Towards an Innovative School 2.0

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16 Toward an Innovative School 2.0

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Introduction

In this chapter, we expand invention pedagogy to include the systemic development of schools. We depict the theoretical background and characteristics of the Innovative School Model and innovation education developed in the national Innokas Network in Finland. The model is a result of 20 years of development work with Finnish schools. As a case example, we portray the work done during 2019–2021 in a project focusing on the development of the Innovative School Model and practices with eight schools from several parts of Finland. At the end of the chapter, we reflect on the Innovative School Model and co-development process with the schools and envision the next version of the model, Innovative School Model 2.0.

The multifaceted nature of the systemic and innovative development of schools is well illustrated by the complex adaptive systems theory (CAS). The theory helps build an understanding of the complexity of the school system and the relationships between the factors influencing it. The nature of systems is characterized by emerging consequences that are formed from the relationships between the system's structures (Morrison, 2002). "Emergence" can be described as an internally led change and adaptation process that is realized through self-organization and the formation of a new order. An emergent and unanticipated new order can be formed at the macro-level through collective micro-level interaction. This new order cannot revert to its founding parts. It can be thought that the new order present at the macro-level is a new model, way of thinking, or working culture that is formed in the process and is present throughout the system. The emergent result is described to be more than the sum of its parts (Mitleton-Kelly, 2006; White & Levin, 2016). In school practice, this means, for instance, a new and established way of acting and being in interaction. Here, we speak of a new school culture that is being built.

The results of these emergent processes that shape schools' working cultures can be compared to the unpredictable results of the innovation process. Innovation processes are also associated with unforeseen and undefined creative processes. Schools' working culture is examined from the perspective of innovation processes by innovation-driven theories such as the theory of the diffusion of innovations (Rogers, 2003), the theory of educational change (Fullan, 2015), and the Innovative

School Model (Korhonen & Lavonen, 2017). The Innovative School Model (Figure 16.1) builds on the theories outlined by Fullan and Rogers and brings them to practice through development work with Finnish schools aimed at systemic change. In the Innovative School Model, all actors in the school context are viewed as participants and innovators: students, teachers, principals, parents, and other stakeholders. Collaboration is encouraged at all levels with peer-to-peer learning among students, teamwork between teachers, and in home and school collaboration, and within various partnerships. The model is supported by research indicating that participant involvement in innovation implementation and reinvention increases the probability of the continued use and development of the innovation. The creative and versatile use of technology in learning and teaching is a leading and cross-cutting theme of the model. The model extends the notion of innovation from hands-on learning innovations typical for invention pedagogy to operational innovations renewing school-level practices, such as teaching practices, school-day structures, and teacher collaboration (Korhonen & Lavonen, 2017). As CAS theory points out, the probability of change can be strengthened through smart system regulations by either changing the system, removing parts of it, or co-development (Mitleton-Kelly, 2006; White & Levin, 2016).

The design and co-development of the Innovative School are approached by applying design-based research (DBR) and by being aware of the elements impacting the school's systemic development under CAS theory: interactions between stakeholders, the structures of joint practice, and circumstantial opportunities and
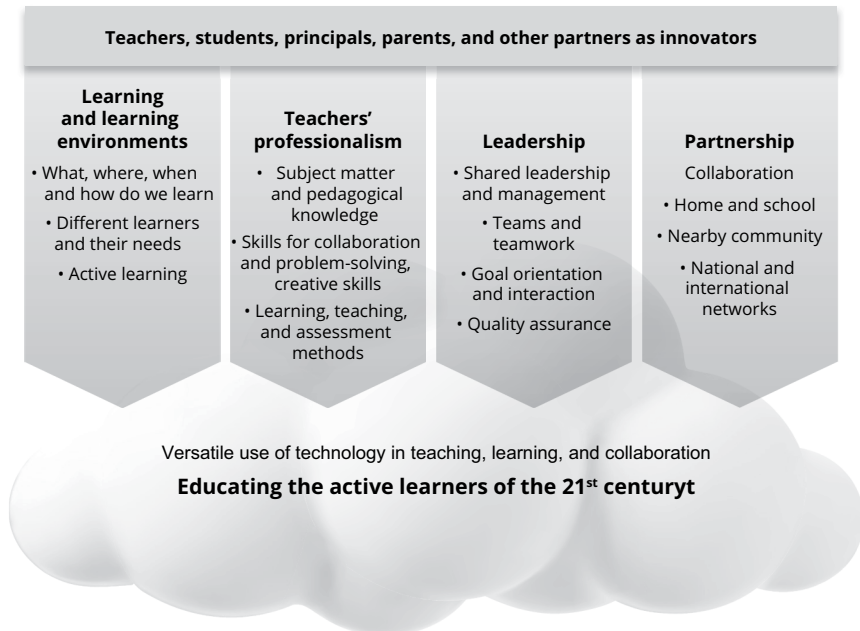

Teachers, students, principals, parents, and other partners as innovators

Learning and learning environments
• What, where, when and how do we learn
• Different learners and their needs
• Active learning

Teachers' professionalism
• Subject matter and pedagogical knowledge
• Skills for collaboration and problem-solving, creative skills
• Learning, teaching, and assessment methods

Leadership
• Shared leadership and management
• Teams and teamwork
• Goal orientation and interaction
• Quality assurance

Partnership
Collaboration
• Home and school
• Nearby community
• National and international networks

Versatile use of technology in teaching, learning, and collaboration
Educating the active learners of the 21ˢᵗ centuryt

Figure 16.1 The Innovative School Model.

(adapted from Korhonen et al., 2014)

limitations, as well as factors affecting the organization and formation of a new order of each school's interests and epistemic spaces (Mitleton-Kelly, 2006; White & Levin, 2016). A key principle in applying DBR is that Innovative School actors and researchers collaborate through research-practice partnerships (RPP, see more in Chapter 1 of this book), identifying the best practices and the challenges of the Innovative School. The development work is iterative, following cycles that cover the design, implementation, and evaluation (Edelson, 2002; Plomp & Nieveen, 2013) of the model and process activities. Co-development produces three types of outcomes: knowledge of Innovative School activities, knowledge regarding iterative co-development processes, and knowledge of successful design solutions, that is, educational innovations (Edelson, 2002).

The key guiding principle in co-development is Dewey's idea of a shared activity. In a shared activity, all participants have the same interest in the accomplishment of the activity (Dewey, 1916/1980). "Shared activity", in the context of educational DBR, means that school actors and researchers design, implement, and evaluate educational innovations together. This requires interaction and building shared knowledge and understanding between school actors and researchers. Biesta and Burbules (2003) characterize communication not as a process in which school actors simply react to a researcher's movements and vice versa but as a process of the mutual coordination of action. Dewey's thoughts are connected to this with the concept that successful coordination requires school actors to react to what the researcher intends to achieve with their activities, just as the researcher reacts to what school actors intend to achieve with their activities. Successful coordination requires that the interacting partners try to anticipate the other's actions (Biesta & Burbules, 2003). By engaging in shared design, by being exposed to similar experiences in the learning environment, and by anticipating each other's intentions, school actors and researchers can reach a stage at which they experience a shared world. New knowledge concerning teaching and learning is constructed through reflections with others who share the same world.

The central concepts in the systemic development of innovative schools are 'educational innovation' and 'innovation education'. Innovations, especially educational innovations, are formed through emergent processes, which support 21st-century school education. Here innovation is understood broadly: it is the product of a creative process that is new to the innovating person or community. A characteristic of the creative process is combining previous knowledge in a new innovative way (Fisher, 2005). Educational innovations are purposefully designed innovations aimed at developing school practice (Nicholls, 1983). Creative processes result in solutions that can be further combined and evaluated to form a feasible innovation that enriches teaching and learning, collaboration as well as the whole school.

The aims of innovation education in the Finnish and invention pedagogy context are twofold (Korhonen & Lavonen, 2017). On one hand, the aim is to guide and inspire children and youths to learn 21st-century competencies by developing tangible *learning innovations* through invention pedagogy. On the other hand, a focal dimension of innovation education in our model is that it also guides all school stakeholders to develop *operational innovations* that renew school practices and

structures with all school stakeholders: students, teachers, staff, parents, and partners. The Innokas approach has a similarity to Shavinina's (2013) characterization of innovation education, the aim of which is to promote societal actions preparing children to become adult innovators. Our approach highlights all students as innovators, whereas Shavinina's model focuses more on the education of gifted students as future innovators. In addition, innovation education in the Finnish and invention pedagogy context views all school actors as innovators and aims at systemic change at the level of the whole school.

Co-creative Development of the Innovative School

The development of the Innovative School Model started at the beginning of the century at a single school in the metropolitan area of Finland. The model has since expanded and been developed through the years in collaboration with researchers and various schools in the Innokas Network (Korhonen et al., 2014; Korhonen & Lavonen, 2017). A central working method has been co-creative development: collaboration between schools and researchers in an RPP. In an Innovative School, development is viewed positively, and it is seen as a continuum and part of everyday schoolwork in a digitalizing society. The idea of school stakeholders as innovators and inventors is central to the practices of the Innovative School and at the center of the Innovative School Model is the courage to think and act differently. The subjects of development are learning and learning environments, teachers' professionalism, leadership, and partnerships (see Figure 16.1).

The Innovative School Model was purposefully developed further in the Innovative School project in 2019–2021. The project was organized by the national Innokas Network, and eight Finnish schools of varying sizes from several parts of Finland participated in the project (see Table 16.1). The schools' activities were guided and supported by the project coordinator in collaboration with local network coordinators. Teams consisting of two to six teachers and the principal were responsible for school-level activities. The project's aims were an RPP with the project's schools to (1) develop the ways innovative schools operate, (2) reflect on and develop the Innovative School Model, and (3) wrap up the developed operations of the innovating school and development process for dissemination.

The schools' activities were guided by DBR methods. The development work was initiated with a status and needs survey targeting teachers and principals in the fall of 2019. The analysis of the questionnaires formed the basis for the development work at schools. The questionnaire was built around the principles and practices of the Innovative School Model. The results of the questionnaires were presented to the school staff and reflected on with them. Based on the results and collaborative reflection discussions, each of the school teams chose a development project to work on.

In all schools, teachers' teamwork and technology utilization in developing and sharing teachers' digi pedagogical competence were raised as core themes of development. In five of the schools, this development work was tied to ongoing or recently initiated processes or upcoming changes in learning environments, such as new school building projects that required a change in working cultures. In

Table 16.1 Schools and development projects of the Innovative School project

School	Number of students	Grade levels	School-specific development project	School size and area	Region
1	650 + 210★	0−10	A model for developing digital competencies	Big Urban	Central
2	730	0−9	A technology-oriented multidis-ciplinary learning module for secondary school	Big Urban	Eastern
3	627	1−9	STEAM learning path	Big Urban	Northern
4	588	1−6	Student agent activities	Medium Urban	Eastern
5	500	1−9	Implementing the steps for digital skills and a digi passport	Medium Urban	Capital
6	450★★	7−9	Space and ways of working for maker education	Medium Urban	Western
7	240	1−6	Co-planning and competence-sharing principles for teachers	Small Rural	Eastern
8	160	0−6	A collaborative model for sharing innovation and project learning	Small Rural	Western

★ Three school units, the project unit with 210 students

★★ 450 until August 2021, 900 after August 2021

addition, based on the results of the survey and conversations, each school chose one or more specific themes for development. In schools 3 and 5, a consistent learning path was developed ranging from the first school years to the end of lower secondary school. School 3 had an emphasis on students' STEAM (science, technology, engineering, arts, and mathematics) skills, and school 5 had an emphasis on digital skills. At two of the schools (schools 4 and 5), the students' role as peer mentors for digital skill development was the focus. In these schools, a group of students took the role of either tutor students or so-called digi agents. In four of the schools (schools 1, 2, 7, and 8) teachers' competence development and knowledge sharing formed the core of the development work. At school 6, the focus was developing a makerspace and related practices.

After the initial need surveys, analyses of the surveys and selection of the development project plans were altered by the COVID-19 outbreak in spring 2020. Schools moved to distance education, and this period in Finland lasted from March to May 2020. The changed circumstances significantly impacted the development work done at school and the teachers' opportunity to take part in the work.

The project plans were altered under the new situation. Some of the planned supportive measures, such as workshops for teachers and a joint project meeting scheduled for the spring, were canceled. Distance meetings and interviews were organized for each participating school to map the situation.

Schools returned to face-to-face teaching in fall 2020, and the project work resumed accounting for the new circumstances. The schools' development work was supported by local regional Innokas Network coordinators and researchers. Co-development was supported during 2020–2021 on multiple levels: (1) among project experts and project teams in school-specific meetings, (2) among school teams, (3) among the whole school staff and students in joint training or development days, and (4) among all project stakeholders in joint development meetings.

Supportive measures targeting all project stakeholders included joint project meetings, training, and shared project tools such as a project plan template and a checklist for a successful development project. During the joint project meeting, the focus was the schools' subprojects, allowing for sharing competence and experiences, sparring, and co-development among all stakeholders. School-specific meetings focused on the development of each subproject with the aid of the project experts. In these meetings, schools were given practical guidance in using project tools, strengths and challenges were identified, and solutions were sought together. In the meetings, the teams ideated supportive measures such as training for the whole school staff. The work of the project teams was built according to the structures of each school.

In the final project year, during joint meetings, project teams were guided to recognize the developments made: the processes, practices, and needed structures and resources. Based on reflections, the school teams planned and produced videos depicting their schools' work on the different dimensions of the Innovative School Model. The videos served as a tool for sharing expertise, as well as modeling and disseminating project results.

At the end of the project in fall 2021, the school teams and Innokas Network regional coordinators were interviewed. In the interviews, the experiences of the Innovative School Model and project were gathered from the perspective of both the schools and the project activities. Additionally, the interviews sought to find ways to further utilize the developed models and practices in schools beyond the project's lifespan. Schools were encouraged to keep up with development work by further working on structures that support competence development in everyday school practices.

Experiences of the Innovative School Model and Development Process

Teacher and principal interviews administered at the end of the project illuminated the project's development process and the dimensions of the Innovative School Model in practice. In the following sections, we describe the experiences of teachers and principals in the Innovative School project by mapping the main elements of the schools' development themes and by building on reflections of previous knowledge from research and development work related to the Innovative School Model (Korhonen et al., 2014; Korhonen & Lavonen, 2017). We elaborate on the experiences from the viewpoint of the four main stakeholder groups: students, teachers, principals, and partnership networks.

Students as Active Co-creators

Our previous research and development projects have shown that in an innovative and inventive school, student participation and agency have a central role in the development of an Innovative School (Korhonen et al., 2014; Korhonen & Lavonen, 2017). In an Innovative School, students work as co-innovators in collaboration with teachers and other stakeholders. In addition to making learning innovations, they are encouraged to influence the whole school by developing needs-based operational innovations such as the practices of their own class, grade level, or even the whole school. Student innovations include recess clubs, recess tool rentals, tutor-student activities, and internships within the school. The innovation skills learned in actual invention projects are geared to a more abstract level through operational innovations.

Promoting students' participation was the developmental focus in three Innovative School projects. In all three schools, a version of student peer-to-peer teaching aimed at sharing student expertise through newly developed structures and practices was developed. These structures included designated teachers and resources for tutor-student activities, time allocated for collaborative work, student training solutions, and student tutoring scheduling systems. In addition, attention was paid to motivating and committing students to activities through making a tutor-student pledge, designing a shirt, or giving a diploma, for instance. For example, students designed a logo for tutor students and participated in building a digital passport with steps for competence development (see Figure 16.2). In one school, the backpack hooks on students' desks were not working properly, and new hooks were designed and manufactured with a 3D printer as a collaborative effort between students and teachers.
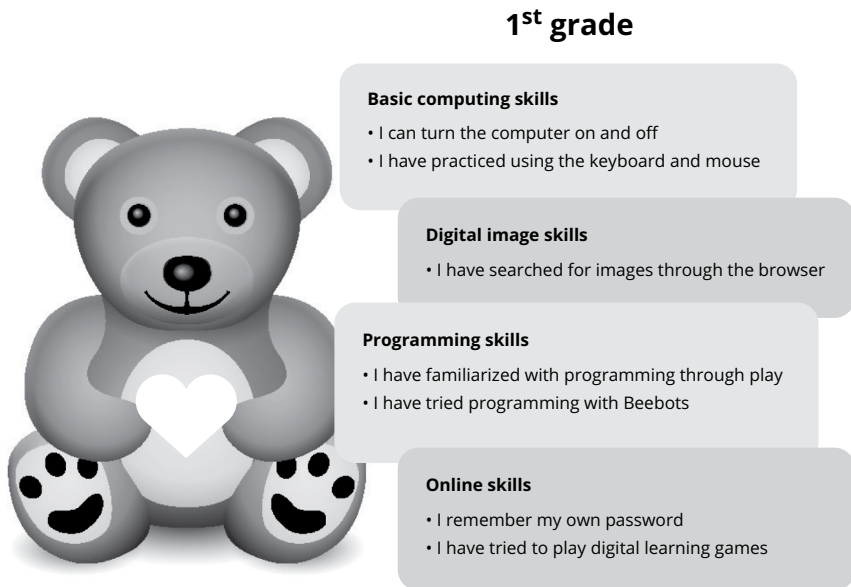
1st grade

Basic computing skills
• I can turn the computer on and off
• I have practiced using the keyboard and mouse

Digital image skills
• I have searched for images through the browser

Programming skills
• I have familiarized with programming through play
• I have tried programming with Beebots

Online skills
• I remember my own password
• I have tried to play digital learning games

Figure 16.2 First graders' digital passport (school 5).

Team Structure and Teaching as a Backbone for School-Level Collaboration

Instead of weekly meetings common to all teachers, many innovative schools hold team meetings according to grade level, subject group, or theme areas. For example, in team meetings, the implementation and evaluation of cross-curricular invention projects are planned so the expertise of all teachers in the team is utilized. It is essential for the development of a systemic school that teamwork is designed on a structurally sustainable basis and as part of the school's daily activities. Key questions from the perspective of a functioning team structure include which need-based themes the activities of the teams are built around, how the activities of the teams are built into the system of the operation and development of the school, and how the activities of the teams are scheduled. The aim of the activity is to establish common teamwork methods that utilize technology and to make operations transparent.

In addition, it is important to decide where the questions and decisions that have emerged from the teams should be presented: For example, is the leader of each team part of the management team, or are the practices developed shared in peda-gogical cafés? There is also a need to consider how teams will be evaluated and developed. When these questions are answered collectively and with the commit-ment of the work community, so-called pseudo-teamwork is often avoided, in which the goals and structures of the teams' activities are unclear. Jointly planned and goal-oriented team activities serve the objective of an inventive, Innovative School (i.e., to support students' learning and growth and, at best, also the endurance of teachers).

The development of practices related to team structure and team teaching also became one of the areas for development in all schools of the Innovative School project. For example, at one school a team outlined the tasks for their STEAM team members and another team constructed a process model for purchases in a new school (see Figure 16.3). Teamwork was already familiar to some of the schools in the project but less familiar to others. Five of the project's schools were offered team teacher training tailored to their wishes and needs, which supported the schools in developing team-teaching practices through research-based knowledge and experience from previous development work. Among other things, the train-ing dealt with the models and structures of team teaching and the factors that challenge and enable it. An essential role in the training was the teachers' reflective discussion about team structure and teaching in their own school and the mapping of developmental needs and ideas.

Collaborative discussions with other project schools and training affected the development of teamwork in schools to varying degrees. At some schools, the structures and operating models of team teaching became increasingly supportive of the school's overall activities during the project. However, at some schools, the importance and potential of team teaching were better identified as a component of holistic school development activities but did not yet lead to changes in ways of working. The results of the development activities were also influenced in part by the attitude of the school management to team teaching.

In the interviews, the teachers at a few schools considered the future of team teaching, continuous competence development, and sharing after the end of the
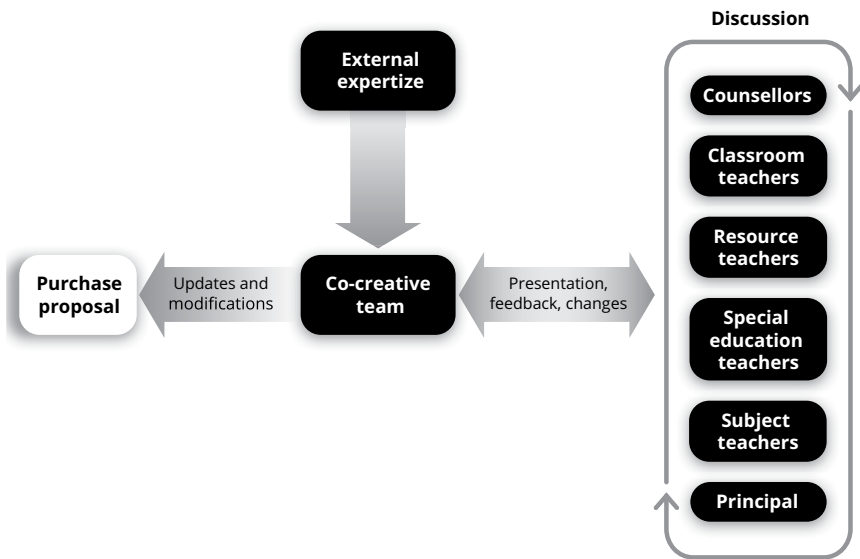
The tasks of the STEAM team

Familiarizing with other schools' makerspaces and pedagogics

Creating a maker working culture

Designing maker space solutions

Mapping making competences and training

Purchasing and maintenance of equipments an tools

Starting maker tutor activities

Designing a maker education learning path

Discussion

External expertize

Counsellors

Classroom teachers

Resource teachers

Purchase proposal

Updates and modifications

Co-creative team

Presentation, feedback, changes

Special education teachers
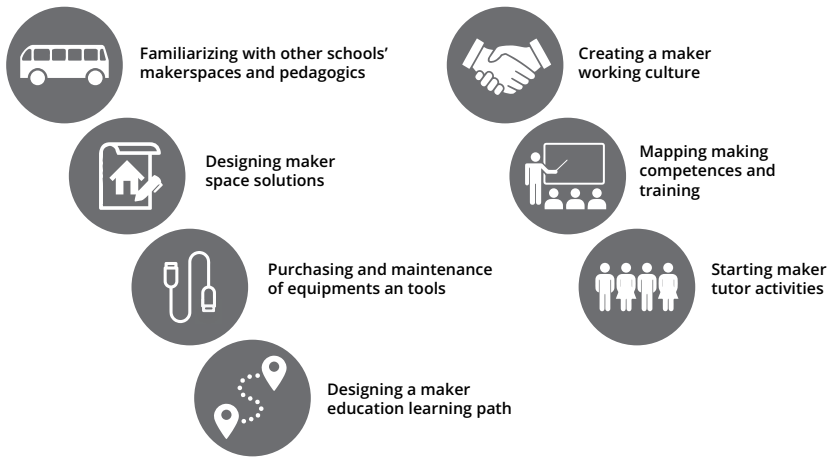
Subject teachers

Principal

Figure 16.3 The tasks of the STEAM team members and a process model for purchases (school 7).

project. At the end of the project, their schools had begun to consider supporting a continuum of holistic development, and it had been decided that the Innovative School project team could continue to support the joint development of the school's activities as a permanent team after the end of the project. It is also important to consider personnel changes in securing the continuity of team activities. One of the project teachers described the challenge posed by staff exchanges well:

> There have been difficult times when we have felt that we [with the other project teacher] have been trying to run things together. Now, we see the light at the end of the tunnel again because a new person has been recruited to the team.
>
> (Subject teacher, School 2)

Using technology in the development and sharing of competencies, which has been the subject of development in all schools, also came to the fore in connection with the activities and sharing of the competencies of the teams. One of the school's six teachers describes the options for using technology from the perspective of a large school:

> We have started using Google Tools and have introduced Google Classroom to all the sharing activities we do. Now that we have a new school, it is easy to say that this is how things will proceed and these are the ones we'll try at first. New school, new tricks. So now we'll test electronic platforms—how to get things done together and share work.
>
> (Subject teacher, School 6)

Leaders as Co-creative Enablers

Developing the elements of an Innovative School Model as part of everyday school activities requires strong and participatory leadership. The school principals and management team, through their own actions, enable the operation of an Innovative School. The change in ways of working and the commitment of actors to community activities require a clear vision built with stakeholders and long-term support. From a leadership perspective, the most important factor is to identify and recognize the strengths of the actors at the school and give them equal opportunities to implement development activities. In most cases, enabling holistic invention at various levels requires leaders to have the courage to act in new ways and share their own responsibilities. Working in a team also gives leaders the opportunity to practice the skills required by teachers and other actors.

Principal teams or management teams can be considered good operational examples of leadership innovations. In them, the tasks related to the management of the school are divided among people so that each handles the school's participatory development activities. For example, one member of the leadership team may be responsible for teacher teamwork and participatory practices for students. In practice, that member of the management team directs those activities within the bounds of resources as part of the school's daily activities.

In the Innovative School project, the management of all schools was involved during the initiation phase of the project and, to varying degrees, during the project. At three schools, a member of the management team was closely involved in the project work throughout the project, while at two project schools, more emphasis was placed on trust in the self-direction of the project team. However, in the final interviews, all project teachers in the schools stated that management support had been obtained for the development work.

> A big thank you [goes out] to the management for making it possible for us to start such a job. Without the involvement of management, this would not be possible in any way. Yes, time and resources are needed to develop this.
>
> (Project teacher, School 3)

The principal of one project school pointed out that the new technologies for competence sharing introduced during the project strengthened self-direction and reduced traditional top-down leadership, transforming the school little by little into a learning community. Information is equally accessible to all, and the information produced by different teams can be used more easily and flexibly, which, in turn, increases the efficiency and transparency of activities. Simultaneously, the activity becomes more communal.

> The courage to act and take a stand has increased. Things have become more agile, and decision making has become easier.
>
> (Principal, School 7)

The principal also emphasized the role of the project as part of the design and construction process of the new school building underway at that school. The project had been a natural part of the change process in the school; it had been implemented considering the skills of the teachers and workload. Thus, the project has become successful and "looks like us [the school]". The principal of the school in question was particularly interested in co-development as a working method of the project. The principal felt that the activities of the project supported his activities as a leader at both his own school and the municipal level.

> The project has also supported my work, and I have been able to develop things not only at the school level but also at the municipal level.
>
> (Principal, School 7)

Network Actors as Collaborative Partners

The Innovative School as an inventive community also pays special attention to partnerships. The most important partners of the school are the parents. An essential role in the activities of an Innovative School is the opportunity for parents to participate in and influence activities, for example, through class committees and the parents' committee. New ways of working together are ideated with students and parents. For example, a traditional parent–teacher meeting can be turned into a Saturday school day: Parents take the role of students in class activities as students, together with teachers, guide parents through the evaluation phase of an invention project. Building trust between home and school through inclusive practices that consider the diverse backgrounds and situations of parents is one of the cornerstones of an Innovative School.

The Innovative School project activities were visible to parents at several schools through development activities related to students. Several schools also

communicated about the project to homes as it started in the winter of 2019–2020. For example, students' enthusiasm for the new role of digital agent received delighted feedback from parents. Project activities were also reflected in homes through school social media channels. However, the involvement of parents in the actual development work did not materialize at the project schools. This was because of the crisis communication to homes caused by COVID-19 in the early phase of the project in spring 2020. At that time, crisis communication became more emphasized, which shifted the focus away from other communication and cooperation between home and school.

The school's other partnerships with nearby actors such as libraries and kindergartens, experts, or companies in various fields also support the operation of the inventive school. In the Innovative School project, the development of invention pedagogy played a significant role at several schools. The theme is naturally linked to entrepreneurship education, and local companies were a natural partner at some schools:

> When we got companies involved in the first year, it brought a slightly different perspective when we started to get information from elsewhere as well. And that is certainly too what the students have been longing for.
>
> (Subject teacher, School 2)

All the schools involved in the project also had other existing networks, such as a regional tutor network or other regional partnerships. The development work based on the Innovative School Model, therefore, encouraged the identification of existing networks and their better and more diverse use as part of the school's daily activities. Most of the project schools already had plans to utilize networks outside the school. Although the implementation of these plans was interrupted during the COVID period, network cooperation was not completely abandoned; rather, the implementation was postponed.

> We have succeeded very well in the goals of the project, in that we have involved all the actors in our own school. All the teachers are positive, and the students like this. The outside-school activities are, of course, not yet realized due to COVID. I am holding a larger meeting for vice principals and other schools that want to join in the future.
>
> (Class teacher, School 8)

In the final interviews, most teachers and principals found that one of the best outputs of the collaborative work with other project schools (networking) was the realization that the challenges schools faced were similar and that the solutions found were applicable and useful regardless of the school type or area. The support provided by the Innokas Network was also emphasized in the project work. During the project, the schools could take advantage of both the research-based support provided by the university and the support of the regional coordinator in their area.

I've asked the regional coordinator many things and the coordinator has always had time to respond. The coordinator has been our biggest support in daily life.

(Class teacher, School 1)

From Projects to Everyday Innovative School Co-creation Practices

The cyclical and iterative nature of DBR activities of the Innovative School project guided the school actors to co-develop both in their own schools and in cooperation with other project schools. All interviewed project stakeholders emphasized the importance of the participatory RPP process and novel shared activities between practitioners and researchers. Participants found that committing to a recurring, scheduled, and joint planning time built into the school's timetable when co-creating was crucial for the development work. In the final interviews, it was brought up that the project schedule and yearly time line influenced the work of the project teams significantly. The scheduled joint meetings and related tasks set important deadlines for the school-specific teams, and during the joint meetings, the participants were forced to present and depict their own development work to others. The financial resources available through the project also enabled the allocation of human resources and the purchase of equipment and software to support the development of the school's activities.

Project activities and results often live for some time as part of school activities. However, without the identification and recognition of enabling and challenging factors influencing development activities, the operational innovations achieved during the development work and then the continuation of the development work as part of school life may end. One key goal of Innovative School work is to achieve results that transfer to everyday practices. With that in mind, in the last phases of the project, we directed schools to think about the future of day-to-day development work beyond the life span of the project in their schools. In the following, we summarize our previous research work and experiences from Innovative School projects with the elements that support the holistic development in everyday school life as observed in the project during 2019–2021.

Co-creation Structures. To ensure the continuity of development work, it is useful to create permanent participatory structures for schools. It is important to consider and design permanent structures tied to the school's yearly plan for iterative competency development cycles and evaluations guiding development work in collaboration with all school actors. It is also good to think about in what situations and when development work needs are mapped, how co-creation is organized, how and when its results are presented, and how they are communicated to actors. Well-thought-out structures make development work part of everyday life, so one need not reinvent the wheel whenever a new development theme starts. It is essential to include the evaluation of development work in the structures. Both the development process and the results of the work should be evaluated systematically, and the results of the evaluation should be taken as a natural part of development work.

Giving space, time, place, and appreciation to presenting the innovations developed, and the challenges also plays an essential role in the process of co-development and the sharing of competencies. Invention fairs, team meetings, pedagogical cafés, or Saturday school days with parents are examples of knowledge sharing enabled and implemented within school structures. These regular and inclusive meeting opportunities for the different actors in the school are needed to form an inclusive community. The communal presentation of developed learning and operational innovations also serves as a stimulus for innovations as a continuous part of school activities.

All actors as innovators. An essential role in the planning of development work as part of the school's everyday activities is how the involvement of all school actors is considered in the needs assessments, in the activities themselves, and in the evaluation that guides the activities. The idea of all actors as innovators should be regularly opened to school actors through practical examples in a variety of contexts. In this way, new participatory approaches gradually become known, while enabling co-development and innovation in the freshest and most creative way possible. Both the results of our previous research before the COVID-19 period and the results of the Innovative School project suggest that in the future it will be important to co-create and share even more operational innovations for promoting student and parent participation as part of the practices of the Innovative School. Enabling and increasing the participation of students and parents also guides teachers and principals to new ways of working. It is important to discuss and decide among the work community who takes the responsibility for developing these participatory activities. Meanwhile, it is useful to note that leading and organizing these activities and truly being sensitive and open to students' and parents' ideas and needs require a time and a place in school structures.

Shared responsibilities. When starting development work, it is important to consider how the work is to be organized and to agree on the people to be responsible. In connection with the needs assessment, it is good to map not only the development needs but also the competence and willingness of teachers and other actors in the school to lead the development. Using existing expertise and recruiting those interested in development work to be responsible for change creates opportunities for an inclusive and inspiring development spirit. In several innovative schools, the areas of development are divided among responsible teams, with each team having responsibility for a certain part of the development work. It is also significant to consider the diverse skills of team members, their interests, and disparate roles. For example, it is often useful to involve both classroom and subject teachers or special education teachers in development work, ensuring continuity and considering different learners.

Continuous support. School actors need support and tools to involve Innovative School actors in development work. New, creative, and technology-based ways of engaging play a key role. The toolkit must include tools that motivate and are easy for the actors in the school to use, reducing rather than increasing the workload. Diverse and regular support tailored to the needs of the school is crucial. Some of the support directly targets the development team and resembles job coaching. Support can also directly target students, a specific group of teachers, the whole

school staff, or school management. Notably, besides experts and researchers, other innovative schools, their development teams, and experts and networks from their own schools can provide support. Development work often helps to better identify the school's competencies. Moreover, new, innovative practices for sharing competencies within one's school emerge during the development work. Participating in national and international networks, either as a listener or as a presenter of innovations, also broadens the perceptions of both students and school staff about the opportunities and importance of developing school activities and sharing knowledge. Activities outside the school or municipality help people to understand the activities of an innovative, inventive school through new perspectives and spark the development of one's own school community.

Reallocated resources. The lack of time and financial resources is often perceived as an obstacle to the development of operational innovations in an Innovative School. Leaders at several schools have set out to plan the use of the school budget and the planning time traditionally allocated for joint meetings of all teachers in new ways. Considering the use of the school's annual budget in collaboration with teachers, such as by enabling grade-level teacher teams to use their own budget has often made it possible to make different purchases than before. Time spent on joint meetings has been cut to once a month, and the other time slots freed for weekly teacher team activities. It is also possible to consider what opportunities the school must finance, for example, a mentor teacher for one day a week to support the activities and development of the whole school.

Versatile use of technology. In the Innovative School project, most schools focused on developing new solutions to use technology as an object of and support for learning. However, it is also good to consider the role of technology as part of the organization of school activities, the interaction of school actors, and support for development work. New solutions utilizing technology at two Innovative School project schools were also reflected in both the school's internal communication and the ways teachers' knowledge was shared. In sharing these solutions and good practices as part of the day-to-day running of an Innovative School, it is important to learn to make extensive use of technology and to dare to bring new technological solutions to different levels of school activity and increase opportunities for all actors' participation.

Building the Innovative School 2.0

The joint development of the Innovative School Model and activities in cooperation with eight Finnish primary schools strengthened our understanding that the development of schools is a complex and multidimensional emergent process (Mitleton-Kelly, 2006). Identifying the complex dimensions in the systemic development of schools of various sizes and cultures and utilizing the identified dimensions to support school activities require a strong commitment to DBR, RPP, and shared knowledge co-creation from both school actors and researchers.

The development work with the project schools brought to life the Innovative School Model we have developed over the years. The operational innovations developed by project schools related to students as co-creators, team teaching and

structures, leaders as co-creative enablers, and network actors as partners are examples of needs-based co-development in schools. These operational practices that guided the learning of digital technology and supported the cooperation and sharing of knowledge between teachers are artifacts that are characteristic of DBR development work (Edelson, 2002; Plomp & Nieveen, 2013).

We are on our way to an Innovative School Model 2.0. In version 2.0, we are moving from describing the activities and operational innovations of the Innovative School Model to asking what factors enable all actors to be innovators and implement both learning and operational innovations. Essential factors in enabling innovation and iterative needs-based development activities are based on this development and research work: the co-creation structures of development work described in the previous section, shared responsibilities, continuous support, reallocated resources, and the versatile use of technology. Innovative School 2.0 builds on the school's actors and the basic elements of its activities to the elements that guide and enable activities. These recognized and overlapping elements relate to the factors that guide self-organization in CAS theory: interactions between stakeholders, the structures of joint practice, circumstances, and each organization's interests (Mitleton-Kelly, 2006; White & Levin, 2016) that in turn influence the organization of joint activities and the new order of the Innovative School.

Adapting CAS theory to the Innovative School Model and invention pedagogy: In self-directed, innovative schools, systemic development can be seen as a design challenge that requires the same skills to work as to create inventions. The design challenge is an open and complex problem that takes shape and becomes more precise as solutions evolve. Actors' development needs can be contradictory, and the level of competence and motivation of the actors varies. Indeed, the ability to manage ambiguity and the courage to create something new are key characteristics of an Innovative School actor. Persistence also plays an essential role; that is, the development of ways of working in each school in a step-by-step organized manner, regularly identifying needs and evaluating the results of the development work.

We will continue the work of developing the Innovative School in collaboration with schools through DBR-based research and development. Our aim is to support schools to be innovative communities that see continued development work as part of their daily practice in the 21st century. The ideal situation is that the school, as an inventive community, develops its activity with curiosity, following its time and considering the challenges and opportunities of the digitalizing society. The school encourages innovation from all stakeholders at various levels. At their best, working with challenging invention and innovation processes, school actors are filled with excitement, grit, and drive while learning to take responsibility for their environment and community.

References

Biesta, G. J. J., & Burbules, N. C. (2003). *Pragmatism and educational research*. Rowman & Littlefield Publishers.

Dewey, J. (1916/1980). Democracy and education. In A. Boydston (Ed.), *The middle works 1899–1924* (Vol. 9). Southern Illinois University Press.

Edelson, D. C. (2002). Design research: What we learn when we engage in design. *The Journal of the Learning Sciences*, *11*(1), 105−121. https://doi.org/10.1207/S15327809JLS1101_4

Fisher, R. (2005). *Teaching children to think*. Nelson Thornes.

Fullan, M. (2015). *The new meaning of educational change* (5th ed.). Teachers College Press.

Korhonen, T., & Lavonen, J. (2017). A new wave of learning in Finland: Get started with innovation! In S. Choo, D. Sawch, A. Villanueva, & R. Vinz (Eds.), *Educating for the 21st century perspectives, policies and practices from around the world* (pp. 447−467). Springer. https://doi.org/10.1007/978-981-10-1673-8_24

Korhonen, T., Lavonen, J., Kukkonen, M., Sormunen, K., & Juuti, K. (2014). The innovative school as an environment for the design of educational innovations. In H. Niemi, J. Multisilta, L. Lipponen, & M. Vivitsou (Eds.), *Finnish innovations and technologies in schools* (pp. 97−113). Sense. https://doi.org/10.1007/978-94-6209-749-0

Mitleton-Kelly, E. (2006). A complexity approach to co-creating an innovative environment. *World Futures*, *62*(3), 223−239. https://doi.org/10.1080/02604020500509553

Morrison, K. (2002). *School leadership and complexity theory*. Routledge. https://doi.org/10.4324/9780203603512

Nicholls, A. (1983). *Managing educational innovations* (1st ed.). Routledge. https://doi.org/10.4324/9781351040860

Plomp, T., & Nieveen, N. (Eds.). (2013). *Educational design research*. SLO.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Shavinina, L. V. (Ed.). (2013). *The Routledge international handbook of innovation education*. Routledge. https://doi.org/10.4324/9780203387146

White, D. G., & Levin, J. A. (2016). Navigating the turbulent waters of school reform guided by complexity theory. *Complicity: An International Journal of Complexity and Education*, *13*(1), 43−80. https://doi.org/10.29173/cmplct24566.