



## **Summary of the Symposium**

# **“Teachers as Learning Specialists – Implications for Teachers' Pedagogical Knowledge and Professionalism”**

**Brussels, Belgium  
18 June 2014**

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The symposium co-organised by the OECD in the framework of the Innovative Teaching for Effective Learning (ITEL) project and by the Department of Education and Training of the Flemish Ministry focused on teachers' knowledge base. The main objective was to get a good understanding of how teacher knowledge can be conceptualised and measured and what elements might influence this knowledge. The themes also included the potential of integrating new findings from the Science of Learning (e.g., in particular, the neurosciences) in this knowledge and what impact the increasing demand on teaching 21<sup>st</sup> century skills might have on teacher knowledge. The discussion also explored the prospective consequences of the above themes on teacher education.

## Opening session

The meeting was opened by **Micheline Scheys**, the Secretary General of the Education and Training Department within the Flemish Ministry. After welcoming the participants she emphasised the importance of teachers' quality, teachers being key for students' learning, outcomes and well-being. She pointed out that educational policies must focus on teacher education including initial training as well as continuous professional development.

Ms. Scheys spoke about the outcomes of multiple stakeholder working groups commissioned by the Flemish Ministry and charged with developing recommendations on teacher training in Flanders. The conclusions of these groups reflect the approach of the OECD ITEL project insofar as they see teachers as learning specialists. The importance of the pedagogical knowledge of teachers for being able to respond to the unique needs and effectively support the learning of each and every student was stressed by the working groups.

Ms. Scheys drew the attention to the complexity of teacher knowledge, as it draws on a variety of sources (previous experience, collaboration with colleagues, formal and informal learning, research etc.) and is thus idiosyncratic. She explained that due to this complexity the content and the dynamics of teacher knowledge often remain implicit, and emphasised that making this explicit is crucial to leverage opportunities to reflect on teacher knowledge and contribute to building a collective knowledge base on learning.

**Dirk Van Damme**, Head of the Innovation and Measuring Progress (IMEP) division and of the Centre for Educational Research and Innovation (CERI) of OECD Directorate for Education and Skills, addressed a keynote framing the symposium questions in the wider context of OECD work on teachers. He explained that knowledge dynamics in a profession is key for the turn-over of collective knowledge, therefore understanding the nature of knowledge dynamics in the teaching profession can contribute to updating teachers' knowledge base. He used TALIS data to demonstrate that teachers, whether they are early career teachers or experienced, think in a rather similar way; suggesting that the knowledge base in teacher education programmes is not being updated. Moreover, very few teachers feel supported in their innovative practices. He emphasised that new teachers could be the carriers of more recent research into the profession and it is crucial to update teacher education to train teachers who can adequately answer the new challenges of the society.

Mr. Van Damme also stressed that the pedagogical knowledge base of teachers does not directly translate into practice. A multitude of intermediary processes such as values and belief systems, rules of conduct, etc. come in between. As a result, the future ITEL study will not immediately translate into visions on teaching quality.

Dirk Van Damme then described how the ITEL project aims to tackle the theme of teacher knowledge and presented the main phases of the project: having concluded the conceptual work, the ITEL team is going to work on developing a measurement instrument in 2014-15, the project will then enter the phase of implementation and data collection, and results will be analysed and reported on in 2016.

**Sonia Guerriero**, the Chair of the symposium and the ITEL Project Lead, introduced the main questions the symposium aims to address:

- How is teachers' general pedagogical knowledge conceptualised? Can it be measured?
- How do teachers' motivations and beliefs about teaching relate to teacher knowledge and how can these relationships be measured?
- Does the knowledge base of teachers sufficiently incorporate the latest scientific research on learning?
- Does teachers' knowledge base meet the expectations for teaching and learning '21st century skills'?

## Expert presentations I – Conceptualising and modelling teacher knowledge

### 1) Modelling teachers' professional competence as a multi-dimensional construct

**Sigrid Blömeke** (Humboldt University of Berlin) gave the first talk entitled *Modelling teachers' professional competence as a multi-dimensional construct*. She emphasised that teachers' general pedagogical knowledge (GPK) is one facet of the complex construct of professional competence, and that researchers now agree that this competence is multidimensional and does not only include cognitive dispositions but also affective-motivational characteristics. In her presentation she showed some of the instruments developed to assess teachers' general pedagogical knowledge, drew the attention to the challenges of measuring GPK and gave recommendations for the future ITEL study.

Blömeke introduced in more details the TEDS-M study, which is a large scale assessment of teacher knowledge carried out across 16 countries by the International Association for the Evaluation of Educational Achievement (IEA). In this study GPK was conceptualised in the following 4 dimensions:

- *Structuring lessons / lesson planning*: components of lesson planning and lesson process; lesson evaluation; structuring of learning goals,
- *Motivating students / classroom management*: achievement motivation; strategies to motivate single students/the whole group; strategies to prevent and counteract interferences; effective use of allocated time/routines,
- *Adaptivity*: strategies of differentiation; variety and use of teaching methods,
- *Diagnosing student achievement*: assessment types and functions; central criteria; teacher expectation effects.

The dimensions were measured along 3 cognitive processes: recalling, analysing and creating/generating. The instrument was validated and the coding schemes were developed by diverse expert panels.

In the second part of her talk Ms. Blömeke highlighted the difficulties and challenges of measuring GPK and shared her ideas on how such studies may be improved. The following limits of measuring GPK were mentioned:

- The face validity with practitioners is quite low resulting in substantial proportions of non- or missing responses.

- There is a gap with respect to transformation into classroom performance (she referred back to Dirk Van Damme's point about the intermediary processes). These mediating processes might need to be addressed with innovative assessments.
- General pedagogical knowledge (PK) is only one facet with regards to student achievement, and this only with respect to classroom management. Student achievement is always content related (achievement in mathematics, second language etc.). There is evidence that PK is necessary but not sufficient to increase student achievement. The huge gap with respect to student achievement might be a threat to the construct validity in many respects. This needs to be addressed by including other facets of teachers' knowledge.

Finally, Ms. Blömeke gave some recommendations for the future ITEL study:

- 1) Apart from paper and pencil tests on cognitive aspects, it would be important to include situation-specific skills.

She explained the Perception, Interpretation and Decision-making (PID) model and suggested that the model might help to understand how the cognitive dispositions are transferred into observable behaviour in the classroom. Ms. Blömeke showed some studies using video-based assessment to capture PID, but also drew the attention to the challenges of applying video-based tools in a large-scale international study.

- 2) Do not only focus on GPK, but include at least pedagogical content knowledge (PCK).

Ms. Blömeke emphasised that student achievement is always situated in the content domain, thus the key factor is PCK. She supported her argument by highlighting results (with mathematics teachers) that gave evidence on the substantial impact of PCK on the curricular level of tasks the teacher uses, the cognitive demand in the classroom and the achievement of students in mathematics. All the studies mentioned showed that it was PCK that had the largest effect size on student achievement (mediated by instructional quality and larger than pure content knowledge).

She added that it is general pedagogical knowledge that predicts how well a teacher manages his/her classroom, which is a necessary precondition (although not sufficient) for higher student achievement.

[Sigrid Blömeke's slides](#)

### *Discussion*

James Pellegrino (University of Illinois) asked whether PID, which is mediating between knowledge and behaviour, is general or content specific. Sigrid Blömeke argued that there are two perspectives: on the one hand it is content related if we model instructional processes and thus must be domain-specific. On the other hand there is the generic perspective of classroom management, which can be assessed in a more general way. She added that in the TEDS-M study two scales were developed: classroom management and mathematics teaching.

Sonia Guerriero (OECD/CERI) asked what other psychological variables would fit in the model presented (referring to slide no. 15), what important factors should teachers know about. Ms. Blömeke underlined that to do well with respect to 'motivating students/classroom management' and 'diagnosing student achievement' a teacher needs to bring together different psychological knowledge pieces among which are developmental psychology and educational psychology. These play an important role in the test as well.

Kirsti Klette (University of Oslo) commented that in the presented model (referring to slide no. 15) there was no connection between individual learning support and students' mathematics achievement, despite the fact that individual support is being strongly emphasised in practice. Sigrid Blömeke explained that, in fact, the study she referred to didn't show significant effects of individual learning support on students' mathematics achievement. However, she warned the audience not to over-interpret the results, as other studies (e.g., by Hattie, 2009) show that strong individual support and feedback do have a strong effect on student achievement. She added that results also depend on how the data is collected, and stressed that this study is reliable to assess instructional quality but without classroom observation it has limits as to evaluating individual learning support.

## 2) Motivations for teaching and relationship to general pedagogical knowledge

The second talk was given by **Johannes König** (University of Cologne). The presentation entitled *Motivations for teaching and relationship to general pedagogical knowledge*, focused on the other main component of teacher competence: the affective-motivational one. He introduced the FIT-choice motivational model and presented the findings of two studies that investigated the impact of various motivational factors on GPK, as well as the hierarchical relationship between these factors.

Building on the previous presentation, Mr. König first presented some follow-up studies carried out using the TEDS-M instrument of measuring GPK. He explained that longitudinal studies carried out in Germany gave evidence that the instrument is not restricted to pre-service teachers but is also applicable for early career teachers. The validity of this instrument was equally confirmed by the results of an Austrian study, which found correlations between the GPK of the teacher and the students' ratings of the instructional quality.

After the introduction, Mr. König focused on teachers' motivation (TM) as an element of their professional competence. He emphasised that TM is relevant firstly because it is an important requirement of professional teachers, secondly, because teacher shortages urge us to find answers to why young people don't choose teaching as a career or why they drop out early. In his talk, Mr. König presented the FIT-choice model of measuring motivation and summarised the results of two studies he and his colleagues carried out linking motivation for teaching and GPK.

The main components of the FIT-choice scale, developed by Watt and Richardson, as Mr. König explained, are self-reports on individual ability related to teaching, individual values, professional beliefs, anticipated advantages, salary, external influences and prior experiences. (See the conceptual framework on Slide no. 10)

The first study presented examines possible effects the FIT-Choice motivational factors have on the acquisition of the GPK of pre-service teachers during initial teacher education. Student teachers' GPK was measured at two occasions in an academic year. Mr. König highlighted the following findings:

- In terms of GPK a large learning gain could be observed within the academic year.
- Regarding correlations between the FIT-Choice scale and GPK, on the whole motivations and knowledge were not closely connected. Nevertheless, some correlations were observed:
  - At both occasions of measurement the highest correlations was between motivation to 'work with children' and knowledge.
  - 'Perceived teaching ability' and 'intrinsic value' were both significantly correlated with knowledge at the second measurement time but not at the first.

- At the first measurement time the extrinsic motivations: ‘job security’, ‘salary’ and motivation of choosing teaching as a ‘fallback career’ were negatively correlated with knowledge,
- ‘Job security’ motivation showed a significant effect on the learning gain between the two occasions of measurement, whereas the other scales did not.

In order to distinguish between direct and indirect motivational effects<sup>1</sup> on attainment, in the second study Mr. König presented, the effects of the FIT-Choice motivational factors on GPK were investigated using a mediation model (for details see Slide no. 15) based on a hierarchical model of achievement motivation (by Elliot and Church). In the model achievement motivation (hope for success vs fear of failure)<sup>2</sup> and goal orientations (learning goal, performance approach and performance avoidance)<sup>3</sup> will mediate between motivations for choosing teaching as a career (intrinsic motivation to become a teacher vs. choosing teaching as a fallback career) and GPK.

Mr. König then summarised the hypotheses and results of his study carried out with more than 6000 pre-service teachers in Germany, Switzerland and Austria. He highlighted the two main research hypotheses:

*Hypothesis 1* Pre-service teachers who choose teaching as a fallback career and report little intrinsic value will have lower GPK.

*Hypothesis 2* The learning goal orientation has a positive and direct effect on GPK. Hope for success motive predicts the learning goal orientation directly, whereas the intrinsic value indirectly.

The main findings were presented as follows:

- At the start of teacher education, motivations for choosing teaching as a career and GPK were only loosely inter-correlated.
- *Hypothesis 1* was confirmed: Future teachers’ motivation to choose teaching as a fallback career is negatively correlated, whereas intrinsic value and perceived teaching abilities are positively correlated with their GPK (esp. in Germany and Austria).
- *Hypothesis 2* was also confirmed: For all 3 countries goal orientations have a mediating function (although in Switzerland in a slightly different way as in Germany and Austria).

Mr. König concluded with some recommendations for future studies on teacher knowledge and motivation:

- 1) Teaching motivations together with other non-cognitive constructs should be taken into account when examining teacher knowledge.
- 2) The actual effects of teaching motivations and the interplay of knowledge and motivation for providing high opportunity to learn for students and student achievement is an area to study.

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<sup>1</sup> Direct effects refer to the actual learning behaviour such as time spent on task or information processing, whereas indirect effects are mediated by educational decisions such as selecting an educational program or course.

<sup>2</sup> Following the classic achievement motivation, activity in achievement settings may be oriented toward the attainment of success or the avoidance of failure. These motives are reflected by two scales applied.

<sup>3</sup> Learning goals describe the learner’s goal to increase his or her competence when doing an academic task. Goal orientations related to performance goals can be differentiated into *performance-approach goals* (the goal of an individual demonstrating his or her competence relative to others) and *performance-avoidance goals* (the goal of avoiding looking incompetent at a task). Learning goals, performance-approach goals, and performance-avoidance goals often make up a trichotomous framework and are measured using three scales.

- 3) In light of the results of the first study, a broad normative discourse about the 'good' teacher should be challenged, and future research should aim to unravel the relationship between motivation and teaching.

### [Johannes König's slides](#)

#### *Discussion*

Sigrid Blömeke commented that there may be a reciprocal effect between motivation and knowledge: while motivation increases knowledge, knowledge may increase motivation in turn, and asked whether there was data from a 3rd measurement time point. Johannes König explained that the study started in 2011, and there would be a 3rd measurement point probably next year (even a 4th one is envisaged 2 years later), with all constructs included. He said that data from the second one is already available, but not yet ready to be presented. He agreed that it would be interesting to investigate the interplay between the various motivational constructs and those with the knowledge in a longitudinal analysis.

Sigrid Blömeke asked whether there is evidence that the FIT-choice scale works in countries with a different cultural context, e.g. Asian countries. Johannes König said that so far besides Western countries, studies have been conducted in the Asian context, e.g. in China, and more are being conducted currently<sup>4</sup>. He emphasised that the meaning of such scales certainly varies across cultural contexts and brought the example of differences in the admission to teacher education programmes (e.g. a low entry selection to these programmes in Germany, whereas in Finland students with specific background and motivation are recruited to the teacher profession). He agreed that further research is needed to see how the scale works in each context.

### **3) Teacher responsibility and its ties to pedagogical knowledge and professionalism**

The third speaker, **Fani Lauermann** (University of Michigan, USA and University of Bonn, Germany) focused on another important element influencing teacher knowledge and scarcely investigated in research: teachers' professional responsibility. She started with clarifying the term learning specialist and professional responsibility, then presented a study (measurement tool and results) she and her co-authors had carried out that investigated the implications of a sense of responsibility for teaching. She summed up her talk by suggesting directions for future research.

Fani Lauermann defined a 'teacher as learning specialist' as someone who is knowledgeable about and can use (general and content-specific) research-based principles of effective teaching. She then synthesised these principles on the basis of research literature highlighting 3 main categories that appear in most lists: social factors influencing learning (e.g., teacher-student relationships), instructional processes influencing learning (e.g., monitoring students' understanding), and motivational processes influencing learning (e.g., mastery orientation toward learning; see Slide no. 3). She then focused on professional responsibility and identified a sense of obligation, a sense of commitment and willingness to hold oneself accountable for which one is responsible as the unique ingredients of responsibility.

Ms. Lauermann showcased some existing research evidence that connect responsibility with factors such as motivation for teaching, self-efficacy, job satisfaction or job performance. She highlighted

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<sup>4</sup> Further details in the Special Issue on Fit-Choice in the Asia-Pacific Journal of Teacher Education, 2012, issue 3.

various challenges of measuring responsibility, in particular she drew the attention to the confusion of the terms responsibility and efficacy, thus measuring more abilities rather than responsibility. Several measures have been developed. Ms. Lauermaun went on to introduce a measurement tool she developed with her colleagues that has been used in 6 countries with pre-service and in-service teachers and that demonstrated the distinction between responsibility and efficacy.

The tool presented conceptualises responsibility as a multidimensional construct and measures it with items based on hypothetical and negative situations to capture the aspects of critical self-judgement and the willingness of being held accountable for outcomes. The study Ms. Lauermaun presented focused on 4 types of outcomes: student motivation, student achievement, positive relationship with students, and teaching and seeks to answer the question:

*Does responsibility have implications for teachers' approaches to teaching, as perceived by:*

- (a) teachers?
- (b) students?

Concerning teachers' perceptions the following results were highlighted about teachers with a strong sense of personal responsibility:

- They report more positive emotions towards teaching: they teach with more enthusiasm, they enjoy the work more.
- They focus more on mastery in the classroom. They emphasise hard work in the classroom, that every child can learn, task mastery and personal improvement.
- They endorse more autonomy-supportive practices such as providing rationales to students, telling students why they have to learn something.
- Responsibility has also been linked to professional commitment and planned persistence, which indicates a higher level of engagement in the teaching profession.

Concerning students' perceptions the study investigated three aspects: perceived teacher enthusiasm, mastery-oriented instruction (the teacher places emphasis on effort, task mastery, and personal improvement) and paying attention to all students vs. differential treatment (the teacher does not prioritise e.g. strong/high achieving students). The main results presented were:

- Teacher efficacy alone failed to predict how their instruction was perceived by students (how capable a teacher felt did not matter in terms of how their students perceived their teacher's practices).
- The more teachers think themselves capable the more likely they were to assume responsibility for student outcomes and for the quality of their teaching.
- Responsibility is a negative predictor of differential treatment for 3 out of the 4 factors (responsibility for student achievement, relationships and teaching), the strongest predictor is responsibility for student achievement (as expected).
- Responsibility for having positive relationship with students is a positive predictor of mastery-oriented instruction (consistent with prior evidence) and also of teacher enthusiasm – the only factor that positively predicted this latter.

Finally, Ms. Lauermaun outlined some directions for future research: to examine latent profiles of teacher responsibility, to study the combined effects of responsibility factors on approaches to instruction, to focus on student responsibility (in fact, the scale has been adapted to measure students' personal responsibility and first studies show implications of responsibility for students' self-regulation, expectancies and values, intrinsic motivation, achievement). She explained that the

long term objective is to connect the two lines of research and examine the combined effects of teachers' as well as students' responsibilities on various educational outcomes.

### [Fani Lauermann's slides](#)

#### *Discussion*

A participant asked about how this responsibility could be changed or improved, what examples there were of designing a training course or intervention. Fani Lauermann explained that the main predictor of willingness to assume responsibility was job autonomy (evidence based on organisational literature – the largest body of research on responsibility). She argued that when teachers are provided with structure, with meaningful job tasks, and are empowered to make decisions on how they provide instructions, they are willing to assume responsibility for what's happening in this classroom. She added that there is little evidence when it comes to designing courses, she contended that how teachers conceptualise their professional roles; whether we can teach about responsibility; why it is important to establish positive relationships with students are to be considered when approaching this question. Concerning research evidence connecting different systems of beliefs such as teacher efficacy and responsibility, Ms. Lauermann stated that in general, if we are capable of producing certain outcomes we are more likely to assume responsibility for those outcomes. She underlined motives for teaching as the third predictor and referred back to Johannes König's talk. In her study, they also used the FIT-choice scale and found that it is not intrinsic motivation that predicts responsibility, but rather social motives for teaching such as the desire to provide a service to society, altruistic motives, working with children.

A participant referred to Carol Dweck's work on the theories of implicit intelligence that people (e.g. student teachers) hold, which showed strong correlations between holding some of these theories and feeling responsibility or self-efficacy. He asked whether Dweck's theories of implicit intelligence, and the possibilities of developing intervention schemes based on scientific theories of intelligence or the entity theories have been considered. Fani Lauermann said that there was no substantial empirical evidence on that, Dweck's studies have not focused specifically on responsibility. However, she agreed with the conceptual reasoning. She argued that assuming responsibility especially in advance was risky, if something goes wrong you would be to blame for the outcome. If teachers take into account considerations like being blamed for what types of responsibility they assume, then implicit theories of ability or entity theory of ability should make a difference. If one considers teaching a learning opportunity then it is not as risky to assume responsibility, while if one believes in fixed abilities, there is not much he/she can do in the face of failure.

A participant inquired about the effects of the learning environment, and asked whether an innovative learning environment makes teachers feel more responsible. Fani Lauermann thought that based on some qualitative studies not specifically measuring responsibility but teachers' identity it should. In addition, she referred to Guskey's work in which he linked teachers' sense of responsibility for student learning to the willingness to implement innovative instructional practices. Nevertheless, she didn't think there is enough evidence to claim that there is a clear connection.

James Pellegrino asked whether the measures of teachers' responsibility were significantly influenced by or characteristic to school leadership or school climate. He wondered if responsibilities are characteristics of teachers that they bring with them or characteristics that are mediated by the environment. Fani Lauermann explained that she had been convinced that responsibility was not

something that you bring in the classroom but that is strongly influenced by the specific context. However, in one of her ongoing studies she and her colleagues found substantial differences between teachers within the same school. She said to have been shocked to find nearly no correlations with the school characteristics such as perceived principal support. Ms. Lauer mann added however, that the school context was related to teacher-reported obligation to fulfil the school objectives, to contributing to the school environment and to job satisfaction. This may suggest that the context matters more for felt responsibility toward the school, but less for felt responsibility toward students (which may be something that transcends the specific school context and may be part of teachers' professional identity).

### Panel discussion on the conceptualisation and modelling of teacher knowledge

**Fien Depaepe** (Katholieke Universiteit Leuven, Belgium) moderated the panel discussion, in which the morning speakers (Sigrid Blömeke, Johannes König and Fani Lauer mann) debated questions related to the conceptualisation and measurement of teacher knowledge. Ms. Depaepe began with summarising the different perspectives presented in the talks also integrating Tamar Voss's work – an invited speaker who could not eventually be present at the symposium. She included the main conceptualisations in a single scheme (see for details [Fien Depaepe's slides](#)).

The first question investigated whether it makes sense to distinguish between general pedagogical knowledge (GPK) and pedagogical content knowledge (PCK) in conceptualisation and in measurement if the two are simultaneously used by teachers to make decisions in the classroom. The panellists all agreed that it was important to distinguish between these concepts despite the overlap between them. They brought together three main arguments. Firstly, from an analytical point of view, the three are not one homogeneous construct. Also, for measurement purposes (e.g. item development) they have to be clearly defined so as not to be confused. Results of previous studies confirmed the theoretical differentiation that goes back to Schulman's work in the 80s. Secondly, when it comes to teacher education, the different types of knowledge are acquired through different opportunities to learn and entail the acquisition of different skills. Thirdly, Johannes König mentioned a pragmatic argument, that is, GPK is the only one that is independent of the subject taught, thus studying it separately has the advantage of being able to carry out cross-disciplinary analyses<sup>5</sup>.

Ms. Depaepe commented that most studies have investigated mathematics teachers so far and her second question referred to the generalisability – to different subjects, levels and cultures – of the different dimensions of knowledge and the measurement instruments. Johannes König pointed out that the TEDS-M study was realised in three different educational cultures (Asia, US, Central-Europe) and both at elementary and lower secondary levels, whereas Sigrid Blömeke mentioned research in Germany that extended the use of the TEDS-M instrument to measure the GPK of German and ESL teachers as well. Furthermore, in these studies the CK and PCK of German and ESL teachers was assessed and the Shulman model could be confirmed once more. It was also emphasised however that the application of these instruments is currently limited to formal school context, thus in

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<sup>5</sup> Mr. König's remark to the summary report: the analyses presented on the relation between GPK and motivation were all based on pre-service teachers with all subjects (not bound to e.g., mathematics like TEDS-M).

kindergarten it probably would not prove to be valid<sup>6</sup>. Concerning the measuring of teacher responsibility, Fani Lauermann underlined that the questionnaire was used across subjects and levels, although for non-academic subject teachers (e.g. music, PE) some adjustment was necessary.

The third topic concerned the reliability - validity paradox: taking into account the complexity and situated nature of the classroom, how can we measure PK without looking at how it is manifested in action. Sigrid Blömeke emphasised that in order to come close to instructional quality and to increase the validity of assessments we do need to go beyond tests that assess cognitive dispositions only, even though it is harder to develop these kinds of tests with respect to sufficient reliability. Ms. Lauermann agreed that looking at the teachers' practices as an independent observer would give another perspective also to study teacher responsibility. Mr. König added that the use of different assessment tools also depends on the objectives of the study. He stressed that video-based assessment is very challenging for international studies because of the different contexts and different classroom language.

Fien Depaepe commented that while there seems to be agreement on what CK is, the picture is less clear what concerns PCK, and even less about GPK, and raised the question of how to proceed towards a general consensus about what teachers should know. Ms. Blömeke argued for bringing together experts from different fields, countries and paradigms and let them negotiate. According to Ms. Lauermann educational researchers do have substantial knowledge on what effective teaching is, she thought the main question was rather how we educate teachers, what toolbox we provide them with.

The panel went on to talk about the impact of the various elements of teacher competence on the quality of instruction. Johannes König cited analyses, which proved the separate impact of GPK on classroom management. Sigrid Blömeke suggested that student outcomes were not only about cognitive outcomes, and said it would be interesting to measure the influence of teachers' affective-motivational characteristics such as motivation and responsibility (controlled for teacher knowledge) on student learning. She strongly emphasised that only by bringing all the elements of teacher competence together can we capture the effects appropriately. Otherwise a risk exists to underspecify the models. Concerning the relationship between the different cognitive aspects, the experts underlined that both CK and GPK are correlated with PCK, which is placed somewhere in between the other two and agreed about the importance of PCK.

The last topic addressed teacher education and professional development questioning how it should be organised to effectively improve GPK. Ms. Blömeke differentiated between the role of pre-service training and CPD, arguing that the main task of the first is to develop teachers' cognitive dispositions whereas in-service teachers have the chance to go back to their classroom and practice what they have learnt. Therefore the challenge there is to help them integrate all the different facets of knowledge and apply it in the classroom, as well as facilitate reflection in a professional learning community. Mr. König shared an example from Germany, where teachers tend to have difficulties to understand what the students bring in the classroom. The challenge there for teacher education according to him, is to go beyond teaching general pedagogical knowledge and skills (e.g. planning a lesson in general), and help teachers acknowledge and build on students' characteristics. Fani

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<sup>6</sup> Ms. Depaepe's remark to the summary report: In countries where kindergarten is not part of formal schooling.

Lauermaun brought in a completely different perspective and suggested that besides talking about what makes a difference for the students, it is equally crucial to recognise the teachers' needs, their sense of autonomy, motivation etc. in order to have fruitful and effective professional development.

## Expert presentations II – New demands to teacher knowledge

### 4) Why should teachers care about neuroscience?

**Daniel Ansari** (University of Western Ontario) focused on the potentials of teaching teachers about cognitive neurosciences in education. He started with showing evidence for brain plasticity, that is the capacity of the brain to adapt to the particular environment of the individual. He then continued with demonstrating that experience-dependent brain changes can be used to study effects of interventions and in parallel he explained the dangers for teachers with a lack of neuroscientific knowledge. He equally presented counter arguments and fears about connecting neurosciences and education, and finally he argued that training teachers in mind, brain and education can lead to a better understanding of their learners and potentially higher quality instruction.

To explain why neurosciences can be interesting for education Mr. Ansari built on the notion of experience-dependent plasticity, that is neuronal circuits are shaped by experience, which would also mean that teachers become the 'orchestrators of neuronal plasticity'. He showed various studies (how brain regions responsible for memory and spatial learning of taxi-drivers develop with experience, or how broad contextual variables such as urbanicity shape the way in which the brain responds to e.g. emotional stimuli, etc.) that prove plasticity. Evidence was also presented related to neuroprognosis: by measuring (with e.g. neuroimaging) the brain activity and brain structure, individual differences in the response to intervention can be predicted. For example the volume of the hippocampus can predict performance gain during an intervention; diffusion tensor imaging proved that the brain is able to set up compensatory mechanisms (a region not typically associated with the skill being improved in the intervention developed), in order to allow children with weak e.g. reading skills to benefit from the intervention.

Next, Mr. Ansari illustrated that neuroimaging can explain more than behavioural measures alone. In his study conducted with students doing the PSAT test<sup>7</sup> (mathematics exam preparing for the SAT), he measured students' single digit arithmetic skills and analysed brain imaging data. Behavioural measures – reaction time level and accuracy – showed no correlation between fluency in arithmetics and PSAT results, however brain network structure for arithmetics did influence subsequent learning:

- The more inefficient a student activates their brain during single digit arithmetics (the brain region associated with quantity representations and procedural problem-solving (the right intraparietal sulcus) is less activated), the poorer they do on the PSAT test.
- Students who used their brain region associated with fact retrieval (left supramarginal gyrus) more during single digit arithmetics were those who did better at the PSAT test.

This implies, argued Mr. Ansari, that neuroscientific evidence can go beyond behavioural evidence and can provide an additional meaningful level of explanation.

The presenter also recognised cautious voices about linking neurosciences to education, drawing the attention to the problem of having multiple levels of analysis, thus making it difficult to make

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<sup>7</sup> Preliminary SAT is a standardised examination in the USA designed to measure students' abilities in three areas: reading, writing, and mathematical reasoning.

connections through to the level of test scores to the behaviour that we observe in the classrooms. He emphasised that it is cognitive neuroscience that is most proximal to what we observe in the classroom. Mr. Ansari warned about the potential adverse effects of neuromyths. Some claims about the brain such as

- people only use 10% of their brain,
- there are people with different learning styles (visual, kinaesthetic or auditory learners),
- people are left or right brain learners,
- there is improvement in the brain beyond what is trained by certain working memory training programmes, etc.

have no scientific evidence backing them. Nevertheless they are very resistant. He stressed that this kind of evidence is not being taught in initial teacher education even though neuromyths are very prevalent and argued that pre-service training should be changed in order to prevent the potential adverse effects of these neuromyths.

Finally, Mr. Ansari argued for productive future avenues. He emphasised the importance of going away from the direct translation of laboratory results to classroom (neuroimaging will not tell teachers what to do). He claimed that what we need is training teachers in mind, brain and education, in how cognitive mechanisms are realised in the brain and how they relate to the behaviour of students, as this will lead to a better understanding of the learners, a critical thinking about the evidence, and might prevent adverse effects of neuromyths. He showed early evidence for teachers completing professional development courses on learning sciences who were subsequently rated as higher in their instructional quality as those who did not have such training. He also urged for training interdisciplinary researchers of education, psychology and neuroscience who can drive the field forward.

[Daniel Ansari's slides](#)

### 5) What is the evidence on teaching and learning 21st century skills?

**James Pellegrino's** (University of Illinois) talk addressed the question of what the 21<sup>st</sup> century skills are and what role they play. He based his presentation on a report commissioned by NRC<sup>8</sup>, entitled "*Education for Life and Work – Developing Transferable Knowledge and Skills in the 21st century*". He first focused on clarifying the terms, then gave evidence of the three domains in which he (and the expert group commissioned for the report) categorised 21<sup>st</sup> century competencies. The second part of the talk concentrated on the aspects of teaching for transfer and finally he talked about the challenges of assessment and the implications for instruction and teacher learning.

Mr. Pellegrino sees the demand from both business and educational leaders, who share certain dissatisfactions with current education systems, for developing skills such as problem solving, critical thinking, and collaboration as one of the main motives for studying this topic. He underlined that all the different stakeholders (teachers, students, parents, employers, etc.) want students to develop knowledge and skills that transcend the educational field and that transfer into other contexts. He first clarified that deeper learning means the process of learning for transfer, that is, the process that enables an individual to take what was learned in one situation and apply it to new situations. He defined transferable knowledge, or in other words, what it means to have 21<sup>st</sup> century competencies, as the product of the process of deeper learning, including content knowledge in a subject area and

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<sup>8</sup> US National Research Council

procedural knowledge of how, why, and when to apply this knowledge. He emphasised that there is no evidence that broad general transfer can be produced, however, it is possible to produce context or domain-bound transfer.

Mr. Pellegrino identified three main categories of 21<sup>st</sup> century competencies as follows:

- *cognitive domain* including e.g. reasoning, memory and knowledge
- *intrapersonal domain* such as self-management, self-direction
- *interpersonal domain* like expressing ideas and interpreting and responding to others' messages,

and stressed that these domains are intertwined. He noted critical issues regarding the evidence base that justifies the importance of the above competency domains, listing some of the problems of empirical studies such as the lack of control variables in quantitative correlational analyses, limited datasets, weak analytic methods, the lack of valid, reliable and useable measures in the more specific domain constructs, etc. Nevertheless, he mentioned that there is evidence indicating that the 3 domains are relevant to long term outcomes and can influence completion of schooling and labour market outcomes.

In the second part of the presentation, Mr. Pellegrino showed emerging evidence indicating that cognitive, intrapersonal and interpersonal competencies can be taught and learned in ways that promote effective transfer. He listed the following conditions that make transfer more likely:

- when learners understand general principles and practices in a certain area;
- when learners understand factual and conceptual knowledge in a subject area and also applicable problem-solving strategies;
- when learners recognize how, when and why to apply their factual, conceptual, and procedural knowledge and skills.

He emphasised that one needs to focus on developing domain specific knowledge that is organised in terms of deep underlying concepts and practices, and showed how the new US standards reflect an emphasis on developing such transferable knowledge.

Next, Mr. Pellegrino talked about the assessment and instructional challenges from the point of view of deeper learning and 21<sup>st</sup> century competencies. He said that current educational policies and accountability systems in many countries rely on standardised assessments that focus primarily on recall of facts and procedures, which he claimed are not appropriate to measure 21<sup>st</sup> century competencies. He emphasised the importance of changing assessment systems, because what we test governs what gets instructed. He then argued that many teachers and administrators are often unfamiliar with the instructional principles that support deeper learning and teaching for transfer. It is therefore crucial that teacher preparation programs as well as practice-based professional development help teachers envision and enact new strategies to foster deeper learning.

As a conclusion the presenter drew our attention to the fact that although many of the so-called 21<sup>st</sup> century competencies have been around for centuries, the main shift is that now we want all members of the population to develop them, whereas in the past we were satisfied with only a small segment to possess these competencies. He argued that despite the lack of substantial evidence, transferable knowledge is important for success in school, work and adult life and can be developed. He also contended that it would be a mistake to teach them apart from the disciplines, they must be developed within specific domains.

## [James Pellegrino's slides](#)

### *Discussion*

Sigrid Blömeke asked about the relationship between the new requirements (deeper learning) and the former understanding and inquired whether the education system should be radically changed or if former understandings of basic knowledge were pre-conditions to achieve the new objective. James Pellegrino suggested that these understandings were co-requisite and had to be taught together. He emphasised that it was possible to engage learners in challenging tasks, that involve deeper thinking but students have to be supported and guided. He expressed his disbelief about having to first build up factual and procedural knowledge and then teach knowledge more amenable for transfer, and suggested to see instruction as teaching an ensemble of knowledge including some basic knowledge (retrieval, basic automatic skills) along with the larger conceptions and principles.

Another question of Blömeke referred to the consequences for teacher education. Mr. Pellegrino contended that this shift of instruction would involve a change in the nature of teaching CK, GPK as well as PCK. An important implication according to him is that teachers need to be in environments where their learning happens in ways that promote deeper learning and transfer.

### **6) Measuring teaching qualities**

The last talk addressed by **Kirsti Klette** (University of Oslo) linked the topic of teacher expertise to the enactment of teaching and put the analysis of teaching in the classroom in the spotlight. After introducing the background and rationale of looking at teaching practice, she reviewed some studies and highlighted the results as well as the differences and similarities with a special regard to the different coding manuals. She presented a video study carried out in Norway and a study on language and arts classes conducted in the US in more detail and summed up her point by arguing about the importance of commonly-developed coding manuals.

The speaker underlined that while understanding teaching quality has a long history in educational research, measuring it based on classroom practice has proven to be difficult. Whereas the former looks at who teachers are (their personalities, values and beliefs, competencies and qualifications, etc.) the latter tries to understand what teachers do in terms of instructional strategies, content coverage and cognitive activation, time on task/ pacing, classroom management, behavioural management, interaction patterns etc. Ms. Klette claimed that weak communication between these theoretical approaches/traditions on the one hand and little discussion between how the different methodological approaches support analyses and enable findings on the other constitute the real problem.

Ms. Klette then went into explaining the progress in the field of classroom observation. She identified technological developments in video design; methodological developments (integrated research design, combining qualitative and quantitative analyses) and coding manuals as ways of measuring teaching qualities as the main recent developments. The presenter contended that coding plays an important role in linking the analyses to criteria, making it explicit, strengthening transparency and transfer, supporting critical re-examination, being able to compare results of studies, etc. She then listed some observation protocols, a number of which have been designed to focus on elements of classroom instruction that could be considered generic elements of high quality teaching regardless of the subject, the level or even the cultural context. Her review of protocols led her to the

conclusion that there is a shared understanding on the key features of teacher expertise linked to classroom teaching and captured the common elements of all manuals in the following four domains:

- instructional clarity,
- cognitive challenge,
- discourse features,
- supportive climate.

Ms. Klette noted that while there are strong findings on how supportive climate affects student achievement, the effects of discourse features are not yet clear based on research evidence.

In the second part of her talk, Ms. Klette presented two video studies: the PISA+ study from Norway and the PLATO study from the US. The PISA+ study consisted of the recording of more than 150 lessons in 3 subject areas (related to the PISA areas: science, mathematics and Norwegian language) and a coding manual developed to assess instructional format, instructional activities and discourse features. The degree of whole class teaching, individual work and work in groups were observed, the study equally scrutinised the nature of this whole class work (whether it was instruction dialogue, question and answer, whole class discussion, student presentation, task management, dealing with misbehaviour or giving messages) and the various metacognitive activities (e.g. activating prior knowledge, topic appetizer, summing up, going over the 'do now', new content knowledge, practical work). The results showed that:

- whole class work dominated all three areas, with science lessons scoring the highest,
- there is a lot of dialogic instruction, whereas traditional lecturing is less present in whole class activities,
- new content knowledge takes up nearly 50% of science classes, practical work and task management are also important, while e.g. very little time is spent on homework checking and metacognitive activities such as introduction 'appetizers', going over 'the do now', making explicit summaries etc.

The PLATO study developed by Grossman focused on the question of distinguishing between practices that are more effective than others linked to English language classrooms. The coding manual captured multiple content domains like reading, writing, speaking and listening and was built on four underlying constructs: instructional scaffolding, disciplinary demand, representations and use of content and classroom environment.

Results of the PLATO manual were linked to measuring practices of English language classrooms that proved to be more effective than others, and has also been used as a tool on professional development, whereas results of PISA+ were used for diagnostic purposes and for developing the instructional practices of teachers.

Finally, Ms. Klette highlighted again that strong commonalities characterise the various coding manuals, which suggests that there is consensus in terms of what high quality teaching is. She argued for harmonising these manuals instead of using local instruments in order to reduce the complexity and facilitate the development of common measurement tools. Such common coding manuals could serve as a way to strengthen teachers' knowledge base relevant for actual classroom teaching and learning (e.g. Van Damme's argument on how existing measures of teacher knowledge do not 'translate into practice'). She claimed that observation protocols can be a way to make progress in the field of teacher expertise, in particular:

- to provide a common technical vocabulary for describing instruction,

- to decompose teaching into discrete components,
- to develop instruments that can travel and do not depend on the context,
- to allow for comparison of quality of instruction across classrooms (subject areas, grade levels and countries).

[Kirsti Klette's slides](#)

### Summary of the break-out sessions

The break-out sessions provided an opportunity for participants to engage in dialogue around one of the four topics:

- How is teachers' general pedagogical knowledge conceptualised?
- What elements might influence teacher knowledge?
- Does the knowledge base of teachers sufficiently incorporate the latest scientific research on learning?
- Does teachers' knowledge base meet the expectations for teaching and learning 21st century skills?

Each session was led by a facilitator, who chose the working method for the workshop. The facilitator then reported back the key points of the session during the final plenary discussion.

#### Group A: How is teachers' general pedagogical knowledge conceptualized?

*Chair: Tracey Tokuhamma-Espinosa (Universidad de las Américas, Quito, Ecuador)*

*Rapporteur: Elke Peeters (Department of Education and Training, Belgium/Flemish Community)*

The participants were asked to reflect on the following question of how teachers' general pedagogical knowledge was conceptualised in terms of the following questions:

- Is Teachers' General Pedagogical Knowledge multi-dimensional? If so, what are the various cognitive dimensions? Can these be measured? If so, what theoretical considerations need to be taken into account in order to design a valid and reliable instrument to measure these dimensions?

In order to stimulate the reflection and the discussion, the participants were asked to disaggregate the elements of GPK and to reflect on the past aspects as well as new ones. They were asked to indicate with which they were in full agreement, and which they had doubts about, including neuroscience, 21<sup>st</sup> century skills and social-affective elements of learning. The presentation of the participants' views on PK was followed by a summary presentation of a set of visual models that conceptualise PK.

The participants were then asked to reflect on these models: Do they still apply? Are there alternative models possible? Are all aspects that the participants believe to be necessary and part of PK represented in these models? The facilitator also asked some related questions such as: is education slow on the uptake of technology? Is it evidence based? Should neuroscience be integrated into teacher formation?

#### Summary of the findings of the groups

The group shared many comments and the majority accepted the traditional GPK model, and a few members expressed discomfort with the idea of changing this model. None of the groups could come up with a new model of visualisation and nobody criticised the names of the 3 categories (general

pedagogical knowledge, content knowledge, pedagogical content knowledge). Participants found that it might be possible/necessary to add categories of attitudinal changes that should be included: e.g. teachers should be lifelong learners, critical thinkers, possess and stimulate creativity and autonomy, among others.

Participants confirmed the earlier remark of one of the speakers that teacher educators have an important role to play and should be good role models for the kind of teaching they are trying to promote. (“Teach what you preach.”)

Some general questions that came up:

- Is the position of the teacher and his/her relationship to the student part of the context?
- What does ‘general’ mean (in GPK)? Is it for all teachers for all levels the same? Can it be differentiated? Can you make cross-cultural comparisons?
- Can one assess GPK?
- How should we train and further develop teachers?
- Does GPK include also personal competences or can it be taught/ is it a subject?

The following general points were made concerning GPK:

- The old concepts related to GPK are still very relevant, but may have changed. For example, technology is not a separate aspect but should be completely integrated into teaching.
- Look to history and what we can learn from it. A participant refers to the 1952 report of Germany, which contains a formulation of GPK . We have to wonder why and who will gain from a “new” concept PCK.
- We have to question the purpose of the knowledge transferred, why is it needed, to what goal, what is the minimum requirement that all GPK should contain?

The following elements were mentioned that should/could be included in GPK:

- All traditional elements of GPK still have a place in teacher formation;
- Classroom management remains an important part in the concept of GPK;
- A thorough understanding of the learning process of the pupil as well as the reflection on the teachers’ own learning process are part of GPK
- Communication skills and collaboration are also very important because students and content can change. That’s why the skill to update and upgrade knowledge is important.
- Being a critical thinker is very important. The group wondered if critical thinking, as well as other less-tangible elements of GPK, would have a hard time being included in GPK because it may not be easy to measure.
- GPK should also include the notion that it is a lifelong learning process, which does not end with a degree or a one-time assessment, so there should be an aspect of teachers’ professional growth within the GPK.

### **Group B: What elements might influence teacher knowledge?**

*Chair: Fani Lauermann (University of Michigan, USA)*

*Rapporteur: Liesbeth Hens (Department of Education and Training, Belgium/Flemish Community)*

Participants of the workshop were first split into 4 groups for discussion then each group presented their main ideas and created a chart. At the end, the facilitator summarised the main ideas and asked for any additions, and for confirmation whether the ideas were accurately represented.

#### *Working definitions of pedagogical knowledge proposed by the participants*

Two types of working definitions were proposed:

- a) acceptance of the already discussed elements of content knowledge, pedagogical knowledge and pedagogical content knowledge; and
- b) an all-inclusive definition, according to which teachers need to know “everything” that has been shown to have an effect on students (this refers to research-based practices). Effect on students was initially limited to learning, but then expanded to include other outcomes such as students’ general well-being and motivation.

Specific elements of “knowledge” that seemed important to the participants but had not been included in the symposium were:

- Teachers’ idiosyncratic experience-based knowledge (Personal note of the facilitator: This may be particularly important to teachers, so that they don’t feel like their experiences and existing expertise are being neglected or even disregarded.)
- Knowledge about organizations (e.g. how do schools work, how do I communicate with others, how do I work with peers within the school). Here, the participants addressed some of the “21st century skills” for teachers (e.g. networking).

#### *Influences on pedagogical knowledge*

There was general agreement about the inclusion of affective and cognitive elements (self-efficacy, anxiety, etc.). The presented research and arguments during the symposium resonated with the participants and they summarised some of these points in their own words.

Additional elements mentioned by the participants:

- Teachers should define their roles as being facilitators of learning rather than information providers. This means coaching students, being respectful, recognizing that students may have more knowledge than the teacher in some areas. The teacher’s expertise should not be defined just based on knowledge, but also based on their ability to facilitate learning. For example, the teacher should be happy when students express knowledge, rather than feel threatened (Personal note of the facilitator: This is very consistent with research by Hattie, as well as with the conceptualisation of teachers’ mastery goals by Ruth Butler).
- Affective and cognitive elements influencing teachers’ knowledge are grounded in context. How much and what gets learned depends on the following contextual characteristics:
  - available resources within the school (e.g. professional development);
  - whether the school represents a safe and collaborative environment (e.g. whether you have to learn on your own or within a community of learners, support for risk-taking and growth); (Personal note of the facilitator: This could be captured by scales of mastery-oriented schools – e.g., Midgley, 2002);
  - demands from the school and from others (e.g. what are the things that others want you to know and do);
  - teacher training (what they have learned in teacher education and professional development);

- personal life outside of school (personal health, family obligations, other personal demands); such demands can impose a limitation on what and how much teachers are capable of learning.

#### *Assessment of relationships between influences and knowledge*

Participants discussed how the relationship between elements influencing teacher knowledge (e.g. efficacy) and teacher knowledge itself could be measured, and came up with the following ideas:

- Survey research using validated scales
- Observations of classroom practices
- Established questionnaire and assessment batteries: TALIS and others
- Seeking an interdisciplinary approach: what can sociologists and other educational researchers (e.g. economists?) bring to the table. Maybe sociologists have useful measures for organizational characteristics?
- Important to take a longitudinal approach: changes in teachers' beliefs and behaviours take time and do not (always) have immediate effects on students
- Assess relationships via interventions. If A is supposed to influence B, then change A to see how B changes. (For example, if we believe that efficacy predicts knowledge, then we may want to manipulate teachers' efficacy in order to test how their knowledge changes over time, as a consequence of our influence on efficacy.)
- Use value-added models to observe changes in student outcomes (learning, motivation, wellbeing).
- Include assessments of intermediary outcomes (satisfaction with an intervention, beliefs about the usefulness of a technique, etc.), even if the final goal is to affect student achievement.
- If we want to connect teacher knowledge to students, the students' perspectives must be included as well.

#### **Group C: Does the knowledge base of teachers sufficiently incorporate the latest scientific research on learning?**

*Chair: Layne Kalbfleisch (George Mason University, USA)*

*Rapporteur: Monika van Geit (Department of Education and Training, Belgium/Flemish Community)*

The main points participants came up with during the session are the following.

#### *The potential of neurosciences-informed education*

- Cases where neuroimaging is adding to our knowledge of behaviour: i.e. that sensory overload could be a factor in autism, or the potential to link patterns of brain activation to predicted achievement outcomes, e.g., Ansari's PSAT results.
- There is a meta-level of knowledge that a teacher needs to have in order to do well. This is where neuroscience can inform a teacher's knowledge about learning readiness and processes. The first few courses of teacher training could be to impart a higher level understanding of the classroom context to move the teacher-in-training beyond just their own past experience and into a more broad and neutral framework? "Here are the 'rules' for this particular niche, which is the classroom."

The teacher's goal is to know when to 'perturb' the nervous system. There has to be a balance between an emphasis on standardised education and the singular teacher knowing when and how to deliver and adapt instruction.

- Make an explicit effort to move the information from the research perspective to the practitioner's perspective. Knowledge transfer is important.

#### *What could neuroscience investigate and how?*

- Neurosciences have focused so far on student outcomes and student achievement. Another focus could be teachers as an instrument or their own perception of themselves as an instrument or an engineer in the classroom.
- Could neuroscientific knowledge be used to increase teachers' intrinsic motivation? Examining intrinsic and extrinsic motivation is a topic that could help bridge between factors driving professional choices of teachers (Lauermaann) linking to student outcomes.
- Ecological validity: This academic research should be driven by the ecologically valid setting of the practitioner's world. For instance, information on classroom management is important. From a cognitive neuroscience perspective, what if classroom management is the lynchpin that determines whether or not meaningful learning occurs? Does that potentially boil down to the teacher's own working memory capacity? This could be reciprocally studied both in situ in the classroom and in a controlled laboratory setting.

#### *Differences and commonalities*

- There is information emerging on the neuroplasticity of individual differences, but also on points in development where brains are ready for the 'same' types of information and skills. Teachers need to understand both.

#### *Neurosciences, 21<sup>st</sup> century skills and teachers' attitudes*

- Relating this to 21st century skills and PCK – neuroscience and psychological sciences have knowledge that can change teacher's attitudes towards teaching and learning – could this be a way to build that intrinsic motivation?
- Pellegrino outlined the Cognitive/Intrapersonal/Interpersonal domains for 21st century learning – can we connect this with what brains have in common at any age?
- Executive functions – this is about how the brain uses the skills and information it has. We are all subject to the limitations of those functions. They mediate what is processed and produced in learning. This could link training to action research and self-study – this would be an opportunity for the teacher to monitor the environment and themselves.
- Neuroscience knowledge can be the gateway because there is a translatable knowledge base for some of the skills that support these higher level skills. Care needs to be taken not to disembodify these skills from the domain contexts in which they are learned. This will eventually change how we view and use standardised assessment.

#### *Teachers' professional development*

- Teachers' scientific literacy should be improved to improve general understanding of neuroscience information and hone a teacher's ability to better target and adapt instruction and protect against the proliferation of neuromyths.
- Action research could be used as a way of framing a problem and promoting a teacher's understanding of themselves as an experimenter or engineer, not just a purveyor of knowledge.

- Obstacle/Goal: Teachers are typically reluctant to participate in research because of paperwork, extra time and effort. Supportive training and working frameworks are needed to facilitate this practice and habit of mind beyond research-initiated efforts.
- Connect teacher training in the classroom with continuous professional development. Give teachers the opportunity to be informed practitioners in the best possible way. Promote the attitudes that impart this level of skill and interest in the teacher.
- Teachers should be self-directed learners to enable students to become the same.

#### Group D: Does teachers' knowledge base meet the expectations for teaching and learning 21<sup>st</sup> century skills?

*Chair: Kirsti Klette (University of Oslo, Norway)*

*Rapporteur: Marie-Anne Persoons (Department of Education and Training, Belgium/Flemish Community)*

The discussion took off from the broad approach to “21<sup>st</sup> century skills” based on the 2012 U.S. National Research Council Report for the Committee on Defining Deeper Learning and 21<sup>st</sup> Century Skills, which identified three broad domains of competence:

- the cognitive domain;
- the intrapersonal domain; and
- the interpersonal domain.

Participants were divided in smaller groups to take stock of old and new challenges for the teachers' knowledge base in each of the above-mentioned domains.

It appeared that in the course of the discussion all groups rapidly touched on more fundamental questions such as:

- Are the 21st century skills really “new” skills?
- What to do with overarching skills which cannot be classified under one or the other domain mentioned above?
- Is it just a question of knowledge base or should the issue of 21st century skills be addressed from the angle of teachers' learning and application of knowledge in a reflective and collaborative practice rather than of knowledge *per se*?

Participants also pointed at several societal trends affecting the teaching profession such as:

- *Increasing cultural diversity* of students challenges teachers to check their own biases and prejudices.
- *Education attainment levels of the population are higher* than in the previous generations. This situation also redefines the role of teachers, who are not the only experts any more but rather guides and facilitators in learning. It also opens new opportunities and challenges in involving parents into the learning process of their children.
- *The rapidly evolving knowledge society* reinforces the need for teachers to regularly update their knowledge and competences and to get involved in lifelong learning. Initial teacher education programmes cannot anticipate all possible changes which will occur in the next decades.
- *Subject-content is changing rapidly* and in professional contexts outside school boundaries; the lines between disciplines are blurring. This poses challenges for redesigning the school curricula and for teachers and students to engage in interdisciplinary work rather than to stick to strict subject demarcation. In preparing study materials and handbooks for new

curricula the teaching profession should take the lead and counterbalance the power of publishers of school handbooks.

- Labour market changes imply that *students should be prepared for broader employability* across the different jobs they will take up in the course of their career. This calls for more attention to transversal skills and deeper (meta-) learning. This evolution has also consequences on the way students will be assessed.
- *Information society*. In a context of an exploding offer of (unstructured) information, teachers play a key role in guiding students to develop a critical attitude towards disparate information sources and develop their critical thinking skills. This also implies that teachers should enhance ICT and digital media skills and their ability to use new forms of communication, such as e.g. social media.
- *Growing impact of international assessments of student performance*, which puts OECD countries in competition with education systems in upcoming economies with high performances in cognitive skills and with less attention to critical thinking and skills for democratic participation.

In conclusion the following observations were made:

1. 21<sup>st</sup> century skills are not necessarily new skills. They have always been implicitly connected to the more “traditional” knowledge base of teachers but the degree in which they have to be mastered by teachers and learners is increasing. It is also becoming more explicit, as well as more universally relevant to the whole teacher and student body.
2. In this context the teaching profession should take the leading role and responsibility in partnership with other stakeholders in education.
3. Teaching and learning of 21<sup>st</sup> century skills is a collaborative process which should encourage teachers to systematically work in teams in daily school practice and to dialogue with society at large.
4. Critical thinking and sustainable development remain of utmost importance from a long-term and sustainability perspective but can be challenged in a context of global competition between education systems.
5. 21<sup>st</sup> century skills should be addressed both from a global perspective and from the angle of the reality of the local school context.
6. Assessment of teaching and learning of 21<sup>st</sup> century skills should take due account of new validated methods, protocols and instruments to measure effective teaching for quality learning.

## Final discussion and wrap up

The symposium ended with a summary of each break-out session by the four facilitators and a discussion with the participants. The issues of teacher education, professional development and teacher professionalism were at the heart of this final discussion, which touched upon three broader topics: why should learning sciences be included in teacher education, does the content of teacher education change as a result (and if, how) and how can teacher education account for the prior experience of student teachers.

### *Learning sciences and research base in teacher education*

A participant asked whether there were discussions in Group B about scientific theories of learning when defining the profession as learning experts. Fani Lauer mann replied that in an attempt to

provide a working definition of pedagogical knowledge one of the participants in Group B said that teachers need to know everything that has been shown to have an influence on learning. Ms. Lauer mann supposed that research based evidence was included there. Layne Kalbfleisch added that Group C also tackled the question from the point of view of why to include the human brain and the human nervous system in teacher education. She listed some points the group came up with:

- understanding ourselves ought to be a first priority (psychologists and doctors as part of their training are subject to being self-assessed so that they know their own biases);
- to help instil meta-level cognition and to help engineer instruction and environment and craft a niche for learning.

Group D also touched upon this theme in relation to 21<sup>st</sup> century skills. Kirsti Klette emphasised that the development of 21<sup>st</sup> century skills is not very solidly based in learning theory. Although there is some research on collaborative learning from psychology, how it is transferred into the classroom is not very clear.

As far as teacher professionalism is concerned, Tracey Tokuhama-Espinosa commented that one of the key things that has to be greater considered is to understand why we do things. She referred back to the analogy with medical professions, in which professionals cannot e.g. prescribe medicine without knowing why they do it. She argued that a deep understanding of why and when best interventions take place (not just how and what to do) need to be included in teacher education and professional development. Thus the theories of learning need to be part of a lifelong learning process and strengthened and updated with new information from neuroscience as well as from cognitive developmental psychology.

A participant articulated the concept of reflective practice and argued for the importance of teachers' learning and their application of knowledge. He raised the hypothetical question of what the teaching profession means in the 21<sup>st</sup> century. He pointed out that the medical profession is tackling the same issues as teachers: to establish research-based practice and the centrality of research in lifelong learning.

#### *Content of teacher education – a zero sum game?*

A participant commented that including knowledge from theories on learning in teacher education entails that something else has to be taken out. He cited the example of Sweden where teacher education according to him is being re-traditionalised and content on the philosophy, sociology, economy and history of education is being excluded in the interest of new scientific knowledge from the learning sciences. He argued that what is being pushed out is an important component of the professional knowledge of teachers and provoked the debate on what to take out at the expense of including e.g. neurosciences in teacher education.

Another participant contended that not developing and not thinking forward to do better and to adapt to the new demands and context of the 21<sup>st</sup> century is problematic. Tracey Tokuhama-Espinosa argued that this was not a zero-sum game. She suggested that incorporating mind and brain education in the basic education curriculum, can be achieved by changing the methodology and leveraging technology to be able to deliver the information effectively and does not necessarily have to be done at the expense of something else. She mentioned flipping classrooms and using face-to-face time for debate and exchanging ideas as more effective ways of delivering content.

A participant saw the solution to this question in the continuum of teacher education. Initial teacher education should not be the only place for learning not only because it is not possible to include

everything, but also because challenges change over time. He stressed that the lifelong learning of teachers had to be more fully understood, and should be a requirement for staying in the profession.

*Unlearning in teacher education – what to do with the prior experience of future teachers?*

A participant brought up the issue of unlearning, that is, what to do with the personal experience of a future teacher starting initial teacher education as a pupil.

Layne Kalbfleisch stressed that ecological validity<sup>9</sup> is important both for educational psychology and the cognitive neurosciences. How neuroscience can inform education is not an easy question as a person in an MRI scanner is not a child embedded in the social complexity of the classroom. At the same time, unlearning neuromyths (see for instance, in Layne Kalbfleisch's own research on a treatment of the right/left brain neuromyth) and studying the executive functions in context could link new knowledge with practice to improve and sharpen heuristic approaches. Done well, this could lead to more precise translation (of information to teachers), application (a teacher's ability to apply this more precise information) and transfer into the realm of explicit knowledge intentional, well-designed practice.

Kirsti Klette suggested that instead of unlearning we should build on and expand those 15000 hours of experience future teachers have already had as learners. Fani Lauermann emphasised that just as we expect teachers to work with students' misconceptions, teacher educators need to apply what they know about student learning in their practice with future teachers. The methods that work with school children work with student teachers as well. As an example she said that when working with future teachers' beliefs about neuromyths it is important to be aware of the reasons why people can be motivated to hold to some misconceptions. Finally, a participant commented that behind the question of unlearning lies reflective practice: giving the teachers the courage to embrace the challenges is crucial.

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<sup>9</sup> A study must approximate the real-world that is being examined.