stage of development, the usability of the environment is improved, and special features that make learning and working with information easier are created there. Services required by special groups can also be provided in the environment. In the end, the users themselves define what kind of an environment they want.

Criteria of a good learning environment

A common standard and the mobility between different worlds it enables will be the strength of virtual worlds based on open source code. Worlds built using the same tools can be linked to each other, and the services and content built for them are available to all users. In the future, different countries, ministries or organisations, actors working for the same issue and groups based on interests or hobbies can build a virtual environment to support their activities, linking them to the future 3D Internet content. The TOY environment is designed to support basic education, but its use and possibilities for use are not limited to that.

Similarly, the environment acts as a work environment for higher educational institutions; a work, leadership and educational environment for companies; or a service environment for specific user groups, such as groups of people with disabilities, tailored to the purpose.

The purpose of a good learning environment, whether traditional or virtual, is to increase meaningfulness and motivation with regard to the issue to be studied and offer an easy-to-use environment for working with information, making learning more efficient. The learners are at the centre of the environment, and the other resources support their learning needs. The virtual world's strength is that it is not limited by the operating models or laws of the real world or their description. The same change that has been implemented in a virtual three-dimensional game-like learning environment also functions in the real world.

In the future, the possibilities of such an environment can be utilised better in modelling traditional learning environments and physical school buildings and designing new environments. Through cave-type spaces and solutions, the users can see opportunities in the real world through the virtual world and participate

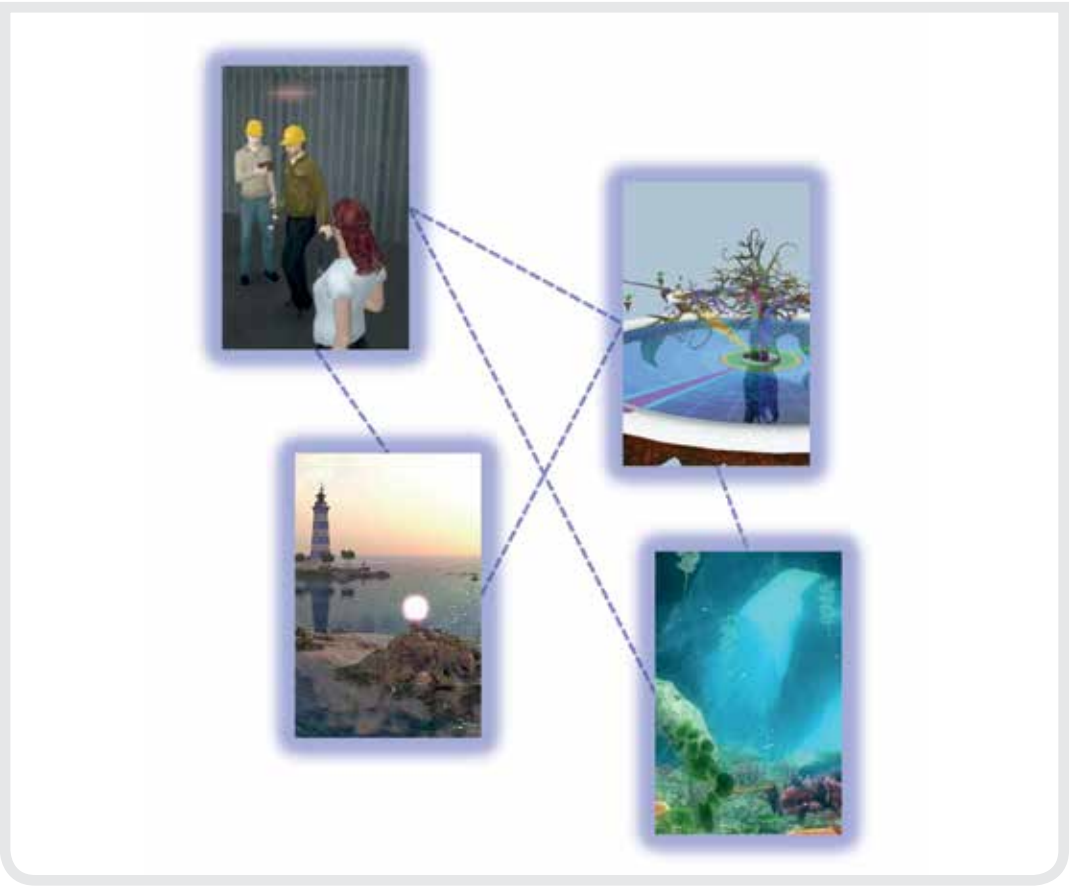


Figure 3. Views of the realXtend 3D environment (www.realXtend.org).

in the development of their own environment. A cave is a physical space in which the virtual world has been projected on the walls. When increasingly more detailed modelled images of the working environments are created, the characteristics of the models are also transferred to be a part of the learning environments.

The Latino Virtual Museum (LVM) produced using realXtend Tundra technology is an example of the use of a virtual learning environment for learning purposes. The environment is a modelled island, where the users can learn about animals (deer,

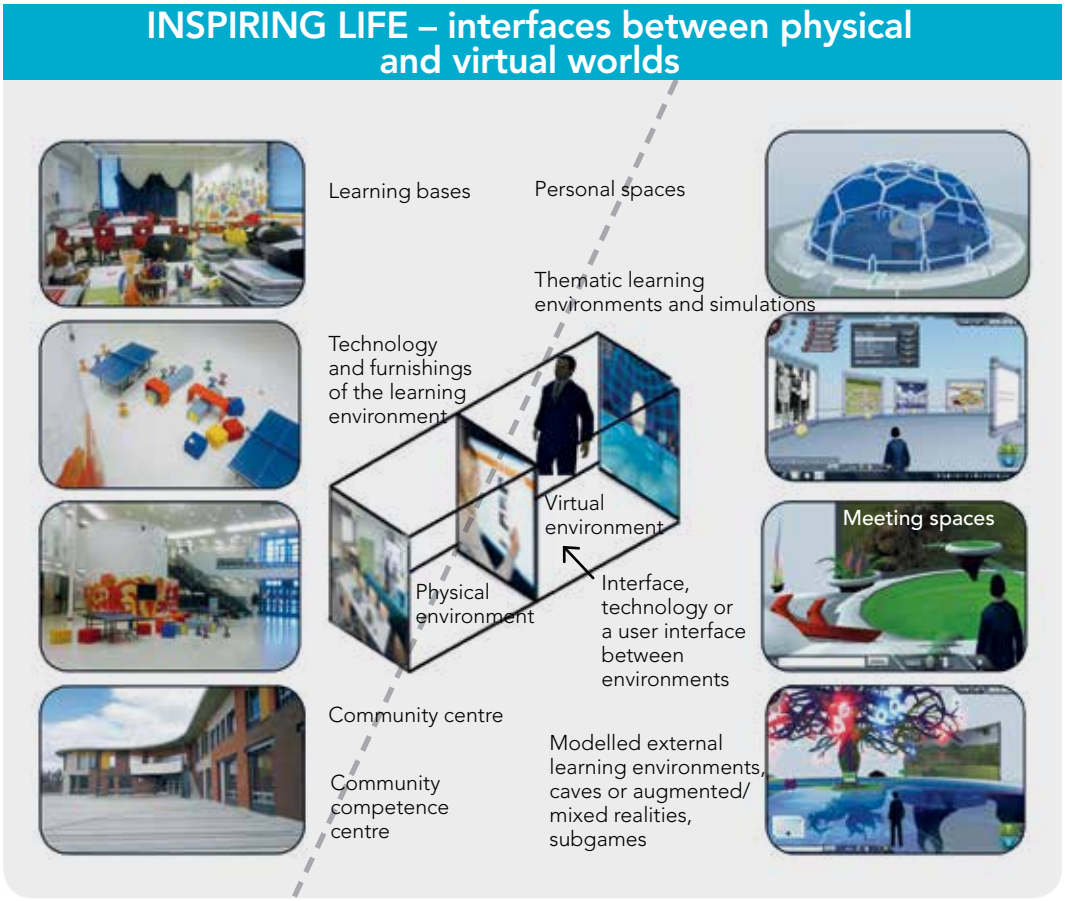


Figure 4. Combining physical and virtual learning spaces.

birds, fish) in their real habitat. In addition to this, the users can connect to a subgame where they can observe the ecosystem as a bird or a fish through an avatar.

The real world and the virtual world approach each other via augmented and mixed reality applications. Bringing modelled objects and interfaces into the real world and connecting to the virtual world through them changes our use of learning processes and revitalises them (see Figures 4 and 5). In the future, we will be able to guide the course of events in the real world through the virtual world. The



Figure 5. Worlds of learning in the realXtend virtual environment.

virtual world includes our previous electronic tools, which become the electronic connection of the next generation to information and learning. It is difficult to predict what kind of terminal devices we will use to process information, but we are clearly moving towards mobile devices and interactive displays.

The strength and the future of virtual worlds lie above all in social spaces, where functionality and gamification are centre stage. People meet in these spaces, whether traditional or virtual. Through these meetings, they learn new things and create networks.



12 Physical and virtual learning environments of the future

PASI MATTILA

Personal Learning Environment, PLE

The idea of a personal learning environment is not realised in current schools because the prevailing teaching practices or the use of technology do not support this view. In contrast, in the school of the future and the personal learning environment, the ways of learning and teaching, technology use and spaces are moving towards a solution where the learners define their own needs and, based on those needs, the learning solutions used.

A personal learning environment combines learning networks, tools and services the learners can use to control their learning and set learning goals. Traditionally, the use of information and communications technology in teaching has been very controlled and based on systems delivered by information technology. A personal learning environment turns the situation upside down, being based on the systems, technologies and applications used by the learners that promote individual and group learning in the situation at hand.

A personal learning environment is usually defined as a technical solution or tool, or a view on utilising technology in learning. The latter definition includes both the technology and the tools and applications used in teaching. Such a view on personal learning environments is nevertheless still narrow and technological. In a real personal learning environment, automatic data processing, the use of information and communications technology (ICT) in teaching and personal learning environments (PLE) are combined in a student-oriented way into a combination of the prevailing pedagogical, architectural and technological points of view, or a space to learn. It includes student, team and group oriented ways of learning and learning environments, as well as technology that supports collaboration and interaction.

A personal learning environment provides learners with the opportunity to control and construct their own learning spaces. A personal learning environment supports students in a) setting their own learning goals, with the supervision and support of the teacher, and b) implementing the learning goals with regard to both the content and the process as well as c) enabling their own learning and communication of the learning process together with other learners, experts and teachers.

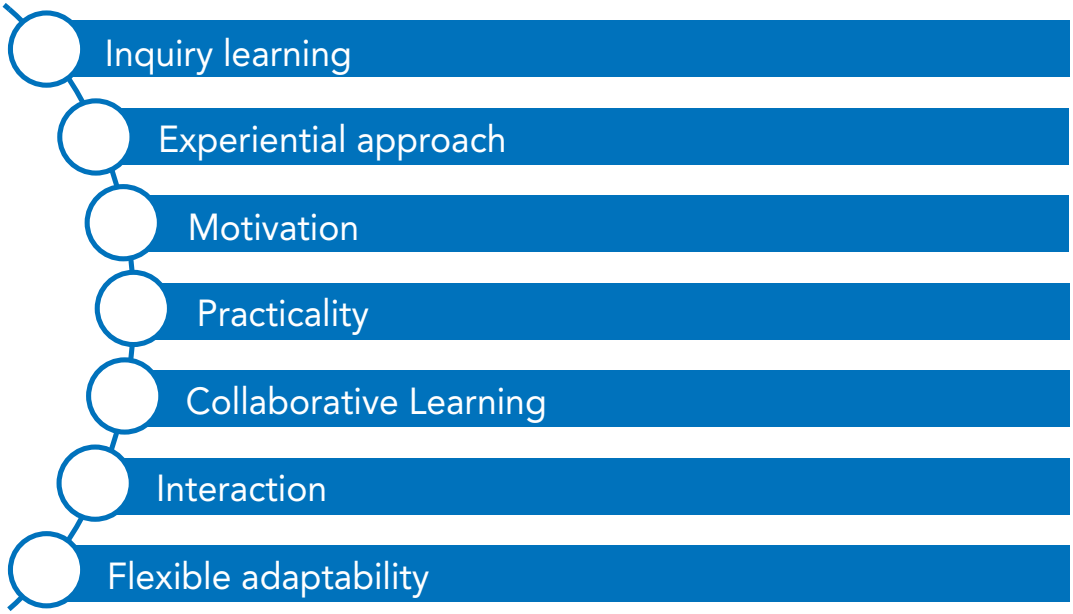
Personal learning environments and the solutions they bring motivate students and give them an opportunity to control their own work and learning. Through a personal learning environment, teachers can ensure that the students commit to planning the learning process, which leads to a less teacher-oriented approach. Personal learning environments, the process and the technology used make it possible to design and implement the future learning environment. In addition to these, personal learning environments can be used to support learning and projects that cross the boundaries between the subjects taught, such as language teaching and STEM as well as science themes, and to implement interactive learning and meeting spaces. Personal learning environments also support individual and different kinds of learning and student needs.

Learning is a social process. From the point of view of socially interactive learning, innovative physical learning environments, mixed and augmented realities and virtual learning environments offer tools for communication and interaction. At their best, virtual learning environments offer environments for multi-user social interaction that removes the dependence on time and place. The benefits of virtual learning environments include 1) combining learning environments and tools, or modelling historical or future learning situations and the related learning tools, 2) utilising simulations in the learning event, as well as 3) social interaction environments in language teaching situations, for example.

Opportunities offered by virtual 3D learning and educational environments in teaching

Virtual 3D learning and educational environments develop increasingly rapidly, and educators around the world have discovered their potential in supporting learning. In fact, teaching is considered one of the most important uses of 3D technology, because it offers endless possibilities for revitalising teaching, motivating students, and using new ways of learning. Inquiry and phenomenon-based teaching can be

implemented in different kinds of authentic learning situations in virtual 3D environments. Game-like content further diversifies the ways of using 3D environments.



Realistic interaction and collaborative learning at their best

3D learning environments create completely new possibilities for virtual communication and interaction. In virtual 3D environments, interaction occurs via avatars that represent the users; these avatars often resemble the users physically, but they may also be more imaginative characters. Acting via avatars increases the users' sense of presence. People around the world are brought into the same virtual space via avatars to communicate and work together. Learning can be very social and interactive, since activity in the same space makes the interaction feel almost real.

Virtual learning environments enable the use of collaborative learning methods. They can be used to implement interactive learning methods that have already been

proven elsewhere, even when the users are in physically separate spaces. Using 3D technology enriches distance teaching and offers opportunities for students from different countries to meet.

New adventures with virtual avatars

In 3D learning environments, users can customise their avatars to look exactly how they want. This makes it possible to try out different roles, such as gender or nationality. In addition to roles, simulations and role playing games can also be arranged in environments that suit different themes. In simulations located in virtual 3D learning environments, it is possible to implement inquiry and practical learning even in situations that would be difficult, dangerous or even impossible in physical spaces – which is one of the greatest strengths of using 3D environments in teaching.

Starting from the students' own needs

Inquiry learning in a virtual 3D learning environment places students at the centre of their own learning by ensuring their participation in the learning experience. The students can learn about complex issues from practical starting points and become accustomed to taking responsibility for their own learning. Decision-making in different situations can be practised in the virtual 3D learning environments, because there it is possible to encounter even surprising situations, to which the students need to be able to react at that exact moment instead of putting off learning until later.

In addition to this, 3D learning environments can be easily adapted to take the students' different needs and preferences into account. It is easier to personalise learning environments virtually than physically. In fact, this creates many opportunities to develop the Personal Learning Environments (PLE) that are considered very topical.

Today, most children already have a lot of experience in information and communications technology through playing virtual games, for example. Many children find playing games enjoyable and motivating, and it would be good to consider how similar learning could be supported at schools by utilising the students' skills. Acting in virtual 3D learning environments increases enthusiasm for learning, thanks to practical learning methods, collaborative learning and individual adaptability, for example. It is important to take the children into account by updating the teaching methods

used at schools, so that they motivate the children to learn and to feel that they are learning useful things.



Figure 1. Diverse possibilities for using 3D environments

Fire safety training in a 3D learning environment

Virtual learning and educational environments can be used in diverse ways to develop various practical skills. A virtual model created based on a real building offers students, teachers and the staff authentic opportunities to practise exiting the area with the help of a fire safety simulation. Learning the escape routes in a new building is challenging, and a virtual environment offers more opportunities to practice escaping and support for the physical fire drills. In the event of a fire, there are usually only a few minutes to leave the building, which is why it is important to practise exiting from different sides of the building.

In the example concerning a 3D fire safety training simulation, the students and the staff can practise exiting in a safe environment without real risks. The users must act in the same way as in a real situation and exit the building safely in time in order to pass the training.



Figure 2. Escape in progress in a fire safety simulation

In a virtual environment, it is possible to learn fire safety-related things in different ways. To begin with, users are advised to familiarise themselves with various fire safety materials in the school gym. Before the simulation, the users can also practise exiting from different sides of the building by learning about suitable escape routes. Each virtual space has an interactive map, with which the users can practise using the escape route by following the arrows on the floor. The user has the right to start the simulation with the goal of practising exiting the building as quickly as possible. The user determines where the fire will start and how much time there is available to exit. When the simulation starts, all users are notified about how much time they have to exit the building, after which they start to exit just like in a real situation. The aim has been to make the situation as authentic as possible. For example, if a user accidentally bumps into another user in the simulation, they may fall down. At the end of the simulation all users receive individual feedback that shows the route they used in exiting and whether they ran into other users or ended up in dangerous areas.

Based on user feedback, practising exiting in both virtual and physical environments is useful. In addition to this, after virtual practice the users start to pay attention to the exit signs and safety issues in the real environment.



Figure 3. Avatar studying materials about fire safety



Figure 4. Avatar learning about a suitable escape route with an interactive map

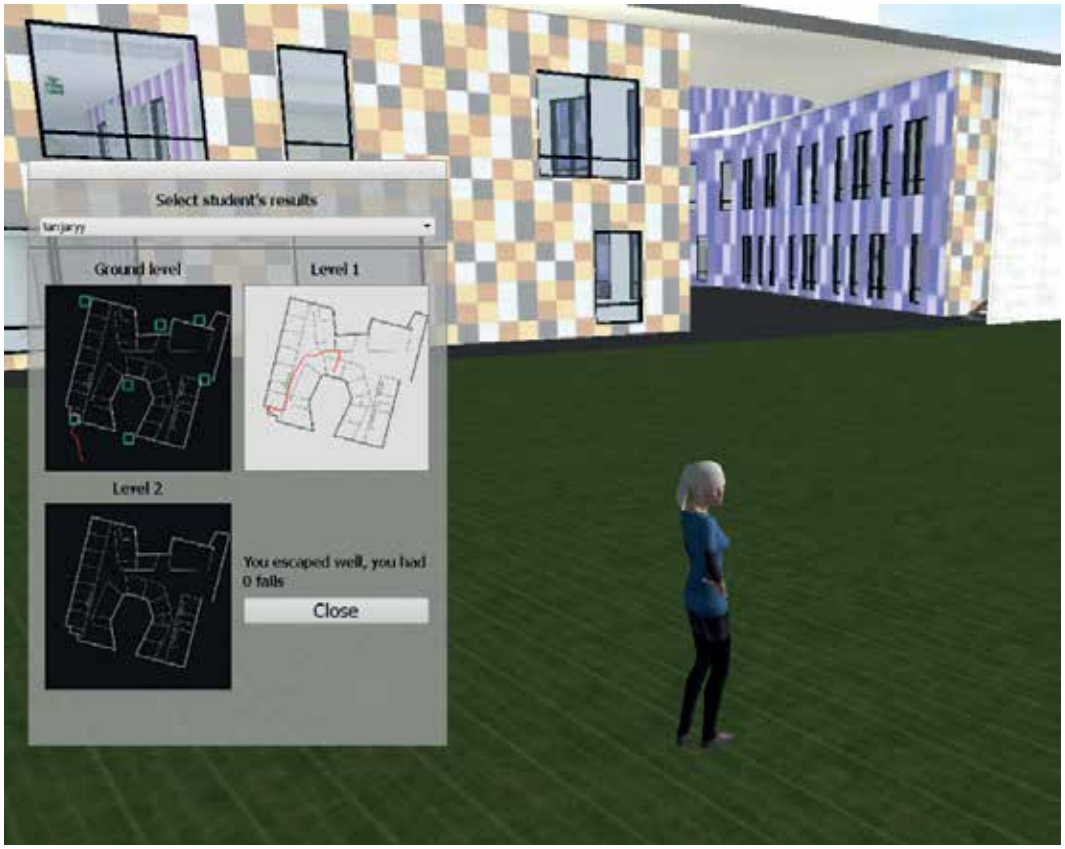
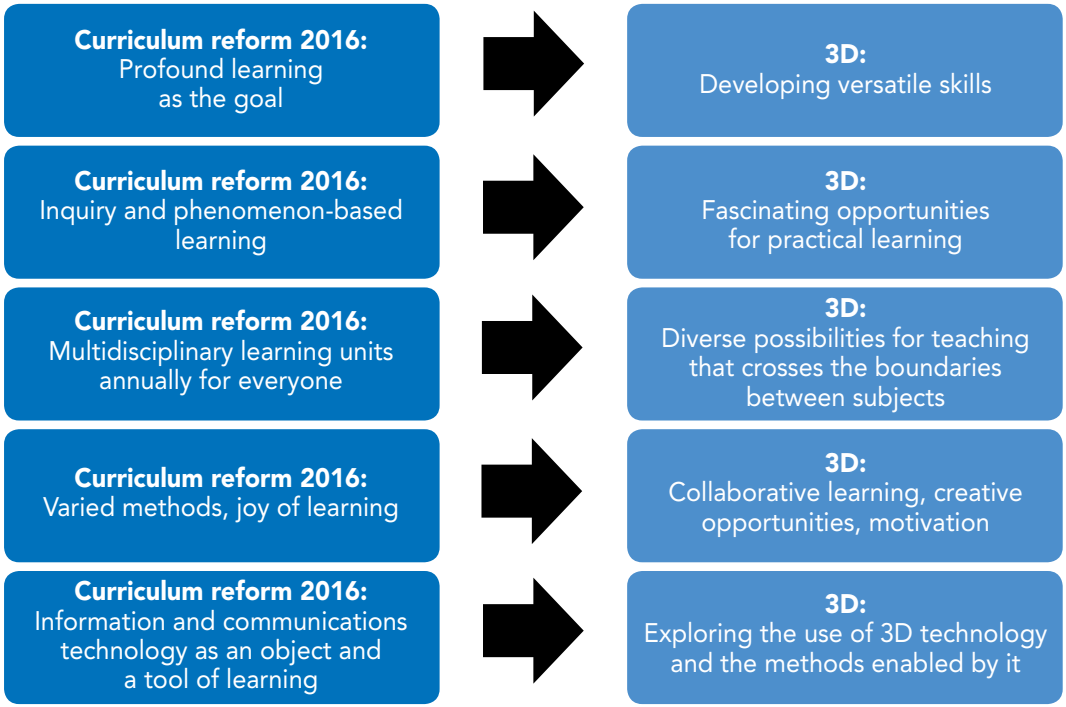


Figure 5. User receiving feedback about their activities in the fire safety simulation



Updating education to meet the needs of today's learners is topical in a changing world, where technology has revolutionised the working culture, while the teaching methods at school often still seem surprisingly similar to those of the last century. In the draft for the core curriculum of basic education, developing the working culture and the functionality of teaching are emphasised. Virtual 3D technology can be used in diverse ways to support many of the main points described in the curriculum reform.

Comprehensive competence and the development of skills are in a central position in the curriculum reform. There will be units crossing the boundaries between subjects at schools for every age group. Students are encouraged to participate in their planning. When describing methods, functionality in particular is emphasised

through inquiry, problem-based and collaborative learning. Virtual 3D learning and educational environments offer many opportunities for learning, in which the goals of the reformed curriculum are realised. For example, using active teaching methods in different situations as well as collaborative learning, including in 3D environments between students in different physical locations, meet the needs defined in the curriculum.

In the curriculum reform, harmonising teaching through multidisciplinary periods is described extensively. In 3D environments, it is natural to implement wholes built around a certain theme, where instead of a single subject, learning about a phenomenon and its related issues take centre stage. Boundaries between subjects feel artificial in the modern world, where situations encountered in working life, for example, can only rarely be categorised as belonging only to a single subject. A virtual 3D environment acts as a suitable space for periods requiring cooperation between teachers and opening opportunities for cooperation between different schools, even in different locations and different countries. The environments could also be used to arrange less common courses or differentiating units for students at different locations, among other things, without forgetting collaborative learning.

In the curriculum, technology is described both as an object of learning and a tool, taking the possibilities of gamification into account. Attention will be paid to gamification, programming and electronic tests in learning in the future. For this reason, educational content such as creating virtual worlds, developing learning avatars and learning to create games by playing interest more and more schools and teachers, not to mention students. In 3D learning environments, students can learn about future technology, develop their own skills and learn new things through inspirational methods. The students can also participate in developing and adapting the environments to suit their needs. In fact, 3D environments can also support motivation for studying, as the students get the chance to learn with the help of game-like methods and see the concrete impact of their activities in different environments.

New spaces and technologies require education. The change from a traditional school into the school of the future does not happen in an instant. It will take time and competence. There is a need in schools and educational institutions to move away from rote memorisation and splintered knowledge into complete entities that are studied in global learning environments. The traditional school needs change, and the time for that change is now!

13 Innovative procurement: an opportunity in developing school and learning environments

PASI MATTILA

Innovative procurement refers to developing a new product, service or method for the needs of the teaching and educational sector, for example. The innovation to be developed is not yet finished, or the market is not ready to utilise it. In that case, a procurement process is needed, in which the producer's and the customer's representatives as well as the end users are able to produce a solution for the needs of the users in multidisciplinary cooperation. At its best, innovative procurement is directly linked to developing the school or the educational institution's operational culture, school construction, technological development or other development projects, as well as developing learning environments and solutions at schools, educational institutions or the field of education.

Innovative procurement

The goal of developing the activities of educational institutions and the public sector is to promote the access of products to the market, improve productivity and develop the quality of services; this also solves the social and financial challenges of the field. It requires seeking and developing new, open-minded solutions. The purpose of innovative procurement is to reform learning and educational services and to develop products and solutions, at its best creating new markets. Innovative procurement creates added value for all parties in the form of solutions that function better or are easier to use. In the best case scenario, the organisation is able to guide the procurement processes via innovative procurement. The method also works as a tool for strategic leadership and development.

Implementing innovative procurement requires cooperation among the actors (customer, tenderer and end user). The tenderer and end user share a common need to develop a new product or new solutions for the market. The goal is to provide the service while creating added value through better quality, more efficient production processes, lower life cycle costs, friendliness to the environment or usability of products and solutions, for example.

By developing innovative procurement, the public sector can provide services to citizens and the educational institutions to their students better and at a lower cost than before. Developing innovative procurement makes it possible for the public sector to cope with future needs, which include the development of technology, economic realities and an aging workforce, as well as environmental and energy efficiency. It also allows end users to participate in the process from the planning to implementation, meaning participatory planning. When the end users participate in the planning from the start, any possible corrections can be made cost-effectively at an early stage. Common benefits seen in innovative procurement include the growth of innovation, better overall economy of the procurement, quality, efficiency, risk management and transparency.

New products, services and methods as solutions

Innovative procurement means 1) purchasing a new product, service or solution, 2) pre-commercial procurement or 3) developing a prototype together. New educational solutions involve clear improvements to the previous solution or development projects concerning a completely new product, in which the procurement is focused on purchasing a product or service. Pre-commercial procurement supports development carried out by companies, in which case the educational institution or other public actor can put up the research and development for tender. The aim is also to create demand by developing innovative procurement through a pre-commercial research and development project in cooperation with the company's developer community and the users' Living Lab user communities. In a prototype project, the company develops marketing together with the public sector actor, increasing the market's trust in the new, nearly finished solution or product with user tests.

An example of innovative procurement

The most typical targets of innovative public procurement are large construction projects, such as new school buildings. In such a project, it is essential to organise a dialogue between the end users of the object of procurement and other key actors, aiming for a more customer-oriented approach. The building is not evaluated based on the things decision-makers consider important; instead, it is evaluated based on the things the end users of the object of procurement see as personally valuable. The customer and the service provider pay attention to the current and future functional requirements of the building, and they can define a solution more clearly and from a wider perspective than before. The interaction between the actors in innovative procurement is joint value production by the customer, the supplier and the end user. This kind of development with participation by the end users can also be called participatory planning.

PPP model

Public-Private Partnership is an innovative public procurement model, in which the service provider chosen to implement the investment or a consortium formed together by the customer and the service provider bear more extensive, long-term responsibility for the procurement than traditionally. In addition to constructing the object of procurement, the service provider's responsibility areas may include planning, maintenance, financing and ownership arrangements as well as different kinds of usage-related services. In Finnish discussions on public procurement, the PPP model is often called the life cycle model, which emphasises the service period defined in the procurement agreement lasting longer than in traditional agreements. The use of the PPP model has become more popular in the last few years particularly in larger infrastructure procurement. A competitive dialogue is usually applied to selecting a service provider in PPP procurement.

PCP method

The Pre-Commercial Procurement model is applied to innovative procurement in which more research and development is required. The PCP model aims to achieve

user-friendly solutions developed together with businesses. In order to avoid monopolistic structures, at least two potential tenderers must participate in the field test phase of a PCP. Usually, a group of tenderers offering a solution are selected for the first phase of a pre-commercial procurement. In the next phase, the number of actors is reduced and the remaining tenderers produce a prototype. In the last phase, the selected tenderers implement pilots on the functionality of the solution. After the pre-commercial procurement process, the solution itself is put up for tender and the final supplier is selected. The benefit of the model for the customer in procurement is sharing the risks related to product development between public customers and potential tenderers.

Afterword

The purpose of this book is to open people's eyes to see teaching and learning, learning spaces, school architecture and technology in a new way. Developing the school is a process linked to the development of learning, leadership and the curriculum.

In Finnish schools, the curriculum reform has supported the change from a traditional school into a future learning environment, enabling the students' development based on their own skills and goals. The curriculum reform has established projects crossing the boundaries between subjects in a central role, along with seeking, constructing and understanding new information. Instead of splintered information and teacher-led teaching, the aim is to foster student-centred thinking and support the students' interaction situations and social communication both in contact teaching as well as global learning situations.

We must move on from the point of view of teachers, textbooks, lecture-style front-led teaching and subject-based learning to a student-centred learning process, supported by personal learning goals, learning spaces and technologies. Decisions at the national and regional level as well as the curriculum reform make it possible to change and develop learning environments, as do school construction projects, renovations, or constructing pilot environments and technology. We must simply have the courage to take the first step and listen to the experts in learning, teaching technology and learning environments, and decide to start the development. The current school and educational system have come to their end; it is time for a change. The decision-makers, leaders and teachers must start changing the operational culture together with the learners, and they must dare utilise the society outside. Schools need a new kind of partnership and expertise.

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Notes

THE SCHOOL OF THE FUTURE is not a building, it is a culture of competence development, a pedagogical culture that has an active role in the development process of the information society.

Schools and educational institutions need comprehensive development of pedagogy and a new pedagogical leadership; this requires systemic change in the operational culture. A change can only be made by ensuring that pedagogical leadership is actively oriented towards the future.

In the educational sector, there is increasing pressure to gain real pedagogical benefits from the use of information technology. Using information technology in a pedagogically meaningful, systematic way in the everyday work at school requires strategic leadership in addition to acquiring equipment and developing new competence.

This book offers methodical tools and processes for information society development and for building schools of the future. With pedagogical leadership and these tools for changing the operational culture, schools and educational institutions can make their own way into the future.

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