INTERNATIONAL CONVENTION ON THE SCIENCE OF LEARNING
SHANGHAI, 1-6 MARCH 2014

SUMMARY REPORT

Introduction

1. The International Convention on the Science of Learning (*Science of Learning: How can it make a difference? Connecting Interdisciplinary Research on Learning to Practice and Policy in Education*) was a collaborative initiative of OECD/CERI, The US National Science Foundation (NSF), UNESCO, Hong Kong University (HKU), Shanghai Normal University (SNU) and East China Normal University (ECNU), which was also the host. It was conceived as a scaling-up of the successful OECD-NSF Conference at OECD Headquarters in Paris in January 2012 (*Innovation in Education. Connecting How we Learn to Educational Practice and Policy: Research Evidence and Implications*); this time with more non-US and non-European partners. See Annex A for a participants list.

Conceptual Background

2. As societies become progressively knowledge-intensive, they increasingly rely on human capabilities to learn and innovate. How each nation's education system prepares or fails to prepare its citizenry to meet these challenges are topics of domestic and global interest. Learning and innovation are critical to the broader concerns of human and national development, and the capacity of a nation to compete in a world of globalized economies and labour markets.

3. A primary driver of educational innovation is basic research focused on how humans learn. The challenge is: how to more effectively use research about how people learn to inform educational policy and practice, and conversely, how to use knowledge and experience gained from educational practice to raise questions that test and refine research being conducted on learning.

4. Two major issues need to be addressed:

a) Knowledge about learning is often not shared or integrated across disciplinary boundaries, even though many disciplines actively conduct research on this important topic. These disconnects stand in the way of a holistic and deeper understanding of learning, which can lead to premature interpretation and/or inappropriate applications of research findings. A Science of Learning that promotes integrative, interdisciplinary approaches to synergistically address the many complexities surrounding learning is the inspiration to bring research about learning to the next level of effort, commitment, and achievement. It will foster the ability of diverse teams of researchers to create common platforms of conceptualization, experimentation, and explanation that catalyse new lines of thinking and investigation to overcome complexities about learning that have long eluded our understanding.

b) While there is implicit acceptance that knowledge about how people learn should be the foundation for how we teach and educate, the reality is that researchers, education policymakers,

and education practitioners rarely have opportunities to examine and discuss the issues surrounding application of evidence-based learning practices.

5. To address these challenges, the convention events were designed to pursue the following goals:

- To promote high-level discussion among researchers, practitioners, and policymakers about recent research on how people learn and their implications for policy and practice;

- To foster the development of an international network on the broad theme of learning, so as to continue the dialogue among research, policy, and practice communities for overcoming key challenges; and,

- To globalize and mobilize the field of an integrative, multidisciplinary Science of Learning by strengthening and exploring new collaborations among U.S. researchers and their international counterparts.

6. The convention included the following four events:

a) Science of Learning Symposium, 1 March 2014. This Symposium brought together exciting new research about learning from the United States, in particular six NSF-funded Science of Learning centres, Asia, and Europe that cut across many disciplines, levels of analysis, and contexts to include: cellular and molecular bases of learning, brain systems for learning, behavioural and cognitive aspects of learning, social-cultural influences on learning, individual differences in learning, use of technology to enhance learning, developmental aspects of learning across the lifespan, and learning in and out of the classroom.

b) International Round Table, 2 March 2014. This was an optional and informal event for convention participants. It was designed to provide an opportunity for participants to get to know system-level developments in education in Shanghai, to be introduced to the strategic developments at East China Normal University, and most important of all, to share with each other the status, developments, and challenges in the area of applying knowledge from learning research to different learning settings and contexts.

c) Dialogue on Science of Learning – How can it make a difference? 3-4 March 2014. The Dialogue was comprised of four sessions. The overall aim of the sessions was to address the thematic question: How can Science of Learning make a difference in practice and policy-making in education? In so doing, the target goals of the Dialogue were to achieve integration in two dimensions: integration among researchers, practitioners and policy-makers, and integration among various disciplines that study learning.

d) International Forum on Science of Learning and Innovation in Education, 5-6 March 2014. This Forum, organized by East China Normal University, aimed to further the dissemination of recent research on how people learn and the dialogue on how science of learning can make a difference in educational policy and practice. The topics included: (i) research on the frontiers of Science of Learning, (ii) how Science of Learning makes differences in educational practice, (iii) how Science of Learning makes differences in educational policy, and (iv) how Science of Learning makes differences in teacher education.

Science of Learning Symposium – Key Findings

7. The Science of Learning Symposium centred around four high-level themes: (1) the social influences on learning; (2) language, bilingualism, and multi-cultural learning; (3) neuroplasticity; and (4) technologies for learning. A panel of researchers presented their latest findings within each theme. The key findings from each presentation are given below.

The Social Influences on Learning

- Andrew Meltzoff (Learning in Informal and Formal Environments (LIFE), NSF Science of Learning Center): Social influences are central to human learning and have neurobiological roots. Children acquire behavioural skills, such as beliefs, attitudes, and roles, through social learning. As children assimilate the cultural stereotypes that apply to them, these have profound impacts on their education and self-concept development.

- Ken Forbus (Spatial Intelligence and Learning Center (SILC), NSF Science of Learning Center): Communication via sketching is critically important for creative thinking and problem solving, especially in fields such as engineering. The use of sketching software can alleviate students' anxiety about sketching.

- Lauren Resnick (LearnLab, Pittsburgh Science of Learning Center (PSLC), NSF Science of Learning Center): New research is beginning to show that guided discussions are essential for the transfer of learning from one academic discipline to another. However, as teachers rarely engage students in structured talk, these finding have implications for teacher education and professional development.

- Susan Levine (Spatial Intelligence and Learning Center (SILC), NSF Science of Learning Center): Young children are sensitive to the math anxiety of important adult role models, such as teachers and parents, and children with math-anxious parents or teachers tend to show less growth in their math knowledge than those without a math-anxious role model.

- Patricia Kuhl (Learning in Informal and Formal Environments (LIFE), NSF Science of Learning Center): Social interaction is important for the learning of language. New evidence on infants' learning of a new language indicates that the social context provides necessary motivational and informational components that are absent in non-social settings.

Language, Bilingualism, and Multi-Cultural Learning

- Laura-Ann Petitto (Visual Language and Visual Learning (VL2), NSF Science of Learning Center): While the brain is highly plastic and learning can occur throughout life, early exposure to two languages and two reading systems is crucial for achieving optimal learning outcomes in education.

- Li-Hai Tan (State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong): The brain takes on culture-specific re-organization based on spoken and written language forms (e.g., alphabetic versus logographic languages), having implications for language teaching.

- Susan Levine (Spatial Intelligence and Learning Center (SILC), NSF Science of Learning Center): Differences in the quality of number and spatial talk that parents have with their young children seems to contribute to individual differences in mathematical and non-verbal cognitive development and readiness for learning in kindergarten and beyond. These findings have

implications for children from lower socioeconomic backgrounds who tend to have difficulty with math problems that require knowledge of the language of ,mathematics possibly due to poorer language input from parents.

- Patricia Kuhl (Learning in Informal and Formal Environments (LIFE), NSF Science of Learning Center): Bilingual people show greater 'cognitive flexibility' in the ability to control attention when compared to monolingual peers, even infants and young children exposed to two languages since birth, suggesting that the brain develops to advance the skills needed for efficiency in an individual's social context.

- Andrea Chiba (Temporal Dynamics of Learning Center (TDLC), NSF Science of Learning Center: Using music to study the coordinated processing of time, this research is finding that the ability to synchronize with others in a group music class can predict a child's attentional behaviour. The ability to synchronize attention through interpersonal interaction is one of the most important skills that children must develop and refine; if this interpersonal dynamic is impaired, the transfer of information will be degraded.

Neuroplasticity

- Andrea Chiba (Temporal Dynamics of Learning Center (TDLC), NSF Science of Learning Center: All learning occurs through plastic changes in the brain. This has implications for developing specialized training progammes to ameliorate impairments or facilitate academic learning, including musical training and exercise.

- ZhouYongdi (East China Normal University): New animal studies are showing that neurons in the prefrontal cortex are capable of holding information, transferring it from one modality to another (visual or haptic), and maintaining it until a decision is made.

- Roberto Lent (Federal University of Rio de Janeiro): New research with patients with callosal dysgenesis is showing that the brain can be modified during critical periods of development to an extent larger than previously thought, having implications for therapeutic, as well as educational, interventions.

- Roi Cohen-Kadosh (Cohen-Kadosh Laboratory, University of Oxford): New research is showing how mathematical achievement relates to differences at the neurochemical level. These findings have implications for designing interventions for learning disabilities and cognitive difficulties through the use of new brain stimulation technologies.

- Laura-Ann Petitto (Visual Language and Visual Learning (VL2), NSF Science of Learning Center): Through investigations with monolingual, bilingual, hearing, and deaf children, this research is showing how the brain is a combination of both 'fixed' and 'flexible' biological systems, having implications for the optimal timing of educational and learning opportunities such as reading development and bilingual acquisition.

Technologies for Learning

- Lauren Resnick (LearnLab, Pittsburgh Science of Learning Center (PSLC), NSF Science of Learning Center): Technology is changing how research on learning is conducted and how teaching is conducted. For example, using detailed online data to personalize learning and guiding instruction, using computers as partners and 'coaches' for learning, and using machines for automated modelling of learning and teaching.

- Ken Forbus (Spatial Intelligence and Learning Center (SILC), NSF Science of Learning Center): New research shows how sketching software can be used to provide immediate feedback to students to facilitate spatial learning.

- Nancy Law (University of Hong Kong): Teaching is seen as an evidence-based design profession. However, research indicates that teachers do not have knowledge of the learning theory underpinning their lesson plans; they have difficulty making the learning goals of a lesson explicit and with knowing whether students have achieved '21st century' skills.

- Patricia Kuhl (Learning in Informal and Formal Environments (LIFE), NSF Science of Learning Center): Research with social technologies that incorporate features of live human social interaction, such as 'teachable agents,' is showing that such technologies can improve learning in people of all ages.

- Roi Cohen-Kadosh (Cohen-Kadosh Laboratory, University of Oxford): This research is showing how the transcranial electrical stimulation (tES) technique to enhance or decrease cortical excitability can be used to enhance performance in a variety of mathematical tasks in adults and children with mathematical learning difficulties.

Dialogue on the Science of Learning

8. The Dialogue on the Science of Learning, which ran for two days, was divided into four sessions. The overall aim of the sessions was to address the question: How can the Science of Learning make a difference in practice and policy-making in education? The target goals were to achieve integration in two dimensions: Integration among researchers, practitioners, and policy-makers, and integration among various disciplines that study learning.

9. Dialogue participants were assigned to one of eight groups, each led by one or two facilitators. Groups discussed one or more pre-set questions, and a synthesis of the discussion was then communicated by a Rapporteur in plenary session. The four sessions and guiding questions (and more specific sub-questions) are as follows:

1) Research perspectives on the frontiers of research on learning and their implications for education practices and policies. More specifically:

   - How have the latest advances in the Science of Learning changed your understanding/views on learning and how can learning be facilitated?

   - Do you think that the Science of Learning is challenging dominant assumptions, belief systems, and professional knowledge systems of educators? If yes, what are some impacts?

   - What in your view is the applicability of current cutting-edge knowledge from the Science of Learning to how learning is organized and facilitated in your own context?

   - To what extent and by what mechanisms are teachers, education practitioners, and policymakers informed of findings and advances in the Science of Learning?

2) Frontline perspectives on why the Science of Learning has not taken centre-stage in abating the global learning crisis.

- To what extent is research on the Science of Learning substantively accessible to educators and policy-makers and what are the mechanisms and geographic dimensions of that access?

- To what extent do educators and policy-makers apply knowledge from the Science of Learning in their daily practices?

- Where is the evidence of the impact of such applications if any? How does such impact manifest itself?

- What are the key enablers and what are the main barriers to such applications?

- What are the most important or urgent areas where Science of Learning should contribute to practices and policies in education?

- What measures should be taken to optimize the positive impact of knowledge from the Science of Learning on learning processes and outcomes?

3) Examples from different countries of applications from the Science of Learning to education policies and practices that are making impact at some scale.

   - What can we learn from these encouraging initiatives?

   - What are the critical conditions that contribute to the positive outcomes of these initiatives?

   - Are there challenges to sustainability and scalability of these encouraging initiatives? If so, what are these?

   - Can we frame the challenges to application of learning sciences research as research gaps? What are some examples?

4) Building on previous discussions to consider ways forward to bring closer connections between Science of Learning and learning-related policies and practices.

   - How should advances in the Science of Learning be communicated to policy-makers, education practitioners, and the general public?

   - What actionable measures can we use to optimize the positive impact of the Science of Learning to address the global learning crisis?

   - How can we implement in a principled way the application cutting-edge research to enhance learning in a variety of contexts and environments?

   - To achieve systemic change from applications of research findings to education practice and/or policy, what additional expertise would be useful?

   - What are the critical challenges? From what can we build a collaborative agenda? What would it take to sustainably implement such an agenda? How should it be enables?

10. A website (http://solconvention.cite.hku.hk/) was set-up by the convention organisers and hosted at the East China Normal University (and which remains active). Dialogue participants were encouraged to use the Participants' Blog to upload a summary of their group discussions, as well as any comments and

feedback. We report here a thematic analysis of the main ideas discussed during the Symposium, Dialogue, and on the Participants' Blog.

Thematic Analysis of Dialogue Discussions

11. The thematic analysis resulted in two major themes: (1) Implications of science of learning research for policy and practice; and (2) Translational mechanisms and barriers to translation.

Research on the Science of Learning: Implications for Policy and Practice

12. It was noted during the discussions that while there is no direct link from the basic research in neurosciences to educational practice, it was nonetheless important for teachers to understand how the brain learns. This is because one of the implications of the research findings presented at the Symposium is that an understanding of neuroscience can be used to understand why things are happening in the classroom, a consequence of which is the potential to personalize learning (e.g., understanding when a student is most attentive and therefore most receptive to learning, or more accurate diagnoses of learning challenges and thus more successful interventions). The concept of personalizing learning is of extreme importance for practitioners – this requires a deep understanding of how to monitor students' thinking and how to structure the instruction to guide their thinking forward. Rather than relying on trial-and-error, an understanding of how the brain learns can improve the practice of teachers in helping them to identify the factors that are influencing learning.

13. A related implication has to do with initial teacher education and the training of teachers. Asking teachers to become more knowledgeable in the science of learning would require additional training in neurosciences and research methods. Without such training (as is currently the case), the average teacher would not know how to be a good consumer of the research (e.g., in being able to determine what neuroscience findings can or cannot say about learning) and might fall prey to damaging 'neuromyths' (e.g., the myths about inherent ability differences or the risks of bilingualism, which the neuroscience on brain plasticity has debunked).

14. But as it is already a challenge to find teachers with adequate pedagogical skills (e.g., recent TALIS data show that novice teachers feel unprepared for practice), are we asking too much of teachers? A point was made about whether we are asking too much of teachers if we now also require them to have an understanding of the learning sciences. For instance, is it really necessary for teachers to have deep knowledge of how learning works in the way a physicist has deep knowledge of physics? In this argument, the distinction was made between teaching at the primary and secondary levels versus teaching at the tertiary level. A deep knowledge of learning is more relevant to primary and secondary teachers, where students have not yet learned how to learn and lack self-regulation and meta-cognitive strategies and where findings from the science of learning are more relevant to optimizing individual differences in learning abilities, as opposed to university or college students for whom these skills have already been learned.

15. A related challenge has to do with teacher educators – if we expect teachers to become knowledgeable about research in the science of learning, we need better educated teacher educators. But this too is a challenge and carries consequences for the educational institutions that provide initial teacher training.

16. A recurrent theme in the discussions was that without the necessary policy supports, no changes could be made to the *status quo*. However, the changes needed in order to make practitioners more knowledgeable about the science of learning have implications at many levels and for a variety of stakeholders in addition to teachers and teacher educators, such as the teacher education institutions that provide initial teacher training (new entry requirements for pre-service teachers; new qualifications for

teacher educators), teacher unions (changes to teacher salaries and career development opportunities), as well as reforms to regulatory or licensing bodies.

17. Despite all these challenges, participants were in agreement that the implications for policy were many and of great importance to improving the outcomes of children. An example was given in connection with the benefits of bilingualism: In some countries where immigration is a part of the economy, policy-makers need to be involved to convince parents, teachers, and the public in general of the benefits of learning multiple languages in the early years and of the risks of not sufficiently learning a mother tongue. The neuroscience findings can be used to give credibility to practices and legitimize policy decisions that might seem counter-intuitive to a non-specialist. At the same time, however, participants discussed how policy-makers should be responsible for protecting the public from unethical practices or the risks of predictive studies, such as early infant testing that can be used to label a child. This concern is closely related to the second theme that resulted from the Dialogue discussions having to do with translation of the neuroscience research findings in making sure that the research is not misinterpreted or misused.

Translational Mechanisms and Barriers to Translation

18. The second major theme resulting from the Dialogue concerns the translational mechanisms, or lack thereof, from research to practice. This was a major topic of discussion and participants overwhelmingly voiced the absence of a systematic mechanism that moves the research findings from the science of learning research to pedagogical practice. Four translational mechanisms resulted through a thematic analysis of the discussions: (1) natural experiments, (2) research-practice collaborations, (3) policy changes to initial teacher education programmes, and (4) knowledge brokerage.

19. In the first case of natural experiments, it was noted that translation between research and practice is an experiment in itself in that an evaluation component should be a part of all educational practices derived from research. For example, to continue with the example of multiple language learning, there are many children who attend school in their second (non-native) language. These are good cases where a natural experiment can be designed for collecting data and evaluating outcomes (whether or not there is an intervention). Evaluation is a crucial component and should be a part of the naturalistic (or experimental) design from the start rather than appended after the fact. Only through proper evaluation of outcomes can an evidence-based decision be made whether to made adjustments or to scale up. On a world-wide scale, there are many instances of naturalistic experiments that can and need to be evaluated to determine their impact on learning outcomes. For policy, the implication is the leadership to ensure that an evaluation mechanism is implemented alongside the experiment to collect the data needed for analysis and evaluation.

20. The example of translation through the analysis and evaluation of naturalistic experiments is related to the second translational mechanism discussed, that of research-practice collaborations. In this case, the translational mechanism is the collaboration between teachers and researchers, whereby they work together to implement and evaluate a new practice (e.g., an innovative teaching method or an intervention) based on research findings. It was suggested that teachers, properly trained, would make the best data gatherers. A component of this mechanism is already in place in most research-intensive tertiary educational institutions as educational researchers will typically use ‘pilot schools’ for collecting the data required for their research. The missing piece is the link to practitioners, typically because the purpose of the data collection is to test theories and so the link to practice is vague or non-existent.

21. An active collaboration between researchers and practitioners can serve three purposes: (1) ensure that the research conducted is relevant to practitioners; (2) engage practitioners in the research process, thereby building capacity for educators to become more knowledgeable about the science of learning; and (3) contribute to the building of a knowledge base for the teaching profession that is relevant

for practice, contains up-to-date research, and is evidence-based. As an example, our Chinese hosts described how the career ladder structure in China is designed to enable collaborations between teachers and researchers. As a result, teachers are given incentives to experiment with innovative methods and to move up the career ladder.

22. A third translational mechanism discussed was to make policy changes to initial teacher education by incorporating courses in the learning sciences as part of the pre-service curriculum. For example, participants from the US discussed how some institutions are beginning to offer Masters and PhD degrees in educational neuroscience. The goal is that these types of programmes can help bridge the gap between the science of learning and educational practice and policy. In addition, practitioners will be trained to become better informed consumers of research so that they can make evidence-based decisions for improving their practice. But this, again, has implications for teacher educators – should they have a role in bridging this gap or in translating from research to practice?

23. The fourth and final translational mechanism discussed was that of knowledge brokerage. Some countries, for example the Netherlands, have set-up a brokerage agency devoted to the translation of research. In China, for example, teachers learn about learning sciences research from professional journals that are published by the ministry. The ministry has the responsibility for learning about new research and disseminating it through professional journals, typically to head teachers who are then responsible for disseminating it further.

24. To this, participants spoke of the need for qualified 'translators,' 'agents,' or 'brokers' who would play an intermediary role to bridge the gap and facilitate the translation between research and practice. For translation to be relevant, the 'translators' need certain qualifications, such as a deep knowledge of both the research (e.g., the neurosciences, how the brain learns) and the practice (e.g., what happens in the classroom in an actual teaching-learning situation). Otherwise, there is the risk of a superficial understanding of what the research actually implies and can lead to neuromyths or a misuse of the findings, such as the misuse of the 'learning styles' research due to a poor understanding of the concept. Here is where policy should intervene in setting guidance or standards.

25. Finally, some participants spoke of the need to translate the research findings for parents, which would require a different kind of language than that used with practitioners, in particular where the science is used to justify policy changes, such as the learning of more than one language in early childhood. For example, in some cultures, parents may misunderstand the cognitive benefit of learning more than one language in early childhood to mean that formal learning is required (e.g., drilling, exercises, tests). However, what the science shows is that learning additional languages in early childhood can happen in a naturalistic context where children are embedded in a context with adult speakers and given opportunities to interact and play naturally. In such cases, it would not be sufficient to simply say to parents that learning multiple languages is beneficial, but it would be crucial to also provide parents with realistic examples of how the learning should look like in real life.

26. In connection with how to move forward, there was some discussion of how the medical model can be adapted as a framework to structure the translation of educational neuroscience research into practice. But participants for the most part voiced a negative opinion of this proposal. For example, some participants expressed concern that students are learners, not patients to be cured, and that modelling a translational mechanism on that of the medical model is parallel to the 'deficit' model in education, which is problematic. Adapting the medical model as a framework for translating research to practice in education could be useful to understanding the relationship with the reference disciplines, such as the neurosciences, cognition, developmental psychology, and so on (i.e., the counterparts of what biology, physiology, anatomy, and so on are for medicine), but again, here too, participants expressed concern that education is more than simply learning about the reference disciplines – education is about 'change,' and

while there is a consensus of what medicine is about (i.e., making or keeping people healthy), a similar consensus does not (yet) exist for education.

27. To sum up, it seems that resistance to the medical model is essentially stemming from a misunderstanding of what it means to adapt the medical framework to educational translation, and more importantly, what the of science of learning research actually means for education. Adapting the medical model to education does not by consequence imply the use of a deficit model. In fact, as the research in neurosciences is clearly showing, the brain is plastic and every child can learn – the implications of this research discredit the concept of a deficit model. Furthermore, a better understanding of the reference disciplines that feed into education (e.g., neurosciences, cognition, developmental psychology and so on) is exactly what proponents of the move to professionalize teaching are arguing for – a more in-depth understanding of how the brain learns. Therefore, one of the implications of educational neuroscience is that education, or at least the understanding of 'learning,' is becoming more scientific. As such, adapting the medical model would seem logical.

Barriers to Translation

28. Throughout the discussions, four barriers to translation emerged from the thematic analysis: (1) lack of a systematized knowledge base; (2) practitioners and the educational system; (3) researchers; and (4) policy and research funding. One of the most discussed barriers to translation was the absence of a systematized, centralized, cumulative knowledge base for education, which was seen to be an essential vehicle for dissemination of findings from research to practice. Where such knowledge bases do exist (e.g., ERIC and other educational databases), they are not in a format that is accessible to practitioners. They are essentially databases meant for researchers, not practitioners. Lacking still is the translational mechanism. Related to this was discussion of the need for a common platform for researchers, practitioners, and policy-makers to facilitate the translation of research to practice and policy. A common platform could also be useful to harness the expertise from all relevant disciplines (e.g., neurosciences, cognition, developmental psychology and so on) to achieve a more comprehensive, deeper, and inter-disciplinary understanding of learning. Likewise, the use of a common language was discussed, currently lacking in education and causing much confusion for all stakeholders. A common language is necessary if we are to link basic science of learning research to what teachers need to know for effective learning.

29. Practitioners were seen as one of the barriers to translation. For example, teachers are not likely to see themselves as translators and whether the educational system expects them to be or to learn to do so is an essential aspect of this barrier. To change this demands a change to the education system altogether, which was discussed in terms of needing to change the profession of teaching. For example, teachers can be trained to be consumers of research, thereby facilitating the translation of research into practice, or more aptly, 'transforming information into knowledge.' But this would require making changes not only to initial teacher education (e.g., curriculum, qualifications of teacher educators) but also changes to practitioners' beliefs (i.e., what it means to be a teaching professional), as well as changes to the structure and governance of the teaching profession. Here, the connection can be made to the medical model again in that medical practitioners are trained to be consumers of research and this is an important component of serving as a medical professional. There was agreement that only through the profession of teaching can teachers' views and beliefs be changed and that, at minimum, teachers and teacher educators should be included in these discussions.

30. Researchers were also seen as among one of the barriers to translation. For instance, there was some discussion of how much evidence is enough evidence, and in this respect, researchers differ from practitioners and policy-makers. Researchers are concerned about generalizability of findings (i.e., whether the samples are large enough and representative enough to make generalizations to the entire population or whether they should be restricted to a certain demographic of students), and they cannot make conclusive

statements without sufficient evidence (this is in fact part of their professional code of ethics). But practitioners and policy-makers don't usually understand this and are more interested in recommendations with quick fixes. Another barrier is that researchers work on topics of basic research, but these are not necessarily the same problems encountered in practice. A related barrier is the perception that research that takes place in classrooms, as opposed to lab-based research using controlled variables, is not seen as scientific enough, and researchers fear damaging their reputations, which would impact their ability to secure research grants. For example, it is not usually possible to run RCT (randomized controlled trial) experiments in education, which for some researchers means that the findings are not valid.

31. A consequence of this is that the standard definition of 'good research' cannot be used to solve real-world problems such as those encountered in education, and thus an alternative needs to be considered. But connecting research to practice means that the research will need to be translated, and this can be done by turning lab-based research into applied or field research under conditions of real learning. There are several important consequences of this: (1) the establishment of a systematized, centralized knowledge base, (2) encouraging researcher-practitioner collaborations, and (3) developing the teaching profession by making teachers better consumers of research. Having a systematic and centralized knowledge base and encouraging researcher-practitioner collaborations can bridge the gap between research and practice and identify commonalities between researchers and practitioners. With incentives for both teachers (e.g., for career advancement) and researchers (e.g., through a funding mechanism), educational research does not need to be restricted to the domain of academics meant for publication in research journals, but could be sustained in the field with ongoing involvement of researchers in applied research.

32. The fourth and final barrier to translation that emerged was related to policy and the issue of research funding. For instance, participants discussed implementing a funding mechanism whereby researchers and practitioners would be encouraged to collaborate in conducting applied research (as discussed above). Participants also discussed how funding agencies (e.g., the NSF) could take a leadership role in changing the perception of educational research by providing specialized funding for applied or field-based research. This would incentivize applied research and set an ethos where the research is valued and thus begin to bridge the research to practice gap. Another factor related to the issue of funding has to do with how research priorities are set, and policy-makers have a role to play in this. For instance, policy-makers, educators, and researchers should be working together to identify research gaps. Here, again, the establishment of a centralized and systematized knowledge base is crucial in order to identify where the research is lacking. Policy could also play a role in incentivizing the development of 'translators' (e.g., through initial teacher education institutions) or by encouraging researchers to translate their research by tying funding to implementing research into practice. Here, too, the medical model could be used as an example.

ANNEX A: PARTICIPANTS LIST

Last Name	First Name	Organization
Adolphe	Otila ossibadjouo	UNESCO
Al Hinai	Fatma	Oman National Commission for Education Culture and Science
Al Yaqoubi	Mohammes	Oman National Commission for Education Culture and Science
Alkiyumi	Mohammed	Ministry of Education
Allan	Sara	Bill & Melinda Gates Foundation
Alzaydi	Maha Mohammed	Ministry of Education, Saudi Arabia
Andrews	Stephen	The University of Hong Kong
Angmo	Helen	Swedish National Agency for Education
Au	Terry Kit Fong	The University of Hong Kong
Basimolodi Mokowe	Oteng	UNESCO
Brown Ruzzi	Betsy	
Chan	Carol	The University of Hong Kong
Chan	Shui Duen	The Hong Kong Polytechnic University
Chan	Fu-man	Education Bureau Hong Kong
Chan	Anissa	St Paul's Co-educational College
Chan	Catherine	Education Bureau Hong Kong
Chan	Catherine	Education Bureau Hong Kong
Chang	Gwang-Chol	UNESCO Bangkok
Chee	Bryan	LIFE Center
Chen	Gaowei	University of Hong Kong
Cheng	Kai-ming	University of Hong Kong
Cheung	Chi Ming	Education Bureau Hong Kong
Chiba	Andrea	UC San Diego
Cohen Kadosh	Roi	University of Oxford
Constance	Male	UNESCO
Della Chiesa	Bruno	Harvard Graduate School of Education
Deng	Ciping	East China Normal University
Denis	Dominique	French Community of Belgium- Ministry of Wallonia- Brussels Belgium
Du	Yue	UNESCO
Duschl	Richard	National Science Foundation, USA
Eddie NG	Hak Kim	Education Bureau Hong Kong
Flaten	Kjersti	Directorate for Education and Training Norway
Forbus	Kenneth	Northwestern University
Frumin	Isak	National Research University Higher School Of Economics
Gao	Xiangping	Shanghai Normal University
Goda	Hanan	Ministry of Education

Last Name	First Name	Organization
Goldman	Susan	Learning Sciences Research Institute, University of Chicago
Gu	Xiaoqing	East China Normal University
Guerriero	Sonia	OECD
Hau	Kit-Tai	Chinese University of Hong Kong
He	Yunfeng	Shanghai Normal University
Ho	Wing Chuen	Education Bureau Hong Kong
Howard-Jones	Paul	University of Bristol
Huang	Du	Guangxi Normal University
Huang	Xiaorui	East China Normal University
Iqbal	Muhammad	Ministry of Education, training & standards in Higher Education, Islamabad Pakistan
Irfan	Yasir	Ministry of Education, Training and Standards in Higher Education
Ischinger	Barbara	OECD
Jiao	Jianli	South China Normal University
Jo Hoffman	Nancy	
Joshua	Nkarabang	UNESCO
Ke	Zheng	East China Normal University
Kikas	Ülle	Ministry of Education and Research
Koong	Maggie	Victoria Education Organisation
Kuhl	Patricia	University of Washington
Lau	Kwok-leung	Chief Executive's Award for Teaching Excellence Teachers Association
Law	Nancy	University of Hong Kong
Leask	Marilyn	University of Bedfordshire
Leng	Jing	East China Normal University
Lent	Roberto	Institute of Biomedical Sciences, Federal University of Rio de Janeiro
Levine	Susan	University of Chicago
Li	Dan	Shanghai Normal University
Lim	Soo-Siang	National Science Foundation，USA
Lin	Lijia	East China Normal University
Looi	Chee-Kit	National Institute of Education
Lu	Jiexin	Shanghai Normal University
Mackay	Anthony	Center for Strategic Education; Australian Curriculum, Assessment and Reporting Authority
Matari	Hermine	Higher Education
McPherson	Bradley	The University of Hong Kong
Meltzoff	Andrew	University of Washington
Minten	Eva	Swedish National Agency for Education
Olster	Deborah	National Science Foundation, USA
O'Meara	James	National Louis University
Pei	Xinning	East China Normal University
Pellegrino	James	University of Illinois at Chicago
Petitto	Laura Ann	NSF-SLC Visual Language Visual Learning, VL2
Punie	Yves	Institute for Prospective Technological Studies (IPTS)

Last Name	First Name	Organization
Rao	Nirmala	The University of Hong Kong
Ren	Youqun	East China Normal University
Resnick	Lauren	University of Pittsburgh
Rouw	Rien	Ministry Of Education, Culture and Science
Rouw	Marinus	OECD
Shang	Junjie	Peking University
Shen	Jiliang	The Ministry of Education，China
Sidorkin	Alexander	National Research University-Higher School of Economics
Stewart	Vivien	Asia Society
Su	Lynn	The University of Hong Kong
Sundby	Eli	Ministry of Education and Research Norway
Tang	Qian	UNESCO
Tawil	Sobhi	UNESCO
Tong	Chong Sze	Hong Kong Examinations and Assessment Authority
Tong	Shijun	East China Normal University
Tse	Shek Kam	The University of Hong Kong
Tucker	Marc	National Center on Education and the Economy
Van Aalst	Jan	University of Hong Kong
Van Damme	Dirk	OECD
Wang	Mei	East China Normal University
Wang	Yan	National Institute of Education Sciences
Wang	Ping	Shanghai Municipal Education Commission
Wong	Lung-Hsiang	National Institute of Education, Singapore
Wong	Lai Kuen	University of Hong Kong
Wu	Nianyang	
Xiong	Jianhui	Education Department Research Center of Ministry of Education
Xu	Binyan	East China Normal University
Xu	Binyan	East China Normal University
Yang	Cuirong	Suzhou University of Science and Technology
Yin	Houqing	Shanghai Municipal Education Commission
Yu	Dongchuan	Southeast University
Yuan	Fangfang	South Dongchang Middle School Attached East China Normal University
Zhang	Yingjing	No.4 Middle School Affiliated to East China Normal University
Zhang	Baohui	Nanjing University
Zhao	Ke	Shanghai University of Finance and Economics
Zhao	Jian	East China Normal University
Zheng	Tainian	East China Normal University