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INNOVATIVE TEACHING FOR EFFECTIVE LEARNING

Background Document: "Teachers' Pedagogical Knowledge: What It Is, How It Functions in the Teaching-Learning Process, and Implications for Teacher Education"

21-22 November

This paper is being developed as part of the background research for the ITEL project. The purpose of the paper is to review the research on how teacher knowledge has been conceptualised in the literature in order to gain a better understanding of what it is and how it relates to teacher quality and student outcomes. The review will also discuss how pedagogical knowledge is learned and how it functions in teacher decision-making in an effort to understand how this relates to quality. The paper will conclude with implications for teacher education and professionalism. This review paper is part of the conceptual work currently in progress in ITEL and accompanies the ITEL "Progress Report" [EDU/CERI/CD(2013)11].

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TEACHERS' PEDAGOGICAL KNOWLEDGE: WHAT IT IS, HOW IT FUNCTIONS IN THE TEACHING-LEARNING PROCESS, AND IMPLICATIONS FOR TEACHER EDUCATION

Introduction and Policy Context

1. The imperative in recent years about improving student outcomes is also about improving the quality of the teaching workforce. The quality of student learning cannot exceed the quality of the teachers tasked with their learning. In recent years, however, recruiting and retaining quality teachers has been a challenge among some OECD countries. In addition to the ageing of the teaching workforce, some countries experience high rates of attrition among new teachers and a shortage of quality teachers in high-demand subject areas and disadvantaged schools. There is also concern about attracting high-achieving and motivated candidates into teacher education programmes and the lowering of qualification requirements in the certification and licensing of new teachers (OECD, 2005).

2. Issues such as these have an impact on the quality of the resulting teaching workforce that is tasked with improving student outcomes. For example, the ageing of the teacher workforce entails the loss of experienced teachers. High attrition rates among new teachers is costly to the system and may prompt education authorities to fill teacher shortages by lowering qualification requirements for the certification of new teachers or by assigning teachers to teach subjects or grades for which they were not trained (for a review, see Santiago, 2002). In such cases, the quality of the teaching workforce is negatively affected.

3. Teacher quality matters for student achievement. Research studies using econometric approaches have shown that teacher quality is an important factor in determining gains in student achievement, even after accounting for prior student learning and family background characteristics (e.g., Darling-Hammond, 2000; Hanushek, Kain, & Rivkin, 1998; Muñoz, Prather, & Stronge, 2011; Wright, Horn, & Sanders, 1997). In these types of studies, predictors of teacher quality have included factors such as class size, certification, type of qualification, degrees earned, or years of experience. However, findings have been inconsistent (e.g., Darling-Hammond, Berry, & Thoreson, 2001; Muñoz & Chang, 2007; Wayne & Youngs, 2003) or minimal when teacher characteristics are examined independently of overall teacher effects (e.g., Goldhaber & Anthony, 2007; Hanushek, Kain, & Rivkin, 1998; Rivkin, Hanushek, & Kain, 2005).

4. It is not surprising that such studies have shown inconsistent results. Factors such as teacher certification, qualifications, or years of experience are proxies assumed to measure quality. In such studies, it is hypothesised that such proxies will differentiate quality teaching (Hill, Rowan, & Ball, 2005). But, in actuality, teachers' competency in the classroom, such as the quality of the instructional skills employed, are not directly examined. In the same way, any policy changes directed at certification or qualification requirements that do not target the actual competences underlying teaching itself risk of being unsuccessful.

5. In a different set of studies, a more direct indicator of teacher quality has been explored by investigating the substance of teachers' knowledge. In this approach, the study of teacher quality goes beyond an econometric approach based solely on distal indicators, such as types of qualifications, numbers of degrees earned, or years of study, to a conceptual investigation of the knowledge base of teachers presumed to underlie quality teaching (Hill, Rowan, & Ball, 2005). Studies of teacher knowledge hypothesise that differences in the conceptual quality of teachers' knowledge can better differentiate quality teaching because (competent) performance is based on an underlying teacher knowledge base. This approach to understanding teacher quality is more complex, but it is more likely to lead to policy changes

that can make an impact on student learning, for example, by exerting a direct influence on the content of teacher education programmes.

Project Objectives

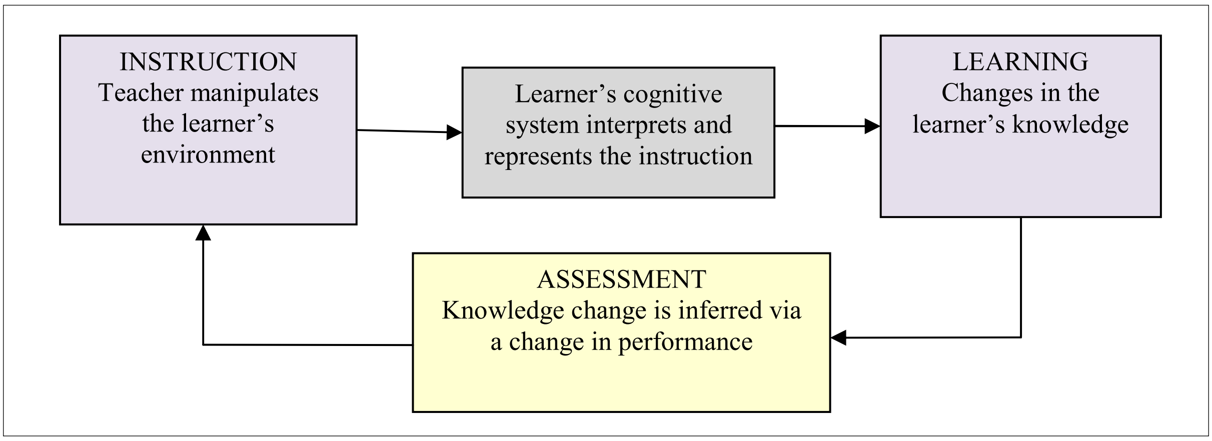
6. In this paper, we review the research on how teacher knowledge has been conceptualised in the literature in order to gain a better understanding of what it is and how it relates to teacher quality and student outcomes. This paper is an output of Activity Strand 1.A (Synthesis of current research literature on teachers' pedagogical knowledge) [EDU/CERI/CD/RD(2011)5] and has been developed as a background report for the ITEL (Innovative Teaching for Effective Learning) project [EDU/CERI/CD(2013)11]. This paper is accompanied by two other papers that together serve as background research for the ITEL project: [EDU/CERI/CD/RD(2013)5], which reports on new findings from the field of neurosciences and implication for teachers' knowledge base, and [EDU/CERI/CD/RD(2013)6], which presents a critical review of teacher qualifications and competence frameworks and how teacher knowledge has been codified in these types of policy documents.

7. The ITEL project focusses on the pedagogical core of the teaching profession, namely, the pedagogical knowledge base of teachers, and questions whether this knowledge base is still in tune with recent advancements in learning research and with new skills demands society expects from students. The field of learning sciences, including the neurosciences, has made significant progress in how the brain processes and retains information which has implications for pedagogical practice. In addition, the policy imperative for the teaching and learning of 21st century skills (e.g., problem-solving, collaboration, communication, creativity) might entail a re-skilling of the current teacher workforce and upgrading of initial teacher education programmes. Thus, a knowledge-intensive profession such as teaching can be expected to process and regularly update its knowledge base.

8. Before reviewing the literature on teacher knowledge, we give a brief overview of the teaching-learning process. It would not be possible to understand the knowledge base of teachers (a psychological concept) without first understanding how the teaching-learning process works (a cognitive concept). As a result, this paper adopts a cognitive-psychological view of teaching and learning. In this view, learning is a cognitive process where effective teaching is defined as a change (i.e., growth) in student knowledge. This means that the learner is the focus of the teaching-learning process and that teaching is viewed from the perspective of the learner. In other words, (effective) teaching is interpreted from the perspective of its effect on underlying learning processes. The paper concludes with implications for teacher education.

The Teaching-Learning Process

9. The teaching-learning process is complex, and to this day, not yet fully understood. A simplistic view in diagram form is given below, adapted from Mayer (2011):



Source: Adapted from Mayer (2011)

10. Under a cognitive view, instruction is defined as the manipulation of the learner's environment to cause a change in the learner's experience. A change in the learner's experience is interpreted as new knowledge and is, thus, learning. These are represented in the light purple boxes. The grey box represents the hypothesised cognitive changes in the learner's mind as the learner interprets and represents the instruction. Evidence of the change in the learner's knowledge is inferred via a change in the learner's performance in an assessment test. Assessment is a crucial component of the teaching-learning process as this is how the effectiveness of the instructional manipulation is determined. In this simplistic diagram, Mayer has nicely captured the complexity of the cognitive process(es) underlying teaching and learning.

11. An example of a more sophisticated model of teaching and learning is one proposed by Seidel and Shavelson (2007) who built on a previous model of teaching and learning developed by Bolhuis (2003). Seidel and Shavelson conceptualise learning as the intentional construction of knowledge in a specific subject domain, in a regulated, goal-directed, and social learning environment, with continuous monitoring and assessment of learning. Effective teachers employ teaching practices that best exploit the learning process. For example, effective teachers are those who differentiate teaching in different content areas (math vs. reading), allow sufficient learning time for students to actively construct their knowledge, structure learning by setting and orienting students towards goals, establish a social learning climate in the classroom, and provide feedback and support for continuous monitoring and evaluation of student learning. Although teaching effects are differentiated by outcome measures in student learning processes, motivational-affective, or cognitive components, the model is based on the perspective of teaching and the student's contribution to the teaching-learning process is not made explicit.

12. In a different set of models, the student's contributions to the teaching-learning process are made explicit and taken into account as inputs to the process of effective teaching. Carroll (1963) proposed a model that is comprised of five elements that contribute to effectiveness of instruction: students' general ability, prior knowledge, motivation to learn, opportunity to learn (i.e., amount of time allowed for learning), and quality of instruction. Three of these five elements (general ability, prior knowledge, and motivation to learn) are student inputs to the teaching-learning process, while the other two (opportunity to learn and quality of instruction) are under the control of the teacher. Carroll's model introduces the concepts of 'learning differences' and 'adaptive instruction' in the teaching-learning process: Teachers need to balance the time needed for instruction with the time available for instruction given that students within a classroom will vary in ability, knowledge, and motivation. For example, students with lower abilities or motivation will require more time for instruction. At the same time, the higher the instructional quality (e.g., ensuring students have the requisite prior knowledge for successfully learning a new lesson),

the less time will be needed for a lesson. Thus, student and teacher are interconnected and interdependent in the teaching-learning process.

13. Slavin (1984) built upon Carroll's (1963) model by concentrating on the alterable components of effective instruction that are under the teacher's control: quality of instruction, appropriate levels of instruction, incentive (i.e., motivating students), and time allocated for learning. According to Slavin's model, the alterable components under the teacher's control combine with student inputs (student aptitude and student motivation) to result in student achievement. Although student inputs are considered fixed in the short-term, they are not immutable and can be affected by classroom practices in the long-term. Slavin also proposed two mediating variables: instructional efficiency (a product of quality of instruction, appropriate levels of instruction, and incentive) and engaged time on task (a product of incentive and time allocated for learning). Like in Carroll's model, Slavin views students and teachers as interconnected and interdependent in the teaching and learning process. For example, student aptitude and student motivation contribute to instructional efficiency and engaged time, which ultimately affect student achievement.

14. This brief overview is meant to illustrate the complexity of the teaching-learning process and the complex relationship between students and teachers. This is in contrast to econometric models which attempt to predict effective teaching by controlling for student factors. While it makes sense to control for differences in student characteristics that are beyond the control of teachers or schools in value-added models of accountability, the above review indicates that student factors are part of, and interdependent with, the teaching-learning process. A model of effective teaching would need to account for these.

15. More importantly, these models presuppose that a teacher's knowledge goes beyond mere knowledge of content (e.g., of math, science, or reading) and classroom management, but should also include knowledge of learners and learning that is typically the purview of cognitive psychologists. In the next section, we review various conceptualisations of teacher knowledge and how it functions in the teaching-learning process. After defining the concept of 'teacher knowledge,' the focus of the section is devoted to teachers' 'general pedagogical knowledge,' as this is the concept under study in the ITEL project.

Teacher Knowledge

16. Similar to the conceptualisation proposed by Verloop, Van Driel, and Meijer (2001), we define the pedagogical 'knowledge base' of teachers to refer to all the pedagogical-related knowledge that is relevant to teachers' activities in a teaching-learning situation. This would include both theoretical (e.g., scientific theories of learning) and practical knowledge (e.g., day-to-day knowledge of practice), but is not meant to refer to guidelines or prescriptions for practice. Under a cognitive-psychological view, this implies a deep understanding of the teaching-learning process – essentially, the knowledge needed for judgement and decision-making for (effective) teaching and learning. As proposed by Verloop, Van Driel, and Meijer, teachers' knowledge base can be made explicit and studied.

17. The study of the structure and content of teacher knowledge began with Shulman (1986, 1987) who proposed that teacher knowledge was comprised of the following categories:

- General pedagogical knowledge (principles and strategies of classroom management and organization that are cross-curricular);
- Content knowledge (knowledge of subject matter and its organising structures);
- Pedagogical content knowledge (knowledge of content and pedagogy);

- Curriculum knowledge (subject- and level-specific knowledge of materials and programs);
- Knowledge of learners and their characteristics;
- Knowledge of educational contexts (knowledge of classrooms, governance and financing of school districts, the culture of the school community); and
- Knowledge of educational ends, purposes, values, and their philosophical and historical grounds.

18. In this seminal work, Shulman formally proposed the concept of 'pedagogical content knowledge,' in which he referred to knowledge which integrates the content knowledge of a specific subject and the pedagogical knowledge for teaching that particular subject. Specifically, pedagogical content knowledge "represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction" (Shulman, 1987, p. 8). This category would also include knowledge of strategies for reorganizing the understandings of learners because students of different ages and backgrounds bring with them prior knowledge, some of which may include misconceptions (Shulman, 1986). According to Shulman, this is the category of knowledge that is fundamental to teachers' knowledge of teaching.

19. The concept of 'pedagogical content knowledge' became the focus of study for many educational researchers because it gave rise to the idea that teachers held a unique form of 'technical' knowledge available only to the profession of teachers (Ball, Thames, & Phelps, 2008; Depaepe, Verschaffel, & Kelchtermans, 2013). For example, Ball, Thames, and Phelps (2008) proposed that pedagogical content knowledge, as defined by Shulman (1986, 1987), is comprised of two categories: 'knowledge of content and students' (knowledge of students' (mis)conceptions) and 'knowledge of content and teaching' (knowledge of instructional strategies). They further proposed that Shulman's concept of 'content knowledge' is comprised of 'specialised content knowledge' (knowledge unique to the work of teachers) and 'common content knowledge' (knowledge common to teachers and non-teachers). With the addition of two more categories ('horizontal content knowledge' and 'knowledge of content and curriculum'), these six categories were hypothesized to contribute to teachers' knowledge base for teaching specific subject content. In Ball, Thames, and Phelp's research, the domain of study is mathematics teaching. Most investigations of pedagogical content knowledge have focussed on mathematics (e.g., Baumert, Kunter, & Blum, 2010; Hill, Schilling, & Ball, 2004; Depaepe, Verschaffel, & Kelchtermans, 2013) or science teaching (e.g., Abell, 2008; Kind, 2009; Schneider & Plasman, 2011).

General Pedagogical Knowledge

20. For the purposes of this review, the focus is on 'general pedagogical knowledge.' Beginning with Shulman (1987), this is proposed to be knowledge of general principles and strategies of classroom management and organization that are cross-curricular or independent of subject matter. However, in contrast to the abundance of studies investigating pedagogical content knowledge, there are but a few studies investigating the components of general pedagogical knowledge; two are reviewed here.

21. Voss, Kunter, and Baumert (2011) proposed a model of general pedagogical knowledge called 'general pedagogical/psychological knowledge,' comprised of five sub-dimensions: knowledge of classroom management, knowledge of teaching methods, knowledge of classroom assessment, knowledge of learning processes, and knowledge of individual student characteristics. A 'psychological' component is included in this model because learning success is proposed to depend on the general cognitive and affective characteristics of the individual student. Specifically, psychological aspects such as general cognitive abilities, motivational and affective characteristics, and prior knowledge will differ among

students and thus impact on individual learning success. As such, teachers need to know how to deal with what the authors refer to as 'heterogeneity' in student learning, which is subsumed in the sub-dimensions of 'learning processes' and 'individual student characteristics.' In contrast to knowledge of classroom management, teaching methods, and classroom assessment, knowledge of learning processes and individual student characteristics is psychological in nature. General pedagogical/psychological knowledge is domain-general and is necessary for "creating and optimizing teaching-learning situations" (p. 953). In this manner, Voss, Kunter, and Baumert's model is similar to those of Slavin (1984) and Carroll (1963) where students and teachers are considered interconnected and interdependent in the teaching and learning process.

22. A model also based on student cognitive learning was proposed by König, Blömeke, Paine, Schmidt, and Hsieh (2011). König et al. used a task-based framework of teacher competence to define and operationalize 'general pedagogical knowledge' by adopting Slavin's (1994) model of effective teaching as a theoretical framework. According to König et al., general pedagogical knowledge is comprised of four dimensions: structure, motivation and classroom management, adaptivity, and assessment. Within this framework, effective teachers were proposed to have acquired general pedagogical knowledge if they showed competency in tasks requiring them to prepare, structure, and evaluate lessons; to motivate and support students and make effective use of time to manage the classroom; to deal with heterogeneous learning groups in the classroom by making use of differentiated strategies and methods of instruction; and to assess students. Unlike Voss, Kunter, and Baumert's (2011) model, however, König et al.'s model does not make explicit the existence of psychological factors underlying learning processes and student characteristics as the model is based on the alterable elements of instruction that are under the control of the teacher (as per Slavin, 1994).

23. One of the reasons for the dearth of studies investigating general pedagogical knowledge is due to the difficulty in defining this concept. For instance, Blömeke, Paine, Houang, et al. (2008) have surmised that cultural differences in perspectives on the role of teachers and schooling contribute to difficulties in defining a construct like general pedagogical knowledge. By contrast, a construct such as 'mathematics' is relatively universal. For the purposes of this review, this brief overview suffices as our interest lies in whether differences in the quality of teacher knowledge have an impact on student outcomes, which is reviewed next.

Relationship to Student Learning Outcomes

24. A positive relationship between teacher knowledge and student learning outcomes would indicate that efforts aimed at improving the quality of teacher knowledge should lead to improvements in learning outcomes. However, like investigations of the (theoretical) components of teacher knowledge, most studies of the impact of teacher knowledge on student learning outcomes are restricted to investigations of pedagogical content knowledge or simply content knowledge. In this section, we review the evidence showing that a positive relationship exists between the quality of teachers' knowledge and student learning outcomes.

25. In a study investigating the quality of teachers' content knowledge of mathematics, Hill, Rowan, and Ball (2005) reported a significant relationship to student achievement gains. In this study, the knowledge category of interest was conceptualised as 'content knowledge for teaching mathematics' and comprised two components: (1) common knowledge of content (the knowledge of the subject that most adults would have); and (2) specialized knowledge used in teaching mathematics to students (the knowledge needed for evaluating solutions, at the level of a mathematician). Their results showed that for every standard deviation difference in teachers' knowledge, students gained about one-half to two-thirds of a month of growth. Data was also collected on the number of mathematics and mathematics methods courses taken as reported by the teachers and whether teachers were certified. Results revealed that neither

certification nor courses taken was significantly related to student achievement gains. Furthermore, neither of these variables showed a strong significant relationship with mathematical content knowledge for teaching as assessed in this study, indicating that these approaches to improving teacher quality do not target the necessary knowledge underlying quality instruction. One limitation of this study, however, is that 'pedagogical content knowledge,' conceptualised as the specialist or technical knowledge of both content and pedagogy that is in the professional domain of teachers, was not assessed.

26. Baumert, Kunter, Blum, et al. (2010) investigated the specific impact of pedagogical content knowledge (of mathematics) on student achievement. Pedagogical content knowledge was operationalized into three assessment dimensions: (1) a 'tasks' dimension, which assessed teachers' ability to identify multiple solution paths; (2) a 'student' dimension, which assessed teachers' ability to recognize students' misconceptions, comprehension difficulties, and solution strategies; and (3) an 'instruction' dimension, which assessed teachers' knowledge of different representations and explanations of standard mathematics problems. In their model, 'instructional quality' was used as a mediator and operationalized into three components: (1) cognitively challenging and well-structured learning opportunities, for example, by drawing on students' prior knowledge and ensuring alignment between the cognitive demands of the tasks and materials chosen by the teacher and curricular demands; (2) learning support through monitoring of the learning process, individual feedback (including motivating students), and adaptive instruction for addressing student difficulties; and (3) efficient classroom and time management, for example, preventing disruptions and using classroom time effectively. All student tests, examinations, tasks, and homework assignments given by the teachers were collected and analysed for the level of cognitive activation demanded and level of alignment with the curriculum. For measuring individual learning support and classroom management, students and teachers completed rating scales. Finally, student achievement was assessed via a national (German) mathematics exam in combination with PISA 2003 results in mathematics and reading literacy.

27. Multilevel analyses showed that teachers' pedagogical content knowledge was a significant predicator in explaining differences in student achievement between classes. Moreover, the relationship between pedagogical content knowledge and mathematics achievement was linear. Analyses of instructional quality showed that the cognitive level of tasks, the curricular level of tasks, and effective classroom management were significant predictors of mathematics achievement. However, individual learning support and classroom management were not found to have a specific effect on mathematics achievement. The mediation model revealed that pedagogical content knowledge influenced the cognitive level, curricular level, and learning support dimensions of instructional quality, suggesting the important contribution of pedagogical knowledge specifically.

28. There is still a debate in the teacher knowledge literature in connection with whether content knowledge, that is, knowledge of subject matter, falls within the concept of pedagogical content knowledge or is independent of it. According to Shulman (1986, 1987), pedagogical content knowledge and content knowledge are separate categories, but not all agree to this separation (see Depaepe, Verschaffel, & Kelchterman, (2013) for a review). Under Baumert, Kunter, Blum, et al.'s (2010) model, these two constructs represent distinct knowledge categories, which were empirically tested in their study as the teachers also completed a mathematics test assessing their conceptual understanding of mathematics topics taught in Grades 5 through 10. Results revealed that teachers' pedagogical content knowledge has more of an impact on student achievement than content knowledge. In regards to measures of instructional quality, teachers' content knowledge predicted the curricular level of tasks (i.e., teachers with higher levels of content knowledge were better able to align the material with the curriculum). However, higher levels of content knowledge had no direct impact on cognitive activation or on the individual learning support that teachers are able to provide when learning difficulties occur. Only pedagogical content knowledge seems to have an impact on the quality of instruction, suggesting that it is a separate category of knowledge, and an important component of teachers' knowledge base for impacting student learning.

29. There are not many empirical investigations of the relationship between teacher knowledge and student outcomes. The few that exist have focused on pedagogical content knowledge. For our purposes, we are interested in studies of general pedagogical knowledge, but these are lacking as well. The study by Voss, Kunter, and Baumert (2011), discussed above, has attempted to investigate this relationship empirically by looking at student perceptions of instructional quality. This is discussed next.

The Impact of General Pedagogical Knowledge on Student Learning Outcomes

30. Based on their conceptualisation of teachers' 'general pedagogical/psychological knowledge,' Voss, Kunter, and Baumert (2011) developed an assessment instrument to investigate the impact of such knowledge on instructional quality. As part of their validation work, a sample of students was asked to rate their teachers on five aspects of instructional quality: (1) cognitive activation (giving students cognitive autonomy, such as comparing and evaluating different ways of solving a problem), (2) pace of instruction (giving students sufficient time to think before responding to a question), (3) classroom management (managing disruptions during lessons), (4) student-teacher relations (caring nature of teacher), and (5) awareness of students' comprehension problems during a lesson. Results showed that student perceptions of instructional quality were related to teachers' general pedagogical/psychological knowledge: Students of teachers with higher general pedagogical/psychological knowledge reported having higher cognitive activation, better instructional pacing, better student-teacher relationships, fewer disruptions, and higher teacher awareness of students' comprehension problems.

31. The current state of the field, however, does not permit any definitive relationships between teachers' general pedagogical knowledge and student outcomes for several reasons. First, it is not yet clear what is meant by 'general pedagogical knowledge.' Second, and related to the first, there is insufficient empirical research. Whereas there is a long history of theoretical work linking teacher knowledge to quality instruction, there is a lack of empirical research testing this hypothesis. A related area of work is the field of research on teacher expertise and how teachers acquire their knowledge. To fully understand teachers' knowledge base, we must also understand how this knowledge is learned and how novice teachers develop their expertise.

Next Steps in the Development of this Review Paper

32. The following sections will be discussed in the next draft of this paper. Full completion of the paper is anticipated for March 2014. The paper will be submitted for internal (CERI Governing Board members) and external peer review.

- How is Pedagogical Knowledge Learned and Developed into Expertise?
  - There is a large literature on teacher learning and expertise (e.g., Berliner, 2001, 2004). In this section, we review this research base, with some discussion of the new concept of 'opportunity to learn' (e.g., Schmidt et al., 2008; Voss, Kunter, & Baumert, 2011) in an effort to understand how this relates to the quality of teachers' knowledge.
- How is Teacher Knowledge Used in Decision-Making?
  - In this paper, we take the view of teachers as 'learning specialists.' As learning specialists, teachers use their pedagogical knowledge for judgement and decision-making in the classroom while the dynamics of the teaching-learning process unfolds. With the learning objective as a starting point, the teacher uses her knowledge of how children learn to create developmentally-appropriate classroom experiences. This also includes real-time assessment of students' learning so as to adapt teaching instruction accordingly. In this section, we

review the literature on teacher decision-making, such as Clough et al (2009); Copeland (1987); Kagan (1988); Shavelson & Stern (1981); Westerman (1981).

- Implications for Teacher Education and Professionalism

  – The evidence reviewed in this paper will show that teacher knowledge is important to the provision of quality instruction and has an impact on student learning outcomes. These findings have practice and policy implications. Efforts directed at improving the quality of instruction should be aimed at improving teachers' knowledge base. In this final section, the discussion will focus on implications for pre-service and in-service teacher education and teacher professionalization in general. A connection will be made to the work reported in the two accompanying papers, [EDU/CERI/CD/RD(2013)5] and [EDU/CERI/CD/RD(2013)6].

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