

# Teachers' knowledge dynamics and innovation in education – Part II

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*Teachers' knowledge is dynamic; it is constantly shaped by new information, collaboration with colleagues, engagement with teaching tools and textbooks, teaching practice in the classroom, and so on. This paper investigates how knowledge dynamics can be described, building on work conducted in the Innovative Teaching for Effective Learning (ITEL) project of the OECD. A review of literature is conducted along three analytical foci in order to explore processes underlying the dynamics of knowledge functions, structures and the emergence of knowledge. The first part of the paper looked at the individual and social perspectives and used data from the ITEL pilot study to illustrate some of the mechanisms. This second part investigates the socio-material perspective and, integrates the three analytical angles into a complexity view of knowledge dynamics and innovation. The integrated view helps highlighting the different ways in which innovation in education is linked to the dynamics of professional knowledge.*

**Kulcsszavak:** Teacher knowledge, knowledge dynamics, professional learning, innovation

## *Introduction*

Teachers' knowledge is dynamic; it transforms through education and professional development, as teachers learn new theories, evidence or teaching methods, and it is also shaped through experience and constructed in professional practice. This paper set out to review the mechanisms underlying the complex dynamics of teachers' knowledge, building on recent work of the Centre for Educational Research and Innovation (CERI) of the OECD carried out in the framework of the *Innovative Teaching for Effective Learning* (ITEL) project (Guerriero, 2017; Révai & Guerriero, 2017; Sonmark et al., 2017; see details in Part I. of this paper (Révai, 2017).

The framework proposed for the analysis (see Table 1) distinguishes three foci: the individual, social and socio-material perspectives based on recent reviews of conceptualising professional knowledge and learning (Mulcahy, 2012). To study knowledge dynamics, the first part of this paper addressed two main questions: What are the dynamics of knowledge functions?, and What are the dynamics of knowledge structures?. These were explored from two analytical perspectives: focusing on individual teachers and on teachers as embedded in their social environment.

The individual perspective of knowledge functions is concerned with the interplay of knowledge production and use, and the processes of mediation. In this sense, teachers' engagement with and in research on teaching and learning has been of increasing concern in both policy and academic communities in many countries. In terms of knowledge structure this perspective looks at how teacher education and teaching experience influence teachers' knowledge, for example, how these facilitate dynamics between theoretical-scientific knowledge on the one hand and knowledge of applying theories in teaching practice and adapting them to classroom contexts on the other. The OECD's ITEL project started to contribute to this evidence base with international data. This perspective of knowledge dynamics can give insight into how innovation emerges and is

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diffused as new knowledge is integrated into practice, or as it is produced through observing and analysing practice.

The social perspective of knowledge functions looks at the processes of knowledge sharing and brokerage in professional communities and networks, as well as the construction of collective knowledge. In terms of dynamics of structures it captures the interplay between tacit and explicit knowledge, in particular how knowledge is managed in organisations and in wider communities. Innovation, in this view, can be considered as new knowledge and practices constructed in and/or spread across social groups, and as new forms of knowledge management. The review conducted in the first part of the paper illustrated the rich evidence base that the individual and social perspectives have yielded in the area of education. However, certain aspects of the complex dynamics of teachers' knowledge have received less attention.

This second part of the paper aims to explore the third analytical angle of the framework, the socio-material approach that has been developed more recently. This view emphasises the embeddedness of individuals not only in social groups, but more broadly, in the material world. While teachers' interaction with other actors greatly influence their knowledge, they also engage with material entities (e.g. documents, objects, technology), which equally contributes to the dynamics of their knowledge. This second part addresses the question "How does knowledge emergence?" through a socio-material lens.

While acknowledging that the framework proposed here may be partial and simplistic, and the various foci may contain overlaps, we intend to demonstrate its potential to highlight different angles of a complex phenomenon. The diversity of perspectives it represents are brought together and integrated in a complexity view of teachers' knowledge dynamics in the second half of this paper. Such an integrated approach proves useful for reflecting on the connection of innovation and knowledge dynamics under a broad systemic view.

Focus of Analysis	Dynamics of Functions: What happens to knowledge?	Dynamics of Structure: What is the interplay of different types of knowledge?	Knowledge Dynamics and Innovation: How does knowledge dynamics relate to innovation?
Individual Focus on individual actors (teachers)	Dynamics of knowledge production, use, mediation <i>Example:</i> research-practice link through engagement of practitioners in and with research	Dynamics of knowledge structure through teacher education and teaching experience <i>Example:</i> interplay between procedural and declarative knowledge	Innovation as the interplay between knowledge production and use: applying new knowledge in practice, producing knowledge based on practice
Social Focus on social groups, communities, organisations, networks of actors	Dynamics as knowledge construction, flow and brokerage <i>Example:</i> communities of practice, social networks	Dynamics of knowledge structure: interplay between explicit and tacit knowledge <i>Example:</i> organisational knowledge management	Innovation as new knowledge and practices constructed in and/or spread across social groups; innovation in knowledge management
		<b>How does knowledge emerge?</b>	
Socio-material Focus on systems of human actors and material elements	Knowledge creation, assemblages of knowledge practices <i>Example:</i> inquiry-based knowledge creation involving interactions with actors and material entities (objects, tools etc.)		Innovation as emerging knowledge practices
Complexity	Individual human actors, social groups and the elements of the material world as a system Knowledge dynamics as the complex interactions of these elements at multiple levels. Innovation, knowledge and learning as emergent phenomena.		

Table 1. Framework for knowledge dynamics and how it relates to innovation

Note: Topics coloured in grey in this table were addressed in the first part of the paper (see also Révai, 2017, p. 10.)

### *A socio-material perspective*

Investigations need to take account of the complexity of professionals’ knowledge dynamics – namely the interaction of multiple actors and elements at multiple levels. Going beyond the social perspective, recent so called “socio-material” approaches highlight the material dimension of human activity to reveal the role of objects, tools, technologies, texts, as well as bodies and actions in professional learning, practice and knowledge (Fenwick, Edwards & Sawchuck, 2012). In this sense, teachers’ knowledge is strongly influenced not only by their interactions with other teachers, but also by the way they engage with teaching materials, objects in the classroom and staff room, technology, and so on. The main characteristics of socio-material approaches include:

- taking a systemic approach of a set of interconnected human and non-human elements and examining the whole system;
- tracing interactions among human and non-human elements of the system and, through this, tracing the emergence of patterns;

- rather than focussing on attributes of the human being (e.g. consciousness or intention), understanding knowledge and learning as embedded in material action and interaction, and tracing how “knowledge, knowers and known” emerge with and in activity (Fenwick, Nerland, & Jensen, 2012).

Unlike the individual approach, in which learning is seen as acquisition of knowledge, and the social approach, wherein learning is based on participation, in the socio-material perspective learning is not simply a movement from incompetence to competence (Engeström, 2001; Engeström & Sannino, 2010). Engeström, studying primarily professionals' work-based learning, proposed the metaphor of expansive learning, to clarify that learners often learn something that is not yet there (Engeström, 2001; Engeström & Sannino, 2010). Knowledge creation in this perspective gains even more importance than in the social approach, as developing “shared objects of activity” collectively becomes the primary focus of exploring professional learning (Paavola, Hakkarainen, & Lipponen, 2004). In this sense, knowledge and learning are not viewed as discrete categories, rather they emerge from the relationships formed amongst the elements of the social and material environment (Mulcahy, 2012).

### *Dynamics of assemblages of knowledge practices*

Knowledge dynamics is a central phenomenon in the socio-material perspective; however, it cannot be discretely described as dynamics of knowledge functions or knowledge structures. This is because knowledge and learning are explored as assemblages emerging from a constantly changing configuration or network of socio-material elements. Consequently, it would be difficult to determine fixed functions or structures. Assemblages can be described as self-organising networks of actors and materialities (“socio-spatial territories”), in which “heterogeneous knowledge practices are enacted” (Blok, 2011, p. 64). For example, as teachers engage in collective inquiry of a certain practice, their learning will be influenced by the environment in which they work. The “assemblage of knowledge and learning” will be determined by the ties formed amongst them, their activities, but also by the objects and arrangements in the staff room (whether there is a whiteboard, computers and a projector, how the desks are arranged, and so on) and how teachers “interact” with them. It will also depend on whether and how teachers “connect with” resources such as teaching and learning toolkits, books, videos, etc. Similarly, the way a teacher's knowledge is then enacted in the classroom is influenced by the configurations of the classroom: the ties and relationships with the students, the material environment of the classroom and the way the students and the teacher connect with them. Such processes are also denoted by emergence, indeterminacy, collective and discursive relationships (Mulcahy, 2012).

The theory of expansive learning is an example of the socio-material approach originating in cultural historical activity theory (Engeström, 2001; Fenwick, Richard, & Edwards, 2010). The unit of analysis, the learner, is the community, and learning is a process that transforms and creates new culture. This process is characterised by horizontal movement and hybridisation, and it leads to the creation of theoretical knowledge and concepts (Engeström & Sannino, 2010). Engeström describes the cycle of expansive learning in seven actions:

1. Questioning: questioning or criticising current practice
2. Analysing the situation: finding historical and empirical causes and explanations
3. Modelling: constructing a model of the new idea
4. Examining the model: experimenting with the model
5. Implementing the model: applying in practice, enriching extending it
6. Reflecting on and evaluating the process

### 7. Consolidating the outcomes into a new stable form of practice (Engeström & Sannino, 2010).

Expansive learning has proved to be a helpful concept to study organisational change, for example when focusing on change in teachers' knowledge and practices (Sorensen, 2014), or when studying how developmental interventions affect teachers' practice (Engeström, Rantavuori & Kerosuo, 2013). As the emphasis of learning is on expanding knowledge, innovation is an inherent feature of this model. Innovativeness in learning and knowledge creation in these models require the interaction amongst agents, their activities, and also among different forms of knowledge (Paavola, Hakkarainen & Lipponen, 2004), i.e. knowledge dynamics and innovation are strongly linked phenomena. Engeström's theory has also strongly influenced the theoretical model of the Innova project (Fazekas, Halász & Horváth, 2017).

Knowledge creation models also emphasise that teachers, for their daily professional practice, need knowledge that is generated through their engagement in systematic inquiry about practice and the knowledge and theory produced by others (Mulcahy, 2012). We illustrate the dynamics of such "knowledge-of-practice" (Cochran-Smith & Lytle, 2009, p.2) through the work of a teaching community in Wales (see Box 1.). The professional learning programme put in place in this school federation involves a systematic questioning of practice, use of available theories and knowledge, the co-construction of new knowledge and practice through experimentation and negotiation, as well as the constant monitoring and evaluation of new 'knowledge practices'. The programme basically includes all actions described in the expansive learning model. Knowledge is in a constant dynamic as it emerges and is being shaped through the social interactions of teachers and leaders, but also their engagement with resources. The material environment plays an important role in these dynamics: objects (one way mirror, video cameras) and technology participate in the process of knowledge creation as teachers consciously introduce and use them. Teachers' knowledge also transforms through their engagement with a range of resources such as teaching toolkits, textbooks, objects and visuals used in the classroom and so on. This example demonstrates how tracing the dynamics through which people, material entities and the linkages between them are assembled, and how these assemblages transform and can contribute to understanding change (Fenwick, Nerland, & Jensen, 2012).

#### **Box 1. Professional learning in the Fern Federation, Wales**

*The Fern federation consists of two small primary schools in a deprived area of Wales. The schools were federated by the regional council as a school improvement strategy as both schools showed unsatisfactory results. The appointed executive headteacher having undertaken an evaluation of teaching in both schools, launched a comprehensive strategic development plan with a strong focus on professional learning aiming at improving teachers' competencies in both general and subject pedagogy.*

*Structures set up as part of the development plan include:*

- *shared leadership with a large share of the teaching staff assuming some kind of leadership role (e.g. leader of data: tracking and monitoring individual student data, following up with teachers, leader of literacy improvement)*
- *"teaching and learning workshops" every two weeks focusing on a chosen area of practice to improve*
- *co-coaching sessions (leaders of teaching and learning coach teachers to provide pedagogical support)*
- *mentoring (for teachers failing to make progress mentor sessions are in place to ensure practice progress)*

*The executive headteacher designed the professional learning programme with a focus on systematic inquiry in a strongly research-based way. Teachers work on areas of pedagogy that they identify as worth improving (for example, questioning, assessment for learning, children's engagement, collective learning). They search literature and share theoretical findings in the workshops, then collectively plan how to apply relevant theories in practice. Having experimented with new or modified practices in their classrooms, teachers then reflect on the process through joint coaching sessions. In parallel, the staff is engaged in action research on pedagogical developments that underpin their own development needs. Dedicated time is ensured for teachers to conduct (individual or collaborative) research projects, and reflect on their impact on their own learning.*

The strategic development plan also included investing in some resources and setting up a system of video-based reflection tool. Resources include:

- a classroom with a one way mirror that allows observers to watch the class without disturbing or influencing children's behaviour (see Figure 1)
- video cameras
- a video library system with individual accounts for each teacher where they can upload their recordings, add reflection notes to them and share them with other users.



Figure 1. Classroom in Craig Yr Hesg Primary School with one way mirror

The videos are used systematically as part of the professional learning programme. All teachers are required to record their lesson at least once every term and share it with the senior leadership team for the purposes of monitoring and evaluating progress. In reality, however, most teachers use the tool on a regular basis for self-improvement both individually and in teams, focusing on specific areas of development. For example, recording can be narrowed down to particular time periods of the lesson to focus on improving teachers' questioning. Several cameras can be used to record specific students or student groups, the teacher or the whole class to enable observing and analysing parallel events, or the individual learning of a student in difficulty and so on. The use of the video tool is also aligned to the thematic professional learning programme, for example, when the staff works on assessment for learning, teachers analyse recordings from this perspective.

Teachers' learning process and products (e.g. research outcomes and findings related to a theme, videos and collective reflections) are systematically stored and are accessible any time.

### Partnerships and networks

The Fern Federation is part of the Welsh pioneer school network charged with developing the new curriculum based on the principles of the Donaldson report (REF). It is also engaged in a wider local development and established a network of leaders of teaching and learning to undertake inquiry-based pedagogical development across a number of schools. The network was initially led by the Federation and progressively enabled other school leaders to lead development in their own schools. In parallel, a group of twenty schools are involved in action research with the purpose of jointly developing pedagogy relating to the Successful Futures document. The aim would be that information can be moved between schools ensuring consistency between groups of schools.

Partnerships have also been established across school levels. Currently the Federation is working with the local high school on a joint project focusing on the development of collaborative learning in grades 7 and 8. It is also a partnership school of the Cardiff Metropolitan University and in this function is charged with ensuring teaching practicum for newly qualified teachers.

Source: Box developed based on interviews conducted 13-16 March 2017 in the framework of the Welsh review of the OECD's Initial Teacher Preparation project, [www.oecd.org/edu/school/talis-initial-teacher-preparation-study.htm](http://www.oecd.org/edu/school/talis-initial-teacher-preparation-study.htm).

The three perspectives presented above – individual, social and socio-material – are strongly interconnected and a number of studies take several of these foci at the same time. Dynamics of explicit and tacit

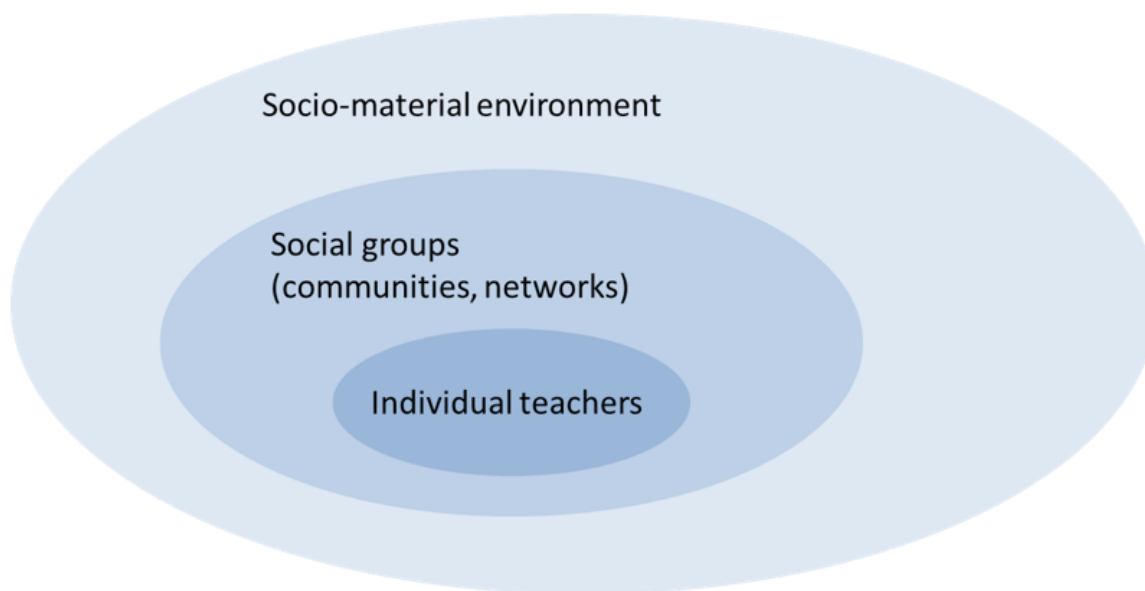
knowledge in organisational literature, for example, can be linked to the conceptualisation of professional learning as an expansive cycle. Studying practice-based innovation, Ellström (2010) proposes that the dynamics between the explicit and implicit dimensions of work can in fact be driving forces for “developmental learning” and innovation. Accounts of communities of practices have also moved beyond the social, towards the socio-material. For example, Davenport and Hall (2002) emphasise the mediating role of not necessarily tangible objects, such as multiple forms of media, in the interactions from which knowledge emerges. The authors also note that professional communities are not restricted to physically well-defined spaces, but may be dispersed. These conditions matter for the role and dynamics of tacit and explicit knowledge: while tacit knowledge might be more manifest in physically close communities, explicit knowledge and thus codification may be more important in distant ones.

The different perspectives should be viewed as complementary angles of analysis, rather than mutually exclusive theories or a linear evolution of concepts. The integrated use of these approaches is particularly useful for studying innovation and knowledge dynamics. In the following, we propose an integrated view.

### *Knowledge dynamics – a complex system*

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Individual teachers, social groups such as professional communities or networks and the whole socio-material world are multiple levels of a system embedded in one another (Figure 2). Knowledge dynamics can then be viewed as the constant emergence, transformation and movement of knowledge as a result of the complex interactions and linkages of the elements of the system within and across these levels. Some scholars classify complexity theory as a socio-material approach (Fenwick, Edwards, & Sawchuck, 2012), but in this paper, it is used as an integrated framework for the individual, social and socio-material perspectives.



*Figure 2. Embedded foci of analysis*

A growing number of studies investigate innovation, knowledge and learning in education using complexity theory. One of the main assumptions of this transdisciplinary field is that in certain systems changes do not

occur in a linear fashion. Complex systems (or complex adaptive systems) are described as a self-similar ensemble of multiple agents (such as actors or organisations) interacting at multiple levels (Duit & Galaz, 2008). The following key characteristics of such systems illustrate how a complexity view reflects teachers' knowledge dynamics as described in this paper.

**Box 2. Vignette: Knowledge dynamics as a complex system in an imaginary professional learning situation**

*A mathematics teacher reads about a method of teaching fractions using lego blocks in a toolkit on the internet. She shares this with her colleagues during a meeting of the maths department. Some of them find it is worth trying, others are not convinced how it is more effective than the methods they already use, and some even argue that playing in the classroom with lego would deviate students' attention from studying, or would undermine their authority. Collective reflection and negotiation follows, some teachers decide to experiment with the method through short activities. These teachers then share their experience, explaining the difficulties and benefits that occurred in the classroom. They collect data on students' progress in different classes ("intervention" and "control" classes). After experimentation, analysis of data, evaluation and refinement of the method, a number of teachers use the method in their own way, while some don't. A group of teachers later propose workshops on "lego for fractions" to colleagues from neighbouring schools.*

*As part of teacher collaboration, a chemistry teacher visits one of the mathematics classes in which the 'lego for maths' method is used, and thinks of how chemical reactions of atoms and molecules could also be modelled with lego blocks. He finds some teaching materials on the internet and starts experimenting with them. The positive results of using lego in teaching and learning in several subjects slowly induce reflection on, and finally implementation of, a more generally play-based pedagogy across subjects in the school.*

- **Connectivity:** the inter-connectedness and inter-relationship between multiple agents of the system, and between these agents and their environment. *In the vignette (Box. 2).* The mathematics teacher connects with an online resource, with colleagues, and teachers' relationships with students are connected to their actions, etc.
- **Embeddedness:** Complex systems are composed of embedded complex subsystems. *In the vignette (Box. 2).* Individual knowledge growth is embedded in the social construction of knowledge within the group of maths teachers, which in turn is embedded in the socio-material assemblage of knowledge practices.
- **Co-evolution:** Elements of the system change based on interactions between them. The interactions provide feedback on themselves, and on the relationships and actions in a number of steps, and these feedback loops are the drivers for the evolution of the system. *In the vignette (Box. 2).* Interaction with the toolkit produces individual knowledge growth. This affects collective knowledge through transfer, which is further constructed in the socio-material environment. Individual teachers' knowledge is then again transformed and expanded. Material elements of the system, such as the teaching method itself, change.
- **Emergent order:** The interactions of the agents result in some kind of global property or pattern that could not be predicted from any individual agent's actions or interactions. Thus unpredictable behaviours and patterns arise. *In the vignette (Box. 2).* As teachers use the adapted method in different ways, heterogeneous knowledge practices emerge from the series of actions and interactions. The method changes. Potentially local schools start connecting in new ways through cross-school workshops.
- **Cascading effects:** The interactions are non-linear, and even small changes in inputs, interactions or stimuli can cause very significant changes across the system. These moments of critical mass or thresholds that trigger large changes are called tipping points. *In the vignette (Box. 2).* If, for example, all



colleagues had opposed to trying out the method, it might have discouraged the teacher from experimenting, or the new method would have remained an individual localised innovation, and cross-institutional effects would not have occurred. (e.g. Chan, 2001; Snyder, 2013; Gladwell, 2000; Fenwick, Edwards & Sawchuk, 2012)

The above description (Box 2.) illustrates how a process of innovation (described in the vignette) can be viewed as a complex system. Indeed, numerous studies conceptualised innovation as complex systems (e.g. Frenken, 2006; Bonifati, 2010; Chae, 2012), and the link between knowledge dynamics and innovation is an important characteristic in many of these. The emergence and diffusion of innovation can be a result of the complex interactions of systems of agents (Frenken, 2006), for example through 'knowledge spillovers'. Knowledge spillovers occur as an impact of knowledge created and exchanged amongst individuals. The way the 'lego for maths' method spreads to 'lego for chemistry', and then leads to a new pedagogical approach in the imaginary situation of the vignette, is an example for internal spillover. If this then spreads to other schools, and potentially affects other sectors in the local environment (e.g. workshops organised in a library), we speak of external knowledge spillover. This case illustrates a cascading effect based on knowledge dynamics leading to innovation.

Studies of service innovation are particularly relevant for educational innovation (Halász, 2018). A conceptual paper by Chae (2012) proposes an evolutionary view of service innovation, according to which new services emerge through the recombination and/or reconfiguration of different resources and contexts, and co-evolve with existing tangible and intangible materials. The author argues that an innovation is more likely to be successful, the more collaborative interactions there are within the network of actors, and the better their competences and environmental contexts are known and are integrated. For example, parents' competencies are mapped and used in the teaching and learning process in the *Dialogue between generations* programme in the H2O school network<sup>1</sup> in Hungary. This innovation builds on the knowledge and use of actors' various competences (in line with findings from network studies reviewed earlier) and induces new configurations of actors, i.e. parents become sources of learning within the school context. It can be seen as a process of co-evolution, in which the knowledge dynamics are a deliberately generated interaction between different sources of knowledge.

As we have seen, innovation and knowledge dynamics in a complexity perspective are very much interconnected. In fact, one of the reasons for the complexity of innovation processes lies precisely in the complexity of knowledge dynamics. This has been recognised in economic literature, in particular related to territorial innovation in industries (Cowan, Jonard, & Özman, 2004; Crevoisier & Jeannerat, 2009), and studies on educational innovations have also started exploring the connection between innovation and knowledge dynamics. The Innova project constitutes an important contribution to this, by adopting a complexity perspective and by giving knowledge and professional learning particular importance in studying innovation (Fazekas, Halász, & Horváth, 2017; Halász, 2017).

## Conclusions

This paper set out to investigate how the dynamics of teachers' knowledge can be described and linked to innovation in education, and proposed three perspectives as analytical angles. The first part of the paper, published in November 2017 (Révai, 2017) reviewed two of these: the individual and the social perspectives. A fo-

1. <https://www.h2oktatás.hu/en/the-method/115-dialogue-between-generations>

cus on individual teachers allowed for studying the change and transformation of knowledge as a result of teacher education, as well as the dynamics of knowledge production, use and mediation in the teaching profession. The knowledge dimension of innovation in this view is interested in how new knowledge becomes integrated into practice, as well as how it is produced based on practice. The social perspective takes account of the social construction of knowledge, and the dynamics in terms of knowledge sharing and brokerage in professional communities and networks. The interplay between tacit and explicit knowledge is of particular concern for knowledge management in organisations or wider communities. Innovation can here be considered as new knowledge and practices constructed in and/or spread across social groups, but also as new ways of managing knowledge. This second part of the paper investigated the third, socio-material perspective, that highlights the importance of the material world and explores the emergence of knowledge and learning from the interaction of human actors (e.g. teachers) with each other, as well as with the tangible and intangible entities that surround them (e.g. desks, documents, tools, technology). Innovation is linked to emerging knowledge practices in the socio-material view.

While some studies present these perspectives as different metaphors for knowledge and learning, or as an evolution of these concepts (Paavola, Lipponen & Hakkarainen, 2004; Mulcahy, 2012), this paper has shown that they all contribute to better understanding teachers' knowledge dynamics. Through the analytical lens of knowledge dynamics, these different angles are thus complementary rather than mutually exclusive. Complexity theory was proposed as a theoretical framework that can integrate the individual, social and socio-material approaches. A complexity view has been found useful for investigating innovation and knowledge dynamics, as well as the ways in which these two concepts are interlinked.

This review of research has shown that different approaches contribute to understanding how teachers' knowledge is created, how it emerges from the interactions of agents in the social and material world. Evidence that links the individual, social and socio-material perspective and studies knowledge dynamics in its complexity seems weaker. Since the dynamics of teachers' knowledge are closely linked to innovation, being a driver, a major component and a consequence of innovation at the same time, more research in this domain would also contribute to facilitating innovation in education. Therefore, endeavours such as the OECD's ITEL project or the Innova research in Hungary are important pieces in educational research and have a great potential to inform the design of education reforms and development interventions, or lead to the upscaling of local innovations. Ultimately, future research should also aim to measure the impact of knowledge dynamics on student learning.

## References

1. Blok, A. (2011). War of the whales: Post-sovereign science and agonistic cosmopolitics in Japanese-global whaling assemblages. *Science, Technology and Human Values*, 36(1), 55–81.
2. Bonifati, G. (2010). "More is different", exaptation and uncertainty: three foundational concepts for a complexity theory of innovation. *Economics of Innovation and New Technology*, 19(8), 743–760.
3. Chae, B. (Kevin) (2012). An evolutionary framework for service innovation: Insights of complexity theory for service science. *International Journal of Production Economics*, 135(2), 813–822.
4. Chan, S. (2001). Complex Adaptive Systems, ESD.83 Research Seminar in Engineering Systems, October 31, November 6, 2001. Retrieved from: <http://web.mit.edu/esd.83/www/notebook/Complex%20Adaptive%20Systems.pdf>
5. Cochran-Smith, M. & Lytle, S. L. (2009). *Inquiry as stance: Practitioner research for the next generation*. New York, NY: Teachers' College Press.

6. Cowan, R., Jonard, N. & Özman, M. (2004). Knowledge dynamics in a network industry. *Technological Forecasting and Social Change*, 71(5), 469–484.
7. Crevoisier, O. & Jeannerat, H. (2009). Territorial Knowledge Dynamics: From the Proximity Paradigm to Multi-location Milieus. *European Planning Studies*, 17(8), 1223–1241.
8. Davenport, E. and Hall, H. (2002). Organizational knowledge and communities of practice. *Annual Review of Information Science and Technology*, 36(1), 170–227.
9. Duit, A. & Galaz, V. (2008). Governance and Complexity—Emerging Issues for Governance Theory. *Governance: An International Journal of Policy, Administration, and Institutions*, 21(3), 311–335.
10. Ellström, P-E. (2010). Practice-based innovation: a learning perspective. *Journal of Workplace Learning*, 22(1/2), 27–40.
11. Engeström, Y., Rantavuori, J. & Kerosuo, H. (2013). Expansive Learning in a Library: Actions, Cycles and Deviations from Instructional Intentions. *Vocations and Learning*, 6(1), 81–106.
12. Engeström, Y. & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, 5(1), 1–24.
13. Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14(1), 133–156.
14. Fazekas, Á., Halász, G., & Horváth, L. (2017). Innováció az oktatásban: az Innova kutatás elméleti-fogalmi keretei. (*Innovation in Education: the Conceptual and Theoretical Framework of the Innova Research Project*). *Neveléstudomány* 20(4), 26–43. Retrieved from: <http://nevelstudomany.elte.hu/index.php/2017/12/innovacio-az-oktatasban-az-innova-kutatas-elmeleti-fogalmi-keretei/>
15. Fenwick, T., Edwards, R. & Sawchuck, P. (2012). *Emerging Approaches to Educational Research: Tracing the Socio-Material*. Routledge.
16. Fenwick, T., Nerland, M., & Jensen, K. (2012). Sociomaterial approaches to conceptualising professional learning and practice. *Journal of Education and Work*, 25(1), 1–13.
17. Frenken, K. (2006). Technological innovation and complexity theory. *Economics of Innovation and New Technology*, 15(2), 137–155.
18. Gladwell, M. (2000). *The Tipping Point: How Little Things Can Make a Big Difference*. Boston, New York, London: Little, Brown and Company.
19. Guerriero, S. (ed.) (2017). *Pedagogical Knowledge and the Changing Nature of the Teaching Profession*. Paris: OECD Publishing.
20. Halász, G. (2018). Innovációs folyamatok a magyar oktatási rendszerben. *Neveléstudomány*, 21(1), 18–41.
21. Mulcahy, D. (2012). Thinking teacher professional learning performatively: A socio-material account. *Journal of Education and Work*, 25(1), 121–139.
22. Paavola, S., Lipponen, L. & Hakkarainen, K. (2004). Models of Innovative Knowledge Communities and Three Metaphors of Learning. *Review of Educational Research*, 74(4), 557–576.
23. Révai, N. (2017). Teachers' knowledge dynamics and innovation in education – Part I. *Neveléstudomány*, 20(4), 7–25.
24. Révai, N. & Guerriero, S. (2017). Knowledge dynamics in the teaching profession, In *Pedagogical Knowledge and the Changing Nature of the Teaching Profession*. (37-72.) Paris: OECD Publishing.
25. Sonmark, K, Révai, N., Gottschalk, F., Deligiannidi, K. & Burns, T. (2017). Understanding teacher's pedagogical knowledge – Report on an international pilot study. *OECD Education Working Papers*, Paris: OECD Publishing.

## *RÉVAI, Nóra: Tanári tudásdinamika és oktatási innováció – 2. rész*

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A tanári tudás dinamikus: folyamatosan alakul az új információk, a kollégákkal való együttműködés, az osztálytermi gyakorlat fényében, a tanítási eszközök, tankönyvek használata révén, stb. Jelen tanulmány az OECD Innovatív Tanítás a Hatékony Tanulásért (ITEL) projektjének keretén belül végzett kutatáson alapul, és azt vizsgálja, hogy hogyan írható le ez a tudásdinamika. A szakirodalmi áttekintés célja, hogy feltárja a tudás funkcióinak és struktúrájának, valamint keletkezésének dinamikáját leíró folyamatokat. Mindezt, három különböző szemszögből elemzi. A tanulmány első része (megjelent: Neveléstudomány 2017. 4. szám) az egyéni és a társas aspektusokat vizsgálja, melyek illusztrálására az ITEL project kísérleti szakaszában gyűjtött adatokat használjuk. A tanulmány jelen második része a társas-materiális perspektívát elemezi, valamint a három szempontot a tudásdinamika és az innováció komplexitáselméleti megközelítésében integrálja. Az integrált szemlélet megvilágítja az oktatási innováció és a szakmai tudás dinamikájának kapcsolatát.

**Kulcsszavak:** tanári tudás, tudásdinamika, szakmai tanulás, innováció